

বাংলাদেশের
সুবর্ণজয়ন্তী
Bangladesh



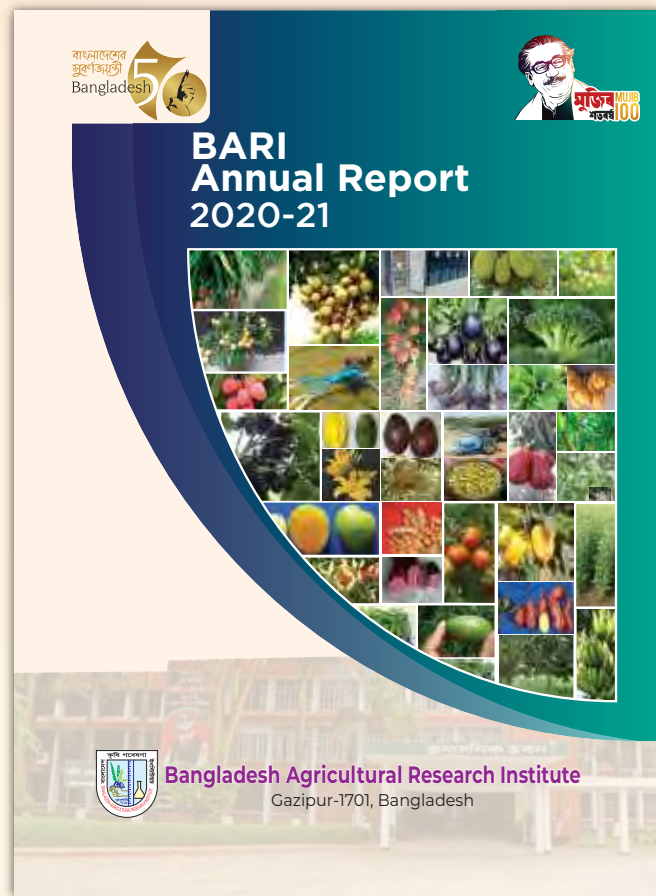
BARI Annual Report 2020-21

BARI Annual Report 2020-21



Bangladesh Agricultural Research Institute

Gazipur-1701, Bangladesh



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Foreword



The annual report is an in-depth, comprehensive overview of the achievements and activities of an organization from the preceding year. It is produced on a yearly basis and informed all about the overall performance, achievements and vision for the future. So, this annual report includes the major findings of the experiments conducted by the scientists of different Crop Research Centers and Research Divisions of BARI during the year 2020-21. The major research areas include variety development of different crops, such as tubers (potato, sweet potato, aroids, etc.), oilseeds (mustard, rapeseed, groundnut, sunflower, safflower, linseed, niger, etc.), pulses (grasspea, lentil, chickpea, mungbean, blackgram, cowpea, pigeonpea etc.), horticultural crops (fruits, vegetables and flowers), spices (onion, garlic, chili, turmeric, ginger, fenugreek, etc.) and cereals (millet, barley, sorghum, etc.).

The area of research also includes improvement of cropping systems, crop, soil, water and irrigation management, plant nutrition, disease and insect management, production economics, development of low-cost farm machineries, postharvest processing, and farm management. Besides, attention was focused on adaptation and mitigation of climate change, plant biotechnological research, improvement of floriculture, and hill farming. Our scientists have also engaged in developing technologies which are appropriate as well as sustainable with a view to narrowing the ongoing gap between current food demand and its production in the country.

The annual report summarizes all the research activities of this year. But it is really very hard to accommodate all the findings of all the studies in such a single volume. So like previous years, only the major findings of the studies have been incorporated in this report. The readers can get information about any of the studies in brief. If anybody wants to have all the generated data, he or she may go through the centre or divisional reports.

I express my heartfelt thanks and appreciate the scientists, editors, and associates who have worked hard to bring this report out. I hope this report will be very useful to scientists, teachers, students, policymakers and other stakeholders who have engaged in agricultural research and development for food and nutrition security.

A handwritten signature in black ink, appearing to read 'Debasish Sarker'.

Dr. Debasish Sarker
Director General, BARI

Bangladesh Map





CHAIRMAN

Director General (Ex-officio)

Member

- ✿ Two eminent scientists, one in social science and other in the field pertaining to the speciality of the Institute (nominated by the Ministry or the Division dealing with agriculture)
- ✿ A representative of the Council (nominated by the Council)
- ✿ The Directors of the Institute (Ex-officio)
- ✿ Two senior scientists of the Institute (nominated by the Ministry or the Division dealing with agriculture)
- ✿ A representative of the DAE not below the rank of Director (nominated by the Ministry)
- ✿ Two representatives, one from the Ministry or the Division dealing with agriculture and the other from the Finance Division not below the rank of Deputy Secretary (nominated by the respective Ministry or Division)
- ✿ Two representatives, one from among the farmers and the other from among the non-Govt. Organizations (NGOs) performing functions similar to those of the Institute (nominated by the Ministry or Division dealing with agriculture)

The Director-in-charge of administration of the Institute acts as secretary of Board.



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01

TUBER CROPS



Tuber crops viz. potato, sweet potato, aroids, yam and cassava are essential food crops. Tuber Crops Research Centre (TCRC), BARI deals with these crops. The main research thrust of TCRC is on variety development considering high yield, short duration, biotic-abiotic stress tolerant, good keeping and processing quality. Breeding, biotechnology, disease & pest management, soil & nutrient management, organic culture, postharvest processing are the major concern groups to improve tuber crops. Achievements during 2020-2021 on varietal improvement, biotechnology approaches, disease management, insect management, production technology, soil, water and nutrient management, postharvest technology, organic culture and technology transfer have been given below:

Varietal Improvement

Potato

Hybridization in potato (Set- I, II, III and IV)

B. C. Kundu, M. N. Amin, T. Jahan, S. Naznin, M. N. Uddin, M. M. Islam, M. Rahman, M. M. Uddin, M. H. Rashid, K. A. Ara and S. Akhter

Hybridization was done at Debiganj and Joydebpur using 157 and 154 clones/ varieties, respectively under 16 hours extended photoperiod to create variability, and to select superior genotypes in the subsequent generations. At Joydebpur, 171 out of 388 crosses and at Debiganj, 555 out of 1522 crosses produced berries. In total 275 g hybrid seeds were produced of which 210 g were at Debiganj and 65g at Joydebpur.

Production of seedling tubers of the potato hybrid populations (F_1C_0)

B.C. Kundu, M.N. Amin, M. Rahman, S. Naznin, M.M. Islam, T. Jahan, M.N. Uddin, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Hybrid true seeds which were produced in 2020-21 at Gazipur and Debiganj were sown at Breeder Seed Production Centre, BSPC, Debiganj, Panchagarh during this season (2020-21). After harvesting of all plantlets, 471 single plants and 656 single tubers of 890 crosses were selected. In total 520 kg seedling tubers were stored for next year.

Selection of potato hybrid clones in subsequent clonal generations (F_1C_1 , F_1C_2 , F_1C_3 and F_1C_4)

M.N. Amin, M. Rahman, B.C. Kundu, T. Jahan, S. Naznin, M.M. Islam, M.N. Uddin, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

During the selection process all potato clones are examined critically. Each generation materials are planted separately. In three generations of single plant, plant row and single plot (F_1C_1 , F_1C_2 and F_1C_3 generations) 325 potato clones weighing 4640 kg were selected and stored at BSPC, Debiganj for further evaluation.

Preliminary yield trial with clonal potato hybrids

M.N. Amin, T. Jahan, M. Rahman, B.C. Kundu, S. Naznin, M.M. Islam, M.N. Uddin, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

An evaluation study was conducted for twelve hybrid clones of potato along with four check varieties BARI Alu-7, BARI Alu-13, BARI Alu-25 and BARI Alu-28 at TCRC, BARI, Gazipur and BSPC, Debiganj, Panchagarh during the last 2020-21year. Almost all the tested clones performed superior against at least one or more traits for any trial environment as the clone 17.167 and 17.159 emerged earlier by 13.33 and 13.67 days respectively at Gazipur; all the clones except 17.18, 17.172, 17.432 showed good vigor in both

locations ; the highest foliage coverage (97%) was gained from the clones 17.19 and 17.66 at Gazipur; the top most plant (91.63 cm) was exposed in the clone 17.18 and 17.159 (89.17cm) at Debiganj; the clone 17.128 showed the maximum figure of stem number /hill (6.23) pursued by BARI Alu-13 (5.83) at Debiganj and 17.18 (5.70) at Gazipur; the highest tuber number per hill was produced from the clone 17.432 (14.70) followed by the clone 17.12a (14.27) at Debiganj and 17.167 (14.17) at Gazipur; the clone 17.432 gave the highest yield (56.27 t/ha) imitated by 17.12a (54.77 t/ha) and 17.159 (53.77 t/ha) at Debiganj and the clone 17.24 (23.31%) and 17.167 (22.95%) achieved the highest dry matter at Gazipur. Considering the performance of all the clones towards the studied parameters, the hybrid clones may be selected as superior for the next year trial.

Secondary yield trial with clonal hybrids (F₁C₆)

M.M. Islam, M.M. Rahman, M.N. Amin, T. Jahan, S. Naznin, B.C. Kundu, M. Rahman, M.N. Uddin, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Six hybrid clones of potato were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at Debigonj, Gazipur and Jamalpur research station of BARI. Combined analysis was done to see the genotype and location interactions. The significant influence was observed for different environmental factors of different locations on the expression of different characters of potato. The clone 16.9 gave highest marketable yield (39.73 t/ha) at 65 DAP in Jamalpur and this genotype also gave highest average marketable yield (31.44 t/ha) which could be a suitable candidate for early bulker. The clone 16.16 gave average highest tuber yield (56.15 t/ha) followed by the clones 16.9 (53.18 t/ha), 16.28 (52.36 t/ha) and 16.62 (51.13 t/ha). In case of dry matter check variety BARI Alu-28 (Lady Rosetta) gave the highest result but average dry matter content of clones 16.7 (21.22), 16.28 (20.28), 16.33 (20.52) and 16.62 (20.44) were also satisfactory (>20%) and were suitable for processing purpose. Clone 16.7 (70.19%) gave larger (>40mm dia) size tubers which is important for processing and export purpose. Considering the marketable tuber yield, dry matter, organoleptic taste, disease, insect

infestation and tuber characteristics (shape, size, colour, scoring) the Clones 16.9, 16.7, 16.16, 16.28, 16.33 and 16.62 can be selected for next year AYT.

Advanced yield trial with clonal potato hybrids

S. Naznin, M. Selim, M.N. Amin, M.N. Uddin, M.M. Rahman, B.C. Kundu, M.M. Islam, M M Rahman, P. Hajong, M.K. Alam, M. Sultana, M.Z.H. Prodhan, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Five clonal hybrids of potato were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at six locations during 2020-21 for seventh generation. Tuber yield at 65 DAP was recorded to identify the early bulker genotypes. No early bulker clone was selected from this study. At final harvest, clone 15.139 and 15.156 were selected for RYT due to their higher tuber yield (44.76 t/ha) and (42.57 t/ha, respectively. In case of dry matter check variety BARI Alu-28 (Lady Rosetta) gave highest result but the average dry matter content of clone 15.156 (21.73%), 15.112 (21.63%) and 15.139 (20.53%) were also satisfactory. Clone 15.139, gave higher percentage of larger sized tuber (84.17%) which is important for processing and export purpose. Clone 15.156 performed best regarding taste, appearance and texture of boiled potato. Clones 15.112, 15.139 and 15.156 can be selected for next year RYT Trial due to their performance regarding tuber yield, dry matter, organoleptic taste, disease and insect infestation and tuber characteristics (shape, size, colour, scoring) etc.

Participatory variety selection with advanced clonal hybrids

S. Naznin, M.M. Rahman, M.N. Uddin, B.C. Kundu, M.M. Islam, M.N. Amin, T. Jahan, M.M. Rahman, P. Hajong, M.K. Alam, M. Selim, M. Sultana, M.Z.H. Prodhan, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Five clonal hybrids with three checks varieties were evaluated at farmer's field under participatory variety selection to understand the performance as well as farmers opinion. In case of average yield of all locations the highest yield was recorded in 15.139 (47.14 t/ha) followed by 15.92 (41.59 t/ha), 15.126 (41.01 t/ha) and 15.112 (40.77 t/ha)

and lowest average yield was found in check variety BARI Alu-28 (Lady Rosetta) (34.95 t/ha). Considering tuber yield, tuber size, shape and colour, farmers of all locations showed their keen interest to all the clones, but varied from location to location. Therefore, further evaluation is needed for confirmation.

Regional yield trial with clonal hybrids of potato

B.C. Kundu, S. Naznin, M.N. Uddin, M.N. Amin, M.M. Rahman, P. Hajong, M.M. Islam, T. Jahan, M.K. Alam, R. Akter, M. Sultana, M.Z.H. Prodhan, M.M. Islam, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Three clonal hybrids of potato namely 14.10, 14.11 and 14.44 along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at six agro-ecological locations during 2020-21 cropping season. Clone 14.11 selected as a early bulker from this study. The highest average yield was found in clone 14.11 (45.86 t/ha) followed by the clone 14.10 (40.19 t/ha). These two clones can be recommended for release as commercial varieties. Average dry matter percentages of tested clones was lower than the popular processing variety BARI Alu-28 (Lady Rosetta) but satisfactory drymatter percent was observed in Bangladesh Condition. Clone 14.10 gave higher percentage (52.09% in no. & 79.25% in wt.) of larger sized tuber which is important for export purpose. Rest two clones also produced satisfactory larger sized tuber. In case of organoleptic taste, the clones 14.11 performed better regarding taste, appearance and texture of boiled potato. Considering tuber yield, organoleptic taste performance, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) these three clones (14.10 and 14.11) can be recommended for release as commercial varieties.

Participatory variety selection of clonal hybrids (RYT)

S. Naznin, B.C. Kundu, M.N. Uddin, M.N. Amin, M.M. Rahman, P. Hajong, M.M. Islam, T. Jahan, M.K. Alam, R. Akter, M. Sultana, M.Z.H. Prodhan, M.M. Islam, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Three clonal hybrids along with three check varieties were evaluated at farmer's fields under

participatory variety selection to understand the performance as well as farmers opinion. The highest average tuber yield was found in 14.11 (48.42t/ha) followed by 14.10 (42.16 t/ha) and lowest average yield was found in BARI Alu-7 (Diamant) (34.51 t/ha). Farmers were very much interested in all the clonal hybrids for their yield, tuber size, shape, color but varied location to location. Therefore, these two clones (14.10 and 14.11) can be recommended for release as commercial varieties.

Preliminary yield trial of exotic potato varieties for table, export and processing purposes

M.M Islam, M.N. Amin, B.C. Kundu, S. Naznin, M. Rahman, T. Jahan, M.N. Uddin, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Fourteen exotic potato varieties including four checks were evaluated at Gazipur and Debiganj for yield. The variety Zina red gave the highest average marketable yield and all the exotic varieties produced satisfactory marketable yield. This is the first-year trial. As the seed potato were collected from different countries, they might not exposed their all characters completely. Therefore, no selection was done in this year. Seeds produced from this trial are kept for 2nd year trial for further confirmation.

Advanced yield trial of exotic potato varieties for table and processing purpose

T. Jahan, M.N. Amin, B.C. Kundu, S. Naznin, M.M. Islam, M.N. Uddin, M.M. Rahman, P. Hajong, M. Rahman, M.K. Alam, R. Akter, M. Sultana, M.Z.H. Prodhan, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Seven exotic varieties viz. Alcander, Delia Red, Hind, Prada, Rslin, Twinner and Twister along with four check BARI Alu-7, BARI Alu-13, BARI Alu-25 and BARI Alu-28 were evaluated at six different agro ecological locations of Bangladesh named as Bogura, Debiganj, Gazipur, Jamalpur, Jashore and Munshiganj during 2020-21. Significant variation was observed due to environmental factors in different locations to the expression of different characters of potato. The exotic variety Delia Red obtained the highest yield within 65 days (30.91 t/ha) followed by Prada (30.77 t/ha). The highest tuber no per hill was gained from the exotic variety

Alcander (13.92) at Jashore followed by Jamalpur (13.41) and Bogura (12.22). The maximum tuber weight/hill (0.85kg) was observed in Hind followed by Rslin (0.81kg) at Jamalpur and the minimum result was gained from BARI Alu-13 (0.29kg) and BARI Alu-28 (0.32kg) respectively at Gazipur. The utmost dry matter (%) was observed in the check variety BARI Alu-28 (26.00) at Jashore followed by Prada (22.86) and Alcander (22.08) at Debiganj. Considering the overall performance, exotic varieties Alcander, Hind and Rslin can be selected for RYT. As well as Twinner and Twister can be selected for late blight resistant.

Participatory variety selection of advanced exotic potato varieties for table, export and processing purposes

M.M. Islam, M.N. Amin, B.C. Kundu, P. Hajong, M.M. Rahman, S. Naznin, T. Jahan, M.N. Uddin, M. Selim, M.K. Alom, M. Rahman, M.N. Amin, M. Sultana, M.Z.H. Prodhan, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Seven exotic potato varieties with four check varieties were evaluated at farmers' field of six different agro ecological environments/locations during 2020-21 cropping season in PVS. Yield of ten tested new exotic varieties varied significantly from location to location. Some cases more than double yield were obtained. Farmer's perception was also varied, for that reason the tested varieties need to be further evaluation for confirmation.

Regional yield trial with exotic potato varieties

B.C. Kundu, S. Naznin, M.N. Uddin, M.N. Amin, M.M. Rahman, M.K. Alam, R. Akter, M. Sultana, M.Z.H. Prodhan, M.M. Islam, P. Hajong, M.M. Rahman, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Seven exotic potato varieties namely Al. Russet, Arizona, Dunstar, HZD 1249, Innovator, Ottawa and Tiamo along with check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were evaluated at six different agro ecological environment/locations during 2020-21 cropping season in RYT. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. Ottawa was selected as early

bulker exotic variety from this study. No early mature exotic variety was found than check variety BARI Alu-28 (Lady Rosetta). Mean yield over the locations Ottawa gave the statistically highest tuber yield (42.36 t/ha) which was statistically similar only with HZD 1249 (41.42 t/ha) and followed by Al. Russet (39.69 t/ha), Arizona (38.85 t/ha). Therefore, these four exotic varieties can be recommended for the release as commercial varieties due to their higher tuber yield potentialities. Among the tested exotic varieties Innovator produced acceptable average dry matter percent (20.01) for processing. Ottawa (85.01%), Innovator (81.65%) and Arizona (81.03%) gave more large (>40mm dia) size tubers which made great contribution towards percentage of tuber number and tuber weight which is important for export purpose as well as some cases processing purpose. Considering tuber yield, organoleptic taste performance, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) these five exotic varieties (Ottawa, HZD 1249, Al. Russet, Arizona and Innovator) can be recommended for release as commercial varieties.

Participatory selection of exotic potato varieties for table, export and processing purposes

T. Jahan, M.N. Amin, B.C. Kundu, P. Hajong, M.M. Rahman, S. Naznin, M.M. Islam, M.N. Uddin, M. Selim, M.K. Alom, M. Rahman, M.N. Amin, M. Sultana, M.Z.H. Prodhan, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Seven exotic potato varieties along with three check varieties were evaluated at farmers' field of six agro ecological environments during 2020-21. Yield varied significantly from location to location. The average highest tuber yield (45.03 t/ha) was recorded in Dunstar followed by Al Russet (43.54 t/ha) and lowest was in Tiamo (33.65 t/ha). Farmers were very much interested in all these new varieties but varied from location to location. Therefore, all these varieties except Dunstar and Tiamo can be recommended for release as commercial varieties.

Observation trial with clonal hybrids and exotic varieties for early heat tolerance

M. N. Amin, M. Rahman, B.C. Kundu, M. M. Rahman, S. Naznin, M.M. Islam, T. Jahan, M.N. Uddin, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Potato is the third major food crop in the world (Tang et al., 2018). Potato production outside the regular growing season results in farmers profit. In addition, potato consumers are attracted due to decreased supply in the market. Further, farmers grow an early potato in the northern regions of Bangladesh and gain more profit due to a higher price at that time. However, potato production may be affected by increased pest and disease pressure and higher soil temperature. We hypothesized that potato varieties showed less significant tuber yield reduction when they are not grown in a normal season. This experiment was taken to find suitable genotypes for earlier cultivation in northern regions of Bangladesh prior to mid of November. Ten varieties were evaluated at the breeder seed production center, Debiganj, Panchagarh and farmers field during 2019-20 and 2020-21 following a randomized complete block design with three replications. The results revealed significant variations due to genotypes for all characters. Germination percent, Plant height, stem per hill, Marketable tuber yield at 65 days, non-marketable yield at 65 days were recorded. The relative position of different varieties on the biplots is based on its projection on to the XY-axis in AMMI Biplot. Considering yield and yield contributing characteristics Innovator, Alcander were performed well in all growing conditions with wider adaptability and stability in tuber yield.

Screening of potato varieties for processing and export potential

B.C. Kundu, M.M. Islam, M.N. Uddin, S. Naznin, M.N. Amin, M. Rahman, P. Hajong, M. Sultana, M.M. Rahman, R. Akter, M.Z. Ferdous, M.A.H. Talukder, M.R. Karim, M.I.A. Hawlader, R. Akter, M.K. Alam, M.A. Khan, M.M. Rahman, N.D. Kundu, M.S. Uddin, A.K.M. Khorsheduzzaman, M.Z.H. Prodhan, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Sixty-two released potato varieties and some advanced lines/varieties were evaluated at ten agro-ecological locations during the 2020-21 cropping season for identification of suitable export and processing quality varieties. Tuber yield, tuber grading, dry matter and dormancy revealed that among the tested varieties varied significantly between the locations and within the location.

According to the considerable character, the variety BARI Alu-29, BARI Alu-35, BARI Alu-40, BARI Alu-41, BARI Alu-47, BARI Alu-51, BARI Alu-52, BARI Alu-61, BARI Alu-62, BARI Alu-63, BARI Alu-66, BARI Alu-68, BARI Alu-79, BARI Alu-81, BARI Alu-84, 13.7, AL Russet and Innovator can be selected for exportable potato variety.

Preliminary observation yield trial of CIP biofortified potato clones

M.H. Rashid, B.C. Kundu, M.M. Rahman, M.N. Amin, M.M. Islam, S. Naznin, E.H.M.S. Rahaman, D. Chanda, M. Rahman, Mohi Uddin, M.A.H.S. Jahan, K.A. Ara and S. Akhter

Fifty CIP bio-fortified and late blight tolerant clones with four checks variety BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (L.Rosetta) were tested at BSPC, Debiganj, Panchagarh. Most of the genotypes (Around 30) produced higher yield and contain high zinc and iron alone or together over the check varieties. The highest yield was observed in CIP-445 (68.30 t/ha) which was followed by CIP-403 (41.26 t/ha) whereas the lowest yield was obtained CIP-421 (12.21 t/ha). In relation to high yield, zinc and iron (at least 2 together) content CIP-402, CIP-406, CIP-410, CIP-412, CIP-415, CIP-416, CIP-417, CIP-421, CIP-422, CIP-424, CIP-426 and CIP-432 were the good performers where CIP-426 and CIP-432 were the best performers on average in these three mentioned characters. So, those clones may be selected as superior for the next year trial (SYT).

Preliminary yield trial of colored flesh potato varieties

S.Naznin, M. Rahman, B.C. Kundu, M.N. Amin, M.M. Islam, M.N. Uddin, T. Jahan M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Eight genotypes of potato from different sources were evaluated along with four check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady-Rosetta) at six locations during 2020-21. At final harvest, 33.33 was selected for SYT due to its higher tuber yield (44.15 t/ha). In case of dry matter check variety BARI Alu-28 (Lady Rosetta) gave highest result. Genotypes 33.32 and 33.33 were

selected for next year SYT due to their performance regarding tuber yield, disease, insect infestation and tuber characteristics specially for their flesh color.

Morphological characterization of advanced breeding lines and exotic potato varieties

S. Naznin, B.C. Kundu, M.N. Amin, M.N. Uddin, M.M. Islam, M. Rahman, T. Jahan, M.M. Uddin, M.H. Rashid, K.A. Ara and S. Akhter

Eight advanced clones of potato developed by TCRC and fourteen exotic varieties were characterized at TCRC, Gazipur during 2020-21 following the DUS descriptor. There were lots of variations in morphological characteristics in addition to agro-morphic characters.

Screening of parental lines for TPS production under extended photoperiod

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A study with 165 genotypes was carried out in the research field of TCRC, Gazipur, 2020 for screening of some parental lines delivering good performance in different angles. The germplasm were planted in different times set on 17th, 18th, 28th November and 1st December, 2020 for the convenience of crossing. Among 165 genotypes, 119 flashed with flowering where 395 crosses were made and 124 crosses produced 562 berries. Finally, some genotypes were selected existing good growth, excellent bearing and good external features named as Dunstar, BARI Alu-27, BARI Alu-35, BARI Alu-37, BARI Alu-39, BARI Alu-47, BARI Alu-73, BARI Alu-81, BARI Alu-82, BARI Alu-83, BARI Alu-85, 7.23, 14.31, 15.112, 15.38, 15.136, 15.139, 16.4, 16.9, 16.62, 33.33, LB-14, Ottawa, Sunred, Delia Red, Tiger, Lal pakri, CIP 07, CIP 102 and CIP 115.

Selfing in diploid potato germplasm

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Selected diploid lines were planted at TCRC and BSPC. Total planted genotypes were 15 in both places. Most of them did not flower at all in both

locations. Some of them produced flowers but there was no viable pollen to self them. Rest of them produced pollen but did not set berry. When selfing, some genotypes were found self-compatible. Only the genotype A-15 and A-56 produced 85 seeds which will be used in the next generation for selfing.

Production of seedling tubers of the selfed populations (F_1S_0)

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Selected diploid parental lines were planted at TCRC and BSPC in 2019-20. Total planted genotypes in 2019-20 were 14 at TCRC and 22 at BSPC. Most of them did not flower at all in both locations. Some of them even produced flowers but there was no viable pollen to self them. Some diploid flowered genotypes were found self-compatible. Only the genotype B-27 gave 15 TPS and used for generating selfed population at BSPC in 2020-21. From them 20 tubers of two progenies of B-27 were produced and stored for next year trial.

Seed multiplication maintenance of released potato varieties, germplasm, lines and TPS parents

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A total of 27760 kg seeds of potato was preserved in Breeder Seed Production Center cold storage, Debiganj, Panchagarh collected from 4844 potato variety/germplasm/hybrid clone during 2020-2021. The preserved materials will be used in future for variety development program.

Multiplication, purification and maintenance of indigenous potato varieties

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Indigenous cultivars of potato are famous for taste, dry matter and preservation quality under natural condition. During 2020-21 cropping year, quality seeds of nine indigenous variety viz. Ausha, Challisha, Dohazari, Indurkani, Lalpakri, Patnai,

Sadaguti, Shilbilati and Sindurkota were produced under net house condition. There are 247 Kg seeds preserved in cold-storage of BSPC, Debiganj, Panchagarh for next year use.

Sweet Potato

Hybridization of sweet potato by polycross method

Z. Alam, M. A. H. Khan, M. S. Alam, M.A.H.S. Jahan, S. M. Sharifuzzaman, K.A. Ara and S. Akhter

To exploit heterozygosity among sweet potato genotypes polycross method has been used to generate half-sib sweet potato hybrid seeds with great variability regarding yield potentiality, dry flesh, earliness, carotene content, disease tolerance & good taste. In reality, there is only one breeding objective- a better variety. The experiment was conducted during 2020-21 at Gazipur Fifty numbers of F₁ seeds were collected from six parents. The highest number of F₁ seeds was collected from BARI Mistialu-12 (25) followed by BARI Mistialu-2 (15) and the lowest number of F₁ seeds from BARI Mistialu-4 (5). These F₁ seeds will be sown in nursery bed next season for vine as well as tuber production and evaluation.

Collection and maintenance of sweet potato germplasm

Z. Alam, M. A. H. Khan, M. S. Alam, M.A.H.S. Jahan, S. M. Sharifuzzaman, K.A. Ara and S. Akhter

Around 17 thousands seeds were germinated from around 25 thousands seeds of sweet potato imported from CIP, Peru and Mozambique. TCRC, BARI, Gazipur is maintaining the germinated seeds in the field as well as plastic pots.

Observational yield trail of CIP sweet potato germplasm

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Early bulkier/type and orange flesh sweet potato germplasm was imported from CIP, Lima, Peru. Around 10 thousand seeds were germinated out of 22591 seeds belongs to 12 families. These germinated seeds were transferred into the pot and

survived plants were transferred into field for vine multiplication. An observational trail was conducted utilizing these genotypes at two locations like Bogura and Jamalpur based on searching early types genotypes and high yielding (normal bulkier/type) genotypes in winter season 2020-21. In Bogura, 111 genotypes were selected as early type and 232 genotypes were selected considering yield. In Jamalpur, 90 genotypes were selected as early type and 153 genotypes were selected considering yield.

Advanced yield trial with CIP clones of sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. Sultana, M. Z. H. Prodhan, M.A.H.S. Jahan, S. M. Sharifuzzaman, K.A. Ara and S. Akhter

Three (3) sweet potato genotypes (CIP400039, Moz1.15 and Moz1.9), enriched of beta carotene and mineral content, were provided by International Potato Centre (CIP). Those genotypes were evaluated with two check varieties viz. BARI Mistialu-4 and BARI Mistialu -8 at Gazipur in 2020-21 cropping season to get a variety comprising high marketable yield, tuber length, number of tuber/plant and weight of tuber/plant. The tested three lines higher yield than the checks varieties.

Regional yield trial with hybrid clones of sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. M. Rahman, M. Sultana, P. Hajong, M. G. Azam, M.A.H.S. Jahan, S. M. Sharifuzzaman, K.A. Ara and S. Akhter

Six hybrid clones namely, H9.7/12, H9.10/12, H6.52/11, H5.ej/10, H16.ej/10 and H9.48/11 were evaluated with two check variety BARI Mistialu 4 and BARI Mistialu 8 in five location during 2020-21 season. All the six studied clones gave satisfactory yield. For conclusive results, the experiment will be repeated in next year.

Regional yield trial with white fleshed sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. M. Rahman, M. Sultana, P. Hajong, M. G. Azam, M.A.H.S. Jahan, S. M. Sharifuzzaman, K.A. Ara and S. Akhter

Two white fleshed local cultivars were evaluated along with BARI Mistialu-3 and BARI Mistialu-10 used as check during 2020-21 cropping season at five locations (Gazipur, Bogura, Jamalpur, Jashore and Pahartali) in RCB design with three replications. Red skinned and white fleshed local cultivar WFRS002 found promising regarding their marketable yield, dry matter content and overall acceptability score.

Participatory variety selection trial with hybrid clones of sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. M. Rahman, M. Sultana, M.A.H.S. Jahan, S. M. Sharifuzzaman, K.A. Ara and S. Akhter

A participatory variety selection trial at farmer's field of was carried out in Gazipur, Bogura and Jamalpur with six hybrid clones namely H9.7/12, H9.10/12, H6.52/11, H5.ej/10, H16.ej/10 and H9.48/11 with two check variety BARI Mistialu-4 and BARI Mistialu-8 during the winter season of 2020-21. Farmers experienced very good mouth feel during testing H_{6.52/11}. Overall, they choose H_{6.52/11}, H_{9.10/12} and H_{9.7/12} in respect of their marketable yield and organoleptic test.

Participatory variety selection trial with white flesh sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. M. Rahman, M. Sultana, M.A.H.S. Jahan, S. M. Sharifuzzaman, K.A. Ara and S. Akhter

A participatory variety selection trial at farmer's field of white fleshed sweet potato was carried out with two local lines namely WFWS001 and WFRS002 with two check variety BARI Mistialu-3 and BARI Mistialu-10 in Bogura, Gazipur and Jamalpur during the winter season of 2019-20. Farmers experienced very good mouth feel during testing both lines. These two lines showed high yield potentiality as well. Overall they choose both clones in respect of their marketable yield and organoleptic test.

Aroids

Preliminary yield trial of mukhikachu lines

M. S. Alam, F. Begum, M. M. Islam, M.A.H.S. Jahan, K. A. Ara and S. M. Sharifuzzaman

Seventeen lines of Mukhikachu (*Colocasia esculenta* var. *antiquorum*) viz. MK-105, MK-127, MK-140, MK-177, MK-178, MK-179, MK-180, MK-181, MK-182, MK-183, MK-184, MK-185, MK-186, MK-187, MK-188, MK-189 and MK-190 were evaluated under Preliminary yield trial during April to November 2020 at TCRC research field, Gazipur. The growth parameters, yield components and yield were statistically significant. The highest yield (19.98 t/ha) was recorded in MK-177 closely followed by MK-178 (19.21 t/ha).

Regional yield trial of mukhikachu lines

M. S. Alam, F. Begum, M. Z. H. Prodhan, M. Sultana, M. M. Rahman, M. T. Islam, P. Hajong, M. M. Rahman, M. A. H. S. Jahan, K. A. Ara and S. M. Sharifuzzaman

Four genotypes of Mukhikachu (*Colocasia esculenta*) viz. MK-122, MK-129, MK-131, MK-176 along with a BARI released variety Bilasi and BARI Mukhikachu -2 as check were evaluated under regional yield trial during March to November 2020. The yield components and yield were statistically significant. The Mukhikachu line MK-122 produced the highest yield (34.07 t/ha) which was statistically similar with MK-129 (33.26 t/ha) at Jamalpur.

Regional yield trial of rhizome producing panikachu lines

M. S. Alam, F. Begum, M.Z.H. Prodhan, M. Sultana, M.R.H. Mondal, M. M. Rahman, M. T. Islam, P. Hajong, M. M. Rahman, M.A.H.S. Jahan, K. A. Ara and S. M. Sharifuzzaman

Six lines of rhizome producing Panikachu (*Colocasia esculenta*) viz. PK-119, PK-179, PK-180 and PK-181, PK-182, PK-183 along with two released variety BARI Panikachu-5 and BARI Panikachu-6 (as check) were evaluated under regional yield trial at Gazipur, Jamalpur, Bogura and Jashore. The results showed significant variation among most of the growth parameter, yield attributes and yield of rhizome producing

Panikachu genotypes. Significantly higher stolon yield was obtained in PK-183 at all the studied locations and it was the highest of 27.13 t/ha at Gazipur. The highest marketable rhizome yield (88.71 t/ha) was obtained in PK-179 at Jamalpur.

Regional yield trial of stolon producing panikachu lines

M. S. Alam, F. Begum, M. Z. H. Prodhan, M. Sultana, M. M. Rahman, P. Hajong, M. M. Rahman, M. A. H. S. Jahan, K. A. Ara and S. M. Sharifuzzaman

Two lines of stolon producing Panikachu (*Colocasia esculenta*) namely PK-134, PK-178 along with two BARI released stolon producing varieties of Latiraj and BARI Panikachu-2 as check variety were included in this experiment for selecting new variety(s) under regional yield trial at Gazipur, Jamalpur, Jashore and Bogura during January to August 2020. Most of the vegetative growth parameters, yield contributing characters and yield were statistically significant between interaction effect of the genotypes and locations. Stolon yield was the highest (20.72 t/ha) in Latiraj at Jamalpur closely followed by BARI Panikachu-2 (20.45a t/ha) at Jamalpur. The marketable rhizome yield was the highest (52.96 t/ha) in PK-178 at Jamalpur.

Maintenance of aroids germplasm

M S. Alam, F. Begum, M. M. Islam, M. A. H. S. Jahan, K. A. Ara and S. M. Sharifuzzaman

Eighteen of Mukhikachu, eleven of Panikachu and one of each of Panchamukhi Kachu, Dudhkachu, Moullovikachu/Sahebikachu and Ghataman Kachu germplasm collected from home and abroad in recent past years and conserved at TCRC field, Joydebpur, Gazipur.

Yam

Regional yield trial of yam (*Dioscorea* spp.)

M.H. Rashid, M. Sultana, M.Z.H. Prodhan, P. Hajong, M.S. Alam, M.M. Molla, M.H.H. Khan, M.A.H.S. Jahan, K.A. Ara and S. Akhter

Five yam germplasm namely HOM 20, HOM 47, HOM 39, HOM 9 and HOM 7 were evaluated at three different agro ecological

environment/locations during 2020-2021 cropping season in RYT. Combined analysis was done to see the genotype location interaction. The significant influence was observed of different environmental factor of different locations on the expression of different characters of yam. Results of the present study clearly indicated among the germplasms, HOM-9 (17.62 kg) and HOM-7 (17.00 kg) offered highest yielder followed by HOM-20 (16.34 kg) and HOM 39 (15.61 kg). So, those could be advanced to release as variety considering the result.

Participatory yield trial of yam (*Dioscorea* spp.)

M.H. Rashid M.S. Alam, M.A.H.S. Jahan, K.A. Ara and S. Akhter

Five yam germplasm namely HOM 20, HOM 47, HOM 39, HOM 9 and HOM 7 were evaluated at Gazipur farmers field during 2020-21 cropping season under PYT. Results of the present study clearly indicated among the germplasms, HOM-39 (12.81 kg) offered highest yield followed by HOM-20 (8.47 kg). So, those could be advanced to release as variety considering the result. The lowest yield obtained by HOM 47 (7.41). So, those could be advanced to release as variety considering the result.

Priliminary yield trial (PYT) of yam (*Dioscorea* spp.)

M.H. Rashid M.S. Alam, M.A.H.S. Jahan, K.A. Ara and S. Akhter

Six yam germplasm namely Bog-01, Bog-02, Bog-03, M-Man-01, M-Man-02 and Lal-01 were evaluated at TCRC, Gazipur during 2020-21 cropping season under PYT. Results of the present study clearly indicated among the germplasms, Results of the present study clearly indicated among the germplasms, Lal-01 (11.50 ton/ha) offered highest yielder followed by Bog-03 (10.96 ton/ha), Bog-01 (9.92 ton/ha) and Bog-02 (7.18 ton/ha). So, those could be advanced to release as variety considering the result. The lowest yield obtained by M-Man-02 (2.86 ton/ha). So, those could be advanced to release as variety considering the result.

Cassava

Preliminary yield trail of some exotic cassava (*Manihot esculenta*) lines

M.H. Rashid, S. Sultana, M.S. Alam, M.M. Molla (Postharvest Division), M.H.H. Khan (Postharvest Division), M.A.H.S. Jahan, K.A. Ara and S. Akhter

Three exotic cassava germplasm namely MEE-01, MEE-02 and MEE-03 evaluated at research field, TCRC, Gazipur during 2020-2021 cropping season under PYT. Results of the present study clearly indicated among the germplasms, MEE-03 offered highest yielder (17.06 ton/ha) as well as possessed the highest starch content (33.39%) with high dry matter content (42.22%) followed by MEE-01 (Yield-16.14 ton/ha, starch content-32.72%, dry matter content-44.20%). So, those could be advanced to release as variety considering the result.

Preliminary yield trail of some local cassava (*Manihot esculenta*) lines

M.H. Rashid, S. Sultana, M.S. Alam, M.H. Rashid, S. Sultana, M.S. Alam, M.M. Molla (Postharvest Division), M.H.H. Khan (Postharvest Division), M.A.H.S. Jahan, K.A. Ara and S. Akhter

Three local cassava germplasm namely MEL-01, MEL-02 and MEL-03 were evaluated at research field, TCRC, Gazipur during 2019-2020 cropping season under PYT. Results of the present study clearly indicated among the germplasms, MEL-03 offered highest yielder (14.82 ton/ha) as well as possessed the highest starch content (30.30%) with high dry matter content (50.87%) followed by MEL-01 (Yield-10.54 ton/ha, starch content-25.60 %, dry matter content-48.43%). So, those could be advanced to release as variety considering the result.

Production Technology

Response of potato varieties to water stress conditions

M. Salim and M. K. Alam

An experiment was conducted at the Tuber Crops Research Sub-Centre, Munshiganj during 2020-21 with four level of irrigations namely I_0 = No irrigation, I_1 = One irrigation at 30 DAP, I_2 = Two irrigation at 30 and 45 DAP and I_3 = Three

irrigation at 30, 45 and 60 DAP with eight newly released potato varieties namely V_1 =BARI Alu-25, V_2 =BARI Alu-28, V_3 =BARI Alu-35, V_4 =BARI Alu-36, V_5 =BARI Alu-37, V_6 =BARI Alu-40, V_7 =BARI Alu-62 and V_8 =BARI Alu-66 with a view to select variety(s) that are high yielding and suitable for cultivation under water stress condition. Results showed that in terms of grade of seed size tuber, BARI Alu-25 and BARI Alu-37 gave the best performance % by number (69.75%) and % by weight (73.81%), respectively in severe water stress condition. Considering the final yield, the best performance (29.99 t/ha) was obtained from BARI Alu-36 under no irrigation condition (I_0). BARI Alu-66 resulted the lowest (31.62%) final yield reduction in water stress condition. The more water stresses the drier matter accumulation trend was found from this study where BARI Alu-28 produced the maximum tuber dry matter percentage (25.66%) which was followed by BARI Alu-25 in water stress condition (I_0). Therefore, considering the yield, yield reduction percentage, grade of seed size tuber and dry matter percentages; BARI Alu-36, BARI Alu-66, BARI Alu-37, BARI Alu-28 and BARI Alu-25 may be cultivated under water stress condition in our country.

Intercropping of different vegetables with potato at Munshiganj region

R. Akter, M. Salim and M. K. Alam

An experiment was conducted during rabi season of 2020-2021 at Tuber Crop Research Sub-Centre, Munshiganj to find out suitable intercrop combination for higher profitability and economic return. Sole potato (100%) and five intercrop combinations (one row of potato and one row of red amaranth, one row of potato and one row of spinach, one row of potato and one row of reddish, one row of potato and one row of cabbage and one row of cauliflower in between two rows of potato) were evaluated in the present study. Significantly the highest potato yield (40.7 t/ha) was obtained from sole crops. Potato yield was reduced (7.20-16.12%) due to intercropping, but it was compensated by the intercrop. Moreover, potato equivalent yield (PEY) of the intercrop treatments was higher than those of sole crops. The highest (63.4 t/ha) potato equivalent yield (PEY) was found

in one row of potato + one row of cauliflower. The highest gross return (Tk316800/ha), net return (Tk. 141000/ha) and benefit cost ratio (1.80) were also recorded in this treatment combination.

Effect of Biochar with compost and fertilizer on growth and yield of potato

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The experiment was conducted to study the effect of biochar with organic and inorganic fertilizer with the improvement of soil chemical, physical, biological properties and potato tuber production. There were eight treatments e.g. T₁. Control (No Fertilizer), T₂. Biochar (3.6 kg), T₃. Compost (Vermicompost 3.2 kg, Trichocompost 3.2 kg, NOC 3.2 kg and CD 4.3kg), T₄. Recommended Fertilizer (Urea 252 g, TSP 159 g, MOP 216 g, Gypsum 144 g, ZnSO₄ 7.2 g, HBO₃ 7.2 g, Sunfuran 14.4 g and CD 7.5 kg), T₅. Fertilizer 75% + Compost 25% (Urea 189 g, TSP 120 g, MOP 162 g, Gypsum 108 g, ZnSO₄ 5.4 g, HBO₃ 5.4 g, Sunfuran 10.8 g and CD 5.7 kg) + (Vermicompost 800 g, Trichocompost 800 g, NOC 800 g and CD 1075 g), T₆. Compost + Biochar (T₃+T₂), T₇. Fertilizer 75%+ Compost 25% + Biochar (T₅+ T₂) and T₈. Recommended Fertilizer+ Biochar (T₄+T₂). The experiment was laid out in RCB design with three replications. T₈ exhibited the highest yield in each plot (16.56 kg), total marketable yield (17.98 t/ha), total non-marketable yield (5.02 t/ha) and total yield in hectare (23.00 ton) which was followed by T₄ yield in each plot (15.89 kg), total marketable yield (16.89 t/ha) and total yield in hector (22.07 ton). Considering all yield contributing parameters, soil and plant sample analysis, yield and economic analysis it can be concluded that T₈ was suitable treatments for recommendation. The highest net return and BCR were recorded in T₈ which was followed by T₄ but the cost of production was higher than return in the rest treatments. This is second year experiment and considering all yield contributing parameters, yield and economic analysis it can be concluded that T₈ and T₄ were suitable treatments for recommendation. The highest net return and BCR

were recorded in T₈ and Biochar is used once with in hundred years. So, biochar was not applied to those treatments where it was used and the input cost of biochar was not included.

Influence of bacterial strain on the salt tolerance and bacterial wilt of potato plants

M.H. Rashid, M.M. Begum, M.T Hossain, I.M Ahmed, M.S. Islam, S. Parvin, M.M Islam, A.H.M.S. Jahan K.A. Ara and S. Akhter

Endophytic bacterium especially *Bacillus* species are being used in the agriculture fields for suppressing the pathogen, mitigating the salt stress, and promoting plant growth activities since last decades over the world. Bangladesh Agriculture Research Institute already lunched these types of novel activities. The study was scrutinized to know the effect of *Bacillus oryzicola* YC7007 to mitigate the salinity and to control the bacterial wilt of potato plants. Our stain YC7007 performed plant growth promotion activities through leaf no. 46.50, leaf weight 51.50 g compared to control 36.00 and leaf weight 45.50 g in in BARI Alu-72 respectively as such, strain YC7007 promoted in the root weight 71.50 g compared with control 21.0 gm in BARI Alu-25, stem weight 37.50 gm comparing to control 21.00 gm in the BARI Alu-72. Strain YC7007 also increased significantly stolon no. 25.50 compared to control 17.50 in the BARI Alu-72, and finally enhanced 20% marketable yield weight compared to control in the BARI Alu-25. However, pathogen could not produce its infection in the control and the doses of saline could not regulate the severe stress incidence. With the interaction of the pathogen and saline versus the YC7007, it needs further study.

Effect of spacing and mulching on weed infestation and yield of potato

M. Salim and M. K. Alam

An experiment was conducted at the Tuber Crops Research Sub-Centre, Munshiganj during 2020-21 with three types of mulch materials namely M₁ = Straw, M₂= Water Hyacinth, M₃= Straw + Water Hyacinth including M₀ = Control (No mulching) with three spacing like S₁ = 75 cm x 30 cm, S₂ = 60 cm x 25 cm and S₃ = 40 cm x 20 cm with a view to

identify suitable mulch materials for potato production and find out the effect of spacing and mulching on yield of potato. Results showed that the best performance (43.37 t/ha) was obtained from treatment combination M_3S_2 i.e. M_3 = straw + water hyacinth with S_2 = 60 cm x 25 cm spacing. Therefore, considering the yield and yield contributing characters, mulch materials like straw and water hyacinth with 60 cm x 25 cm spacing may be practiced to cultivate potato in our country to get maximum yield.

Dry matter partitioning and yield of processing of potato varieties

M. Salim and M. K. Alam

An experiment was conducted at the research field of the Tuber Crops Research Sub-Center, Bangladesh Agricultural Institute, Munshiganj, during the potato growing season of 2020–21 with three processing potato varieties viz. BARI Alu-25, BARI Alu-28 and BARI Alu-29. The objective of this experiment was to evaluate three processing potato varieties for growth pattern, dry matter partitioning to the sink and yield performance of processing potato varieties at different days after planting (DAP). Five different harvests were undertaken during the growing season to determine dry matter (DM) partitioning to various parts of the plant. The results revealed that during the first harvest (at 60 DAP) the percentage of leaf DM, root DM and the total DM accumulation did not differ significantly among varieties whereas the percentage of stem DM and tuber DM differ significantly. During the second harvest (at 70 DAP), most of the parameters like percentage of leaf DM, root DM, tuber DM and the total DM accumulation was identical among the varieties while percentage of stem DM was varied significantly. No significant variation was found during the third harvest (at 80 DAP) among the varieties for all the parameters whereas BARI Alu-25 gave the highest total DM accumulation and had the highest DM translocation towards tuber and the least towards root. During the fourth harvest (at 90 DAP), percentage of stem DM, root DM and the total DM accumulation differed significantly among the varieties whereas the variation was non-significant in case of leaf DM and tuber DM

percentage among the varieties. At 90 DAP; all the varieties accumulated more 80% tuber dry matter accumulation. During the final harvest (at 100 DAP), significant variation was observed for the tuber DM, total dry matter accumulation and tuber fresh yield among the varieties whereas BARI Alu-25 obtained the maximum tuber dry matter percentage and the total DM accumulation per plant. BARI Alu-25 produced a significantly higher (35.21 t/ha) fresh tuber yield and BARI Alu-29 yielded the least (25.34 t/ha). From this, it can be concluded that BARI Alu-25 appeared to be the highest yielder, followed by BARI Alu-28.

Effects of seed tuber size on yield and quality of processing potato varieties

M.W. Rahman, M.M. Islam, M.Z. Masud and M.M. Uddin

The experiment was conducted at Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh during the Rabi season of 2020-2021 to study the effects of seed tuber size on yield and quality of processing potato varieties. Three varieties viz: BARI Alu25 (Asterix), BARI Alu28 (Lady-Rosetta) and BARI Alu29 (Courage) and four tuber sizes viz: 28 – 35 mm, 36 – 45 mm, 46 – 55 mm and >55 mm were used in the study. The two-factor experiment was laid out in a randomized complete block design (RCBD) with three replications. The unit plot size was 3 m × 3 m. Tuber yield, dry matter and tuber size of potato were significantly influenced by seed tuber size and varieties. The highest tuber yield (34.55ton/ha) was found in BARI Alu25 and the lowest (29.93ton/ha) was recorded in BARI Alu28, which was statistically identical to BARI Alu29. Maximum dry matter (23.21%) was recorded in BARI Alu28 and minimum dry matter (19.04%) was found in BARI Alu25. Maximum medium (40 – 55 mm) and large size (>55 mm) tuber was found in BARI Alu29, which was statistically identical to BARI Alu28. We know that tuber size and dry matter is very much important for processing varieties. For this reason, BARI Alu29 and BARI Alu28 is suitable for tuber processing. The highest tuber yield (34.12ton/ha) was found in G_4 (>55 mm), which was statistically similar to G_3 (46 – 55 mm) and G_2 (36 – 45 mm). The lowest tuber yield (28.90

ton/ha) was recorded in G₁ (28 – 35 mm). Dry matter was showed insignificant effects among different tuber size of potato. Maximum medium (40 – 55 mm) and large size (>55 mm) tuber number and weight percentage was found in G₁ (28 – 35 mm), which was statistically identical to G₂ (36 – 45 mm) and G₃ (46 – 55 mm) in case of tuber weight percentage. For getting maximum medium and large size of potato tuber for processing, tuber size G₁ (28 – 35 mm) was found superior over other tuber size of potato.

Effect of tuber size and spacing on yield of BARI Alu-90

M.R.H. Mondol, M.A. Akther, M.M. Sultana and S. Parvin

The experiment was conducted at TCRSC, Bogura during rabi 2020-21 to find out optimum seed tuber size and plant spacing for enhancing the productivity of BARI Alu 90. Three levels of tuber size viz. T₁= < 28 mm (small), T₂= 28-55 mm (medium) and T₃ = > 55 mm (large) along with three levels of spacing viz. S₁= (60 X 25) cm, S₂= (50 X 25) cm and S₃ = (40 X 25) cm was included in the study. The results revealed that in considering yield, > 55 mm tuber size at 50 X 25 cm spacing treatment combination showed better performance (52.02 t ha⁻¹) followed by 28-55 mm tuber size at 50 X 25 cm spacing (50.98 t ha⁻¹). But according to economic analysis, the highest gross margin (Tk 557,670/ha) and BCR (2.69) was estimated from 28-55 mm tuber size at 50 X 25 cm spacing treatment combination.

Effects of seed tuber size and spacing on yield and processing quality of potato

M.W. Rahman, M.M. Islam, M.Z. Masud and M.M. Uddin

An experiment was conducted at Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh during the Rabi season of 2020-2021 to study the effects of seed tuber size and spacing on yield and processing quality of potato. Three spacing viz: 50 cm x 25 cm, 60 cm x 25 cm, 70 cm x 25 cm and four tuber sizes viz: 28 – 35 mm, 36 – 45 mm, 46 – 55 mm and >55 mm were used in the study. The two-factor experiment was laid out in a randomized complete block design (RCBD) with three replications. Potato variety BARI Alu 29 (Courage)

was used as a test crop. The unit plot size was 3 m × 3 m. Tuber yield, dry matter and tuber size of potato were significantly influenced by different levels of spacing and seed tuber size. Significant variation was not observed between tuber yield and dry matter content of potato by different level of spacing. Maximum medium and large size tuber were found in S₃ (70cm x 25 cm). Tuber size G₄ (>55 mm) was found better for getting higher yield and this size was suitable for table purpose. On the other hand, minimum medium (40 – 55 mm) and large size (>55 mm) tuber was found in G₄ (>55 mm). We know that tuber size is one of the important factors for processing. For getting maximum medium (40 – 55 mm) and large size (> 55 mm) of potato tuber for processing, tuber size G₁ (28 – 35 mm) was found superior over other tuber size of potato. This is the first-year result of this experiment and it will be continued to verify the findings.

Effect of planting time and fertilizer levels on yield of beta-carotene content sweet potato

M.R.H. Mondol, M.A. Akther, M.M. Sultana and S. Parvin

The experiment was conducted at TCRSC, Bogura during rabi 2020-21 to find out the optimum date of planting, fertilizer doses and productivity and profitability of beta-carotene content sweet potato. Four levels of planting dates viz. D₁ = 30 October, D₂ = 10 November, D₃ = 20 November and D₄ = 30 November along with four levels of fertilizers viz. F₀ = control, F₁=60:55:80 kg of NPK, F₂=80:75:100 kg of NPK and F₃= 100:95:120 kg of NPK per hectare were included in the study. The results revealed that among all treatment combinations 20 November planting date with 100:95:120 kg of NPK/ha fertilizer doses treatment combination showed better performance in considering yield (46.99 t ha⁻¹), gross margin (Tk 795,131/ha) and BCR (4.62).

Sensory evaluation of sweet potato shoot as leafy vegetables

S. Parvin and S. Sultana

Sweet potato (*Ipomoea batatas*) leaves especially the beta carotene fortified varieties are rich in functional macro and micro nutrients such as dietary fibers, antioxidants and other micronutrients

deficient in the predominantly starchy staples. In this study about fifteen varieties and ten lines were studied. Considering taste/mouthfeel, bitterness and presence of fiber most of the participants in organoleptic evaluation preferred much BARI Misty Alu 11 (scored 4.4) as leafy vegetables which was followed by sweet potato lines WF 002 (scored 4.2) and H_{9.7/12} (scored 4.2). These leaves can therefore provide a nutritional base diets for the nutritionally vulnerable in rural and urban communities.

Effect of organic herbicides on major weeds species and yield of organic potato

M.K. Alam, S. Parvin and M.H. Rashid

A field experiment was conducted at 'Organic Block' of tuber crops research centre, BARI during Rabi season of 2020-21 to find out the suitable organic herbicide against weeds in organic potato fields. Efficacy of organic herbicides in controlling weeds was evaluated by spraying just after planting and continued 5 days interval till 60 days. There were five treatments viz. T₁ = Salt @ 50kg/ha, T₂ = Vinegar @ 150ml/l, T₃ = Neem oil @ 50 ml/l, T₄ = Eucalyptus oil @ 50ml/l and T₅ = Control (no weeding), with one potato variety BARI Alu 46. This investigation indicates that there was significant difference among the treatments in respect of weed control and organic tuber yield. The maximum weed control efficiency (74.8%) as well as highest tuber yield (26.01 t/ha) was recorded in eucalyptus oil treated plot (T₄) which was followed by neem oil and was statistically similar. Significantly lowest yield (14.9 t/ha) was obtained in control plot (T₅) and among the treatments, poor weed control efficiency (48.3%) was observed in salt treated plot.

Efficacy of botanicals to control virus diseases transmitted by aphids in organic potato production

M.K. Alam, S. Parvin and M.H. Rashid

An experiment was conducted to evaluate the efficacy of five different botanical pesticide to suppress the aphid infestation and thereafter incidence of two major virus diseases namely PLRV and PVY in potato field under organic management practices. The experiment was executed at the organic block under TCRC research

field, Joydebpur during the year of 2020-21. Five botanicals namely rape seed oil, mahogany oil, neem oil, karam cha oil @ 2 ml/liter and Bioneem Plus (Azadiractin) @ 1ml/l were chosen as the treatment. BARI Alu 36 was used under organic production system where soil fertility was managed with different organic fertilizers like Cow dung, Vermicompost, Trichocompost, and Neem Oil Cake @ 5t/ha each and different treatments were applied at 10 days interval from 30 days after planting to haulm pulling. Mean aphid number per ten plants as well as incidence of PLRV and PVY was recorded at three different dates (45, 60 and 75 DAP). At the initial dates (45 and 60 DAP), neem oil performed better in reduction of aphid infestation (1.41 and 2.91, respectively) while Bioneem plus gave the best result (4.18 per 10 plants) at the final stage (75 DAP) and was statistically similar. More or less similar trends were observed in case of viral diseases. Furthermore, plant vigority (8.51) as well as tuber yield (24.3 t/ha) were found better from the plot treated with Bioneem plus which was identical with neem oil.

Effect of different botanical pesticides to control potato tuber moth (ptm) under storage conditions

M.K. Alam, M. J. Haider, S. Parveen and M. Salim

Seven botanicals namely *Lantana camara*, *Eucalyptus globulus*, *Tagetes minuta*, Pyrethrum flowers *Azadiractha indica*, *Nicotiana tabacum* and *Mentha viridis* were evaluated against potato tuber moth including two checks (Talcum powder and untreated check) under storage conditions at TCRSC, BARI, Munshiganj during the year of 2020-21. BARI Alu 36 was used as material produced under organic production system at organic block, TCRC, Gazipur following organic practices. Similar size tubers were chosen and about 14 tubers weighed 1.0 kilogram. The tubers were surface sterilized and were shacked well with 25 g of the extract treated with talcum powder/1 kg tubers. The tubers were kept in the wooden box in ambient condition for natural infestation by PTM. Data recording yet not completed. Till today, tuber infestation was reduced in botanicals. Lantana and neem showed the best performance against PTM

infestation. However, final conclusion to be drawn after completion of the experiment.

Effect of botanicals to control late blight disease in organic potato production

M.K. Alam, S. Parvin and M. Begum

An experiment was conducted to evaluate the efficacy of eight different botanical pesticide to suppress the mycelium growth in *in vitro* condition as well as to reduce the disease severity in organic field condition. The experiment was executed at TCRC, BARI Joydebpur during the year of 2020-21. Eight botanicals namely *Menthavirdis*, *Allium cepa*, *Azadirachta indica*, *Datura stramonium*, *Nicotiana tabacum*, *Lantana camara*, *Citrus limon* and *Corchorus capsularis* (plant extract powder @ 2%) were chosen as the treatment. BARI Alu 63 was used under organic production system. In laboratory, mint, Neem, lantana were found to be effective to suppress the mycelium growth. More or less similar performance was observed in case of field condition. Lantana showed the best performance (1.33) to reduce disease severity which was followed by neem and mint, respectively and was statistically similar. Accordingly, the highest tuber yield (24.8 t/ha) was found in lantana which was followed by neem and tobacco.

Efficacy of botanicals to control soft rot disease of organic potato under storage condition

M.K. Alam, M. Begum, S. Parveen And M. Salim

An experiment was conducted to evaluate the efficacy of nine different botanicals against soft rot disease under storage conditions at TCRSC, BARI, Munshiganj during the year of 2020-21. Nine botanicals namely *Allium cepa* (seed), *Allium sativum* (leaves), *Azadirachtaindica* (leaves/seed), *Capsicum annum* (Fruits), *Datura stramonium* (leaves), *Nicotiana tabacum* (leaves), *Lantana camara* (leaves), *Corchorus capsularis* (leaves) and *Swerita chirata* (whole plant) were chosen as the treatment including two control bleaching powder and zero control. BARI Alu 36 was used as material produced under organic production system at organic block, TCRC, Gazipur following organic practices. Plant extracts were collected following standard procedures and were tested to control soft rot disease of potato under storage condition. Lantana and garlic showed the best performance

(4.18%) to suppress disease incidence which was followed by neem, tobacco, bleaching (5%) and was statistically similar with most of the botanicals. More or less similar trends were observed in percentage of severity of tuber soft rot. The best (1.84%) performance was found in lantana which was followed by bleaching and garlic while least performance (33.5%) was observed in case of control treatment.

Effects of different registered organic fertilizers on the yield and yield contributing characters of potato

S. Parvin, M.K. Alam and M.H. Rashid

This experiment was executed at the organic block under TCRC research field, Joydebpur during the year 2020-21 to assess the influence of organic fertilizers on the yield of potato. Performance of four organic fertilizers namely ACI organic fertilizer, North Bengal Organic Fertilizer, Onnopurna organic fertilizer, Mega organic fertilizer with one potato variety e.g. BARI Alu36 was evaluated. ACI Organic Fertilizer with BARI Alu36 gave the highest yield (27.96 t/ha) which was statistically higher than other the treatments.

Soil, water and nutrient management

Soil is the most important natural resource of Bangladesh and judicious soil management is the most important for getting desired yield and keeps the soil with full potential for further cultivation. Due to high cropping intensity, soil resource of Bangladesh has been over exploited and soil fertility declines. Soil, water and nutrient management section is currently working on soil fertility and organic matter enrichment through INM and IPNS system of tuber crops cultivation.

Integrated nutrient management for potato-groundnut-t. Aman rice cropping pattern

M. W. Rahman, M.M. Islam, S.M.A.H.M.Kamal, M.M. Uddin, K.A. Ara and S. Akhter

An experiment was conducted to develop a suitable fertilizer package through organic manure and chemical fertilizer management for the cropping pattern and to increase crop productivity and sustain soil health at Grey Terrace soil of Joydebpur and Non-calcareous Grey Floodplain soil of Debiganj. There were six treatments: T1

(Control, native nutrient), T2 (100% recommended dose of fertilizers, RDF), T3 (Poultry manure, PM@ 3t ha⁻¹ + IPNS), T4 (Cowdung, CD @ 6 t ha⁻¹ + rest from RDF), T5 (125% RDF) and T6 (Farmer's practice, FP). The experiment was laid out in a randomized complete block design (RCBD) with three replications. Organic manure in combination of reduced rate of inorganic fertilizers showed better performance regarding yield, marginal benefit cost ratio, pest and disease infection. The highest tuber yield (36.0 t ha⁻¹) was found in T3 (PM 3 t ha⁻¹ + IPNS) at Debiganj. The highest marginal benefit cost ratio (MBCR, 15.5) was recorded in T3. The minimum scab infection (0.02%) was recorded in T3 and while T4 showed no infection. This is the pattern experiment, so conclusion will be drawn latter.

Determination of fertilizer dose for promising released panikachu variety

M.M.Islam, M.S. Alam, M.Z.H.Prodhan, M. M. Rahman, K.A.Ara and S. Akhter

The experiment was carried out at Grey Terrace soil of Joydebpur and Tista Meander Floodplain soil of Bora to update and optimize the fertilizer package of panikachu matching the soil and agro climatic condition and to maximize yield of panikachu. There were six treatments - T1 (NPKS), T2 (-N), T3 (-P), T4 (-K) and T5 (-S). The experiment was laid out in a randomized complete block design (RCBD) with four replications. The stolon and rhizome yields were significantly influenced by the different treatments. The highest stolon (28.2 t/ha) and rhizome (30.9 t/ha) yields were observed in T1 at Bogura where all nutrients were applied with cowdung. Among the locations, Bogra showed the highest stolon and rhizome yield. The highest nutrient uptake and recovery were also noted in T1. Optimum N, P K and S rate for maximizing the stolon and rhizome yield were 170, 40.0, 157 and 16 kg/ha, respectively.

Effect of zinc on biochemical parameters, processing quality and zinc bio-fortification in potato tuber

M.M. Islam, M.W. Rahman, M.S. Alam, M.H.H. Khan, K.A. Ara and S. Akhter

An experiment was conducted to study the effect of zinc on zinc concentration in potato tuber as bio-fortification and to evaluate the influence of zinc on

the quality of potato tuber at Non-calcareous Grey Floodplain soil of Debiganj and Grey Terrace Soil of Joydebpur. There were five treatments - T1 (0kg Zn/ha), T2 (1.5 kg Zn/ha), T3 (3 kg Zn/ha), T4 (4.5 kg Zn/ha) and T5 (6 kg Zn/ha). The experiment was laid out in a randomized complete block design (RCBD) with three replications. Yield of potato was significantly ($p \leq 0.05$) influenced by the different levels of zinc. The highest potato tuber yield (40.8 t ha⁻¹) was found in T4 at Debiganj followed by T5 at Debiganj. The crop response to fertilizer application was positive and quadratic in nature. From the quadratic response function, the optimum dose of Zn was recorded as 4.50 and 3.50 kg ha⁻¹ for Debiganj and Joydebpur, respectively. The highest dry matter content 23.2 and 21.1% for Joydebpur and Debiganj, respectively) was found in T4 (4.5 kg ha⁻¹). The lowest cutworm infestation was noted in T3 followed by T4 and T5. The highest specific gravity found in T3 while the maximum TSS was recorded in T3 and T4. The no scab infection was found in the plots. The other parameter will be incorporated after receiving the lab analytical data.

Effect of Tumama on the yield and quality of potato in grey terrace soil

M. M. Islam, S. Alam, K.A. Ara and S. Akhter

An experiment was conducted to study the effect of tumama on the yield and quality of potato and to investigate the post-harvest properties of soil at Grey Terrace Soil, Joydebpur. There were four treatments - T1 (control, native nutrient), T2 (Tumama 1966 kg/ha), T3 (Cowdung 5000 kg/ha + Tumama 984 kg/ha) and T4 (100% RDF). The experiment was laid out in a randomized complete block design (RCBD) with four replications. Yield of potato was significantly ($p \leq 0.05$) influenced by the different treatments. The highest potato tuber yield (30.7 t ha⁻¹) was found in T2. The highest dry matter content (23.4%) was found in T3, which was closely followed by T2 (23.2). The highest TSS (6.6°Brix) was found in T2. The minimum cutworm infestation (2.84%) was noted in T4 followed by T2. There no scab infection was recorded in the plots. The maximum P and Zn absorption were found in T2 while maximum K and Fe absorption were recorded in T3. The maximum Total-N, S and B availability were observed in T2 while maximum

P and Zn availability were noted in T4. The other parameters will be incorporated after receiving the data.

Assessment of atmospheric carbon absorption through potato

M.M. Islam, M.W. Rahman, M.A.K. Mian, K.A. Ara and S. Akhter

An experiment was conducted to find out suitable potato variety in respect of carbon absorption and to estimate the organic carbon adding in soil through potato residues. There were five treatments : T1 (BARI Alu-7 + Residues add), T2 (BARI Alu-25 + Residues add), T3 (BARI Alu-41 + Residues add), T4 (BARI Alu-7 + no residues add) and T5 (BARI Alu-25 + no residues add) and T6 (BARI Alu-41 + no residues add). The experiment was laid out in a randomized complete block design (RCBD) with three replications. Yield of potato tuber was significantly ($p \leq 0.05$) influenced by the treatment. The maximum potato tuber yield (38.2 t/ha) was found in T6, which was statistically identical to T3 (36.1 t/ha). The lowest scab infection was found in BARI Alu-41 while the minimum cutworm infestation was recorded in BARI Alu-7. The maximum leaf and stem biomass were found in T3 while the highest tuber biomass was recorded in T6. The total carbon input from the potato plant (2.59 t/ha) was found in T6, which was very closely followed by T3 (2.57 t/ha). The other parameter will be incorporated after receiving the rest data.

Effect of thiovit on the yield and quality of potato through controlling scab disease

M.M. Islam, M. W. Rahman, M. M. Rahman, K.A. Ara and S. Akhter

An experiment was conducted to study the effect of thiovit as a source of sulphur in controlling *Streptomyces scabies* in potato and to find out the suitable dose of thiovit for potato at Grey Terrace soil of Joydebpur and Non-calcareous Grey Floodplain soil of Debiganj. The popular potato variety BARI Alu-7 (Diamant) was evaluated under different levels of thiovit. The five different levels of sulphur were: T1 (0 kg thiovit /ha), T2 (20 kg thiovit /ha), T3 (40 kg thiovit /ha), T4 (60 kg thiovit /ha) and T5 (80 kg thiovit /ha). The experiment was laid out in a randomized complete

block design (RCBD) with three replications. Different thiovit levels and locations showed significant effect on the yield of potato over locations. The highest tuber yield (40.8 t/ha) was found in T5 at Debiganj followed by T4 (39.5 t/ha) in the same location. T4 showed the maximum dry matter content in potato tuber. The minimum scab infection was also recorded in T4. The maximum specific gravity was also noted in the same treatment. The other parameters will be added after receiving the lab data.

Response of potato to phosphorous in Old Himalayan Piedmont Plain Soil

M. M. Islam, M.W. Rahman, K.A. Ara and S. Akhter

An experiment was conducted to study the effect of phosphorus on the yield and quality of potato and to evaluate the effect of p fertilizer on p uptake and fertilizer p recovery at non-calcareous grey floodplain soil of Debiganj. There were seven treatments - t1 (0kg p/ha), t2 (20 kg p/ha), t3 (40 kg p/ha), t4 (60 kgp/ha), t5 (80kg p/ha), t6 (100kg p/ha) and t7 (farmer's practice, FP). The experiment was laid out in a randomized complete block design (RCBD) with three replications. Yield of potato was significantly ($p \leq 0.05$) influenced by the different levels of phosphorus. The highest potato tuber yield (44.7 t ha⁻¹) was found in t4. The crop response to fertilizer application was positive and quadratic in nature. From the quadratic response function, the optimum dose of p was recorded as 70.0 kg ha⁻¹ for Debiganj. The highest dry matter content (21.2%) in potato tuber was recorded in t4. There no scab infection and cutworm infestation were recorded in the plots. The other parameter will be incorporated after receiving the lab analytical data.

Tuber crops disease management

Survey of major potato diseases of Bangladesh

M.M. Rahman, M.Z. Masud, A.K. Saha, M.M. Begum and M.M. Uddin

A survey work was conducted to observe the incidence of potato diseases in northern part of Bangladesh. Late blight disease incidence was relatively high in Dinajpur, Panchagarh, Thakurgaon and lower in Rangpur, Kurigram,

Nilphamary, Lalmonirhat and Gaibandha districts. Black leg and bacterial wilt disease incidence was higher in early season of potato cultivation where as lower in season. Common scab, mosaic, stem rot, early blight, stem canker and black scurf, PVY were as less disease incidence of potato in Bangladesh.

Performance of different organic matter for disease free organic potato production

A.K. Saha and M.M.E. Rahman

There were five different organic matter like Tobacco dust (Barley) waste @ 5.0 t ha⁻¹, Tobacco dust (Local) waste @ 5.0 t ha⁻¹, Varmi compost (Annapurna) @ 3.0 t ha⁻¹, Mustard oil cake (MOC) @ 1.50 t ha⁻¹, Kazi Jaibo Sar (KJS) @ 5.0 t ha⁻¹ Tobacco dust @ 3.0 t ha⁻¹ + Sulphate of Potash (SoP) @ 0.25 t ha⁻¹, MOC @ 1.0 t ha⁻¹ + SoP @ 0.25 t ha⁻¹, KJS @ 3.0 t ha⁻¹ + SoP @ 0.25 t ha⁻¹ were used in cropping season 2019-2020 and 2020-21 to produce organic potato where TCRC, BARI developed Recommended practice and control (no added organic matter) was also as treatment. Potato yield > 24 to ≤ 25.00 t/ha was recorded in tobacco dust waste @ 5.0 t ha⁻¹ used treatment and yield range of 04 different organic matter was 24.11 to 18.00 t/ha while 38.00 to 40.00 t/ha was in TCRC, BARI recommended fertilizer dose. Lower common scab disease incidence (<5%) and severity (<1.00) was in organic matter used for organic potato production.

Fungal Disease Management

Evaluation of potato varieties/lines against late blight disease by detached leaf methods

M.M. Begum

The Detached Leaf Bioassay (DLBs) of *Phytophthora infestans* on BARI Alu-7, BARI Alu-46, BARI Alu-53, BARI Alu-77, BARI Alu-90 and BARI Alu-91 and ten CIP lines namely CIP-401, CIP-402, CIP-403, CIP-444, CIP-445, CIP-446, CIP-447, CIP-448, CIP-449 and CIP-450 were conducted during 2020-21 cropping season to observe their performance in controlling late blight disease causing pathogen under laboratory conditions. The all tested varieties found susceptible to *Phytophthora infestans* with various level ranged from 50-100%. BARI Alu-91 provided

50% leaf rot after 10 days of incubation and can be tested again for further study.

Efficacy of new fungicides in controlling late blight of potato

M.M. Rahman, M.Z. Masud, M. N. Amin, F. Khatun, M.M. Begum and M. M. Uddin

A total of 30 different new fungicides with 1 control and one positive control Acrobet MZ were tested against late blight disease of potato at the BSPC, Debiganj, Panchagarh during the Rabi 2020-21. Results reveal that most of the tested fungicides reduced the disease significantly over control. Among the 30 fungicides the sixteen, viz. 30, 107, 144, 180, 183, 185, 186, 193, 194, 198, 200, 202, 298, 321, 323 and 332 showed excellent performance (35.37 t/ha, 35.94 t/ha, 38.18 t/ha, 32.16 t/ha, 38.29 t/ha, 36.49 t/ha, 31.75 t/ha, 34.79 t/ha, 33.09 t/ha, 37.29 t/ha, 35.02 t/ha, 35.61 t/ha, 36.16 t/ha, 36.17 t/ha and 35.16 t/ha respectively) and two Bio fungicide showed less reduction in controlling late blight disease.

Screening of potato varieties and germplasm against late blight

A.K. Saha and M.M.E. Rahman

Field experiments were conducted to evaluate to evaluate 38 (thirty eight) BARI released potato varieties, 04(four) germplasm and 02 (two) indigenous cultivars against late blight disease during 2015-2016, 2016-17, 2017-18, 2018-19, 2019-20 and 2020-21 cropping season under natural inoculum pressure in farmers' field, Khaturia, Domar, Nilphamari and RARS, BARI, Burirhat, Rangpur. None of the variety/germplasm/indigenous cultivar was found immune. From this study, germplasm like, Alouette and Carolus released as late blight resistant variety as BARI Alu-90 and BARI Alu-91, respectively. Variety BARI Alu-46 also was highly resistant in all cropping season but in last two cropping seasons it was resistant against Late blight. Germplasm viz. Twinner and Twister found highly resistant since 2018-19 cropping year and newly included Levante showed moderate resistant. Rest two late blight resistant varieties like BARI Alu-53 and BARI Alu-77 were highly resistant in cropping seasons 2015-16 and 2016-17 but from 2017-18 cropping season showed moderate resistant but in 2019-20

cropping season, BARI Alu-77 was resistant against late blight and BARI Alu-53 was susceptible. BARI Alu-57 was always resistant or moderate resistant. Yield of BARI Alu-46, BARI Alu-53, BARI Alu-57, BARI Alu-77, BARI Alu-90 (Alouette), BARI Alu-91 (Carolus), Twinner and Twister was 30.87 to 49.47 t ha⁻¹, 9.63 to 29.88 t ha⁻¹, 24.58 to 29.33 t ha⁻¹, 17.79 to 29.37 t ha⁻¹, 35.11 to 53.79 t ha⁻¹ and 31.23 to 38.50 t ha⁻¹, 36.43 to 38.09 t ha⁻¹ and 30.58 to 33.56 t ha⁻¹ respectively.

Effect of different fungicidal combinations in controlling late blight of potato

A.K. Saha and M.M.E. Rahman

Effectiveness of thirteen different sole and combined fungicides were evaluated against late blight of potato at RARS, BARI, Burirhat, Rangpur in 2019-20 and 2020-2021 cropping season. Fungicides and fungicidal combinations significantly reduced late blight disease and increased tuber yield over control (where no fungicide was used). Zampro DM (Ametoctradin 30% + Dimethomorph 22.5%) was the best one for disease management ($\geq 95\%$ over control) and yield. The highest yield (42.30 t ha⁻¹ and 40.22 t ha⁻¹ in 2019-20 and 2020-21 cropping season, respectively) was harvested from Zampro DM sprayed plot.

Efficacy of new fungicides in controlling late blight of potato

A.K. Saha and M.M.E. Rahman

The experiment was conducted at RARS, BARI, Burirhat, Rangpur during rabi season of 2020-21 to evaluate 15 (fifteen) new fungicides against late blight of potato under natural inoculum pressure. Coded 302 and 428 fungicides effectively managed late blight disease of potato and yielded more than 30 t/ha.

Screening of new fungicides against leaf blight of panikachu

M. M. Begum, F. Islam and S. Alam

A total of ten new fungicides viz. Melody Duo (Iprovelicurb and Propineb), Dithan-M-45 (Mancozeb), Secure (Fenamidon and Mancozeb), Limine-M-45 80 WP (Mancozeb), KG Gold 80 WP

(Mancozeb), Sweet Max 72 WP (Mancozeb and Cymoxanil), Limine-MZ 60 WP (Mancozeb and Dimethomorph), Gold Plus 72 WP (Mancozeb and Cymoxanil), KB Moxalin 72 WP (Mancozeb and Cymoxanil) and Redomyl Gold (Mancozeb and Metalexyl) and positive control (Infected plant rouging and without fungicide) and negative control (Infected plant without rouging and without fungicide) were used were tested against leaf blight of Panikachu at Joydebpur during 2020-21 at Kharif season. All fungicides reduced the late blight disease of Panikachu with various levels compared to both control. The fungicide namely Limine-M-45 80 WP (Mancozeb) gave the highest reduction of the leaf blight followed by Sweet Max 72 WP (Mancozeb and Cymoxanil).

Development of cost-effective integrated fertilizer management practice utilizing agricultural waste tobacco dust for disease free potato production

A.K. Saha and M.M.E. Rahman

Study of 2019-20 and 2020-21 cropping season at RARS, Burirhat, Rangpur revealed that use of tobacco dust waste (TDW) (≥ 800 kg ha⁻¹) as organic fertilizer significantly increased total and marketable potato yield and decreased common scab disease (incidence and severity) over control (Only recommended chemical fertilizer dose i.e. RCFD used plot) and cow dung (5 t ha⁻¹) + recommended chemical fertilizer (RCFD) used plot. There was no significant difference among tobacco dust waste dose 2000, 25000 and 3000 kg ha⁻¹ with recommended fertilizer dose (RCFD) for tuber yield (range from 40.77 to 47.48 t ha⁻¹), marketable sized fresh tuber (>28 mm diameter) yield (range from 37.49 to 42.73 t ha⁻¹). Common scab disease incidence and severity was decreased as the tobacco dust waste dose increased. There was no significant differences among TDW 3000 Kg ha⁻¹ + RCFD, TDW 3000 Kg ha⁻¹ + (-10%) recommended chemical fertilizer (RC) NPKS, TDW 3000 Kg ha⁻¹ + (-20%) RC- NPKS, TDW 2500 Kg ha⁻¹ + RCFD and TDW 2000 Kg ha⁻¹ + RCFD for total tuber and fresh marketable tuber yield in both cropping years.

Bacterial Disease Management

Screening of different BARI released varieties against common scab disease of potato at Joydebpur

M.M. Begum

Twelve potato varieties viz. BARI Alu-79, BARI Alu-81, BARI Alu-82, BARI Alu-84, BARI Alu-85, BARI Alu-86, BARI Alu-89, BARI Alu-90, BARI Alu-91, BARI Alu-7, BARI Alu-8, and BARI Alu-25 were evaluated to screen resistant varieties against scab disease at Tuber Crops Research Centre, BARI, Joydebpur, Gazipur during 2020-21 cropping year under the field condition at Rabi season. Considering scab incidence, whereas BARI Alu-79, BARI Alu-82, BARI Alu-84 and BARI Alu-86 performed better and found completely free from common scab of potato.

Effect of different chemicals in controlling common scab disease of potato

A.K. Saha and M.M.E. Rahman

There were 10 (ten) different chemicals were evaluated against common scab of potato as treatment and soil drenching (30,45 and 60 days after planting) at RARS, BARI, Burirhat, Rangpur in 2020-2021 cropping season. Used chemicals significantly reduced incidence and severity of common scab and potato tuber yield over control where no chemical was used against common scab. There was no incidence and severity was recorded on potato tuber where, Blitox (Copper Oxy-Chloride) and Timsen™ (n-alkyl dimethyl benzyl ammonium chloride 40% + Stabilized urea 60%) was used and tuber yield was 26.16 t ha⁻¹ and 25.45 t ha⁻¹ respectively while, 32.22 t ha⁻¹ tuber yield was in control plot.

Effect of different organic matter for managing soil-borne diseases (common scab) and yield of potato

A.K. Saha and M.M.E. Rahman

Seven different organic matter and their combination along with recommended chemical fertilizers viz. Cow dung @ 5.0 t ha⁻¹, Ash @ 5.0 t ha⁻¹, Cow dung @ 2.50 t ha⁻¹ + Ash @ 2.50 t ha⁻¹, Kazi jaibo sar @ 1.0 t ha⁻¹, Annapurna jaibo sar @ 1.0 t ha⁻¹, Mustard oil cake @ 0.50 t ha⁻¹, Farah

jaibo sar @ 1.0 t ha⁻¹ and Tobacco dust waste @ 0.85 t ha⁻¹ were tested for management of common scab disease and yield of potato during 2019-2020 and 2020-2021 cropping season at RARS, Burirhat, Rangpur. Annapurna jaibo sar, Mustard oil cake, Farah jaibo sar and Tobacco dust significantly lowered common scab disease incidence and severity. Tobacco dust waste used treatment was the best one for disease control (Incidence 10.20% and 6.44% and Severity i.e. PDI- 2.14 and 1.29 in 2019-2020 and 2020-2021 cropping season, respectively) as well as highest potato tuber yielder (Marketable fresh yield >28 mm dia: 40.75 t ha⁻¹ and 38.91 t ha⁻¹, and total yield- 48.42 t ha⁻¹ and 43.61 t ha⁻¹ in 2019-2020 and 2020-2021 cropping season, respectively).

Screening of early potatoes (*Solanum tuberosum* L.) Varieties/ germplasm against bacterial wilt disease

M.M Rahman, M.Z. Masud, M.N. Amin, A. K. Saha, M. M. Bgum, M. M. Islam and M.M.

Bacterial wilt (BW) caused by bacteria *Ralstonia solanacearum* is the most devastating disease of potato (*Solanum tuberosum* L.) in Bangladesh especially for table-stock crop production in the early planting Season. More than 100 different varieties are cropped in different regions only in Bangladesh. Potato growers usually crop multiple varieties in the northern part of Bangladesh to satisfy the market demands for table-stock potatoes having specific physical properties. Table-stock potato cultivation a bit earlier than the normal growing season, temperature and humidity prevail higher in the environment and thus crop is severely affected by BW causing economic loss. Eleven potato varieties (Ten BARI Released and one local cultivar seven) were evaluated under natural inoculum pressure to find out early varieties against bacterial wilt disease in farmers' field situation at Notun Bondar, Debiganj, Panchagarh during 2020-2021. BARI Alu-13 (Granola) and BARI Alu-56 show no BW disease, whereas BARI Alu-29 (Courage) shows maximum disease incidence (4.33%) which is statistically similar with BARI Alu-31 (3.66%) and local cultivar seven (3.33%). Among the tested Varieties BARI Alu-13 (Granola), BARI Alu-79, and BARI Alu-62 provided maximum tuber yield 16.34 t/ha, 12.15

t/ha and 11.81 t/ha respectively. As such they may be considered as early season cultivars.

Validation trial of seed and soil treatments in controlling common scab disease of potato at Joydebpur

M.M. Begum

An experiment was conducted at TCRC, BARI, Gazipur to find out the effective management practices in controlling common scab of potato var. Diamant. A total of eight (08) treatments were selected as seed and soil treatments. The effect of treatments varied among them to reduce common scab of potato. The treatment T₄ means seed treatment with Boric acid @ 2.0% found to be more effective to control common scab based on disease the incidence and severity. The other treatments T₇ (Seed treatment with Boric acid @ 1.5% before seed sowing) and T₈ (Seed treatment with Dithane M-45@ 0.2% before seed sowing) also performed better and gave the lower scab incidence and severity compared to other treatments. There is no negative effect observed among the treatments on the germination and yield.

Viral Disease Management

Evaluation of potato lines for PLRV and PVY resistance under the infection pressure (third progeny)

M. M. Begum

Eighteen potato lines were evaluated against PLRV and PVY to find out the resistant source (s) at Joydebpur, Gazipur during 2020-21. Based on all parameters, the lines The lines 15.117 and 15.126 found free from PLRV, PVY and combine virus infection and gave higher germination, yield and vigour compared to the check Diamant. The experiment will be repeated in the next season.

Evaluation of potato lines for PLRV and PVY resistance under the infection pressure (First progeny)

M. M. Begum

Nineteen potato lines were evaluated against PLRV and PVY to find out resistant source (s) at Joydebpur, Gazipur. All lines including a check

variety Diamant were exposed to the infection pressure of PLRV and PVY in the cropping season of 2020-21 at Joydebpur. In this year, there were not found any virus infection among the tested lines. Based on germination, yield and vigour, the eight lines 16.16, 16.9, 16.28, 17.19, 17.12, 17.66, 17.159 and 17.24 were found to be better for providing higher value of germination, yield and vigour.

Detection of potato viruses (PLRV, PVY, PVX, PVM and PVS) in the supplied samples of different companies through DAS-ELISA

M. M. Begum

A total of 565 plantlet samples from different government and non-government organizations were tested for the presence of viruses by using specific DAS-ELISA detection separate kits as PLRV, PVY, PVX, PVS and PVM according to manufacturer's instructions (Bioreba AG, Switzerland). Out of the 565 samples, 55% had completely virus free and 45% had infected with different alone and combine viruses. Among virus infected samples, the highest number of viruses found PVY and it was 41% and the second highest was mixed viruses (26%) and the third was PVX which was 18%.

Evaluation of sweet potato varieties /germplasms for resistance to virus diseases

M.M. Begum, S. Alam and Z. Alam

An experiment was conducted to screen the sweet potato lines against different virus diseases in 2020-21 cropping season at Tuber Crop Research Centre, Bangladesh Agricultural Research Institute, Gazipur. Twelve sweet potatoes germplasms were evaluated against virus diseases and only mild mosaic virus was observed in the field. Among 12 tested lines, BARI SP-16, H 6.52/11, WFRS-001, HS. EJ/10, MOZ-1.15, MOZ-1.9, H 16.EJ/10, H 9.7/12, H.9.48/11, WFRS-002, Antho-1 and H9.10/12 performed as the best lines for showing virus free infection. The experiment will be repeated in the next season.

Post-Harvest Management and Storage

Screening of different released varieties against post-harvest disease under natural storage conditions

M. M. Begum

A total of eight (08) potato varieties namely BARI Alu -7, BARI Alu -8, BARI Alu -38, BARI Alu -46, BARI Alu -53, BARI Alu -73, BARI Alu -78 and BARI Alu -79 were evaluated to post harvest rottage and shelf life at Joydebpur under natural storage conditions during 2020-21. The percentage of tuber rot due to disease was increased with the increase of time. Considering overall performance, all tested found to be better for 90 days of preservation with lower rottage value ranged from 0-6.19%, while BARI Alu -7, BARI Alu-8, BARI Alu -53 and BARI Alu -73 found suitable for long shelf life up to 180 days.

Feed the Future Biotechnological Potato Project

Detached leaf bioassay on the late blight resistant GMO potato lines and maintenance of *Phytophthora infestans* isolates in Bangladesh under FTFBPP project during 2020-21

M.M. Begum, P. Wharton, K. Hokanson and D. S. Douches

The survey work was conducted for observing the status of late blight infection in Bangladesh. A total of 220 potato and 39 tomato samples under different divisions were pasted in FTA cards for diversity analysis. The pure culture of *P. infestans* from potato and tomato was isolated successfully from different regions of Bangladesh. Twentysix isolates of *P. infestans* from potato and 2 isolates from tomato were isolated and maintained properly in pea agar media and sent to University of Idaho, USA for molecular characterization during 2020-21. The Detached Leaf Bioassay (DLBs) was conducted on the two GMO lines namely DIA-MSU-015, DIA-MSU-255 and one check DIA-MSU-DIA during this year. The two lines DIA-MSU-015 and DIA-MSU-255 found completely resistant to late blight pathogen, while DIA-MSU-DIA found susceptible.

Tuber Crops Insect Pest Management

Development of management approaches against root aphid (*Pemphigus* sp.) Attacking potato

M. Z. H. Prodhan

The field trial was conducted at the farmer's field of Gonomongal, Khetlal, Joypurhat during 2020-21 to find out the most effective management option for root aphid on potato. There were six treatments viz. T_1 = Clean cultivation (Destroy weed + proper irrigation to prevent cracking, cracks provide a way for aphid to enter the soil), T_2 = T_1 + 2 sprays of Matrin (Biotrine 0.5%) @ 1.4ml/L of water from initial stage of infestation at 10 days interval, T_3 = T_1 + 2 sprays of Nitro (Chlorpyrifos + Cypermethrin) @ 2ml/L of water from initial stage of infestation at 10 days interval, T_4 = T_1 + 2 sprays of Thiamethoxam @ 0.5g/L of water from initial stage of infestation at 10 days interval, T_5 = T_1 + 2 sprays of Imidacloprid @ 0.5ml/L of water from initial stage of infestation at 10 days interval and T_6 = Untreated control. The lowest infestation was found in T_4 which was statistically similar with T_5 . But in case of Marginal Benefit Cost Ratio, the highest value was also obtained from T_5 which was very close to T_4 .

Evaluation of released potato varieties and advanced materials against potato cutworm (*Agrotis ipsilon*) in field condition

M. Z. H. Prodhan

Twentyfive advanced materials namely 13.17, 13.7, 14.10, 14.11, 14.12, 14.31, 15.112, 33.1, Alberta, Alcander, Al Russet, Arigona, Delia Red, Dunstar Hind-1, H2D-1249, Innovator, Katadin, Prada, Ottawa, Red Marker, Rslin, Tiamo, Twinner, Twister along with six released varieties BARI Alu-25, BARI Alu-29, BARI Alu-53, BARI Alu-77, BARI Alu-90 and BARI Alu-91 were evaluated against cutworm at Tuber Crops Research Sub Centre, BARI, Bogura during 2020-21. Among the germplasms, BARI Alu-25 Rslin, Ottawa and 15.112 showed higher infestation. The rest germplasms showed comparatively lower infestation.

Development of effective integrated management package against sweet potato weevil in field condition

M. Z. H. Prodhan

The trial was conducted at Tuber Crops Research Sub Centre, BARI, Bogura during 2020-21 to develop an effective integrated management approach for sweet potato weevil in field condition. There were four treatments viz. T₁: Pheromone trap + Earthing-up three times (30, 60 and 90 DAP), T₂: Pheromone trap + Soil REcharge @ 3g/L of water at 45 days and 90 days after planting, T₃: Farmer's practice (Chlorantraniliprole) @ 15kg/ha at 60 days and 90 days after planting with irrigation, T₄: Untreated control. Sex pheromone based treatments showed lower infestation and offered higher yield. Huge number of moth was trapped in pheromone traps. Number of captured weevil/trap/week was 26.28 in T₁ and T₂ which reduced the infestation.

Integrated management of cutworm (*Agrotis ipsilon*) in potato

M. Z. H. Prodhan

The field trial was conducted at Tuber Crops Research Sub Centre, BARI, Bogura during 2020-21 to find out the most effective management option for cutworm on potato. There were six treatments viz. T₁= Poison bait: (Rice husk 5kg + sugar 200g + Cartap + water) (Three times at 15 days interval starting from after emergence of the seedling), T₂= Chlorantraniliprole (Ferterra 0.4G) @ 15kg/ha application during land preparation and earthing up, T₃=Sex pheromone mass trapping, T₄= T₁+ T₃, T₅= T₂+ T₃ and T₆= Untreated control. Very little infestation (less than 2%) was observed in the study, yield did not varied significantly.

Management of potato tuber moth (PTM) in storage condition

M. Z. H. Prodhan

The field trial was conducted at Tuber Crops Research Sub Centre, Bogura during 2020-21 to develop an ecofriendly management package against PTM under storage condition and to estimate the extent of damage. There were five treatments viz. T₁ = Mass trapping for potato tuber moth with attract and kill method, T₂ = Pheromone mass trapping for potato tuber moth, T₃ = Spraying of Abamectin @ 1.5 ml/L of water (Spray to wet tuber and then dried in shade), T₄ = Potato tubers covered with thin layer of dry sand (0.5 cm sand layer) + Carbrayl (Sevin 85 WSC @ 1g/10 kg

sand) in storage and T₅ = Untreated control. The lowest infestation was found in T₄ followed by T₂. This is a serious pest of potato in storage, caused 100% damage within 52 days.

Field efficacy of attract and kill method against potato tuber moth in field condition

M. Z. H. Prodhan

The experiment was conducted at Tuber Crops Research Sub Centre, Bogura during rabi, 2020-21. There were two treatments viz. T₁ = Pheromone mass trapping for potato tuber moth and T₂ = Pheromone mass trapping for potato tuber moth with attract and kill method. No damage symptom was observed in the field and no moth was captured in both Pheromone trap and attracts and kills method.

Survey and monitoring of new pest arthropods infesting tuber crops

M. Z. H. Prodhan

Survey and monitoring was conducted at different tuber crops growing areas during 2020-21 to document new pest arthropods infesting tuber crops. Four new insect pest were found to attack, among them severe infestation of *Spodoptera litura* was observed in Bodolgachi, Naogaon.

Screening of different sweet potato varieties/lines against sweet potato weevil (*Cylas fromicarius* Fab.)

M. Z. H. Prodhan

Twelve advanced materials along with two checks of sweet potato were evaluated against sweet potato weevil at Tuber Crops Research Sub Centre, Bogura during 2020-21. Among the genotypes, White flesh White skin and Moz 1.9 showed comparatively less infestation than other advanced materials/varieties. Genotype CIP-400039 and H_{16.ej/10} had higher infestation.

Survey, monitoring and documentation of major insect pests of mukhikachu

M. Z. H. Prodhan

A field survey was conducted in Bogura during 2020-21 to document the insect and mite pests of mukikachu. Several insect-mite pests viz. Common cutworm (*Spodoptera litura*), Spittle bug, Aphid, Mealy Bug, Grass hopper and red mite were found

to attack the crop. Although the pests are occasional, but sometimes common cutworm and red mite caused serious damage.

Studies on succession of insect-mite pests on yam

M. Z. H. Prodhan

The trial was conducted at Tuber Crops Research Sub Centre, BARI, Bogura during 2020-21 to observe the succession of the insect-mite pests of yam and their damage severity. Result revealed that 4 species of insect pests i.e. leaf roller, June beetle, hairy caterpillar and Tussock moth were found to attack the crop. All the pests were appeared at vegetative stage and caused minor damage.

Studies on succession of insect-mite pests on cassava

M. Z. H. Prodhan

The trial was conducted at Tuber Crops Research Sub Centre, BARI, Bogura during 2020-21 to observe the succession of the insect-mite pests of cassava and their damage severity. Only mealy bug were found to attack the crop at vegetative stage and caused minor damage.

Tuber crops biotechnology and seed production

Production, distribution and *in vitro* maintenance of potato varieties/germplasm

M.M.H. Molla, F. Akhter, S. Islam and K. A. Ara

Plantlets were produced from shoot, meristem and virus free tubers of different potato varieties and genotypes using MS media under aseptic conditions. A total of 15650 disease free plantlets of BARI released potato varieties were planted at Breeder Seed Production Centre, Debiganj for G₀ generation development during 2020-2021. Moreover, 286.0 kg virus free mini tubers of BARI released varieties have been planted for breeder seeds production. Mother stocks of the varieties are being maintained by subcultures for future multiplications and short term conservation.

Production of minituber (G₀) from *in vitro* plantlets at net house conditions

M.M.H. Molla, S. Islam, F. Akhter and K. A. Ara

Mini tuber production of potato has been done from virus free *in vitro* plantlets of potato at the net

house of TCRC, BARI during 2020-21. This experiment has been conducted at net house of TCRC, BARI, Gazipur during 2019-20. Data were recorded plant height, stem number, number of minituber and weight of minituber per plant from BARI Alu-7, BARI Alu-25, BARI Alu-41, BARI Alu-46 and BARI Alu-72. The highest plant height was recorded from the variety BARI Alu-41 (61.46 cm) followed by BARI Alu-46 (53.40cm). Maximum stem was recorded the variety BARI Alu- 25 (7.75). BARI Alu-46 followed by BARI Alu-72 produced highest tuber number and weight of tuber per plant.

Performance of *Gracilaria tenuistipitata* seaweed agar on tissue culture of tetraploid potato (*Solanum tuberosum* L.)

M.M.H. Molla, F. Akhter, S. Islam, S. Naznin, S. Uddin, M.K. Uddin, M.A. Salam, A.Z Chowdhary and S.M. Bakhtiar

Gracilaria tenuistipitata produced in the Bay of Bengal, Cox's Bazar beaches and agar was extracted from this seaweed at Seaweed Lab, On Farm Research Division, BARI, Cox's Bazar. The locally extracted agar (BdAgar) was tested for *in vitro* potato plantlets production at Tissue Culture Lab, Tuber Crops Research Centre, BARI, Gazipur-1701. Phytoagar (Ducifa, Netherlands), HiMedia agar (India), Agar agar (Mark, India) and Food grade agar (China) were used as checked. BARI Alu-7 was used as plant material. Six concentrations of agar powder viz. 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9% were tested to optimize the requirement for 1.0 L MS media. Locally extracted agar (BdAgar) @ 0.6% was found suitable to solidify the media where Phytoagar, HiMedia and Agar agar needed 0.7, 0.7 and 0.9%, respectively. The color of the media produced by BdAgar was found light yellowish after autoclaving where transparent colored media was produced by Phytoagar, HiMedia agar and Agar agar powder. Food grade agar @ 0.7% solidified the media but it was elastic type. Plantlets could not grow well over there. Potato plantlet grown well in BdAgar, Phytoagar and HiMedia agar supplemented MS media. For rooting behavior study, ½ (half) strength MS media supplemented with 1.0 g/l IBA was tested. BdAgar, Phytoagar, HiMedia agar and Agar- agar @ 0.5, 0.7, 0.7 and 0.9%, respectively was needed to solidify the rooting media. It may be concluded that 0.5-0.7% locally extracted BdAgar

supplemented MS media was suitable for the production of potato tissue culture plant where Phytoagar and HiMedia agar needed 0.7%. However, the following modifications of BDAgar needed for the improvement of quality and color of media: (i). Bleaching of fresh seaweeds should be optimized and (ii). alkali treatment should be followed properly to remove the sulfate group and to get enough agar gel strength.

Improvement of indigenous promising potato cultivars through meristem culture and their yield performance study with traditional cultivars

F. Akhter, M.M.H. Molla, S. Islam and K. A. Ara

Meristem culture has become a powerful and successful tool for virus elimination from virus infected plants and has been successfully applied in potato. A total of twentyfive meristems were isolated and cultured from two indigenous varieties namely Shilbilati and Lalpakhri on basal MS media. Out of twentyfive meristems, DAS ELISA test has been conducted of ten meristem derived plantlets and virus free plantlets were not obtained, others plantlets have been subculture and will be tested for DUS-ELISA.

Tissue culture of cassava (*Manihot esculenta* Crantz) germplasm

F. Akhter, M.M.H. Molla, S. Islam, A.T.M. T. Islam, M. H. Rashid and K. A. Ara

This study was conducted at the tissue culture lab, TCRC in BARI during 2020-2021 with a view to establish a protocol for *in vitro* multiple shoot production. multiple shoots were produced from nodal explants of cassava by a two-step procedure. Nodal explants were cultured in liquid Murashige and Skoog (MS) medium supplemented with different concentration of thidiazuron (TDZ) for 2 weeks followed by culture on agar-solidified MS medium supplemented with different concentration of 6-benzyl amino purine (BAP) and gibberellic acid (GA_3). TDZ caused the nodal explants to expand and this expansion (growth) continued during culture with BAP and GA_3 . From this expanded explants, clusters of buds and fasciated stems developed continuously and this gave rise to shoots. Nodal explants in liquid MS medium supplemented with 0.05 mg/l (T_3) TDZ showed better performance for expand explant after 7days of culture. MS media supplemented with 1.5 mg/l

BAP and 0.20 mg/l GA_3 (T_4) showed highest number of shoots/explant (average 7 shoots/explant) after 7 days of culture.

***In vitro* propagation of stress tolerant potato varieties and standardization of nutrient film technique protocol for quality seed production**

S. Islam, M. M. H. Molla, F. Akhter, M.M. Rahman, H. Rashid, and K. A. Ara

Plantlets were growing excellent and vigorous. All the varieties showed significant variation among them. Among the varieties BARI Alu-46 performed better compared to BARI Alu-7 and 72. The highest plant height, number of stems per plant, tuber number per plant and weight of tuber per plant were found in BARI Alu-46 and showed statistically significant different from other varieties. To grow the plants well in the greenhouse, at least 60-80% humidity is required. This experiment needs to be done again with the optimum greenhouse condition for potato plants.

***In vitro* propagation technique development in mukhikachu (*Colocasia esculenta* L.)**

M.M.H. Molla, F. Akhter, S. Islam, S. Alam and K. A. Ara

This study was conducted at the tissue culture lab, TCRC, BARI during 2020-2021 with a view to establish a protocol for *in vitro* propagation of mukhikachu. Murashige and Skoog (MS) media supplemented with different concentration of 6-benzyl amino purine (BAP) and Indole butyric acid (IBA) have been tested in this study. Cent percent (100%) culture initiated shoots in MS medium supplemented with 8 mg/l 6- benzyl amino purine (BAP) and 0.5 mg/l Indole butyric acid (IBA). Maximum number of shoots (4-5) per explant was obtained from MS media supplemented with 8 mg/l 6- benzyl amino purine (BAP) and 0.5 mg/l Indole butyric acid (IBA) after 5-6 days of culture. The second highest shoot initiation (70%) and number of shoots/explant (4.0) was recorded in MS medium supplemented with 6 mg/l 6- benzyl amino purine (BAP) and 0.5 mg/l Indole butyric acid (IBA). Culture initiation in MS medium supplemented with 4 mg/l 6- benzyl amino purine (BAP) and 0.5 mg/l Indole butyric acid (IBA); and MS medium supplemented with 2 mg/l 6- benzyl amino purine (BAP) and 0.5 mg/l Indole butyric acid (IBA) showed 60% and 50% shoot induction, respectively.

Molecular Breeding and Genetics

Molecular characterization of BARI released sweet potato varieties using SSR marker

F. Akhter, M.M.H. Molla, S. Islam, Shahabuddin Ahammed and K. A. Ara

The study has been conducted at Molecular Biology Lab, TCRC, BARI, Gazipur during 2020-21. In this study, we determined the genetic diversity of 15 BARI released sweet potato varieties using microsatellite markers. They were analyzed for diversity using 10 simple sequence repeat (SSR) primers. The presence of bands was scored for each SSR and for each variety and the data were analyzed by principal coordinates analysis. The polymorphic SSR loci revealed a diverse relationship among the sweet potato varieties, which was grouped into two major clusters by unweight pair group method analysis (UPGMA). Cluster analysis showed a Jacquard coefficient ranging from 0.00- 0.81 indicating high genetic diversity among those varieties.

Fingerprinting of indigenous potato varieties of Bangladesh using SNP marker

M.M.H. Molla, F. Akhter, S. Islam, B.C. Kundu and David Douches

Twentyone indigenous potato cultivars (IPVs) of Bangladesh have been selected for fingerprinting. This experiment has been executing jointly at Molecular biology lab, TCRC, BARI, Gazipur, and Michigan State University, USA. The genotypes have been characterized by SNP analysis. In the dendrogram with the 21 samples, there are clear duplication present. Primarily, we are thinking that out of the 21 samples are really from 6 different varieties having some clones have different names in different parts of the country. Secondly, in the large dendrogram 20 of the 21 clones cluster away from the US materials. This indicates a South American origin of these lines. Only one cluster with the US/European germplasm.

Fingerprinting of BARI released cloned potato varieties using SSR marker

M.M.H. Molla, S. Islam, F. Akhter, Shahabuddin Ahammed and B.C. Kundu

The study has been conducted using BARI released clone potato varieties. These varieties have been

developed through hybridization by TCRC. DNA-based fingerprinting using SNP marker has been shown to discriminate among potato clones. The objective of this study was to identify and distinguish accurately and efficiently clone potatoes for an applied fingerprinting system of cultivated potato. The UPGMA cluster analysis led to the grouping of the 12 varieties in two major clusters I and II (Figure I). It was observed that the three varieties were at cluster I and nine varieties found at cluster II. In cluster I, BARI Alu-35 and BARI Alu-40 showed 100% genetic similarity and clustered together those were also 80% similarity with BARI Alu-50. Cluster II was divided into three groups (G_1 , G_2 and G_3) where G_1 contained three cloned potato varieties BARI Alu-48, BARI Alu-62 and BARI Alu-63 where BARI Alu-48 showed genetic similarity with BARI Alu-62 and BARI Alu-63 78% and 75%, respectively. On the other hand, BARI Alu-36, BARI Alu-37, BARI Alu-41 and BARI Alu-56 grouped together where BARI Alu-37 and BARI Alu-41 showed higher genetic similarity (80%) as well as BARI Alu-36 and BARI Alu-56 showed 76% genetic similarity. But, BARI Alu-47 and BARI Alu-57 showed 69% similarity that formed G_3 . Besides, dendrogram showed that lower genetic similarity (63%) between BARI Alu-48 and BARI Alu-57.

Chloroplast genome sequencing and qtl analysis of heat tolerant and late blight resistant potato varieties

M.M.H. Molla, S. Islam, F. Akhter, M.M. Rahman, M. Eakramul Haque and Shahabuddin Ahammed

This basic research project has been proposed for four years. We described 1st, 2nd and 3rd year results earlier. Heat tolerant (BARI Alu-72,73), late blight resistant (BARI Alu-46, 53, 77) and susceptible potato varieties (BARI Alu-7, 8, 13 and 25) were used in this study. Genomic DNA, chloroplast (cp) and cpDNA have been isolated from BARI Alu-7, 25, 46, 53, 72, 73 and 77. Good quality DNA have been sequenced. Approximately 2G of data for each cp genome obtained with a 150 bp read length. Gap closing was minimized based on the sequence of the complete cp genome from *Solanum tuberosum* cultivar Desiree chloroplast (DQ386163.2). The chloroplast genome sequences of the five genomes ranged from 176,021bp (BARI

research field and BARI Alu-77 (9.18%) in RARS, Rangpur. For exploring R-gene in the resistant varieties, DNA was isolated, purified and quantified to run PCR with selective R-gene markers. PCR analysis was done and found *Phu6*, *apbt*, *stol*, and *blb1* R-gene in BARI Alu-46, 53, and 57.

Secondary yield trial of combined PVY and PLRV resistance germplasms

S. Islam, M.M.H. Molla, F. Akhter, M.M. Rahman, M.N. Amin, M.M. Begum, K.A. Ara and David Douches

The M2 and M3 populations were planted at BSPC research field in 2019-2020 to find out superior lines of PVY and PLRV resistance which were developed by MAS and ELISA. Their yield performances with our control varieties BARI Alu-7 (Diamant) and BARI Alu-25 (Asterix) also were evaluated. Genetic Markers were used to screen those lines in the previous year using DNA from the young leaf tissue. In 2017-18, 133 lines were planted and from them, 80 lines were virus-negative. ELISA test was done for 64 lines, and from them, 45 lines found combined PVY and PLRV virus-free and resistance to PVY and PLRV of potato. Tubers of them were kept and 35 lines out of 45 planted this year to look at the yield performance. Some lines were found round and some them produced more than 40 t/ha.

Advanced yield trial (SYT) of anthocyanin rich potato germplasm

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Three exotic varieties along with 4 check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) BARI Alu-53 and BARI Alu-82 (L. Rosetta) were evaluated at five different agro-ecological locations of Bangladesh (Gazipur, Debiganj, Bogura, Munshiganj and Cumilla) during 2020-21 for third generation trial. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. The mean performance of selected genotypes over locations was statistically significant. The ranges of days to plant stand at 30

DAP was 23.33-60.00, plant height at 65 DAP 38.0-98.3 cm, stem number per plant at 65 DAP 2.6-6.26, tuber number per plant 4.27-15.4 and tuber weight per plant 203.86g – 814.6g. The percent dry matter was found statistically highest in BARI Alu-53 (21.22%), followed by Read marker#2, MSZ109-10PP, BARI Alu-07 and BARI Alu-82. Specific gravity was higher in MSZ109-10PP (1.083) followed by BARI Alu-53 (1.080). In both cases of tuber grade by number (%) and weight (%), most of the breeding lines produced the desired number of medium size tubers (28-40 and 40-55mm size) at all the locations. Seed tuber grade percentage showed satisfactory performance among the genotypes and over the locations. Specifically, Highest seed tuber by number and weight was found in BARI Alu-53 followed by BARI Alu-82. The yield range at 65 DAP for the MSZ109-10PP was 13.84-25.27 t/ha. The highest mean yield was found in MSZ109-10PP compared to another germplasm. The 2nd highest yield production at 95 DAP germplasm was BARI Alu-7 (36.84 ton/ha). Tuber yield per hectare was found statistically significant in all the varieties. Finally, Exotic variety MSZ109-10PP, Red Marker, and Katahdin can be selected for RYT based on field performance for nutrient rich category and Katahdin for earliness.

Molecular detection of different strain of PVY and PLRV diseases in Bangladesh

S Islam, F. Akhter, M. M. H. Molla., M.M. Begum, M.M. Rahman, Shahabuddin Ahmad and K.A. Ara

Indigenous potato tubers were collected from Rangpur and Jamalpur to see their virus presence. Tubers were planted in TCRC, Gazipur in 2019-20 and 2020-21. Most of the germplasm produced virus symptom and found PVY, PLRV most after ELISA test. Infested tubers were stored to get RNA for sequencing the viruses. All most all the lines produced more than 2 Kg tubers from the infected germplasm, which was stored for next year's trial.

Screening of wild diploid potato genetic resources for combined resistance to late blight, scab and virus diseases

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Thirtyseven clones of A population were planted in BSPC, Debiganj and OFRD, Rangpur in 2020-21 to screen them out from virus, scab and late blight diseases. Visual inspection of virus infection and late blight of potato were recorded both in BSPC and OFRD, Rangpur, respectively. Scab disease was not observed in this year of the experiment. During this experiment, visual inspection of virus infection was recorded both in BSPC and OFRD, Rangpur. In virus infection, PLRV and PVM were observed and recorded in their specific clones of diploid resources. 37 clones of A population were produced and found 25 clones were infected with PLRV, PVM and virus complex. Only this year 2020-21 12 clones did not show any virus symptom (Table 1). For late blight, populations were observed in RARS, Rangpur and none was found resistance to late blight. All were more or less 100% infected with late blight disease and found dead within 60 days of planting.

Dihaploid production from potatoes of 4x-genotypes by anther culture

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Desired variety, BARI Alu-25 (Asterix), and BARI Alu-62 were planted in crossing block and greenhouse conditions to get anthers frequently for haploid production of potato. Anther culture was doing with the variety of BARI Alu-25 (Asterix) and BARI Alu-62. Plants were grown up for flower bud collection. After the collection of flower buds of BARI Alu-25 (Asterix) and BARI Alu-62, an appropriate protocol was followed and placed in a rotary shaker in Linsmaier and Skoog (1965) media for 6 weeks. Linsmaier and Skoog media was better to get embryos. No regeneration happened from the embryos.

Morpho-molecular characterization of bari released varieties and developed advanced panikachu lines

F. Akhter, F. Begum, S. Islam, M. M. H. Molla, Shahabuddin Ahmed and Kabita Anzu-Man-Ara

The study was conducted at Molecular Biology Lab, TCRC, BARI, Gazipur during 2020-21. In this study, genetic diversity of BARI released six panikachu varieties and seven advanced lines was

determined using microsatellite markers. Morphological data were recorded in different stages of growth and DNA extraction from young leaves were completed by using CTAB method. Ten pairs of SSR primers were designed for diversity analysis among the varieties and lines in molecular level.

Determination of diversity and molecular characterization of advanced breeding lines of potato using SSR markers

T. Jahan, M.M.H. Molla, M.S. Islam, F. Akhter, S. Naznin, B.C. Kundu and S. M. Sharifuzzaman

A study was conducted with 21 genotypes (Arizona, Alcander, Al. Russet, Dunstar, Delia Red, Hind, HZD1249, Innovator, Ottawa, Prada, Rslin, Tiamo, Twister, Twinner, 14.10, 14.11, 14.44, 15.92, 15.112, 15.139, 15.156) along with four checks: BARI Alu-7, BARI Alu-13, BARI Alu-25 and BARI Alu 28 at molecular lab of TCRC, BARI, Joydebpur, Gazipur during the last 2020-21 year for determination of diversity and molecular analysis. In this program, twenty Simple Sequence Repeat (SSR) Markers were used. In the lab, DNA extraction of all samples was completed following the modified CTAB methods. Still now, the study is running. After extraction, the DNA amplification condition will be standardized according to primer. Genotyping will be done in agarose gel followed by staining with ethidium bromide and gel electrophoresis. Finally, bands on gel images will be scored and analyzed.

Introgression of disease resistance r-genes in tetraploid potato for late blight

S. Islam, M. M. H. Molla, F. Akhter, M.M. Rahman and K. A. Ara

All the TCRC developed late blight resistant varieties, BARI Alu-46, BARI Alu-53, BARI Alu-77, BARI Alu-90 and BARI Alu-91 were planted in the crossing block in 2020-21 to get the TPS. Artificial light was provided to get flower of the potato plants. After getting flowers, all possible combination was used to get maximum crosses of the varieties. Flowers from the planted potato varieties did not come out at a time, whenever the chances of synchronization happened, crosses were made among the selected parents in the crossing.

After some possible crosses, 37g of TPS were found and stored for the next year experiment.

Identification and characterization of r-genes for late blight disease of potato in CIP germplasm

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Late blight resistance CIP germplasm and as a control from the released resistance and susceptible varieties of BARI were planted in TCRC Gazipur during 2020-21 season. Resistant varieties along with susceptible varieties were planted in TCRC, Gazipur. There were no late blight disease in the field during 2020-21 season. Only yield and yield related traits were evaluated this year. Significant variations were found among the potato germplasm. The germplasm CIP-450 took the highest days to emerge (22.33 days) followed by CIP-445 (21days). The lowest days was observed for the emergence in BARI Alu-25 (18 days) followed by BARI Alu-46 (19 days). For the plant stands at 30 DAP, almost all the varieties were stands out of 36 plants in the plot. The highest plant height was observed in BARI alu-53 (91.66cm) followed by CIP402 (77.66 cm). CIP-445 produced highest stem number per plant followed by CIP-448 (3.33). BARI Alu-53 produced highest tuber number (11.55) and tuber weight per plant (452.22g). Specifically, Highest seed tuber by number and weight was found in BARI Alu-53 followed by BARI Alu-46. The yield range was 25.99-31.33 t/ha. The highest mean yield was found in CIP-449 (31.33 t/ha) followed by CIP-445 (30.01 t/ha) and BARI Alu-53 (29.81 t/ha). The statistically significant similar tuber produced germplasm were CIP-449, CIP-445, BARI Alu-53, CIP-450, BARI Alu-46 and CIP-447.

Genetic Engineering

In vitro regeneration of sweet potato (*Ipomoea balatas* L) for transgenic protocol development

F. Akhter, M.M.H. Molla, S. Islam and K. A. Ara

In vitro plantlets were established from nodal explants. 0.5 mg/l Kn was used in BAP supplemented with MS media according to

(0.0,0.5. 1.0, 1.5, 2.0 mg/l). Among these combinations, MS+ 2.0mg/l BAP +0.5mg/l Kn showed the best results in case of no of nodes and no. of leaves/plantlet for both varieties, BARI MISTI ALU-4 and BARI MISTI ALU-8. For regeneration study and development of transformation protocol internodes, petioles, leaf segments of *in vitro* plantlets were used for callus formation. Explants were cultured on Murashige and Skoog (MS) media supplemented with six combinations of 2, 4-D (0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 mg/L) and 6-benzylaminopurine (BAP) 0.5 mg/L. Friable callus was obtained of both varieties from internodes and petioles cultured on MS media supplemented with 3 mg/l 2, 4-D + 0.5 mg/L BAP after 45 days of inoculation.

Production of Quality Potato Seed

Development of low-cost nutrient solution for mini-tuber production in aeroponic technique

M.H. Rashid, B.C. Kundu, M.M. Islam, S. Naznin, F. Akhter, M.M.H. Molla, M.A.H.S. Jahan, K.A. Ara and S. Akhter

Potato (*Solanum tuberosum* L.) productivity is highly constrained by limited supply of high quality seed tubers in Bangladesh. Production of TC-based seed potato starts with meristem tip culture technique. The resultant plantlets are grown in net-house for production of mini-tubers. This method is expensive and time consuming due to limited productivity. To overcome this situation Aeroponics is an excellent modern technique. Besides, nitrogen is essential nutrient element which is supplied from Ammonium nitrate (NH₄NO₃) and Potassium nitrate (KNO₃) which is restricted in Bangladesh by the government and not readily available in the market as well as the price is too high. That's why it is necessary to develop a nutrient solution with available chemical at a low price. All varieties performed the best by the application of T₁. All vegetative parameters were the highest in all T₁ treated varieties except stolon length where T₂ performed the best. The lowest value of all characters were T₃ treated plants of all varieties except BARI Alu-63. BARI Alu-63 showed the lowest value in T₂ treated plants. An important character, maximum number of stolon (6.50) was produced by BARI Alu-63 in T₃ treated plants where that variety produced only 2.00 stolon

in T1. BARI Alu-63 and BARI Alu-72 showed the lowest yield characters in T3 treated plants. Among the varieties, the highest number of mini-tuber (29.58), weight of mini-tuber (148.92 g), total number of mini-tuber (118.33) and total weight of mini-tuber (595.67 g) were recorded on the potatoes of BARI Alu-72. After 80 DAP, analyzing all characters with the effect of treatments and performance of varieties it could be concluded that T1. CIP developed aeroponic solution (Existing) was the best treatments for aeroponic culture and BARI Alu-46 was the best variety among three. After completion of this experiment and observing the yield characters it could be concluded that T1. CIP developed aeroponic solution (Existing) was the best treatments for aeroponic culture and BARI Alu-72 was the best variety among three.

Performance of CIP biofortified potato germplasm under aeroponic culture

M.H. Rashid, B.C. Kundu, M.M. Islam, S. Naznin, F. Akhter, M. A. Ali, D. Chanda, E.H.M.S. Rahaman, M.M.H. Molla, M.A.H.S. Jahan, K.A. Ara and S. Akhter

Potato (*Solanum tuberosum* L.) productivity is highly constrained by limited supply of high quality seed tubers in Bangladesh. Production of TC-based seed potato starts with meristem tip culture technique. The resultant plantlets are grown in net-house for production of mini-tubers. This method is expensive and time consuming due to limited productivity. To overcome this situation Aeroponics is an excellent modern technique. Forty biofortified and ten late blight tolerant germplasm were collected from the CIP, Peru. In 2020-21 cropping year, the result of this experiment was very promising. CIP-435 gave the highest number of mini-tuber and CIP-408, CIP-412, CIP-416, CIP-421, CIP-426, CIP-428, CIP-429, CIP-440 and CIP-441 were good performer for mini-tuber production in aeroponic culture. From the aeroponic structure about 3 kg mini-tubers obtained.

Production of nucleus seed potato (mini tuber, G₀) using *in vitro* plantlet

M.M. Rahman, M. Rahman, M.N. Amin, M. M. M. H. Molla and M.M. Uddin

This work was carried out to produce quality minituber from *in vitro* plantlet. A total of 4456 kg

(Table-4) mini-tubers were produced from 71240 plantlets during 2020-21 crop season at Debiganj. CIP Biofortified accessions were multiplied for next year trial setup at different locations. The highest amount was 915 kg contributed by the variety BARI Alu-25 (Asterix).

Breeder and foundation seed potato production at BSPC, BARI, Debiganj, Panchagarh during 2020-2021

M.M. Uddin, A. K. Das, M.N. Amin, M. W. Rahman, M. Z. Masud, M.M. Rahman and M. Rahman

This work was carried out to produce high quality breeder and foundation seed potato in Bangladesh. In order to supply quality seed potato to BADC, NGO's, farmers and for the next year research activities, 135 acres of land were under seed potato production at BSPC Debiganj during 2020-21 of which 80.0 acres were under nucleus seed (minituber) and breeder seed production program (290 field net house-FNH and 3 permanently built net house -PNH). Rest area was covered with foundation seed (open field), true potato seed (TPS) and research activities. A total of 683.078 ton potato seed produced at BSPC during 2020-21, among them 194.405 ton was breeder seed and 322.688 ton was foundation seed. The highest amount was contributed by the variety BARI Alu-25 (Asterix) and BARI Alu-29 (Courage).

Seed production and distribution of sweetpotato and aroids

M. S. Alam, Z. Alam, F. Begum, M. A. H. Khan, M. A. H. S. Jahan, K. Ara, S. M. Sharifuzzaman

Seed production is a regular programme of TCRC for varietal maintaining and distribution to farmers or different adaptive or demonstration trials. Eighty eight thousands of vine cuttings of the sixteen Sweetpotato varieties, around sixty thousand Panikachu suckers of the six Panikachu varieties and around five hundred kilogram of corms (Seed) of the two Mukhikachu varieties were produced at TCRC field, Gazipur. From that around 44.20 thousand vine cuttings of sweetpotato, around 27 thousand suckers (seedlings) of Panikachu and around 300 kilogram corms (seed) of Mukhikachu varieties were distributed for farmers.

Post Harvest Technology

Storage behaviour of potato varieties and hybrid clones under natural condition

T. Hasan, M.H. Rashid, M.A.H.S. Jahan, K.A. Ara and S.M. Sharifuzzaman

An experiment was conducted during March to August 2020. Tubers of exotic potato varieties and clonal hybrids of RYT, AYT and SYT were evaluated for storage behavior under natural condition. In case of exotic varieties Sun Red and Messi performed better while for hybrid clones 13.7 and 13.17 under RYT performed better storage performance in natural condition. Among the ten exotic genotypes studied under AYT, Innovator was the best performer along with Dunstar, Alberta, Al Russet and Ottawa. In case of the five hybrid clones evaluated under AYT, 14.31 showed good storage performance. Regarding secondary yield trial (SYT), the exotic genotypes of Twister, Divers and Delia Red showed good performance with all the hybrid clones.

Processing

Studies on the processing quality (chips and french fry) of potato cultivars and hybrid clones

T. Hasan, M.H. Rashid, M.M. Molla, M.H.H. Khan, M.A.H.S. Jahan, K.A. Ara and S.M. Sharifuzzaman

Six hybrid clones of SYT were studied for their processing quality in the form of Chips and French Fries. 16.7 and 16.28 varieties showed better performance in case of both chips and French fries. 14.10 and 14.11 out of 3 hybrid clones exhibited better performance for French fries at RYT level. Among the seven exotic materials at RYT Ottawa and Al Russet produced excellent chips and French fries whereas Innovator performed better only for French fries. Among the exotic genotypes in AYT Alcander, Hind, Rslin and Twinner were better for chips and Alcander and Delia Red gave better quality French fries. Among the hybrid materials for AYT, 15.112, 15.126, 15.139 and 15.156 showed better performance for chips and 15.92 and 15.156 were good in French fries.

Technology Transfer

Promotion and Dissemination Activities

Adaptive trials with newly released potato varieties

B.C.Kundu, M.N. Uddin, M.M. Islam, S.Naznin, T. Jahan; M.R. Islam, M.M. Hossain, O.A. Fakir, M.H. Rashid, M.K. Shahadat, M.S.I. Khan, M.M. Islam, N.D. Kundu, M.S. Uddin, M.M Kader, P. Hajong, M.K.U. Ahamed, M.H. Hossain, M.M. Kamruzzaman, M.M. Howlader, M. Asaduzzaman, M.S Ahamed, N.D. Kundu, M. Samsuzaman, M.R. Islam, M.S. Rahman, M.F. Uddin, M. Sultana, M. Z.H. Prodhan, M.A.H. Talukder, M.Z. Ferdous, J.A. Mahamud, S. Sultatn, M.O. Kaiser, M. Selim, M.K. Alom, M.R. Amin, M. Mohiuddin, M.N. Sarker, N. Sultana, M. Muniruzzaman, G.N. Hasan, S. Roy, M.H. Khan, M.S. Huda, A.K.M. Khorseduzzaman, M.N. Amin, A.K. Saha, A.A. Mahamud, M.J. Alom, M.M. Anwar, M.M. Uddin, K.A. Ara, S, Akhter

Adaptive trials with new potato varieties were conducted at thirty three districts to promote as well as to know the farmers acceptance about the new potato varieties. All the tested varieties varied between and within location. The average highest yield over the location 35.94 t/ha was recorded in BARI Alu-62 followed BARI Alu-41 (35.06 t/ha) and BARI Alu-63 (34.92 t/ha). BARI Alu-37 was the lowest yielder (31.19 t/ha). Farmers reaction varied between the locations. All the tested varieties accepted by the farmers of different location. Their demand is timely supply of quality seed of the tested new varieties.

Promotion and dissemination of newly released climate smart (heat& salt tolerant) potato variety at farmers' field

B.C. Kundu, M.N. Uddin S. Naznin, M.M. Islam, T. Jahan, E.H.M.S. Rahaman, M.R. Islam, M. Rafi Uddin, M.M. Hossain, O.A. Fakir, M.H. Rashid, M.K. Shahadat, M.R. Islam, M.K.R. Bhuiyan, M.S.I. Khan, M.M. Islam, M.M. Choudhury, A.H.M.A. Faisal, M.S. Bhuiya, M.M. Uddin, K.A. Ara and S, Akhter

Promotion and dissemination trials with Climate smart new potato varieties were conducted at eight districts to promote as well as to know the farmers acceptance about the new potato varieties. In each district the trial was replicated 5-15 locations. The tested three varieties varied between and within location. Average yield over the location of BARI Alu-72 was 27.78 t/ha, BARI Alu-73 was 24.53 t/ha and BARI Alu-78 was 24.63 t/ha. The highest yield 36.54 t/ha, 30.88 t/ha and 33.99 t/ha of all tested varieties BARI Alu-72, BARI Alu-73 and BARI Alu-78, respectively was observed in Barishal. Whereas lowest yield was in Dumuria, Khulna for all the tested varieties. Farmers reaction varied between the locations. All the tested varieties accepted by the farmers of different location. Their demand is timely supply of quality seed of the tested new varieties.

Promotion and dissemination of newly released late blight resistant potato varieties

B.C. Kundu, M.N. Uddin, S. Naznin, M.M. Islam, T. Jahan, A.K. Saha, M.M. Rahman, Z. Masud, M.N. Amin, M.Sultana, M.Z.H. Prodhan, A.A. Mahmud, M.J. Alom, M.Z. Ferdous, M.A.H.Talukder, M.M. Uddin, K.A. Ara, S. Akhter

Fourty five field trials were conducted on BARI released late blight resistant potato varieties viz. BARI alu-46, BARI alu-53 and BARI Alu-77 (Sarpomira) at farmers' field of eight lateblight disease prone districts in Bangladesh (Bogura, Gaibandha, Joypurhat, Kurigram, Lalmonirhat, Nilphamari, Panchagar and Rangpur) during 2020-2021 for promotion and dissemination. Yield of BARI Alu-46 and BARI alu-53 ranged 30.87 to 45.48 t/ha and 28.45 to 34.31 t/ha, respectively. BARI Alu-77 (Sarpomira) was test only two locations produced 27.29 t/ha and 25.68 t/ha. Incidence of common scab, virus and late blight were found very low compared to farmers' adjacent plots. Farmers were very happy to observe the performance of the varieties as late blight resistance and yield.

Promotion and dissemination BARI released sweet potato varieties in saline areas (Satkhira)

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Twenty demonstration of sweet potato varieties were conducted at six upazila in Satkhira and Khulna during 2020-2021. The aim of the demonstration was to evaluate the performance of these sweet potato varieties in saline areas and expand the varieties among the farmers. Out of twenty, five demonstrations were set at Haroddah, Satkhira. At Haroddah mean yield ranged from 28.82 to 39.50 t/ha. Highest root yield was recorded from BARI SP-14 (39.50 t/ha) while the lowest was BARI SP-10 (28.82 t/ha). Mean yield recorded from Magura, Tala, Kolaroa, Debhata and Asasuni ranged 26.21 to 33.69 t/ha. Highest mean yield (33.69 t/ha) recorded from BARI SP-15 and the lowest was 26.21 t/ha obtained from BARI SP-10. The varieties had different skin and flesh color, which attracted farmers. At Khulna, most of the farmers chose BARI Misti Alu-8 for its red attractive color and highest yield (31.40 t ha⁻¹) production purpose.

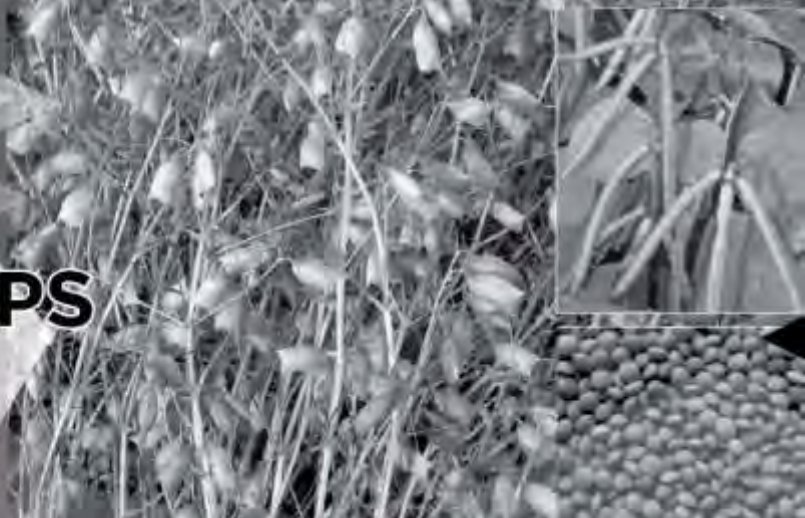
Adaptive trial with panikachu varieties at different AEZ of Bangladesh

M.S. Alam, F. Begum, Z. H. Prodhan, M.M. Rahman, M. T. Islam, M.I. Nazrul, M. A. H. S. Jahan, K. Ara, S. M. Sharifuzzaman, S. Akhter

Adaptive trials with Panikachu varieties were conducted at four districts to disseminate as well as to know the farmers' acceptance about the varieties during 2020 crop season. On average both the stolon producing Panikachu varieties viz. BARI Panikachu 1 (Latiraj) and BARI Panikachu 2 gave similar yield. The highest stolon yield (21.11 t/ha) was recorded in Jamalpur from BARI Panikachu-1 (Latiraj). The highest rhizome yield (81.70 t/ha) was recorded in Jamalpur from BARI Panikachu-6.

02

PULSE CROPS



Blackgram

Varietal Improvement

Hybridization and advancement of generations

Hybridization of blackgram was conducted for the development of high yielding, short maturing and small seeded with Blackgram Yellow Mosaic Virus (BYMV) tolerance blackgram during Kharif II season, 2020 at Pulses Research Centre, Ishwardi, Pabna. Five parents with desired characters viz. Thakurikalai, BG-2, BARI-Mung-5, RU-139 and BARI Mash-3 were used and a total of 149 successful crossed seeds were collected from fifteen cross combinations that will be sown during the next season for confirmation of blackgram F_1 generations. Fifteen F_1 s obtained from Kharif II, 2019 were grown along with their parents at Pulses Research Centre, Ishwardi, Pabna during Kharif II, 2020 and on the basis of desired characters viz. stem pigmentation, pod hairiness, BYMV tolerance, plant height, podding intensity, pod length, seed size etc. fourteen accessions were confirmed. Fifteen F_2 segregates were grown in F_2 , nine F_3 progenies in F_3 and nine F_4 progenies in F_4 along with the check BARI Mash-3 were grown where those were bulked for retention of large extent of variability in the next generation. Moreover, eight F_5 s were grown along with check varieties at Pulses Research Centre, Ishwardi, Pabna from which thirty six lines/families were selected which will be grown in the next year at observation trial.

Regional Yield Trial of Blackgram

The trial was carried out to determine the performance of six blackgram genotypes (BBLXK2- 12005-5, BBLXK2- 12005-6, BBLXK2- 12002-4, BBLXK2- 12002-2, BG-2 and

BG-7) with two check varieties (BARI Mash-3 and BARI Mash-4) for yield and yield contributing characters at PRSS, Gazipur; PRC, Ishurdi, Pabna and RPRS, Madaripur during Kharif II, 2020 in a RCB design with 3 replications. In case of days to flowering and days to maturity over three locations, no genotype performed earlier than check variety BARI Mash-4, but all genotypes flowered early at Ishurdi location and mature early at Madaripur location. Among the all genotypes check variety BARI Mash-4 was bold seeded. The highest mean seed yield was recorded in BBLXK2- 12005-5 (1163.8kg/ha) followed by BBLXK2- 12002-4 (1156.5 kg/ha) BBLXK2- 12005-6 (1041.5 kg/ha) and BBLXK2- 12002-2 (1041.5 kg/ha) than check BARI Mash-3 (1014.9kg/ha). Therefore, four genotypes BBLXK2- 12005-5, BBLXK2- 12002-4, BBLXK2- 12005-6 and BBLXK2- 12002-2 were selected on their overall performance and disease reaction over location for further evaluation in Participatory Variety Selection trial on farmer's field in next season at different locations of Bangladesh.

Studies of Genetic Variability of Blackgram Germplasm

The genetic base of blackgram is predominantly very narrow. Ninety five genotypes of blackgram were evaluated to estimate genetic variation among the genotypes for their potential use in crop improvement. The experiment was conducted in RCB design with three replications. All the genotypes were grouped into five clusters based on D2 values. The composition of different clusters varied from 05 to 39 genotypes. Cluster II comprised of 39 genotypes followed by cluster III, IV, V and I consisting of 39, 24, 15, 12 and 05 genotypes respectively. The diversity was also supported by the appreciable amount of variation

among the cluster means for different characters. Cluster V exhibited the lowest mean value for days to flower (39) and days to maturity (70) while the highest mean value for days to flower (45) and maturity (75) in cluster III. Lowest plant height was found in cluster II. The highest pods per plant were observed in cluster I followed by cluster V. In case of seed size, the largest was recorded in cluster IV. The highest yield per plant was found in cluster I followed by cluster V. The use of identified diverse genotypes in breeding might help to develop high yielding blackgram varieties.

Screening of Blackgram Germplasm under Waterlogging Stress at Germination

Blackgram (*Vigna mungo* L.) are exposed to waterlogging at germination when grown on waterlogged soil after recession of flood water. Three BARI developed varieties- BARI Mash-1, BARI Mash-3, BARI Mash-4 and an advanced line- BBLX-K2-12002-4 were evaluated in four waterlogging treatments (drained control, 4, 7 and 10 days waterlogging) in the pot soil condition. Waterlogging was reduced germination with the increase of waterlogging duration. Among the genotypes, there was significant variation of waterlogging tolerance in all the waterlogging treatments. In drained control, genotypes showed close to 100 % germination. Significant variation of germination was found in 4, 7 and 10 days waterlogging, however 10 days waterlogging showed more clear variation among the genotypes in response to waterlogging tolerance. At 10 days waterlogging, BARI Mash-3 exhibited 23% germination while BARI Mash-1, BBLX-K2-12002-4 and BARI Mash-4 showed 37%, 33% and 38% germination respectively at the end of experimental period.

Evaluation of Blackgram Germplasm in Charland Areas of Gaibandha

The trial was conducted with eight promising lines E2 (BG-2), E3 (BG-4), E4 (BG-7), E5 (BBLX-08008-2-1), E6 (BBLX-08010-4-1), E7 (BBLX-08010-2-1), E8 (BBLX-04001-1) and E9 (BBLX-06006-4) along with two checks E1 (BARI Mash-3) and E10 (BARI Mash-4) varieties of Blackgram in charland of Saghata, Gaibandha during 2020-21. The highest yield (1.69 t ha⁻¹) was obtained from

E8 (BBLX-04001-1) lines with early maturity (65 days) compared to the check BARI Mash-3 (1.18 t ha⁻¹) and BARI Mash-4 (1.28 t ha⁻¹). In other, E5 (BBLX-08008-2-1) produced the seed yield of 1.19 t ha⁻¹, similar to BARI Mash-3 (E1). The lowest yield (0.64 t ha⁻¹) was recorded from E3 (BG-4). However, among the 8 new lines, E8 (BBLX-04001-1) showed the best yield performance as well as a greater number of pods plant⁻¹ (46) and 100 seed weight (3.80 g).

Screening of blackgram lines resistant to yellow mosaic virus

A field experiment was conducted at Pulses research center during Kharif-II season of 2020. The aim of this study was to search high yielding as well as diseases tolerant genotypes. Screening result revealed that all the test entries varies significantly considering their, plant height population, pods per plant, plant height, number of pods per panicle, number of pods per plant, and yield except first pod bearing node. The highest yield (1165 Kg/ha) was produced by the entry BBLXK-2092005-2 and the lowest yield was harvested from BBLXK-2086136 (830 kg/ha). 2.67-6.33. The maximum score (5.33) of BYMV found in the line BBLXK-2092005-2 and minimum (2.00) in BBLXK-204003-6 and BBLXK-204002-15

Lentil

Varietal Improvement

Hybridization and advancement of generations

Hybridization of lentil was conducted to develop high yielding, short duration, micronutrient enriched and stemphylium blight tolerant/resistance variety during rabi season, 2020-21 at Pulses Research Centre, Ishwardi, Pabna. Four parents with desired characters viz. BARI Masur-3, BARI Masur-8, BLX -05008-12 and BLX -05008-10 were used and a total of 257 successful crossed seeds were collected from five cross combinations that will be sown during the next season for confirmation of lenti F₁ generations. Fifteen F₁s obtained from rabi, 2019-20 were grown along with their parents at Pulses Research Centre, Ishwardi, Pabna during rabi, 2020-21 and on the basis of desired morphological characters fourteen

accessions were confirmed. Eleven F_2 segregates were grown in F_2 , thirteen F_3 progenies in F_3 and five F_4 progenies in F_4 along with the check BARI masur-7 and BARI masur-8 were grown where those were bulked for retention of large extent of variability in the next generation. Moreover, nine F_{5S} were grown along with check varieties at Pulses Research Centre, Ishwardi, Pabna from which 209 single plants were selected which will be grown in the next year at observation trial.

Observation Trial of Lentil

Twenty nine individual plants selected from last season's F_5 population were grown with check variety BARI Masur-7 and BARI Masur-8 during rabi season of 2020-21 at Pulses research center, Ishwardi, Pabna following RCB design with two replications. Evaluating the performance of yield, yield contributing traits and disease reaction, seven genotypes out of 20- BLX-15003-7, BLX-15003-8, BLX-15004-3, BLX-15004-7, BLX-15009-4, BLX-15009-5 and BLX-15010-5 were selected for next year PYT.

Preliminary Yield Trial of Lentil

The trial was carried out to assess the performance of yield and yield contributing traits of nine promising lentil genotypes at five different locations viz. Ishwardi, Gazipur, Madaripur, Jamalpur and Jashore during rabi, 2020-21. Significant variations were observed for days to flower, days to maturity, plant height, pods per plant hundred seed weight and the yield performance at almost all the locations. Among the genotypes, BLX-14004-5 flowered and matured earlier than the other genotypes. In comparison to plant height, genotype BLX-14002-6 showed dwarfness while BLX-14001-12 was tallest. The highest pods/plant was obtained from BLX-14004-5 followed by BLX-14005-5. None of the entries was out yielded over BARI Masur-8, but the yield of BLX-14001-1, BLX-14001-4, BLX-14001-12, BLX-14002-6, BLX-14004-5 was higher than BARI Masur-7.

Regional Yield Trial of Lentil

The trial was carried out to assess the performance of yield and yield contributing traits and the stability of seven promising lentil genotypes in six

different locations viz. Ishwardi, Jamalpur, Gazipur, Barishal, Madaripur and Jashore during rabi, 2020-21. Significant variations were observed in respect of all yield attributes and yield performance of the tested genotypes. Among the genotypes, BLX-13005-20 flowered and matured earlier than the other genotypes followed by BLX-13005-26. The genotype BLX-13002-6 showed the lowest plant height in compared to others, while BARI masur-8 was the tallest genotype. The highest pods per plant were found from BARI Masur-8. The lowest seed weight was found in BLX-13003-2 and highest in BARI Masur-8. None of the entries was out yielded over BARI Masur-8, but the yield of BLX-13004-7, BLX-13002-6, BLX-13005-20, BLX-13005-26 was higher than BARI Masur-7.

Participatory Variety Selection of Lentil

The experiment was carried out to evaluate the performance of yield and yield contributing traits of eight genotypes of lentil at farmers' field of five locations viz. Pabna, Jashore, Barishal, Jamalpur and Madaripur during rabi, 2020-21. Significant variations were observed in respect of all yield attributes and yield performance of the tested genotypes across locations. Among the genotypes, BLX-05002-3 flowered and matured earlier than the other genotypes followed by BLX-11004-8 and BLX-11004-11. BARI Masur-7 showed the lowest plant height in compared to others, while BLX-05002-3 was the tallest genotype. The highest pods per plant were found from BARI Masur-8. The lowest seed weight was found in BLX-12005-4 and highest in BARI Masur-8. Among the entries BLX-11004-8 was out yielded over BARI Masur-8 and the yield of BLX-11004-11, BLX-11004-8, BLX-11014-8, BLX-05002-3 was higher than BARI Masur-7.

Effect of *rhizobium* inoculant on nodulation and yield of lentil

A field experiment conducted at PRC, BARI, Ishwardi, Pabna during Rabi season of 2020-2021 to evaluate the biological nitrogen fixation potential of *Rhizobium* inoculant in lentil. The experiment was laid out in a Randomized Complete Block Design with assigned 8 different treatments. The treatments were T_1 =Untreated control, T_2 =Recommend dose of Fertilizer

($N_{18}P_{18}K_{27}S_{15}Zn_{0.7}B_{0.9}$ kg ha⁻¹), T₃= Rhizobium inoculant, T₄=T₂+T₃, T₅= T₄-25% less of RDN (Recommended dose of nitrogen), T₆= T₄-50% less of RDN, T₇= T₄-75% less of RDN, and T₈=T₄-100% less of RDN. The lentil variety was BARI Masur-9. The lentil was sown on 12 November 2020 and harvested on 15 February 2021. Fertilizers were applied as per specification of treatment. The highest seed yield (1.16 t ha⁻¹) obtained from Rhizobium + recommended dose of fertilizer (T₄) and the lowest seed yield (0.53 t ha⁻¹) recorded in the control (T₁). The maximum nodule number (20 plant⁻¹) found in T₃ while the minimum nodule number (9 plant⁻¹) was in control. Yield increased over control was 70-119%. The highest gross margin (Tk 30360 ha⁻¹) and BCR (1.74) were found in Rhizobium + RDF (T₄).

Determination of dose and spray schedule of folicur and nativo fungicides for controlling blight disease of lentil

The experiment was conducted at Pulses Research Center (PRC), BARI, Ishurdi, Pabna during 2020-21 season to evaluate the efficacy Nativo and Folicur fungicide dose and number of application in controlling Stemphylium blight disease. Ten treatments were viz; Nativo, two doses with two times and three times applications and Folicur three doses with two times and three times applications; and a control treatment. Severity of stemphylium blight was assessed in all treatments on a weekly basis. A quantitative scale ranging from 0 to 10 was used. Quantitative data were transformed to percentage disease severity and efficiency of fungicides on Stemphylium blight control was analyzed by the Area under Disease Progress Curve (AUDPC). There was no statistical difference for disease control between numbers of applications and dose except for higher Folicur dose and application but distinct difference for seed yield. However, all fungicide treatments significantly differed from control for control disease and seed yield. In Marginal Benefit Cost Ratio (MBCR), all the combination performed better over control but most economical combination was Folicur (1ml/L) & two times application with highest MBCR of 1:9.8. The lowest MBCR (2.9) was found Folicur (2ml/L) and three time's application. From the presented data, it could be recommended that two

times of; Nativo @ 05.g/L or Folicur @ 1ml/L at 7 days interval for management of Stemphylium blight disease of lentil in Bangladesh.

Biological controls of root rot disease of lentil and chickpea in field condition

The experiment was conducted at Pulses Research Center (PRC), BARI, Ishurdi, Pabna during 2020-21 season to find out the effect of Trichoderma based bio control product on root rot disease of lentil and chickpea under field conditions. No root rot disease was observed in treated plot both lentil and chickpea experiment but most important thing that it was also absent in control plot. Results revealed that the maximum seed yield (2000 Kg/ha) of chickpea was found at Geoderma (*Trichoderma*spp) treated plot and minimum (1689 Kg/ha) was Trico compost treated plot. Where as in lentil experiment, the maximum yield (1361 Kg/ha) was found at Bioderma treated plot and the minimum yield (996 Kg/ha) in control treated plot. Economic analysis showed all the treatment performed better over control in lentil experiment but most of the treatment showed negative MBCR in Chickpea root rot disease management. Based on the presented data, most economical treatment was found in seed treated with Geoderma both lentil and chickpea root rot disease control. In field condition, it is very difficult to monitor that the biological control agents are worked properly or not. So, next year this experiment will be conducted at controlled condition together with field condition.

Screening of lentil germplasm against stemphylium blight

The screening trial was conducted with 27 accessions based on previous year's evaluation for Stemphylium Blight (SB) resistance at Pulses Research Centre (PRC), Ishurdi, Pabna. These accessions were screened in natural field environment and showed varying level of resistance. Lentil variety BARI Masur-1 (susceptible) was used as check throughout the experiment. The highest frequency of resistance to SB was found in ILL-4705, ILL-6314, ILL-6367 and BLX-06004-2 (0.0) and yielded 2058, 1863, 2337 and 2845(Kg/ha) respectively. These lines were selected from two years trial among 61 of

lentil lines received from ICARDA and now they could be used in lentil breeding for stemphylium blight resistance.

Socio-economic study of lentil cultivation in some selected areas of Bangladesh

The study assessed the adoption of improved lentil varieties, estimated the profitability of production, and explored farmers' perceptions on lentil cultivation in Bangladesh. The study analyzed 360 households data collected from 240 improved variety adopters and 120 non-adopters spread in the six lentil growing districts namely Faridpur, Magura, Kushtia, Jhenaidah, Manikgonj, and Sirajganj. Along with descriptive statistics, the study used different models for analyzing the data. About 71% of lentil growing households adopted improved lentil varieties, and 29% used local cultivars. BARI Masur-8 was the highest adopted variety in the highly-intensive growing areas, whereas BARI Masur-6 and BARI Masur-4 were popular in the medium-intensive and low-intensive growing areas. Pulse training, the profitability of production, farmers' innovativeness, and farmer's extension contact were the major factors of improved variety adoption. The yield of improved variety (1.63 t/ha) was much higher than local cultivars (1.08 t/ha). The highest yield was found in medium-intensive growing areas due to the use of better variety and a higher level of inputs. Human labour, seed, TSP, MoP, other fertilizers, pesticides, irrigation, and variety had a positive and significant effect on the yield of lentils. Improved lentil cultivation was profitable from the financial point of view (Tk. 48,165/ha) and an economic perspective (Tk.15,083/ha). Again, the domestic production of improved lentils had a comparative advantage (DRC=0.72). Most farmers wanted to increase improved lentil cultivation in the next year considering the higher yield and net benefits. Oppositely, a good portion of lentil farmers also wanted to decrease lentil cultivation due to lack of suitable land, biotic and abiotic stresses, and seeds of improved variety. Farmers should be encouraged to expand their lands for improved lentil cultivation to increase their benefit, improve soil fertility, and for a better comparative advantage of production.

Grasspea

Varietal Improvement

Hybridization and advancement of generations

Hybridization of grasspea was conducted develop high yielding with high biomass, short duration, medium/small sized low ODAP contained seed and powdery mildew tolerant/resistant grasspea variety during rabi season, 2020-21 at Pulses Research Centre, Ishwardi, Pabna. Five parents with desired characters viz. Sirajgonj local, BGP 13009, BARI Khesari-5, 144995 and BGP 13010 were used and a total of 215 successful crossed seeds were collected from nine cross combinations that will be sown during the next season for confirmation of grasspea F₁ generations. Fifteen F₁s obtained from rabi, 2019-20 were grown along with their parents at Pulses Research Centre, Ishwardi, Pabna during rabi, 2020-21 and on the basis of desired morphological characters twelve accessions were confirmed. Nine F₂ segregates were grown in F₂ and six F₃ progenies in F₃ along with the check BARI khesari-3 and BARI khesari-5 were grown where those were bulked for retention of large extent of variability in further generation which will be grown in the next rabi season.

Evaluation of Grasspea (Set-I) Genotypes

The experiment was conducted for evaluating the grasspea exotic germplasm during 2020-21 at PRC, Ishwardi, Pabna. A total of 21 genotypes along with two check varieties BARI Khesari-3 and BARI Khesari-5 was evaluated. Variability was found in all the yield contributing parameters. Days to flowering ranged from 47-68 days, Pods per plant ranged from 30 to 49 and yield per hectare ranged from 975 kg/ha to 1970 kg/ha. Based on the morphological features in the field, yield per plant and others yield contributing characters total 5 genotypes were selected for further evaluation in the replicated observation trial in the next season and selected genotypes are 114505, 114509, X2009-14-12S-24, 114585 and 16690.

Evaluation of Grasspea Genotypes (Set-II)

The experiment was conducted at Pulses Research Centre, Ishwardi, Pabna and RPRS, Madaripur during rabi season of 2020-21 to evaluate the local and exotic germplasm of grasspea genotypes/lines.

Five selected grasspea local and exotic lines and two check variety BARI Khesari-3 and BARI Khesari-5 were evaluated in the trial. Results showed that almost all the yield contributing characters under this study were significantly differing among the genotypes across locations. Among the genotypes, IGYT-124 flowered and matured earlier than the other genotypes followed by IGYT-123 and IGYT-125. The genotype IGYT-124 showed the lowest plant height in compared to others, while BARI Khesari-5 was the tallest genotype. The highest pods per plant were found from IGYT-123. The lowest seed weight was found in IGYT-122 followed by IGYT-125 and highest in BARI Khesari-3. Among the entries IGYT-122 and IGYT-123 was out yielded over the check varieties.

Preliminary Yield Trial of Grasspea

The trial was carried out to evaluate the performance of seven grasspea genotypes with check BARI Khesari-5 for yield and yield related traits in three locations viz. Pulses Research Centre, Ishwardi, Pabna; PRSS, Gazipur and RPRS, Madaripur during Rabi 2020-21. Different genotypes of grasspea showed variations among all the parameters across all the environments. The genotype BKG 0002-4 flowered and matured earlier considering the mean values of three locations followed by Patuakhali local. Mean plant height was maximum in Patuakhali local and minimum in BKG-0002-4. Highest mean pods per plant found in Patuakhali local. The mean highest 100 seed weight recorded from BARI Khesari-5 and lowest from Sirajgonj Local. Among the entries Sirajgonj local, BGP-13010, Narail local and BGP 13009 was out yielded over BARI Khesari-5.

Evaluation of Grasspea Genotypes in Charland Areas of Gaibandha, Bogura and Jamalpur

The trial was conducted with eight promising lines of grass pea with two check varieties, BARI Khesari-3 and BARI Khesari-5 at Saghata, Gaibandha; Sariakandi, Bogura and Jamalpur during the rabi season of 2020-21 cropping year. Significant variations were found in different yield contributing characters across locations. Mean plant height was maximum in BGP-13004 followed by BGP-13008 and minimum BARI Khesari-3.

Highest mean pods per plant found in BARI Khesari-3 followed by BGP-13009. The mean highest 100 seed weight recorded from BARI Khesari-5 followed by BGP-13009 and lowest from BGP-13004. The genotype BGP-13009 provided the highest mean seed yield over the check varieties and lowest yield performed by BKG-0002-4 across the locations. Compared to three locations, almost all the genotypes produced higher yield at Gaibandha and Jamalpur; and Bogura location showed comparatively low yield.

Screening of Grasspea Germplasm under Waterlogging Stress at Germination

Grasspea (*Lathyrus sativus* L.) crops are exposed to waterlogging at germination when grown as relay in rice-based cropping. Three BARI developed varieties- BARI Khesari-1, BARI Khesari-3, BARI Khesari-6 and a local cultivar-Barisal local (BL) were evaluated in four waterlogging treatments (drained control, 4, 7 and 10 days waterlogging) in the pot soil to identify waterlogging tolerance at germination and to optimize methodology for screening waterlogging tolerance. Germination was reduced remarkably by the waterlogging treatments. All four genotypes showed close to 100 % germination when grown in drained soil and even in 4 days waterlogging. Significant variation of germination was found in 7 and 10 days waterlogging, but 10 days waterlogging showed more clear variation among the genotypes in response to waterlogging tolerance. At 10 days waterlogging, BARI Khesari-1 exhibited 40% germination while BARI Khesari-3, BARI Khesari-6 and Barisal local showed 70%, 68% and 67% germination respectively at the end of experimental period. This results indicate that BARI Khesari-3, BARI Khesari-6 and Barisal local are waterlogging tolerant in contrast to waterlogging sensitive BARI Khesari-1. Such marked differences in waterlogging tolerance at germination in grasspea illustrate prospects for selection to improve adaptation to relay sowing in Bangladesh.

Performance of mixed cropping of grasspea and mustard under relay cropping systems

The field experiment was carried out at Pulses Research Centre, BARI, Ishwardi, Pabna during 2020-21 to verify the performance of grass pea as

mixed crop with mustard under relay cropping systems with T. *Aman* rice. The treatment combinations used for the experiment were T₁: Sole grass pea (100% grass pea @ seed rate 60 Kg ha⁻¹), T₂: sole mustard (100% Mustard @ seed rate 7 Kg ha⁻¹), T₃: 100% grass pea + 5 % mustard, T₄: 100% grass pea + 10 % mustard, T₅: 80% grass pea + 15 % mustard, and T₆: 80% grass pea + 20 % mustard. Seeds of grass pea (BARI Khesari-5) and mustard (BARI Sarisha-11) were broadcasted on 03 November, 2020. The result showed that sole mustard (T₂) gave the highest seed yield of mustard and 100% grass pea + 5 % mustard (T₃) contributed the minimum seed yield of mustard. On the other hand, the maximum yield of grass pea (1095 kg ha⁻¹) was obtained from sole grass pea, which was influenced by mixed cropping with mustard. Considering the yield and economic analysis, it can be concluded that 80% grass pea + 20 % mustard was more profitable than other treatment combinations.

Population fluctuation of grasspea aphid, *aphis craccivora* koch in relation to sowing time and its effect on grain yield

The experiment was conducted at Pulses Research Centre (PRC), BARI, Ishurdi, Pabna during rabi, 2020-21 to find out suitable time(s) of sowing to avoid aphid infestation. Seven sowing dates with one week interval starting from 09th November, 2020 to 21th December, 2020 were considered as seven treatments of this experiment. The percent twig infestation by aphid was higher in late sown crop (crop sown in December) than that of early sown crop (crop sown in November). The variation in sowing time resulted in availability of different stages of crop at a time and the difference in aphid population might be due to succulent stage of late sown crop which was preferred by aphid population for feeding and multiplication. However, the highest seed yield (1511 kg/ha) was obtained from the crop sown on 16th November which was at par with crop sown on 23th November (1443 kg/ha). The yield in 09th November (1276 kg/ha) sown crop was reduced probably due to extra early sowing, but found higher than the crop sown on 30th November (1162 kg/ha), 07th December (959 kg/ha), 14th December (913 kg/ha) and 21th December (517 kg/ha) respectively. The reduction of yield in late

sown crop on 07th December 14th December and 21th December was probably due to heavy infestation of aphid along with delayed sowing. So, grasspea should be sown in November to get higher yield by avoiding aphid infestation.

Chickpea

Varietal Improvement

Hybridization and advancement of filial generations in chickpea

Hybridization and advancement of F₁ to F₅ generations were conducted during Rabi 2020-21 at PRC, Ishurdi, Pabna. Five parents were used in crosses and a total of 136 successful cross seeds were harvested from 15 cross combinations. Fifteen, seven and nine populations and seventeen families were selected from F₁, F₃, F₄ and F₅ respectively to advance the generation.

Observation trial of chickpea

Thirteen lines selected from last season's F₅ families were grown with check variety BARI Chola-5 and BARI Chola-10 during rabi season of 2020-21 at Pulses research center, Ishwardi, Pabna following RCB design with two replications. None of the entries were out yielded over checks. In respects to Botrytis Gray Mold disease, we did not find any symptom of the disease this year. The experiment will be repeated next year as PYT.

Regional yield trial of chickpea

The experiment was conducted to evaluate the performance of yield and yield contributing traits as well as the yield stability of seven genotypes in four different locations viz. Ishurdi, Jamalpur, Gazipur and Jashore during Rabi, 2020-21. Significant variations were observed in respects to yield and yield contributing traits. Considering yield and yield contributing traits, two entries BCX-13005-3 and BCX-13002-2 were selected for next year trial as PVS.

Evaluation of chickpea exotic germplasm

The experiment was conducted at PRC, Ishwardi, Pabna during 2020-21 to find out most suitable genotypes under Bangladesh condition. A total of 21 genotypes along with one check BARI Chola-10

were evaluated. Variability was found in all the parameters. Based on yield and yield contributing traits, 5 genotypes viz. ICCV-181635, ICCV-181636, ICCV-181634, ICCV-181624 and ICCV-181633 were selected for observation trial in the next year.

Performance of chickpea genotypes under optimum and late sown condition

Chickpeas are exposed to terminal heat stress when the sowing is delayed. A field experiment was carried out at PRC, Ishwardi, Pabna and RARS, Jashore at optimum (23rd-26th November) and late (23rd-26th December) sowing to identify late sown potential genotypes. Based on yield and its contributing traits, the entry ICCV 12110, BCX 13005-8 and ICCV 07102 performed better in late sowing at both the locations.

Effect of rhizobium inoculant on nodulation and yield of chickpea

A field experiment conducted at PRC, BARI, Ishwardi, Pabna during the Rabi season of 2020-2021 to evaluate the biological nitrogen fixation potential of Rhizobium inoculant in chickpea. The experiment was laid out in a Randomized Complete Block Design with three replications and assigned eight treatments. The treatments were T₁=untreated control, T₂=Recommend dose of fertilizer (N₁₈P₁₈K₂₇S₁₅Zn_{0.7}B_{0.9} kg ha⁻¹), T₃= Rhizobium inoculant, T₄=T₂+T₃, T₅= T₄-25% less of RDN (Recommended dose of nitrogen), T₆= T₄-50% less of RDN, T₇= T₄-75% less of RDN, and T₈= T₄-100% less of RDN. The chickpea was sown on 14 November 2020 and harvested on 23 March 2021. The highest seed yield (2.23 t ha⁻¹) found in Rhizobium + a recommended dose of fertilizer (T₄) and the lowest seed yield (1.06 t ha⁻¹) obtained from the control (T₁). The maximum nodule number (53 plant⁻¹) was recorded from T₄, while the minimum nodule number (23 plant⁻¹) was in control. Yield increased over control was 19-52%. The highest gross margin (Tk. 70,260 ha⁻¹) and BCR (2.57) were in Rhizobium +RDF.

Growth and yield performance of BARI Chola-10 as influenced by nipping practices at different growth stages

The experiment was conducted at regional agricultural research station, Jashore field during

Rabi 2019-20 and 2020-21 to investigate the growth and yield performance of BARI Chola-10 as influenced by nipping practices at different growth stages. The experiment was conducted in split plot design. There were two factors in this experiment, viz. Factor A: Various growth phases of nipping (03), i) E1= 30 days after emergence ii) E2= 40 days after emergence iii) E3= 50 days after emergence, Factor B: Different heights of nipping practices (04): T1= Control, T2= Nipping 5 cm from growing tip, T3= Nipping 8 cm from growing tip, T4= Nipping 10 cm from growing tip. Factor A was allocated in main plots and factor B was allocated in sub plots. Seeds were sown in the field on 25 November and 26 November in 2019 and 2020, respectively. The highest combined mean in the two year experiment of additional grain yield over control (380 kg ha⁻¹) was observed in nipping at 05 cm from tip after 50 days of emergence. The highest combined mean in the two year experiment of additional vegetable yield over control (733 kg ha⁻¹) was observed in nipping at 10 cm from tip after 50 days of emergence. The highest combined mean of additional total TK over control (48183 TK) in the two year experiment was observed in nipping at 05 cm from tip after 50 days of emergence. The highest combined mean of MBCR (13.16) in the two year experiment was observed in nipping at 05 cm from tip after 50 days of emergence. Considering MBCR nipping at 05 cm from growing tip after 50 days of emergence practice can maximize the productivity of chickpea.

Incidence of chickpea pod borer, *helicoverpaarmigera* (hubner) on the promising varieties of chickpea

Incidence of chickpea pod borer, *Helicoverpaarmigera* (Hubner) on the promising varieties of chickpea in four different chickpea growing areas of Bangladesh were determined by conducting the experiment at Pulses Research Center, BARI, Ishurdi, Pabna; Godagari, Rajshahi; Regional Agricultural Research Station, Jashore and Faridpursadar, Bangladesh during rabi 2020-21. Six promising varieties of chickpea considered as treatments of the experiment which were: T₁ = BARI Chola-5, T₂ = BARI Chola-9, T₃ = BARI Chola-10, T₄ = BARI Chola-11, T₅ = BINA Sola-4 and T₆ = BINA Sola-8. The highest pod borer

infestation was found at FaridpurSadar (17.61 to 22.31%) followed by Godagari, Rajshahi (7.31 to 13.69%); RARS, Jashore (3.56 to 13.24%) and the lowest were at PRC, Ishurdi (0.38 to 3.53%) irrespective of varieties. Varietal performance in receiving pod borer infestation showed significant difference among the varieties in the locations. No specific variety showed specific resistance in receiving pod borer infestation in the locations. Considering yield among the varieties in the locations, the highest yield was found at Ishurdi (1587 to 2238 kg/ha) followed by Rajshahi (954 to 1260 kg/ha), Jashore (637 to 1477 kg/ha) and the lowest was at Faridpur (541 to 1070 kg/ha). Yield loss due to pod borer infestation were the highest at Faridpur (115 to 239 kg/ha) followed by Rajshahi (84 to 170 kg/ha), Jashore (53 to 127 kg/ha) and the lowest was at Ishurdi (6 to 82 kg/ha) irrespective of varieties.

Fieldpea

Varietal Improvement

Hybridization and advancement of filial generations in Fieldpea

Hybridization and advancement of F_1 to F_5 generations were conducted during Rabi 2020-21 at PRC, Ishurdi, Pabna. Four parents were used in crosses and a total of 60 successful cross seeds were harvested from 15 cross combinations. Ten each of F_2 and F_4 , and 10 families from F_5 were selected to advance the generation.

Observation trial of fieldpea

Eleven lines selected from last season's F_5 families were grown with check variety BARI Motor-2 and BARI Motor-3 during rabi season of 2020-21 at Pulses research center, Ishwardi, Pabna following RCB design with two replications. Based on yield performance, earliness and disease reaction, seven entries viz. BFP-15009-1, BFP-15002-2, BFP-15004-1, BFP-15004-3, BFP-15004-5, BFP-15004-6 and BFP-15004-8 were selected for next year PYT.

Participatory varietal selection of fieldpea

The experiment was conducted at the farmer's field of Pabna, Madaripur, Barisal and Jessore region

during rabi, 2020-21 to evaluate the performance of field pea genotypes/lines for searching the high yielding and disease resistant variety. Significant variation was found among the genotypes in all the traits. Considering the yield potentiality and farmer's preference the genotype BFP-11017 was selected for further evaluation to release as variety.

Effects of seeding method and seed rate on yield and yield attributes of fieldpea

A field experiment was conducted at PRSS, BARI, Gazipur during *Rabi* season 2020-21 to find out the sowing method and optimum seed rate of BARI Motor 3 for better crop growth and yield. The experiment was conducted in randomized complete block design with three replications. There were three sowing methods- line sowing at 40 cm and 50 cm, and broadcast sowing; and three seed rates i.e., 70 kg ha⁻¹, 80 kg ha⁻¹, 90 kg ha⁻¹ and 100 kg ha⁻¹. The crop sown on 19 November 2020 and harvested on 03 March 2021. It was observed that between line and broadcast sowing there was no significant difference. Among the seeding methods line sowing with 40cm gave better yield and yield attributes over other treatments. Comparing with seed rates 100 kg ha⁻¹ increased plant population and grain yield. SR @ 100 kg ha⁻¹ X Line spacing 40 cm of BARI Motor 3 gave better growth and yield.

Performance of different varieties/genotypes of pea as affected by shoot picking for vegetable and grain production

A field experiment was conducted at Pulses Research Sub-Station, Gazipur during the *Rabi* season of 2020-21 to find out the suitable adapt variety for the higher production of vegetable, grain and economic net return. The experiment was conducted in randomized complete block design with three replications. Three varieties such as BARI Motor-1, BARI Motor-2, BARI Motor-3 and two promising line (promising line-1 and promising line-2). The crop was sown on 27 November 2020 and harvested on 28 February 2021. The tallest plant was found in BARI Motor-3 while the dwarf plant was found in BARI Motor-2 and promising line-2. The highest grain yield was found from BARI Motor-3 while the lowest grain yield was found from BARI Motor-2. In case of vegetable

yield, the highest vegetable yield was obtained from BARI Motor-3. However, based on conomic analysis, BARI-Motor-3 is a suitable cultivar in establishing, increasing both grain and vegetable yield at PRSS, Gaziur.

Effects of seeding time on yield and yield component of promising pea genotype (bp001)

A field study was carried out at PRSS, BARI, Gazipur and Pulses Research Centre, BARI, at Ishwardi, Pabna during 2020-21 to find out the optimum sowing time on growth and yield for these promising pea genotypes BP001. The experiment was carried out with four different sowing time e.g. i) 15 November; ii) 25 November; iii) 05 December and iv) 15 December under Randomized Complete Block Design with three replications. The crop was harvested on 10-18 March 2021. The results revealed that the highest yield (3083 kg ha⁻¹ at Gazipur and 2598 kg ha⁻¹ at Ishwardi) was found in 15 November followed by 20 November and the lowest yield (1458 kg ha⁻¹ at Gazipur and 1046 kg ha⁻¹ at Ishwardi) was recorded in 15 December.

Selection of suitable herbicides for controlling *parthenium* weed in fieldpea

A field experiment was conducted at Pulses Research Centre, Ishwardi, Pabna during 2020-21 to find out the suitable herbicide to control *parthenium* weed in field pea. Nine treatments were viz. T₁= Panida-33EC (*Pendimethaline*), T₂=Bonmora (*2,4-D Amine*), T₃= Weednil (*Quizalofop-p-ethyle*), T₄=Bajna (*Atrazine + Mecitrone*), T₅=Activar (*Oxadizon*), T₆=Extrapower (*Bispiriback Sodium*), T₇= Jenirice (*Ethoxisulphuran*), T₈= Control (No Weeding), T₉= Hand weeding were included in this experiment. Herbicides were applied at moist condition of soil after irrigation for proper seed germination that means pre-emergence condition. The experiment was laid out in a Randomized Complete Block Design with three replications. The sowing date was on 25 November 2020 and harvested on 08 March 2021. The herbicide Bajna treated plot gave higher branches plant⁻¹, pods plant⁻¹ and consequently gave higher yield. The highest gross return, gross margin was obtained from Bajna treated plot also. Therefore, Bajna was suitable

herbicide for controlling *Parthenium* weed in field pea.

Profitability and varietal adoption of fieldpea in some selected areas of Bangladesh

The study was conducted in Pabna, Jashore and Gopalganj districts to know the varietal adoption of fieldpea and to estimate economic and financial profitability of fieldpea during 2020-2021. Adoption related data were collected from 16 districts through DAE. Results revealed that majority land under fieldpea cultivation were occupied by local variety. The yield of local variety was lower than that of BARI varieties.

Mungbean

Varietal Improvement

Hybridization and advancement of fillial generations in mungbean

Hybridization and advancement of F₁ to F₅ generations were conducted during Kharif- I, 2021 at PRC, Ishurdi, Pabna. Seven parents were used in crosses and a total of 445 successful cross seeds were harvested from eleven cross combinations. Six, twelve and nine populations, and 27 families were selected from F₁, F₃, F₄ and F₅ respectively to advance the generation.

Observation trial of mungbean

Twenty six families selected from last season's F₅ treated as lines mungbean lines were grown with check variety BARI Mung-6 and BARI Mung-8 in Kharif-I season of 2021 at Pulses research Centre, Ishwardi, Pabna followed RCB design with two replication. Among the test entries significant differences were observed for all the traits. Six entries BMXK1-16009-5, BMXK1-16010-3, BMXK1-16009-1, BMXK1-16010-1, BMXK1-16006-8 and BMXK1-16008-3 were selected for PYT in the next rabi season.

Evaluation of mungbean minicore genotypes

The investigation was undertaken to evaluate the performance of 296 mungbean mini core genotypes including BARI Mungbean-6 for yield and yield related traits in Kharif I, 2021 at RPRS, Madaripur. The result revealed that yield/plant, (53%), no. of

pods/plant (52%), MYMV scoring (30% at 45 DAS and 18% at 55 DAS), no. of seeds/plant (22%), plant height (17%) and 100-seed wt. (15%) were the most variable when referring to their CV. Considering yield/plant and disease resistance to MYMV 10 promising lines V1000170 B-BR, V1001412 AG, V1001576 BG, V1002432 AG, V1003252 BG, V1003337 BG, V1003801 BG, V1003942 AG, V1004965 BG, V1004973 B-BLM were selected

Evaluation of AVMU mungbean lines

The present investigation was undertaken to evaluate the performance of 52 AVMU mungbean lines including BARI Mungbean-6 for yield and yield related traits in Kharif II 2020 at RPRS, Madaripur. The result revealed that yield/plant, (98%), no. of pods/plant (41%), no. of seeds/plant (13%), plant height (22%) and 100-seed wt. (19%) were the most variable when referring to their CV. Considering yield/plant and disease resistance to yellow mosaic virus seven promising lines 1618, 1608, 1604, 1607, 1602, 1637, 1623 were selected from 52 AVMU mungbean genotypes.

Adaptive trial with mungbean varieties

A field trial was conducted at RARS, Rahmatpur, Barishal during Rabi season of 2020-21 to evaluate the performance of existing improved mungbean varieties. Seven selected mungbean varieties including BARI and BINA mungbean varieties viz. BARI Mung-3, BARI Mung-5, BARI Mung -6, BARI Mung-7, BARI Mung-8, BINA Mung-5, and BINA Mung-8 were evaluated in the trial. Results showed that, BINA Mung-8, BARI Mung-6 and BARI Mung-7 produced the statistically identical highest seed yield than other varieties.

Weed control in mungbean cultivation in late rabi season

A field study was conducted at the farmer's field of Rahmatpur, Babuganj, Barishal to evaluate some weed control options in mungbean cultivation in late Rabi season of 2021. The experiment was carried out with five different weed control options like- Control (W_1), One hand weeding at 20 DAE (W_2), BARI weeder at 20 DAE (W_3), W_2 + BARI weeder at 20 DAE (W_4) and Weednil @1.5ml/L water at 20 DAE (W_5) under randomized complete

block design with three replications. BARI Mung-6 was used as variety. The experiment was laid out at 25th February, 2021. Results revealed that, (one hand weeding at 20 DAE + Application of BARI Weeder at 40 DAE) significantly increased seed yield of mungbean (1543.3 kg/ha). Cost and return analysis of mungbean as affected by different weed control options were represented. The highest gross margin (TK. 68602.00 ha⁻¹) and BCR (4.43) were found in BARI weeder at 20 DAE and the lowest gross margin (TK. 29802.00 ha⁻¹) was found in control and the lowest BCR (2.31) was in One hand weeding at 20 DAE.

Foliar application of commercially available micro and macro-nutrients for the management of flower thrips and pod borers of mungbean

The effect of foliar application of micro and macro-nutrients on flower thrips and pod borers infestation in mungbean was studied at Pulses Research Centre, BARI, Ishurdi, Pabna, Bangladesh during kharif-I, 2021. Flower thrips and pod borer infestation was reduced by the application of micro and macro-nutrients in mungbean. Flower infestation reduction over control ranged from 10.00 to 13.49% and pod infestation reduction ranged from 15.69 to 37.88%. The highest percentage of flower infestation reduction (13.49%) was found in Nutra-phossprayed plots which was similar to Thiovit. The highest percentage of pod borer infestation reduction (37.88%) was found in Muriate of Potash sprayed plots followed by Nutra-phos. The yield increase over control ranged from 7.50 to 26.01%. The highest yield (1865 kg/ha) obtained from Nutra-phos sprayed plots but the highest benefit comes from Thiovit. This might be due to lower cost of Thiovit uplift the profit margin and showed the higher MBCR (3.99) than that of Nutra-phos sprayed treatment. So, it is seen that foliar application of Thiovit, Nutra-phosor McChili+ Solubor would be profitable option for managing flower thrips and pod borers of mungbean with higher yield compared to untreated ones.

Evaluation of some integrated management packages against flower thrips and pod borers of mungbean

Effectiveness of integrated management approaches using blue sticky trap, bio and synthetic

insecticides were evaluated against flower thrips and pod borers of mungbean at Pulses Research Centre, Ishurdi, Pabna, Bangladesh during kharif I 2021. All of the management packages significantly reduced flower infestation, thrips population and pod borer infestation in mungbean. The highest percentage of reduction of flower infestation and thrips population was observed in the IPM package 3: (Installing blue sticky trap + two spraying of chlorfenapyr (Intrepid 10 EC) @ 1 ml/l at 100% flowering and 100% podding stage + third spraying with Emamectin Benzoate (Proclaim 5 SG) @ 1 g/l at seed developing stage) which was at par with IPM package-2 followed by recommended practice (Farmers practice). But the highest pod borer infestation reduction was found in IPM package 2 followed by IPM package 1, recommended practice and IPM package 3. The highest yield and accordingly additional return come from IPM package 2: (Installing blue sticky trap + two spraying of Bio-Chamak (*Celastrus angulatus* 1% EW) @ 2.5 ml/l at 100% flowering and 100% podding stage + third spraying with spinosad (Success 2.5 EC) @ 1.2 ml/l at seed developing stage) followed by recommended practice (farmers practice). But the highest benefit (MBCR 3.39) comes from recommended practice. This might be due to higher cost of IPM components brought down the profit margin and showed the lower MBCR than that of recommended practice. Although IPM packages under this study are not financially profitable as recommended practice but considering environment friendliness, the IPM package 2: (Installing blue sticky trap + two spraying of Bio-Chamak (*Celastrus angulatus* 1% EW) @ 2.5 ml/l at 100% flowering and 100% podding stage + third spraying with spinosad (Success 2.5 EC) @ 1.2 ml/l at seed developing stage) would be the best package for controlling flower thrips and pod borers of mungbean with higher yield in the insects prone cropping areas without harming the ecosystem.

Financial profitability and constraints to the production, processing & marketing of mungbean seed in some selected areas of Bangladesh

An Assessment of financial profitability and constraints to the production, processing and

marketing of mungbean seed in two southern districts namely Jhalokathi and Barisal were made through an extensive field survey during 2020-2021. The study revealed that the farmers of these areas used very low doses of fertilizers in almost all the areas. Total production cost for mungbean seed was estimated at Tk.59846/ha in which 62 and 38 percent were total variable cost and total fixed cost. Average per hectare yield of mungbean seed were 1115 kg/ha. Gross return of mungbean seed was estimated at Tk. 71384/ha. Gross margin and net return was found to be Tk. 34192/ha and Tk. 11538/ha, respectively. Benefit cost ratio (BCR) was 1.19 in all study areas. TSP, MoP and human labour were found to be significant impact on yield of mungbean seed. Maximum farmers (94%) responded that labour crisis was the major constraints along with insects infestation, insecticides not work properly, lack of training, high price of insecticides, lack of good seed, disease infestation.

Pigeon pea

Screening of pigeon pea genotypes for higher yield

The study was conducted at Pulses Research Centre, BARI, Ishwardi, Pabna during Rabi season of 2020-2021 to find out the suitable genotypes of pigeon pea for higher yield. Thirty five pigeon pea germplasm were studied. The experiment was laid out in Randomized Complete Block Design with three dispersed replications. Results revealed that among the genotypes, Naogaon local showed minimum duration to maturity (278 days), 8 accessions provided maximum duration to maturity (more than 300 days) and rest of gave moderate days to maturity (285–299 days). The seeds were sown on 30 April, 2020. Yield plant⁻¹ ranged from 95 g to 720 g, where Naogaon local gave the highest yield (720 g), BD-3113, BD-3121, BD-3124, BD-3131, BD-3134, BD-3135, BD-3136, BD-3140, BD-3141, BD-3143, Joypurhat local-1, Joypurhat local-3 gave the medium yield (more than 300 g plant⁻¹). So, these accessions may be used in pigeon pea variety improvement program.

Cowpea

Adaptation of cowpea genotypes for southern region

An experiment was implemented at RARS, Rahmatpur, Barishal, RPRS, Madaripur and OFRD (farmers field) at Noakhali during Rabi season of 2020-21 to evaluate the performance of eight selected cowpea germplasms with one check variety (CPL-1-17, CPL-2-17, CPL-3-17, CPL-4-17, CPL-5-17, CPL-6-17, CPL-7-17, CPL-8-17 including one check variety BARI Felon 1) in southern agro-climatic conditions. Results showed that of the characters under this study were statistically insignificant among the genotypes. Among the location Madaripur gave highest yield irrespective of genotype. Genotypes CPL-7-17, CPL-8-17 gave highest yield comparing other genotypes including check and also locations.

Evaluation of IITA cowpea genotypes

An evaluation of cowpea genotypes was implemented at RARS, Rahmatpur, Barishal, RPRS Madaripur and RARS Hathazari during Rabi season of 2020-21 to evaluate thirty one cowpea genotypes including one check variety in southern agro-climatic conditions. Results showed that all the characters under this study were significantly different among the genotypes except days to maturity, plant height and number of branches/plant. Among the genotypes highest yield per plant was found in G6 and was followed by G12, G29, G13 and G14. Based on the studied trait fifteen genotypes were selected for next year evaluation.

Screening of cowpea germplasm for salinity

Cowpea is an important legumes in southern part of Bangladesh. A study was conducted at glass house during Rabi season of 2020-21 to evaluate the exotic cowpea germplasm for salinity tolerance. A total of forty six were evaluated in the trial. Based on SPAD value and Na^+/K^+ ratio E-32, E-59, E-97 and E-92 were found promising.

Effect of different mulch materials on soil salinity and yield of cowpea

This trial was carried out at the farmer's field of Kuakata, Kalapara, Patuakhali during late

Rabiseason of 2020-21. In the saline area, soil moisture is rapidly lost during the late Rabi season which is a critical problem for producing winter crops. So this program was conducted to find out an effective ways to retain moisture in the soil by the use of mulching materials in winter cowpea production. Surface mulch has significant effect in reducing evaporation and decreasing soil salinity level. The aim of the study was to compare the effect of different mulch materials on cowpea seed yield. Different mulch materials such as no mulch, straw mulch, rice husk mulch and polythene mulch were tested under randomized complete block design with three replications. BARI Felon-1 was used as the variety. Mature pods of polythene mulch treated plots harvested from 10 March to 25 March 2021 and other treated plots from 15 March to 3 April 2021. Results revealed that, polythene mulch (1680 kg ha^{-1}) significantly increased the highest seed yield of cowpea whereas the lowest seed yield (1480 kg ha^{-1}) was obtained from rice husk mulch from no mulch. The highest BCR (1.48) was found from straw mulch treatment and the lowest (1.18) in rice husk mulch

Performance of different legumes as forage in southern region of Bangladesh

A field study was carried out at the farmer's field of Babuganj, Barishal to evaluate some pulses variety as forage in Rabiseason of 2020-21. The experiment was carried out with three varieties of two pulses e.g. BARI Khesari-2, BARI Khesari-3 and BARI Motor-3 under randomized complete block design with three replications. Different pulse crop's seeds were sown on 17 November, 2020 as relay in the existing Transplanted *Aman* rice field just drained out of water from the field before 15 days of rice harvest. Results revealed that, all the yield and yield contributing characters were statistically significant except green forage yield. Considering green forage yield, numerically BARI Motor-3 produced the highest green forage (22.67 t ha^{-1}) and the lowest (15.53 t ha^{-1}) was in BARI Khesari-3 which very similar to BARI Khasari-2. But BARI Khesari-2 produced the highest dry forage yield (5.87 t ha^{-1}) and the lowest (2.80 t ha^{-1}) in BARI Motor-3. The highest gross margin (TK.138690.00 ha^{-1}) and BCR (7.93) were found in BARI Motor-3 and the lowest gross margin (TK.

99240 .00 ha⁻¹) and BCR (4.97) were in BARI Khesari-3.

Effects of pulse-based cropping pattern on crop performance and soil health

A field experiment was initiated at Pulses Research Centre, BARI, Ishwardi, Pabna during 2020-21 to evaluate the crop performance and soil health through developing the pulse-based cropping pattern. The experiment was carried out with six different cropping patterns e.g i) CP₁ = Lentil–Mungbean – *T.Aman*, ii) CP₂ = Lentil– Boro rice – *T.Aman*, iii) CP₃ = Chickpea –Mungbean–*T.Aman*,iv) CP₄=Fieldpea–*Boro* rice–Blackgram, v) CP₅ = Grasspea – Mungbean –*T.Aman*, vi) CP₆ = Lentil– Mungbean – Blackgram (Native Soil). This was laid out in Randomized Complete Block Design with three dispersed replications. The crops were sown 20 November 2020 and harvested on 13-31 March 2021. BARI Masur-8 (CP₁) gave the highest seed yield (2713 kg ha⁻¹) and the lowest (1026 kg ha⁻¹) in BARI Chola-10 (CP₃). It also gave highest gross return, gross margin and BCR.

Regional Agricultural Research Centre, Ishwardi, Pabna

Horticulture Division

Evaluation of hyacinth bean lines

The experiment was conducted at Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2020-21. Nine hyacinth bean lines viz., DL Isd-001, DL Isd-003, DL Isd-004, DL Isd-007, DL Isd-008, DL Isd-010, DL Isd-014, DL Isd-017 and DL Isd-018 were included in the study. The experiment was laid out in RCB design with three replications. Three plants were planted in each plot. Seeds were sown on 10 September 2020 and transplanted in the main plot on 10 October 2020. The land was fertilized with cow dung, Urea, TSP, MOP and gypsum @ 10000, 60, 200, 150 and 111 kg/ha, respectively. Total amount of cowdung, TSP and gypsum were applied in pit one week before transplanting. Urea and MOP were applied as top dressing at 30 days after transplanting. The plants were allowed to grow on trellis. Irrigation, weeding, pest control and other intercultural operations were done as and when

necessary. Data were recorded from each plant and analyzed statistically with R software. A wide variation was found in days to flowering. The earliest flowering (77 days) was observed in DL Isd-014 followed DL Isd-018 and DL Isd-014 (78 days) by and the delayed flowering (94 days) in DL Isd 017. But the early harvesting was done in DL Isd-018 (108 days). Number of fruits per plant ranged from 73 to 292 and the maximum (292) number of fruits per plant was harvested from DL Isd-018 whereas, minimum (73) was in DL Isd-014. However, the longest fruit (14.10 cm) was recorded from DL Isd-014 followed by DL Isd-007 and DL Isd-008 whereas, the shortest fruit (8.23 cm) was from DL Isd-010. On the other hand, the widest fruit (3.50 cm) was recorded from DL Isd-007 and the narrowest fruit (1.83 cm) was from DL Isd-010. The highest average single fruit weight (13.75 g) was recorded from DL Isd-008 and the lowest (9.83 g) was in DL Isd-010. Weight of fruits per plant and yield varied among the lines. The highest fruit weight per plant (2.93 kg) as well as yield (29.33 t/ha) was obtained from DL Isd-018 and lowest fruit weight (0.86 kg) and yield (8.57 t/ha) was obtained from DL Isd-014. In regarding fruit fly infestation, the minimum infestation (4.13%) was observed in DL Isd-018 and maximum (20.86%) was in DL Isd-014. Considering yield, shape & size, appearance and borer fruit fly infestation, the line DL Isd-18, DL Isd-07, DL Isd-004, Isd-001 and Isd-017 were found promising. These lines may be selected for preliminary yield trial.

Regional yield trial of eggplant lines (green)

Nine advanced eggplant lines viz., SM Isd-023, SM Isd-038, SM 220, SM 232, SM-234, SM 253B, SM-262 and SM-275 with BARI Begun-6 were investigated at Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2020-21 to find out the suitable line yield performance and insect pest tolerant to release as a variety. The experiment was conducted in RCB design with three replications. Seeds were sown in the seedbed on 20 September 2020 and seedlings were planted in the field on 8 November 2020. Unit plot size was 7.0 m x 0.7 m maintaining row to row 70 cm and plant to plant spacing 70 cm. The land was fertilized with cow dung, urea, TSP, MOP and

gypsum @ 10000, 375, 150, 250 and 120 kg/ha, respectively. Days to 50% flowering was the earliest (90 days) in SM 253B and delayed (100 days) in BARI Begun-6. Similarly, early harvesting (121 days) was done in SM 253B and delay harvesting (44 days) in BARI Begun-6. The number of fruits per plant (22) was recorded maximum in SM Isd-038 which was statistically similar to SM 220 (21) and minimum (10) in BARI Begun-6. The longest fruit (16.52 cm) was harvested from SM 275 and the shortest fruit (9.36 cm) from SM 262. On the other hand, the widest fruit (9.31 cm) was obtained from SM Isd-023 followed by BARI Begun-6 (9.30 cm). The highest

average fruit weight (257 g) was obtained from SM 275 and the lowest (150 g) was in SM 262. The highest fruit weight per plant (3.30 kg) as well as marketable yield (67.35 t/ha) was recorded from SM Isd-038 and the lowest fruit weight per plant (1.65 kg) and marketable yield (33.57 t/ha) was obtained from SM 232. The fruit infestation caused by BSFB was maximum (18.55%) in SM232 while the lowest (9.91%) was in SM 220. Virus infection was ranged 0-15%. Considering yield performance, pest reaction, fruit shape and colour SM Isd-038 was found promising. This line may be selected for varietal development.

Breeder seed production of vegetable

Sl. No.	Crop	Variety	Quantity (kg/no.)	Remarks
1	Spinach	BARI Puishak-2	13.00	Kharif, 2020
2	Kangkong	BARI Gimakolmi-1	11.50	
3	Stem amaranth	BARI Danta-1	3.50	
4	Tomato	BARI Tomato-14	0.90	Rabi, 2020-21
		BARI Tomato-19	1.10	
		BARI Tomato-20	0.30	
5	Eggplant	BARI Begun-1	2.40	
		BARI Begun-6	2.90	
6	Red amaranth	BARI Lalshak-1	49.00	
7	Garden pea	BARI Motorshuti-1	100.00	
		BARI Motorshuti-3	380.00	
8	Spinach	BARI Palongshak-1	22.00	
9	Hyacinth bean	BARI Sheem-5	0.50	
		BARI Sheem-6	3.50	
Total seed (kg)			590.6	
13	Pointed gourd (Cuttings)	BARI Hybrid Patol-1	1900	
		BARI Patol-1	500	
		BARI Patol-2	500	
		Male plant	100	
Total cutting (no.)			3000	

Seedling production of different vegetable crops

Sl. No.	Crop	Variety	Number	Remarks
1	Tomato	BARI Tomato-14	2000	
		BARI Tomato-15	500	
		BARI Tomato-19	1000	
		BARI Tomato-20	1000	
2	Eggplant	BARI Begun-1	300	
		BARI Begun-4	200	
		BARI Begun-6	500	
		BARI Begun-10	400	
3	Bottle gourd	BARI Lau-3	100	
		BARI Lau-4	50	
4	Cauliflower	BARI Fulcopi-1	1000	
5	Hyacinth bean	BARI Sheem-4	100	
		BARI Sheem-6	100	
6	Capsicum	BARI Mistimorich-2	200	
Total			6450	

Sapling/seedling production of different fruit crops

Sl. no.	Variety	Quantity (No.)
1	BARI Aam-3	200
2	BARI Aam-4	700
3	BARI Aam-11	130
4	BARI Batabilebu-4	200
5	BARI Batabilebu- 6	300
6	BARI Malta-1	50
Total		1580

Breeder seed production of onion

Sl. No.	Crop	Variety	Quantity
1	Onion	BARI Paiz-6 (seed)	43.00 kg
		BARI Paiz-6 (bulb)	900.00 kg
		BARI Paiz-4 (bulb)	700.00 kg
		BARI Paiz-5 (bulb)	130.00 kg
		BARI Paiz-5 (seed)	120 g

Training/ Workshop/Field day

Sl. No.	Date	Topics	Batch	No. of participants
1	23.6.2021	Farmers training on “Improved production technology of litchi”	1	40
2	24.6.2021	Farmers training on “Improved production technology of summer vegetable”	1	40
3	22.6.2021	Workshop on “Introduction to promising Horticultural technologies of BARI: Varieties and agro-technologies”	1	100
4	5.3.2021	Field day on ‘Improved production technology of breeder seed production on vegetable crops’	1	100
4	4.11.2020	Field day on ‘breeder seed production on onion’	1	140

Agronomy Division**Weed management using herbicides under zero tillage mulched condition in garlic field**

The experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during 2020-2021 to find out the suitable herbicide for controlling weed in garlic under zero tillage mulched condition. Nine treatments were included viz; T₁ = Commit (Pretilachlor), T₂ = 2,4-D Amine (2, 4-D), T₃ = Weednil (Quizalofop-p-ethyl), T₄ = Sunrise (Ethoxysulfura), T₅ = Whip Super (Fenoxaprop-p-ethyl), T₆ = Ronstar (Oxadiazol), T₇ = Panida (Pendimethalin), T₈ = Hand weeding at 25, 45 and 65 DAT, T₉ = Control. The experiment was laid out in a Randomized Complete Block design with three replications. The crop (clove) was planted by dibbling on the muddy soil just 2 to 3 days after harvesting T-aman rice on 09 November 2020 maintaining 15 cm × 10 cm plant spacing, and harvested on 30 March 2021, respectively. Fertilizer was applied @ 155-35-125-30-2-1kg ha⁻¹ of N-P-K-S-Zn-B, respectively. One third nitrogen was applied as basal and two third was top dressed in two equal installments at 25 and 50 days after emergence. Other fertilizers were applied on the muddy soil as basal before planting and covering the soil surface by rice straw. Weeding was done as per treatments. Herbicides were applied at pre-planting condition (24 hr before planting). The results showed that the lowest weed dry weight at

80 DAT (45 g m⁻²) was recorded in T₇ which was identical to T₇, and the highest weed dry weight (525 g m⁻²) was obtained from control. Panida produced significantly higher bulb yield (9.80 tha⁻¹) followed by Hand weeding and Ronstar (9.65 t/ha and 9.29 tha⁻¹, respectively) and the lowest in Control (4.21 t ha⁻¹). The highest gross return (Tk. 588000 ha⁻¹), gross margin (Tk. 389550 ha⁻¹) and BCR (2.96) were obtained from Panida followed by Ronstar. Therefore, on the bases weed control efficiency and economic return Panida was suitable herbicide for controlling weed in garlic under zero tillage mulched condition.

Optimization of doses and time of application of pendimethalin on weed control of onion

A field experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during 2020-2021 to find out the appropriate dose, and time of spray of Panida for weed control of onion. Four doses of Panida herbicide viz; D₁) 3 ml L⁻¹ of water, D₂) 5 ml L⁻¹ of water, D₃) 7 ml L⁻¹ of water, D₄) Control, and four spraying time namely, ST₁) Spraying just after planting and irrigation, ST₂) Spraying 3 days after planting and irrigation, ST₃) Spraying at 5 days after planting and irrigation, ST₄) Spraying at 7 days after planting and irrigation were included in the experiment. Herbicides were applied as per treatments. The experiment was laid out in a split plot design with three replications. The crop was fertilized with 110-

52-75-20 kg ha⁻¹ of N-P-K-S, and 5 t ha⁻¹ cowdung (Krishi Projukti Hatboi-2019). Half of N and full amount of all fertilizers were applied as basal. Rest half of fertilizers were top dressed at 30 DAP. Onion was sown on 05 January 2021 and harvested on 30 March 2021. Dose and spraying time of Panida had significant effect of bulb yield. The treatment combination of 7 ml L⁻¹ of water with spraying just after planting and irrigation (D₃ST₁) produced the highest bulb yield (13.99 t ha⁻¹) and the lowest bulb yield (9.69 t ha⁻¹) was obtained from D₄ST₄. On the basis of economic point of view D₃ST₁ combination could be applied for controlling weed in onion field.

Characterization of pigeon pea germplasm

The study was conducted at Regional Agricultural Research Station, Ishwardi, Pabna during rabi season of 2020-2021 to find out the suitable genotypes of pigeon pea for higher yield and productivity. The experiment involved thirty one pigeon pea germplasm viz., BD-3111, BD-3112, BD-3113, BD-3114, BD-3115, BD-3116, BD-3117, BD-3118, BD-3120, BD-3121, BD-3122, BD-3124, BD-3125, BD-3126, BD-3127, BD-3129, BD-3130, BD-3130, BD-3131, BD-3133, BD-3134, BD-3135, BD-3136, BD-3137, BD-3138, BD-3139, BD-3140, BD-3141, BD-3142, BD-3143, BD-3144 and Naogaon local were evaluated. The experiment was laid out in Randomized Complete Block design with three dispersed replications. Seeds were sown in rows with spacing 1 m. Fertilizers @18-24-30-18-2.0-1 kg ha⁻¹ N-P-K-S-Zn and B were applied during final land preparation. The seeds were sown on 15 April 2020. The crop was harvested during the period of 17 November 2020 to 14 January 2021. The genotype Naogaon Local and BD-3117 gave higher seed yield of 426 g plant⁻¹ and 254 g plant⁻¹, respectively. These accessions may be used in pigeon pea improvement program.

Plant Pathology Division

Survey of aloe vera plant diseases

A comprehensive survey was conducted in seven villages of sadar upazilla in Natore district to identify the incidence and severity of different diseases of Aloe vera and to know the existing

management practices during Rabi season 2020-2021. Eighteen farmers were interviewed with a pre-designed structured questionnaire during this survey period. Three major diseases of Aloe vera were observed in the surveyed areas and were reported by the Aloe vera producing farmers as a major limiting factor of Aloe vera cultivation. From the survey it was found that leaf spot, leaf blight and wilt diseases of Aloe vera are predominant. Plant samples (leaf and root) were collected and observed in the plant pathology laboratory for identification of the diseases and pathogens following standard method. The isolated fungi were identified based on morphological characteristics observed under a compound microscope. *Alternaria spp* and *Fusarium proliferatum* were isolated from the infected leaves of Aloe vera which caused leaf spot and leaf blight diseases. On the other hand *Fusarium spp* was isolated from infected roots which caused wilt disease of Aloe vera.

Management of alternaria leaf spot and flower blight disease of marigold

A field experiment was conducted at Regional Agricultural Research Station Ishurdi, Pabna during Rabi season of 2020-2021 to find out the effective fungicides against *Alternaria* leaf spot and flower blight of marigold. Local cultivar of marigold was used in the study. Eight different fungicides viz. T₁= Tilt 250 EC @ 0.05%, T₂= Autostin 50 WDG @ 0.2%, T₃= Rovral 50 WP @ 0.2%, T₄= Contaf 5EC @ 0.1%, T₅= Companion @ 0.2%, T₆= Score 250 EC @ 0.2%, T₇= Indofil M 45 @ 0.2%, T₈= Secure 600wg @ 0.2% and one unsprayed Control were used in this experiment. Among the treatments the lowest severity of leaf spot (2.67%) and flower blight (11.67%) were found in score 250 EC followed by rovrail 50 WP. The highest severity of leaf spot (18.33%) and flower blight (38.33%) were found in control plots. In case of total fresh flower/ha the highest (1353840) was recorded from Rovral 50 WP treated plots followed by Score 250 EC (1105453) treated plots whereas, the lowest (281068) was recorded in control plots. The lowest infected flower (26.16%) was recorded in Score 250 EC treated plots, while the highest (83.52%) was found in control plots.

Effect of glyphosate and ammonium sulfate (nh₄)₂so₄ for controlling orobanche of mustard

The trial was conducted at Regional Agricultural Research Station Ishurdi, Pabna during Rabi season of 2020-21 to find out one / more effective management practices against *Orobanche* of mustard. Seven treatments viz. T₁= Glyphosate @ 60 ml and 120 ml/ha at 30 DAS and 55 DAS, T₂=1% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS, T₃= 125% of recommended fertilizer (N & P) + Glyphosate@60ml and 120 ml/ha with 0.25% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS, T₄= 125% of recommended fertilizer (N & P) + Glyphosate@60ml and 120 ml/ha with 0.50% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS, T₅= 125% of recommended fertilizer (N & P) + Glyphosate@60ml and 120 ml/ha with 0.75% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS, T₆= 125% of recommended fertilizer (N & P) + Glyphosate@60ml and 120 ml/ha with 1% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS and T₇= Control were tested for their performance against the disease. All the treatments gave satisfactory reduction of orobanche and increased plant growth as well as yield of mustard. The number of orobanche/m² ranged from 3.44 – 34.06. The lowest (3.44/m²) was found in treatment T₆ while the highest (34.06/m²) was recorded in control plots. The highest reduction of number of *Orobanche* over control (89.90%) was found in T₆ and the lowest (33.62%) was in treatment T₂. The highest yield (1264 kg/ha) was recorded from treatment T₆, while the lowest (823 kg/ha) was found in control plots.

Stemphylium blight disease and yield of lentil as influenced by date of sowing, fungicide spray and variety

The experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during rabi season 2020-21 to find out the effect of date of sowing and fungicide (Folicure) spray on 9 BARI released variety viz. BARI Masur-1, BARI Masur-2, BARI Masur-3, BARI Masur-4, BARI Masur-5, BARI Masur-6, BARI Masur-7, BARI Masur-8 and BARI Masur-9. There were 4 date of sowing viz. 10 Nov. 20 Nov. 30 Nov. 10 Dec. In sprayed condition all the variety yielded higher than unsprayed condition. As the date of sowing

was delayed yield of BARI Masur-9 increased. But in case of other varieties yield was decreased as the sowing date was delayed in sprayed and unsprayed condition. BARI Masur-8 yielded the highest in all treatment combination, while the yield of BARI Masur-9 was lowest than all other varieties in all combinations.

Yield loss assessment of lentil varieties due to stemphylium blight disease

The experiment was conducted at RARS, Ishurdi, Pabna during Rabi season of 2020-21 to measure and quantify the loss of yield in lentil varieties due to *Stemphylium* blight disease. Two spray conditions viz. spray with Rovral (Iprodione) @ 0.2% and no spray as well as nine BARI released variety viz. BARI Masur-1, BARI Masur-2, BARI Masur-3, BARI Masur-4, BARI Masur-5, BARI Masur-6, BARI Masur-7, BARI Masur-8 and BARI Masur-9 were used in this experiment. Yield loss ranged from 5.30% - 13.50%, while the highest loss was found in Masur-7 and the lowest was in BARI Masur-9 compared to sprayed plots. The highest yield (2823 kg/ha) was found in sprayed plots of BARI Masur-8 while the lower (1191 kg/ha) was recorded in non sprayed plots of BARI Masur-9.

Germplasm evaluation against leaf curl virus of chili

The experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during rabi season 2020-21 to find out resistant chili lines against leaf curl virus disease. A total of 46 entries were screened against leaf curl virus under natural field condition. All the lines were found highly susceptible against the disease.

Evaluation of new fungicides against early blight of tomato

The experiment was conducted at RARS, Ishurdi, Pabna during rabi season 2020-21 to find out effective fungicides against early blight of tomato. Twelve new fungicides and control were used in this experiment. The disease reduction over control ranged from 8.69 to 34.78%. The highest disease reduction over control was recorded in fungicide 454 @ 2 g/l with 34.78% and the lowest were recorded in fungicide 369 @ 1.50 g/l with 8.69%.

Evaluation of new fungicides in controlling powdery mildew of pumpkin

The experiment was conducted at RARS, Ishurdi, Pabna during rabi season 2020-21 to find out effective fungicides against powdery mildew of pumpkin. The experiment was carried out following Randomized Complete Block Design with three replications. The test variety was BARI Mistikumra-2. Seedlings were established in seedbed and transplanted in the main field on November 16, 2020. The unit plot size was 2m x 2m and spacing was 1m x 1m. Twelve new fungicides and control were tested for their performance against the disease. But no disease was observed in this experiment. So the experiment may be repeated in the next year.

Oilseed Research Centre

Regional yield trial of *brassica napus*

Twelve genotypes of *Brassica napus* namely Nap-15027, Nap-15029, Nap-15037, Nap-16006, Nap-16009, Nap-16013, Nap-18005, Nap-18025, Nap-18033, Nap-19080 including two check varieties BARI Sarisha-8 and BINA Sarisha-9 were tested for adaptability and oil quality at RARS Ishurdi, Pabna during rabi season 2020-2021. The genotype Nap-15029 showed the highest seed yield 1228 (kg/ha) among the tested entries and it was 18.53 % higher than the cheek variety BINA Sarisha-9 (1036 kg/ha) and 21.70% higher than the check variety BARI sarisha-8 (1009 kg/ha) followed by genotype Nap-16006 (1096 kg/ha).

Regional yield trial of double low genotypes of *brassica napus*

Seven genotypes of *Brassica napus* namely NAP-14-001, NAP-14-004, NAP-14-007, NAP-14-010, NAP-14-011 including two check varieties namely BARI Sarisha-13 and BARI Sarisha-14 were evaluated to find out short duration high yielding double low genotypes at RARS Ishurdi, Pabna during rabi season 2020-2021. The highest seed yield (1384 kg/ha) was recorded in check variety BARI sarisha-13 followed by the genotype Nap-14-007(1376 kg/ha) and Nap-14-004 (1329 kg/ha). The genotype Nap-14-007 gave 20.38 % and Nap-14-004 gave 16.27% higher yield than the check variety BARI Sarisha-14 (1143 kg/ha).

Preliminary yield trial of *brassica juncea*

Twelve genotypes namely BJ10-10104(Y), BJ10-1010411(Y), BJ12014(Y)-01, BJ2014(Y)-02, BJ2014(Y)-03, BJ2014(Y)-05, BJ-11536(7)-2, BJ-11536(9)-2, BJ1-11536(9)-6, BJ-11536(11)-1 and BJ-11536(12)-3 including check variety BARI Sharisha-11 were evaluated for good agronomic trait and higher yield at RARS, Ishurdi, Pabna during rabi season 2020-21. The genotype BJ-2014-Y03 gave the highest seed yield (2597 kg/ha) among the tested entries and it was 23.20% higher than the cheek variety BARI Sarisha-11 (2108 kg/ha) followed by BJ-11536- (9)-2 (2481 kg/ha) and BJ-11536- (12)-3 (2438 kg/ha) which gave 17.70% and 15.65% higher than the cheek variety BARI Sarisha-11 respectively.

Regional yield trial of *brassica juncea*

Nine genotypes BJ-11536 (12)-1, BJ-11536 (12)-5, BJ-11536 (12)-6, BJ-1110(12)-1, BJ-53611(12)-8, BJ-1111(7)-7, BJDH-05 and BJDH-20 including one check variety BARI Sharisha-11 at RARS, Ishurdi, Pabna during rabi season 2020-21 to find out the early maturing high yielding genotype. The highest seed yield (2396 kg/ha) was recorded in the genotype BJ-53611-(12)-8 among the tested entries and it was 26.11% higher than the cheek variety BARI Sarisha-11 (1900 kg/ha) followed by BJ-1111- (7)-7 (2237 kg/ha) and BJ-11536 (12)-6 (2183 kg/ha) which gave 17.73% and 14.89% higher than the cheek variety BARI Sarisha-11 respectively and the lowest yield (1665 kg/ha) was found in BJDH-05.

Preliminary yield trial of *brassica rapa* (set-1)

Twenty genotypes of *Brassica rapa* viz. BC-100614(4)-10, BC-100614(8)-1, BC-100614(8)-2, BC-100614(8)-3, BC-100614(8)-7, BC-100614(4)-2, BC-100614(4)-4, BC-100614(4)-5, BC-100614(4)-6, BC-100614(4)-8, BC-100614(4)-11, BC-100614(4)-18, BC-100614(4)-19, BC-100614(4)-20, BC-100614(7)-3, BC-110714(7)-4, BC-110714(7)-7, BC-110714(7)-8, BC-110714(9)-5 including check varieties BARI Sharisha-14 were tested at RARS, Ishurdi, Pabna during rabi season 2020-21 to select short duration high yielding genotypes with better agronomic traits and wider adaptability to fit in between T. aman and Boro rice cropping pattern. The highest seed yield (1632

kg/ha) was recorded in the genotype BC-100614(4)-11 among the tested entries and it was 45.58% higher than the cheek variety BARI Sarisha-14 (1121 kg/ha) followed by BC-100614(8)-2 (1626 kg/ha), BC-100614(8)-3 (1619 kg/ha) and BC-100614(4)-4 (1600 kg/ha) which gave 45.05% , 44.42% and 42.72% higher than the cheek variety BARI Sarisha-14 respectively and the lowest (1053 kg/ha) was found in BC-100614(4)-20.

Regional yield trial of *brassica rapa* (set-1)

Nine promising genotypes of *Brassica rapa* viz. BC-100614 (1)-6, BC-100614 (3)-1, BC-100614 (8)-4, BC-100614 (4)-7, BC-120114, BC-110714 (7)-2, BS-15YF-01 and BC -20-GS-1 including check variety BARI Sharisha-14 were tested at RARS, Ishurdi, Pabna during rabi season 2020-21 to select short duration high yielding genotypes with better agronomic traits and wider adaptability to fit in between T. aman and Boro rice cropping pattern. Among the tested genotypes the genotype BC-120114 showed the highest seed yield (1993 kg/ha) and it was 53.07 % higher than the cheek variety BARI Sarisha-14 (1302 kg/ha) followed by BC-110714 (7)-2 (1944 kg/ha) and BC -20-GS-1(1909 kg/ha) which gave 49.31% and 46.62 % higher than the cheek variety BARI Sarisha-14 respectively.

Regional yield trial of *brassica rapa* (set-2)

Ten promising genotypes of *Brassica rapa* viz. namely OTBC-18315 (Y), OTBC-18322 (Y), OTBC-19024 (Y), OTBC-15015 (Y), OTBC-15020 (Y), OTBC-15022 (Y), OTBC-17032 (Y), OTBC-17033 (Y) including two check variety BARI Sharisha-14 and Tori-7 were tested at RARS, Ishurdi, Pabna during rabi season 2020-21 to select short duration high yielding genotypes with better agronomic traits and wider adaptability to fit in between T. aman and Boro rice cropping pattern. Among the tested entries the genotype OTBC-17032 (Y) showed the highest seed yield (1959 kg/ha) and it was 33.17 % higher than the cheek variety BARI Sarisha-14 (1471 kg/ha) and 39.23 % higher than the check variety Tori-7 (1407 kg/ha). The second highest yield was obtained from the genotype OTBC-19024 (Y) (1711 kg/ha) followed by OTBC-17033 (Y) (1687 kg/ha) and OTBC-

15015 (Y) (1661 kg/ha), while the lowest seed yield was recorded from the genotype OTBC-15022 (Y) (1290 kg/ha).

Preliminary yield trial of sesame

Twelve genotypes of sesame viz. SES-115, SES-22, SES-0570, SES-65, SES-79, SES-JP-25, SES-5, SES-JP-24, SES-78, SES-52 and SES-70 including check variety BARI Til-4 were tested at RARS, Ishurdi, Pabna during kharif season 2020-21 to find out the high yielding and widely adaptive lines. Among the tested entries days to flowering ranged from 50 to 53. Number of branches per plant ranged from 3.47 to 7.20. Maximum 1000-seed weight (3.19 g) was recorded from the genotype SES-70 and the lowest (2.53 g) was found in the genotype SES-52. The highest seed yield (1150 kg/ha) was recorded in check variety BARI Til-4 followed by the genotype SES-65 (1138 kg/ha) and lowest yield (823 kg/ha) was found in the genotype SES-5.

Regional yield trial of sesame (set-1)

Eight genotypes of sesame viz. SES-31, SES-14, SES-79, SES-65, SES-05115, SES-05178 and SES-0570 including check variety BARI Til-4 were tested at RARS, Ishurdi, Pabna during kharif season 2020-21 to find out lines with desired agronomic characters and wider adaptability. Among the tested entries days to flowering ranged from 49 to 55. Days to Maturity ranged from 78 to 85. Plant height ranged from 114.60 to 128.87 cm. The highest seed yield (1203 kg/ha) was recorded in the genotype SES-31 among the tested entries and it was 26.10% higher than the cheek variety BARI Til-4. Second highest yield (1101 kg/ha) was found in the genotype SES-14 followed by the genotype SES-79 (1082 kg/ha) which gave 15.41% and 13.41 % higher than the cheek variety BARI Til-4 respectively and the lowest (745 kg/ha) was found in the genotype SES-05115.

Regional yield trial of sesame (set-2)

Nine genotypes of sesame viz. SES-JP-25 (Y), SES-05163, SES-2065, SES-JP-69 (Y), SES-JP-47 (Y), SES-02010-OIR, SES-58 (Y) including two variety BINA Til-1 and BARI Til-4 were tested at RARS, Ishurdi, Pabna during kharif season 2020-21 to find out lines with desired agronomic

characters and wider adaptability having white seed coat colour. Among the tested entries days to flowering ranged from 43 to 51. Number of pods per plant ranged from 31.93 to 48.73. The highest number of seeds per pod (110.53) was recorded in the genotype SES-JP-69 (Y) followed by, the genotype SES-58 (Y) (109.87) while the lowest (54.53) was found in check variety BARI Til-4. The highest seed yield (1361 kg/ha) was recorded in the genotype SES-02010-OIR among the tested entries and it was 17.23% higher than the check variety BARI Til-4 (1161 kg/ha) and 58.62% higher than the check variety BINA Til-1 (858 kg/ha). Second highest yield (1210 kg/ha) was found in the genotype SES-JP-47 (Y) which gave 4.22% higher than the check variety BARI Til-4 and 41.03% higher than the check variety BINA Til-1 and the lowest (643 kg/ha) was found in the genotype SES-05163.

Morphological characterization of grasspea germplasm

The study was conducted at Regional Plant Genetic Resources Center, Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2020-2021 to identify the important traits of grasspea accessions. The experiment involved 301 grasspea accessions. Variations were observed in respect of days to first flowering, days to 50% flowering, days to maturity, plant height, number of seeds per pod, 100-seed weight and yield per plant among grasspea accessions. The first flowering initiation was observed earlier in BD-3316, BD-3390 and BD-3436 (51 days) and day to 50% flowering was earlier in BD-3454 (63 days) grasspea accession. The earlier maturity was found in BD-3375, BD-3376, BD-3435, BD-3436 and BD-3437 (124 days) than the other accessions. Variations among grasspea accessions were observed in different qualitative characteristics like pigmentation found in stems, leaves and flowers. Stem colour was showed light green for 7.97%, green for 62.13%, purple-green for 20.93%. Plant growth habit found erect for 17.61%, semi-erect for 35.55%, spreading for 67.77% and prostrate for 14.62%. Three types of number of leaflets per leaf was found one pair for 5.98%, two pair for 89.04% and more than two pair for 4.98%. Different flower colour were observed white blue for 1.99%, blue

for 90.03%, pink for 0.33%, violet blue for 6.98% and violet flower colour for 0.33%. Seed shape was observed rhomboid for 82.39%, square for 4.98%, triangular for 8.64%, obtriangular for 3.65% and oblate or flattened type seed shape showed 0.33%. Seed size was observed small for 5.32%, medium for 42.52% and large for 52.16%. Seed coat colour varied different categories like grey for 42.86%, brown for 48.50%, yellow-green for 0.66%, pink for 0.66%, red-purple for 3.32%, grey mottled for 3.32% and green mottled for 0.66%. Seed coat pattern observed absent for 3.65%, marbled for 12.62%, dotted for 82.39% and mixture for 1.33%. Two types of cotyledon colour found among accessions as yellow for 77.40% and orange showed 22.59%. Different biotic stress susceptibility on pest and diseases were found among 301 grasspea accessions. Variations were observed in different quantitative characteristics among grasspea accessions as number of secondary branches per plant varied from 8.00 to 30.00, 39 accessions showed highest number of secondary branches per plant (16.00-30.00). The number of pods per plant varied from 52.50 to 338.50, 26 accessions showed highest number of pods per plant (200.00-338.50). BD-3378 produced highest number of pods per plant (338.50) and lowest in BD-3207 (52.50). Yield varied from 4.56 g to 36.63 g per plant, BD-3446, BD-3394, BD-3450, BD-3458, BD-3411, BD-3395, BD-3404 and BD-3428 accessions showed high yielding (34.28-36.63 g/plant) and BD-3207 accession found low yielding (4.56 g per plant).

Morphological characterization of lentil germplasm

The study was conducted at Regional Plant Genetic Resources Center, Regional Agricultural Research Station, Ishurdi, Pabna during Rabi season of 2020-2021 to study the genetic diversity in lentil germplasm and to identify accession having useful traits. The experiment involved 102 lentil accessions. Variations were observed in respect of time to flowering, time to maturity, plant height, number of seeds per pod, 100-seed weight and yield per plant among lentil accessions. Days to 50% flowering was earlier in BD-3983 (53 days) than the other accessions. The earlier maturity observed in BD-3962 (105 days) simultaneously

with other 37 accessions. Variations among lentil accessions were observed in different qualitative characteristics like plant pigmentation were observed in stems, leaves and flowers. Maximum Seedling stem pigmentation was present for 44 accessions (43.14%) and absent for 58 accessions (56.86%). Variations in tendrils found prominent maximum 57 accessions (55.88%) and rest accessions showed rudimentary 45 accessions (44.12%). The flower ground colour was white maximum for 41 accessions (40.20%), white with blue veins for 35 accessions (34.31%), blue for 18 accessions (17.65%) and rest accessions showed violet for 8 accessions (7.84%). Pattern of testa was observed as dotted for 87 accessions (85.29%), spotted for 1 accessions (0.98%), marbled found for 10 accessions (9.80%) and rest accessions observed complex for 4 accessions (3.92%). Colour pattern on testa was found grey for 23 accessions (22.55%), brown for 79 accessions (77.45%) and black colour testa pattern was not found. Cotyledon colour found orange-red for 102 accessions (100.00%). Pest and disease susceptibility observed none for 7 accessions (6.86%) but it was observed low, medium and high susceptibility to pest and disease which affected by aphid and stemphylium blight disease symptom found in stem and leaves. Variations were observed in different quantitative characteristics as numbers of pods per plant varied from 51.00 to 309.00 and BD-3988 produced significantly the highest number of pods per plant (309.00). BD-3988 produced significantly the highest number of seeds per plant (618). Yield variations were showed from 1.70 g to 9.89 g per plant and the highest seed yield (9.89 g/ per plant) was recorded from BD-3988 lentil accession. BD-4016, BD-4013, BD-4000, BD-3996, BD-3958, BD-3957, BD-3938 and BD-3923 lentil accessions showed higher yield (8.00-9.55 g/plant) and the lowest yield (1.70 g/ per plant) found from BD-3954 lentil accession.

Morphological characterization of country bean germplasm

The study was conducted at Regional Plant Genetic Resources Center, RARS, Ishwardi, Pabna in the season of 2020-2021 to identify the important traits of country bean accessions and to know genetic diversity of country bean accessions. The

experiment involved twenty country bean germplasm. Variations were observed in different qualitative characteristics among country bean accessions. Epicotyl and hypocotyl colour showed variations as green and purple colour. Pigmentation were found in stem, leaf, flower, pod and seed among them. Stem colour was no colour for 9 accessions (45%), localized to nodes for 1 accession (5%), medium colour for 4 accessions (20%) and dark colour for 6 accessions (30%). Leaf colour intensity was light green for 2 accessions (10%), intermediate green for 9 accessions (45%) and dark green for 9 accessions (45%). Flower colour was white for 3 accessions (15%) and purple for 17 accessions (85%). Pod colour was G-138 A for 7 accessions (35%), purple-P-77 for 2 accessions (10%), white-155 A for 3 accessions (15%) and G-PM for 7 accessions (35%). Pod shape was elongate for 4 accessions (20%), flat for 11 accessions (55%) and flat wavy for 5 accessions (25%). Remarkable variations were showed within seed colour, seed shape, seed size and seed texture. Significant variations were also found among quantitative characteristics like leaf length and leaf width, length of rachis and peduncle, number of flowers, nodes per rachis, number of pods per rachis, pods per plant, edible fruit weight and 100 seed weight. The first flower initiation was noticed in DL Ish-001, DL Ish-002 and DL Ish-003 (51 days). The number of pods per plant varied from 120.00 to 372.50, the 4 accessions produced highest number of pods per plant (325.00-372.50) and 6 accessions gave moderate number of pods per plant (215.00 to 287.50). The highest edible pod weight for 5 pods (75.40 g /5 pods) was recorded from DL Ish-009 and the lowest edible pod weight for 5 pods (36.80 g /5 pods) from DL Ish-008. The highest edible pod weight for 5 pods (74.70 g /5 pods) was recorded from DL Ish-003 and the lowest edible pod weight for 5 pods (23.50 g /5 pods) from DL Ish-018. The highest edible pod yield per plant (3.51 kg/plant) was observed from DL Ish-007 and the lowest (0.56 kg/plant) from DL Ish-018. The accessions DL Ish-007, DL Ish-005, DL Ish-019 and DL Ish-001 gave highest edible pod yield per plant (2.43 to 351.00 kg/plant).

03

OILSEED CROPS

Rapeseed - Mustard (*Brassica spp.*)

Varietal Improvement

Maintenance of germplasm of *Brassica rapa* L., *Brassica juncea* L. and *Brassica napus* L.

M A LATIF AKANDA and M. Q. I. MATIN

A total 145 accessions of which 81 accessions of *B. rapa* L., 46 of *B. juncea* L. and 18 of *B. napus* L. were grown in rabi 2020-21 in order to maintain the existing germplasm of oiliferous *Brassica rapa* L., *B. juncea* L. and *B. napus* L. and to use in future breeding programme. A total 145 accessions of which 81 accessions of *B. rapa* L., 46 of *B. juncea* L. and 18 of *B. napus* L. Each accession were grown. Unit plot size was 3 rows 3 m long and row to row distance 30 cm and plant to plant distance 5 cm after thinning. Twenty plants were selected randomly from middle row of the plot. Seeds collected from randomly selected ten plants of each germplasm were stored to maintain the germplasm of *B. rapa* L., *B. juncea* L. and *B. napus* L. and for using in the future breeding programme.

Development of short duration inbred lines in *Brassica rapa*

M A Latif Akanda and A B M Khaldun

The most adaptive variety Tori-7, high yielding varieties BARI Sarisha-9, BARI Sarisha-12 and Kalaynia, short duration local cultivar Din-2, short duration line BC-2193, low erucic acid lines, SBC-3593, SBC-4093, SBC-6823 and SBC-8693 were used as source populations for developing inbred lines. Two hundred and sixty six plants were selected from 114 rows for selfing. Total 1665 buds were selfed from which 1133 effective siliquae and 4599 seeds were obtained. Selfed seeds were stored for maintaining as inbred lines in the next year. The

most adaptive variety Tori-7, high yielding varieties BARI Sarisha-9, BARI Sarisha-12 and Kalaynia, short duration local cultivar Din-2, short duration line BC-2193, low erucic acid lines SBC-4093, SBC-6823 and SBC-8693 were used as source populations. Selfed seeds from individual plant of source populations obtained from previous year were sown following plant to row method. Selfed seeds were sown along with Tori-7 as check. Seeding was done on 01 December 2020. Unit plot size was 1 row 3m long. Short duration plants were selected comparing with check variety for selfing. Proper bagging was done to protect out crossing. Selfing of plants was done through bud pollination. Advancing S5 to S6 generation From the results of selfing of Tori 7, BARI Sarisha 9, BARI Sarisha 12, Kalaynia, Din-2, BC-2193, SBC-3593, BC-4093, SBC-6823 and SBC-8693, two hundred and sixty six plants were selected from 114 rows for selfing for advancing S5 to S6 generation from eleven source populations. Total 1665 buds were selfed from which 1133 effective siliquae and 4599 seeds were obtained. Selfed seeds were stored for maintaining as inbred lines in the next year.

Evaluation of F5 generation in *Brassica rapa*

M A Latif Akanda and A B M Khaldun

BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-17 and BARI Sarisha-6 were used as female parents and S6 generation of BARI Sarisha-9 and Tori-7 were used as male parents to develop single crosses during 2014-15. F1s were crossed with BARI Sarisha-6 and BARI Sarisha-17 to develop three-way crosses during 2015-16. F1 –F4 were developed through selfing during 2016-20. Days to maturity ranged from 85-88 days. Early and desirable plants were selected for selfing and 80 plants were selfed. Two hundred and eighty five siliquae were obtained from which 2218 seeds were

obtained. Selfed seeds were stored to advance F6 generation. BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-17 and BARI Sarisha-6 were used as female parents and S6 generation of BARI Sarisha-9 and Tori-7 were used as male parents to develop single crosses during rabi 2014-15. F1s were grown during rabi 2015-16 and crossed with BARI Sarisha-6 and BARI Sarisha-17 to develop three-way crosses. F1 –F4 generation were developed through selfing during 2016-20. F5 seeds of three-way crosses of eight cross combinations were sown on 01 December 2020 at Joydebpur. Unit plot size was 5 rows 3m long. Selfing was done through bud pollination to produce F6 generation. Days to maturity ranged from 85-88 days. Early and desirable plants were selected for selfing. No. of selfed plants from different cross combinations ranged from 7-13 and total 80 plants were selfed. Four hundred and ninety three buds were selfed to develop F5 generation. Two hundred and eighty five siliquae were obtained from which two thousand two hundred and eighteen seeds were obtained. Selfed seeds were stored to advance F6 generation in the next season.

Evaluation of segregating generations of *Brassica rapa*

M A Latif Akanda and A B M Khaldun

Families of F6 generation of two cross combinations having both yellow and brown seed coat colour were evaluated. Families of F6 generation of five cross combinations having both yellow and brown seed coat colour were evaluated. Single plant selection method was followed. Considering earliness (maturity duration upto 85 days), erect and compact plant type, seed colour, seed size and siliqua shape, disease and insect tolerance, plants were selected from each family and seeds of selected plants of individual family were bulked and stored for evaluation in the next year.

A. F6 generation

Families of F6 generation of two cross combinations having both yellow and brown seed coat colour were evaluated during rabi 2019-20 at Joydebpur. Families were sown following family to row method along with BARI Sarisha-14 as check in 4-rows 3m long plot with spacing 30cm and 5cm

between rows and plants, respectively. Seeding was done on 01 December 2020. Single plant selection among families was done based on short duration (maturity duration upto 85 days), erect and compact type having desirable agronomic characters, disease and insect tolerance. Three families having yellow seed coat colour of one cross combination and three families having brown seed coat colour of two cross combinations were evaluated. Considering earliness (maturity duration upto 85 days), erect and compact plant type, seed colour, seed size and siliqua shape, disease and insect tolerance, all families were selected for further evaluation. Seeds of selected plants of individual family were bulked and stored for evaluation in F6 generation in the next year.

B. F6 generation

Families of F6 generation of five cross combinations having both yellow and brown seed coat colour were evaluated during rabi 2019-20 at Joydebpur. Families were sown following family to row method along with BARI Sarisha-14 as check in 4-rows 3m long plot with spacing 30cm and 5cm between rows and plants, respectively. Seeding was done on 01 December 2020. Single plant selection among families was done based on short duration (maturity duration upto 85 days), erect and compact type having desirable agronomic characters, disease and insect tolerance. Twenty families having yellow seed coat colour of four cross combinations and three families having brown seed coat colour of one cross combination were evaluated. Considering earliness (maturity duration upto 85 days), erect and compact plant type, seed colour, seed size and siliqua shape, disease and insect tolerance, twenty one families were selected for further evaluation. Seeds of selected plants were bulked and stored for evaluation in the next year.

Growing of F4 generation originated from 16 parents of *B.rapa*

M. M. Ali and U. Kulsum

Eight brown sarson parents and eight yellow sarson parents were utilized to produce single crosses which were different developed varieties and advanced lines of *B. rapa*. Single crosses were made in 2013-14 following double-crosses in 2014-15. Complex crosses were done in 2015-16 and

2016-17 to accumulate desirable genes into a single parent. F₁, F₂, and F₃ generations were developed in 2017-18, 18-19, and 19-20 respectively. The F₄ seeds along with the parents were sown on 26 November 2020. The 54 progenies (28 brown seeded & 26 yellow seeded) from F₃ selected based on seed coat color and yield per plant were allowed to grow as F₄ generation. Unite plot size was 2 rows 3m long with 30 cm row spacing. Single plant selection method was applied. Recommended fertilizer doses and intercultural operations were done as necessary. A total of 203 single plants were selected from 54 progenies of F₄. Out of 203 single plants, 80 were yellow seeded and 123 were brown seeded. In yellow seeded, days to flowering and days to maturity ranged from 30-35 days and 85-95 days respectively. Plant height ranged from 79-165 cm, siliqua length, branches per plant, siliqua per plant, seeds per siliqua and seed yield per plant ranged from 3.1-8.9 cm, 2-26, 30-441, 14-37, and 7-38 gm respectively. Brown seeded, days to flowering ranged from 30-35 days and days to maturity 84-95 days. Plant height ranged from 88-164 cm. siliqua length, branches per plant, siliqua per plant, seeds per siliqua, and yield per plant ranged from 3.1-8 cm, 2-22, 45-592, 12-38, and 5-54 gm respectively. The seeds of selected single plants with desirable characters were stored separately for next year sowing as the F₅ generation.

Observation trial of *Brassica rapa* (Set-I)

M A Latif Akanda and A B M Khaldun

Sixteen lines of *Brassica rapa* having yellow flower and yellow seed coat colour along with BARI Sarisha-14 as check were evaluated with two replications. Maturity duration ranged from 85-90 days. Four lines were matured within 87 days. The highest number of siliquae/plant recorded in BS-14x-BS-15-1 and highest number of seeds/siliqua recorded in BC-2014-Y02-1-2. Seed yield ranged from 1595-22187 kg/ha. Considering earliness, seed yield and other yield contributing characters, four lines BC-2014-Y02-1(net), BC-2014-Y02-1-2, BC-2014-B08 and BC-2014-Y01 were selected for the next trial and other variety development activities. Sixteen lines of *Brassica rapa* having yellow flower and yellow seed coat colour were selected last year from F₇ generation of different

cross combinations. These lines along with check as BARI Sarisha-14 were evaluated with two replications under Observation Trial of *Brassica rapa* (Set-I) at Joydebpur during 2020-21. The lines were sown on 26 November 2020 in 3 rows of 3m long with spacing of 30 cm and 5cm between rows and plants, respectively. The seedlings were thinned after few days of germination 5 cm apart. All intercultural operations were done timely to raise a good crop. Data were taken on days to flowering, days to maturity, plant height (cm), no. of siliquae/plant, no. of seeds/siliqua, 1000-seed weight (g) and seed yield/plot. The plot yield was converted into kg/ha to measure the yield of the line. Variations were observed among the lines and significant variations recorded all the parameters except plant maturity duration. Maturity duration ranged from 87-90 days in case for the tested lines. Four lines were matured within 87 days including check variety BARI Sarisha-14. The lowest duration recorded in BC-2014-Y02-1 with a significant higher yielding entry compared to the check one. Plant height ranged from 82-101 cm. Number of siliquae/plant ranged from 49-110. The highest number of siliquae/plant recorded in BS-14x-BS-15-1. No. of seeds/siliqua ranged from 14-39. The highest number of seeds/siliqua recorded in BC-2014-Y02-1-2. 1000-seed weight recorded in a range of 2.25-4.4 g. However, the variation of seed weight was not significant, yet, the seed size was desirable from the entries. Seed yield ranged from 1595-2187 kg/ha. The highest seed yield recorded in BC-2014-Y02-1-2 (2187 kg/ha).

Observation trial of *Brassica rapa* (Set-II)

A B M Khaldun and M A Latif Akanda

Twelve lines of *Brassica rapa* having brown seed coat colour along with one check as BARI Sarisha-9 were evaluated with two replications under Observation Trial of *Brassica rapa* (Set-II) at Joydebpur. Maturity duration ranged from 88-91 days. The highest number of siliquae/plant was recorded in BS-14 x -SAU-1-3. Seed yield ranged from 1305-2063 kg/ha. Considering earliness, seed yield and other yield contributing characters, four lines BS-6 x-BS-1-6, BS-14 x -SAU-1-4, BC-100614(Y)-10 and BS-14 x -BS-15-10 were selected for the next trial. Twelve lines of *Brassica rapa* having yellow flower and brown seed coat

colour were selected last year from F7 generation of different cross combinations. These lines along with one check as BARI Sarisha-9 were evaluated with two replications under Observation Trial of Brassica rapa (Set-II) at Joydebpur during 2020-21. The lines were sown on 2 November 2020 in 3 rows of 3m long with spacing of 30 cm and 5cm between rows and plants, respectively. Data were taken on days to flowering, days to maturity, plant height (cm), no. of siliquae/plant, no. of seeds/silqua, 1000-seed weight (g) and seed yield/plot. The plot yield was converted into kg/ha. Variation was observed in all the studied parameters, however, significant difference recorded in number of seed/silqua and seed yield. Maturity duration ranged from 88-91 days. Plant height ranged from 83-95 cm which is almost desirable plant stature. The highest plant height was recorded in BC-100614(Y)-10. Number of siliquae/plant ranged from 78-134. The highest number of siliquae/plant was recorded in BS-14 x -SAU-1-3. Number of seeds/silqua ranged from 14-36. 1000-seed weight recorded in a range of 2.26-3.48 g. However, the variation of seed weight was not significant, yet, the seed size was desirable from the entries. Seed yield ranged from 1305-2063 kg/ha. The highest seed yield recorded in BS-6 x BS-1-6 (2063 kg/ha).

Preliminary yield trial of *Brassica rapa* (Set-I)

A B M Khaldun, M A Latif Akanda, M R Humauan, M H Rahman And M A Monim

Nineteen lines of Brassica rapa having yellow seed coat colour along with one check as BARI Sarisha-14 were evaluated at Joydebpur, Ishurdi, Jessore and Rahmatpur. Maturity duration ranged from 84-88 days and seed yield ranged from 1527-2227 kg/ha in Joydebpur location. The line BC-100614(8)-1 produced the highest seed yield (2227 kg/ha) at that location. In case of multi-location findings, maturity duration, days to maturity ranged from 84-87 days and seed yield ranged from 1251-1629 kg/ha over locations. The line BC-100614(8)-1 produced the highest seed yield over locations. Considering earliness, seed yield and other yield attributing characters recorded over the locations, five lines like BC-100614 (8) - 1, BC-100614 (4) - 10, BC-110714 (7) -8, BC-110714 (7) -7 and BC-100614 (4) -4 were selected for RYT in the next

year. The experiment was conducted at Joydebpur, Ishurdi, Jessore and Rahmatpur during rabi 2020-21 with 19 genotypes of Brassica rapa having yellow seed coat colour along with one check as BARI Sarisha-14. The experiment was laid out in randomized complete block design with three replications. The plot size was 3m x 0.9m. Seeding was done on 22 November 2020 at Joydebpur, 9 November 2020 at Ishurdi, 6 November 2020 at Jashore and 17 December 2020 at Rahmatpur as continuous sowing in rows of 30 cm apart. The seedlings were thinned after few days of germination 5 cm apart. All intercultural operations were done timely to raise a good crop. Data were taken on days to flowering, days to maturity, plant height (cm), no. of siliquae/plant, no. of seeds/silqua, 1000 seed weight (g) and seed yield/plot. The plot yield was converted into kg/hectare. The data were analyzed statistically. Mean performance of different lines at Gazipur location is presented in Table 8. Significant variations were observed for days to maturity, number of siliquae/plant at Joydebpur location. Maturity duration ranged from 84-88 days. Plant height ranged from 86-95 cm. The lowest plant height was recorded in BC-110714(9)-5 (86 cm). Number of siliquae/plant ranged from 42-75. The highest number of siliquae/plant was recorded in BC-110714(7)-4 (75). Number of seeds/silqua ranged from 20-34. 1000-seed weight recorded in a range of 3.03-4.03 g. However, the variation of seed weight was not significant, yet, the seed size was desirable from the entries used for the trial of advanced lines. Seed yield ranged from 1527-2227 kg/ha at Gazipur location.

Preliminary yield trial of *Brassica rapa* L. (Set-II)

M K Alam, M Kadir, M I Riad, A B M Khaldun and M A Latif Akanda

The experiment was conducted with ten lines *Brassica rapa* having yellow seed coat color along with two check varieties as BARI Sarisha-14 and Tori-7 at RARS Jamalpur and Oilseed Research Center, Joydebpur during Rabi season 2020-2021 were evaluated for yield and yield contributing characters. Seed yield ranged from 1333-2298 kg/ha at Joydebpur location and the highest seed yield was recorded BC-14043(Y). Days to maturity

ranged from 78-82 over the locations. Seed yield ranged from 1334-1806 kg/ha over locations. BC-14031(Y) produced the highest seed yield than check variety BARI Sarisha-14 and Tori-7 over the locations. Considering location wise seed yield and other yield contributing characters, four lines like BC-14003(Y), BC-14031(Y), BC-14043(Y) and BC-15010(Y) were selected for evaluation in RYT. The experiment was conducted at Regional Agricultural Research Station, Jamalpur and Oilseed Research Center, Joydebpur, during Rabi season 2020-2021 with 10 promising genotypes of *Brassica rapa*. It was laid out in randomized complete block design with three replications. BARI Sarisha-14 and Tori-7 were used as checks. The plot size was 3 m x 2 m. Seeds were sown on the 17th November, 2020 in Jamalpur and 20th November in Joydebpur, continuous and row was 30 cm apart from each. The seedlings were thinned after 7-11 days of germination 5 cm apart. Data were taken on plant height, primary branches/plant, secondary branches/ plant, pod/plant, length of pod, seed/pod, days to mature and yield per plot. The plot yield was converted into hectare. The data were analyzed statistically. The performances of different genotypes at Jamalpur location are expressed in Table-9. Significant differences observed for the traits plant height, pod/plant, and length of pod, seed/pod, and yield per hectare. Maturity duration ranged from 80-73 days. Plant height ranged from 92-72cm. The highest plant height recorded in BC-19020(Y), BC-18021(Y) and BC-14043(Y) and lowest plant height recorded in BC-14003(Y). The highest primary branches recorded in BC-14016(Y). No. of pods/silique per plant ranged from 56-14. No. of seeds/silique ranged from 33-14. Seed yield ranged from 1469-1144 kg/ha. The highest seed was recorded in BC-14031(Y) which was 1469 kg/ha. It gave 21% and 27% higher yield than check varieties BARI Sarisha-14 and Tori-7, respectively and took 77 days to maturity. The second highest yield was produced by BC-14003(Y). It produced 1344 kg/ha which was 11% and 16% higher than check varieties BARI Sarisha-14 and Tori-7. It took 78 days to mature. In addition, BC-14016(Y) and BC-18007(Y) lines showed third highest yield performance among the entries. These four

genotypes may be cultivated between T-aman & Boro rice.

Preliminary yield trial of *Brassica rapa* L. (Set-III)

M K Alam, M Kadir, M I Riad, A B M Khaldun and M A Latif Akanda

Ten lines of *Brassica rapa* having brown seed coat color along with two checks as BARI Sarisha-9 and Tori-7 were evaluated at Jamalpur and Joydebpur. Maturity duration ranged from 67-76 days at Jamalpur location. The highest seed yield was recorded in BC-15005(B) at Jamalpur location and gave 33% and 42% higher yield than check varieties BARI Sarisha-9 and Tori-7, respectively. Maturity duration over locations ranged from 74-79 days. Seed yield ranged from 1201-1463 kg/ha over locations and the highest yield was recorded in BC-18020(B). Considering seed yield and other yield contributing characters, four lines like BC-18020(B), BC-15005(B), BC-15033(B), and BC-15025(B) were selected for evaluation in RYT. The experiment was conducted at Regional Agricultural Research Station, Jamalpur during Rabi 2020-2021 with 12 promising genotypes of *Brassica rapa*. It was laid out in randomized complete block design with three replications. BARI Sarisha-9 and Tori-7 were used as checks. The plot size was 3.0 m x 1.5 m. Seeds were sown on the 19th November, 2020 at Jamalpur and 20th November 2020 at Joydebpur in continuous and row was 30 cm apart from each. The seedlings were thinned after 7-11 days of germination 5 cm apart. Data were taken on plant height, primary branches/plant, secondary branches/ plant, pod/plant, length of pod, seed/pod, days to mature and yield per plot. The plot yield was converted into hectare. The data were analyzed statistically. The mean performances of different lines at Jamalpur location is expressed in Table-10. Significant differences observed for the traits maturity, plant height and yield per hectare. Maturity duration ranged from 67-76 days. Plant height ranged from 91-106 cm. Primary branches ranged from 3.20-4.27 no. No. of silique per plant ranged from 39.13-55.60. No. of seeds/silique ranged from 13.93-18.60. The highest no. of seed/silique was recorded in BC-18008(B) and BC-19020(B). From the Table 10. It was observed that BC-15005(B) produced the highest yield. It gave

1579 kg/ha seed yield which was 33% higher yield than BARI Sarisha-9. The second highest yield was produced by BC-15033(B). It produced 1473 kg/ha yields and it was 24% higher than check variety BARI Sarisha-9. The third highest yield was recorded from BC-14021(B). It produced 15% higher yield than check variety BARI Sarisha-9. They took only 68 days to mature. BC-15005(B), BC-15033(B) and BC-14021(B) lines may be cultivated between T-Aman & Boro rice.

Regional yield trial of *Brassica rapa*

A B M Khaldun, M A Latif Akanda, M Khorshed Alam, M R Humayan, M H Rahman and M A Monim

Eight lines of *Brassica rapa* along with BARI Sarisha-14 as check were evaluated at Joydebpur, Jamalpur, Ishurdi, Jashore and Rahmatpur for seed yield and yield contributing characters. Maturity duration ranged from 85-92 days at Joydebpur location. Seed yield ranged from 1453-2024 kg/ha and the highest seed yield was recorded in BC-120114 (2024 kg/ha) at Joydebpur location. Regarding the multi-location results maturity duration ranged from 84-86 days and seed yield ranged from 1531-1889 kg/ha. The line BC-100614(3)-1 produced the highest seed yield over the tested locations. Considering earliness, seed yield and other yield attributing characters, four lines like BC-100614(3)-1, 1881, BC-100614(8)-4 and BS-15YF-01 were selected for adaptive trials in the next year.

The experiment was conducted at Joydebpur, Jamalpur, Ishurdi, Jashore and Rahmatpur during rabi 2020-21. It consisted of eight advanced lines of *Brassica rapa* along with one check as BARI Sarisha-14. The experiment was laid out in randomized complete block design with three replications. The plot size was 3m x 1.2m. Seeding was sown on 22 November 2020 at Joydebpur, 15 November 2020 at Jamalpur, 9 November 2020 at Ishurdi, 6 November 2020 at Jashore and 17 December 2020 at Barishal in continuous sowing and row was 30 cm apart from each. Significant variations were observed for number of siliqua per plant and seed yield at Joydebpur. Maturity duration ranged from 85-92 days. Plant height ranged from 91-99 cm. The lowest plant height was recorded in BC-120114. Number of siliquae/plant

and number of seeds/siliqua ranged from 32-64 and 25-41, respectively. The highest number of seeds/siliqua was recorded in BC-120114. The lowest number of seed/siliqua was recorded in BS-15YF-01. Seed yield ranged from 1453-2024 kg/ha. The highest seed yield was recorded in BC-120114 at Joydebpur location. The lowest seed yield was recorded in BS-20-GS-1.

Preliminary yield trial of *Brassica napus* L.

M K Alam, M Kadir, M. I. Riad, A B M Khaldun, M A Latif Akanda and M H Rahman

Ten lines of *Brassica napus* along with two check varieties BARI Sarisha-8 and BARI Sarisha-13 were conducted at Jamalpur, Jashore and Oilseed research center, Gazipur during rabi, 2020-2021 to evaluate the yield and yield contributing characters. Maturity duration ranged from 78-83 days and seed yield ranged from 1766-1217 kg/ha at Jamalpur location. Compare to maturity duration over locations ranged from 83-86 days where check variety BARI Sarisha-8 was the longest which required 84 days over locations. Seed yield ranged from 1531-1887 kg/ha over the locations. At Jamalpur Nap-18009, Nap-18010, Nap-18013, Nap-16004 and Nap-16021 produced higher seed yield than check variety BARI Sarisha-8 and BARI Sarisha-13. In Jashore, Nap-20008 and Nap-18010 gave higher yield than check variety and most of the entries gave the highest yield than check varieties BARI Sarisha-8 and BARI Sarisha-13 in Joydebpur. Among the genotypes Nap-18010 produced the highest yield included in this trial. It was laid out in randomized complete block design with three replications. BARI Sarisha-8 and BARI Sarisha-13 the released variety of *Brassica napus* was used as check. The plot size was 3 m x 2.1 m. Seeds were sown at these locations on the 30th November, 25th November and 22th November 2020 at Jamalpur, Jashore and Gazipur, respectively in continuous and row was 30 cm apart from each. Significance differences among the genotypes were observed for maximum yield contributing characters except primary branches per plant, siliqua per plant and seeds per siliqua. Maturity duration ranged from 78-83 days. Plant height ranged from 78.73-98.53 cm. The lowest plant height recorded in Nap-18002. No of siliquae/plant ranged from 37.60- 59.73.

Seeds/siliquea ranged from 27.13-33.53. Seed yield ranged from 1217-1766 kg/ha. The highest seed yield was recorded in Nap-18010 which was 16% and 24% higher yield than check varieties BARI Sarisha-8 and BARI Sarisha-13. It took 81 days to mature. Primary branches/plant, Pods/plant, number of seeds/pod was performed moderately high. The 2nd and 3rd highest yield was obtained from Nap-16004 & Nap-16021. They produced 11 % & 6 % higher yield than existing napus variety BARI Sarisha-8 and also 19 % and 14 % higher yield than check varieties BARI Sarisha-13. They took 80-84 days to mature. They had good number of seed/siliquea. These lines may easily be fitted in between T-Aman and Boro rice.

Regional yield trial of *Brassica napus* L.

M K Alam, M Kadir, M I Riad, A B M Khaldun, M A Latif Akanda, M R Humauan and M A Monim

Ten lines of *Brassica napus* along with BARI Sarisha-8 and BINA Sarisha-9 as checks were evaluated at Jamalpur Ishurdi, Rahmatpur and Oilseed Research Center, Gazipur during rabi 2020-2021 for seed yield and yield contributing characters. Maturity duration ranged from 83-85 days and seed yield ranged from 1166-1601 kg/ha at Jamalpur location and the highest seed yield was recorded in Nap-15037. Compare to maturity duration over locations ranged from 92-93 days where check variety BARI Sarisha-8 was the longest which required 93 days over locations. Seed yield ranged from 1530-1816 kg/ha over the locations. At Jamalpur Nap-15037, Nap-15029, Nap-16013, and Nap-15027 produced higher seed yield than check variety BARI Sarisha-8 and BINA Sarisha-9. The line Nap-15037 produced the highest seed yield over locations and it also produced the highest and second highest seed yield at Jamalpur, and Gazipur locations respectively. Considering earliness, seed yield and other yield contributing characters, three lines Nap-15037, Nap-15029 and Nap-18033 were selected for Adaptive Trial in the next year. It was laid out in randomized complete block design with three replications. BARI Sarisha-8 and BINA Sarisha-9 the released varieties of *Brassica napus* were used as checks. The plot size was 4 m x 2.10 m. Seeds were sown on the 16th November, Jamalpur, 10th November, Ishurdi, 25th November, Rahmatpur

and 26th November, Joydebpur, 2020 in continuous and row was 30 cm apart from each. The seedlings were thinned after few days of germination 5 cm apart. The mean performances of different lines at Jamalpur location is presented in Table 13. Significant variations were observed among the lines for all the characters were studied. Maturity duration ranged from 83-85 days. All the lines were showed earlier maturity except check varieties BARI Sarisha-8 and BINA Sarisha-9 (85 days). Plant height ranged from 80-103 cm. The lowest plant height was recorded in Nap-15037(80cm) and also showed highest primary branches (2.53). No. of siliquae/plant and no. of seeds/siliquea ranged from 37-58 and 22-45, respectively. The highest no. of siliquea was recorded in Nap-15029 which was statistically different with other genotypes. The highest no. of seeds/siliquea was recorded in Nap-15037. The lowest no. of seeds/siliquea was recorded in Nap-15029. The highest yield was produced by the genotype Nap-15037. It produced 1601 kg/ha yield, which was 23% higher yield than existing *Brassica napus* variety BARI Sarisha-8 and also 15% higher yield than BINA Sarisha-9. Over the locations, maximum yield was observed in Gazipur from Nap-18033(2586kg/ha) and second highest yield was recorded in Gazipur by Nap-15037(2474kg/ha). In Rahmatpur, maximum seed yield was observed in Nap-18005(2381 kg/ha) and took 93 days to mature. The lowest seed yield was recorded in Ishurdi and also taken longer days to maturity than other locations.

Evaluation of segregating generation of *Brassica juncea*

M A Latif Akanda and A B M Khaldun

A total of 122 plants from thirteen cross combinations having brown seed coat colour and 23 plants from two cross combinations having yellow seed coat colour were selected in F6 generation (Set-I). A total of 18 families from three cross combinations having black/brown seed coat colour were selected and 12 families from three cross combinations having yellow seed coat colour were selected in F6 generation (Set-II). Plants were selected considering erect, seed colour, seed size and siliquea shape. Harvested seeds from selected plants and progenies were stored for further evaluation in the next year.

F₆ generation (Set-I)

Single plant selection method was followed. A total of 122 plants from eleven cross combinations having black/brown seed coat colour and 23 plants from two cross combinations having yellow seed coat colour were selected considering erect and compact plant type, seed colour, seed size and siliqua shape. Two cross combinations were discarded. Seeds from selected plants of individual cross combinations were harvested in bulk. Seeds were stored for evaluation in Observation Trial in the next year.

F₆ generation (Set-II)

A total of twenty three families from three cross combinations having black/brown seed coat colour were evaluated and eighteen families were selected for further evaluation. Fourteen families from three cross combinations having yellow seed coat colour were evaluated and twelve families were selected for further evaluation. Considering erect and compact plant type, seed colour, seed size and siliqua shape, single plant selection method was followed. Harvested seeds from selected plants of individual family were bulked. Seeds were stored for evaluation in the next year.

Observation trial of *Brassica juncea*

A B M Khaldun and M A Latif Akanda

Thirteen lines of *Brassica juncea* along with BARI Sarisha-11 as check were evaluated at Gazipur with two replications in 2020-21 season. Maturity duration ranged from 100-103 days. Seed yield ranged from 1402-2235 kg/ha. The highest seed yield recorded in BJ-2014-B06(Y) (2235 kg/ha) followed by BJ-2014-B09 (2209 kg/ha). Considering earliness, seed yield and other yield contributing characters, three lines BJ-2014-B06(Y), BJ-2014-B09 and BJ-2014-Y04 were selected for the next trial. The lines were sown on 29 November 2020 in 3 rows of 3m long with spacing of 30 cm and 5 cm between rows and plants respectively. The seedlings were thinned after few days of germination 5 cm apart. Maturity duration ranged from 100-103 days. Plant height ranged from 123-130 cm. Number of siliquae/plant ranged from 106-154. Number of seeds/siliqua ranged from 11-14. 1000-seed weight recorded in a range of 2.78-3.22 g. However, the variation of

seed weight was not significant, yet, the seed size was desirable from the entries. Seed yield ranged from 1402-2235 kg/ha. The highest seed yield recorded in BJ-2014-B06(Y) (2235 kg/ha) followed by BJ-2014-B09 (2209 kg/ha).

Preliminary yield trial of *Brassica juncea* L.

M A Latif Akanda, A B M Khaldun, M R Humauan and M H Rahman

Eleven lines of *Brassica juncea* having yellow seed coat colour along with BARI Sarisha-11 as check were evaluated at Gazipur, Ishurdi and Jashore. Maturity duration ranged from 99-102 days and seed yield ranged from 1457-1943 kg/ha at Joydebpur location and the highest seed yield was recorded in BJ-11536(9)-2. Regarding performance of multi-location, maturity duration ranged from 103-105 days and seed yield ranged from 1863-2105 kg/ha over locations. The line BJ-11536(9)-2 produced the highest seed yield. Considering seed yield and other yield contributing characters, three lines like BJ-11536(9)-2, BJ-11536(11)-1 and BJ-10-10104(Y) were selected for evaluation in RYT. Days to maturity ranged from 99-102 days. Plant height ranged from 125-141 cm. Number of siliquae/plant ranged from 88-152. Number of seeds/siliqua ranged from 11-13. 1000-seed weight recorded in a range of 2.35-2.99 g. However, the variation of seed weight was not significant, yet, the seed size was desirable from the entries used for the trial of advanced lines. Seed yield ranged from 1457-1943 kg/ha. The highest seed yield was recorded in BJ-11536(9)-2.

Regional yield trial of *Brassica juncea* L.

A B M Khaldun, M M A Latif Akanda, M R Humauan, M H Rahman and M A Monim

Eight advanced lines of *Brassica juncea* along with BARI Sarisha-11 as check were evaluated at Gazipur, Jamalpur, Ishurdi, Jashore, and Rahmatpur for yield and yield contributing characters. Maturity duration ranged from 99-101 days at Gazipur and seed yield ranged from 1451-1911 kg/ha at Joydebpur location and BJ 11536 (12)-6 produced the highest seed yield followed by BJ 1110 (12)-1 (1685 kg/ha). Regarding maturity duration, days to maturity ranged from 105-107 days and seed yield ranged from 1575-1791 kg/ha over locations. The line BJ 1111 (7)-7 produced the

highest seed yield over locations. Considering seed yield and other yield contributing characters, three lines BJ 1111 (7)-7, BJ 11536 (12)-1 and BJ 53611 (12)-8 were selected for Adaptive Trial in the next year. Maturity duration ranged from 99-101 days. Plant height ranged from 122-138 cm. Number of siliquae/plant ranged from 94-113. The highest number of siliquae/plant was recorded in BJ 1111 (7)-7. Number of seeds/siliqua ranged from 13-15. 1000-seed weight recorded in a range of 2.32-3.27 g. However, the variation of seed weight was not significant, yet, the seed size was desirable from the entries used for the trial of advanced lines. Seed yield ranged from 1451-1911 kg/ha. BJ 11536 (12)-6 produced the highest seed yield (1911 kg/ha) followed by BJ 1110 (12)-1 (1685 kg/ha).

Maintenance of CMS, maintainer and restorer lines of *Brassica napus*

M A Latif Akanda and A B M Khaldun

The experiment consisted of two CMS lines like CMSZ1 (248) and CMSZ2 (279), two maintainer lines like Nap-248M and Nap-279M and one restorer line, Nap-14-01R. Days to flowering and maturity for CMS lines ranged from 22-23 days and 90 days, respectively. In total 323 buds of 45 plants of two CMS lines were crossed with two maintainer lines. Two thousand four hundred and twenty two seeds were obtained from 202 siliquae. Days to flowering and maturity for restorer and maintainer lines were 22-24 days and 90-95 days, respectively. Eight hundred and fourteen buds were selfed from 102 plants. In total 8227 seeds were obtained from 686 siliquae. Seeds were stored for future breeding programme. It was conducted at Gazipur during rabi 2018-19. Unit plot size was four rows three meter long. Seeding was done on 30 November 2020. CMS lines were crossed with maintainer lines. Maintainer lines and restorer line were selfed. Bagging was done to protect out crossing. Crossing and selfing were done by hand pollination. Days to flowering and maturity for CMS lines ranged from 22-23 days and 90 days, respectively. In total 323 buds of 45 plants of two CMS lines were crossed with two maintainer lines. Two thousand four hundred and twenty two seeds were obtained from 202 siliquae. Seeds were stored for future breeding programme. Results on selfing for maintenance of maintainer and restorer lines are

presented in Table 20. Days to flowering and maturity for Nap-248M, Nap-279M and Nap-14-01R were 22-24 days and 90-95 days, respectively. Eight hundred and fourteen buds were selfed from 102 plants. In total 8227 seeds were obtained from 686 siliquae. Seeds were stored for future breeding programme.

Development of hybrid variety in rapeseed

M A Latif Akanda and A B M Khaldun

Long duration CMS and restorer lines were back crossed with short duration *Brassica napus* lines, and BARI Sarisha-8 and BARI Sarisha-13 to develop short duration parental lines. CMS lines were crossed with selected Restorer line (Nap-2014-01R) to develop test cross hybrid seed and previously developed test cross hybrids were evaluated. Seeds were stored for the next year evaluation.

I. Development of short duration parental lines in *Brassica napus* L.

Two CMS lines [CMSZ1 (248) and CMSZ2 (279)], one Restorer line (Nap-14-01R), three short duration (87-88 days) of *Brassica napus* lines (Nap-0876, Nap-0869 and Nap-205), two varieties (BARI Sarisha-8 and BARI Sarisha-13) and one *Brassica napus* line (Nap-14-015) were used as experimental materials. The experiment was conducted during rabi 2020-21 at Gazipur. Seeds were sown on 01 December 2020. CMS lines were crossed with three short duration *Brassica napus* lines, and BARI Sarisha-8 and BARI Sarisha-13. Restorer line was crossed with BARI Sarisha-8 and BARI Sarisha-13 and Nap-14-015. Bagging was done to protect out crossing. Crossing was done by hand pollination. Days to maturity for CMS lines ranged from 90-92 days and for *Brassica napus* lines/varieties ranged from 87-95 days. Seven hundred and fifty seven buds of 101 CMS plants were crossed with short duration *Brassica napus* lines/varieties. Four hundred and nineteen siliquae was obtained from which 5040 seeds were obtained. Seeds were stored for back crossing in the next year. Days to maturity for restorer line was 95-96 days and for *Brassica napus* varieties/lines ranged from 94-96 days. Three hundred and sixty three buds of 48 restorer plants were crossed with short duration *Brassica napus* varieties/lines. Two

hundred and two siliquae were obtained from which 2432 seeds were obtained. Seeds were stored for back crossing in the next year.

II. Development of test cross hybrid in *Brassica napus* L.

CMS line [CMSZ1 (248) was crossed with Restorer line (Nap-2014-01R-P6) and CMS line [CMSZ2 (279) was crossed with Restorer line (Nap-2014-01R-P10) to develop test cross hybrid seed. Seeds of female and male parent were sown on 01 December 2020 following 4:2 ratio. Unit plot size was twenty rows of 3m long. Netting was done to protect out crossing. Hand pollination was done for proper seed setting. The experiment was conducted at Gazipur. Days to maturity of CMS lines was 90 and 92 days and restorer lines was 101 days. Two hundred and sixty five gram seeds of CMSZ1 (248) x Nap-2014-01R-P6 and 195 gram seeds of CMSZ2 (279) x Nap-2014-01R-P10 were obtained. Hybrid seeds of test crosses was stored for evaluation in the next year.

III. Evaluation of test cross hybrids in *Brassica napus* L.

Two CMS lines, CMSZ1 (248) and CMSZ2 (279) were crossed with Restorer lines, Nap-2014-01R-P6 and Nap-2014-01R-P10 during last rabi 2019-20 to develop test cross hybrids. Developed two hybrids were evaluated during rabi 2020-21. Hybrid seeds were sown on 01 December 2020. Unit plot size was 20 rows of 3m long with 3 replications. The experiment was conducted at Gazipur. Results on test cross hybrids, CMSZ1 (248) x Nap-2014-01R-P6 and CMSZ2 (279) x Nap-2014-01R-P10 are presented in Table 24. Days to flower was 22 and 23 days and days to maturity was 104 and 103 days, respectively for test crosses. Seed yield for hybrid CMSZ1 (248) x Nap-2014-01R-P6 was 1744 kg/ha and for hybrid CMSZ2 (279) x Nap-2014-01R-P10 was 2089 kg/ha.

Heterosis study of hybrids developed through selected restorers

M. M. Ali and U. Kulsum

Twenty-four restorer lines have been developed through backcrossing incorporating early genes. These restorers lines were used to produce 24 test cross hybrids in 2017-2018. From the performance

of 24 hybrids fifteen restorers with good heterosis were selected in 2018-2019. In 2019-20 test cross hybrids were developed with the selected restorer considering the fertility status of restorer and seed yield of test hybrid. Finally nine hybrids were selected. This year an experiment was conducted with the selected nine hybrids along with check variety BARI Sarisha-13. Unite plot size was 3 m long 5 lines with 30 cm spacing. The hybrids were sown on 26 November 2020. Recommended doses of fertilizer and other cultural operations were done when necessary. Standard heterosis was calculated. Most of the hybrids were over yielded compared to check variety BARI Sarisha-13. The hybrids namely, Hybrid-4, Hybrid-16, Hybrid-3, Hybrid-23, and Hybrid-14 showed around 30% to 40% higher seed yield compared to the standard variety BARI Sarisha-13. In the case of maturity, all the hybrids took less time to mature than BARI Sharisha-13 except hybrid-14. Out of nine hybrids, eight have been shown positive heterosis in seed yield. Maximum heterosis was observed in the hybrid-4 (39.9%) followed by Hybrid-16 (37.1%) in seed yield (kg/ha). In isolated condition (using net) fifteen test cross hybrid was also developed this year. Heterosis study of hybrids will be done next year in two locations. The CMS line and maintainer line have been maintained through bud crossing & selfing. A total of 1507 buds were crossed from which 1235 buds developed. The average success of the different cross combinations was 81%.

Development of double low short duration genotypes through interspecific hybridization

I. Evaluation of f5 generation

M A Latif Akanda and A B M Khaldun

BARI Sarisha-17 of *Brassica rapa*, Nap-0876 and Nap-0569 of *Brassica napus* having high erucic acid but short duration were crossed with Nap-14-001, Nap-14-004, Nap-14-007, Nap-14-010 and Nap-14-011 of *Brassica napus* having low erucic acid, high yielding but long duration. Developed 15 F1s were selfed to develop F5 generation. Maturity duration for 15 cross combinations ranged from 86-99 days. One thousand eight hundred and four buds from 234 plants were selfed to develop F5 generation. One thousand five hundred and seventy four siliqua were obtained from which 10920 seeds

were obtained. Selfed seeds were stored to advance F6 generation in the next season. Parent materials of the experiment consisted of two species (*Brassica rapa* and *Brassica napus*). BARI Sarisha-17 of *Brassica rapa*, Nap-0876 and Nap-0569 of *Brassica napus* [high erucic acid (30-45%) but short duration (80-85 days)]. Nap-14-001, Nap-14-004, Nap-14-007, Nap-14-010 and Nap-14-011 of *Brassica napus* [low erucic acid (less than 2%), high yielding (2.0-2.5 t/ha) but long duration (100-105 days)]. BARI Sarisha-17, Nap-0876 and Nap-0569 were crossed with Nap-14-001, Nap-14-004, Nap-14-007, Nap-14-010 and Nap-14-011 during last rabi 2015-16. Developed 15F1s were selfed during 2016-2019 to develop F5 generation. Developed 15F5 s were sown on 01 December 2020 at Gazipur. Selfing was done through bud pollination to produce F6 generation. Maturity duration for cross combinations ranged from 86-99 days. No. of selfed plants from different cross combinations ranged from 9-24 and total 234 plants were selfed. One thousand eight hundred and four buds were selfed to develop F5 generation. One thousand five hundred and seventy four siliqua were obtained from which 10920 seeds were obtained. Selfed seeds were stored to advance F6 generation in the next season.

Regional yield trial of double low genotypes of *Brassica napus* L.

M A Latif Akanda, A B M Khaldun, M R Humauan and M H Rahman

Five genotypes (double low) of *Brassica napus* along with BARI Sarisha-13 and BARI Sarisha-14 as checks were evaluated to know the performance of the genotypes and to develop 'double low' (Canola) variety. Maturity duration ranged from 99-100 days at Gazipur. Seed yield ranged from 2341-2514 kg/ha among the tested materials and the genotype Nap-14010 produced the highest seed yield (2514 kg/ha) followed by Nap-14011 (2425 kg/ha) at Gazipur location. Regarding maturity duration, days to maturity ranged from 99-100 days and seed yield ranged from 2174-2314 kg/ha over the locations and among the tested entries. The line Nap-14004 produced the highest seed yield over locations. Considering seed yield and other yield contributing characters, genotypes Nap-14004, Nap-14007 and Nap-14010 were selected for

Adaptive Trial in the next year. The genotypes were evaluated at Gazipur, Ishurdi and Jashore during rabi 2020-21 to know the performance of the genotypes and to develop 'double low' (Canola) variety. The genotypes were sown on 26 November 2020 at Gazipur, 10 November 2020 at Ishurdi and 7 November 2020 at Jashore in 3 rows of 3m long with spacing of 30 cm and 5cm between rows and plants, respectively. The seedlings were thinned after few days of germination 5 cm apart with three replications. Variations were observed among the genotypes for days to maturity, no. of siliqua/plant and seed yield. Maturity duration ranged from 99-100 days for the genotypes of *Brassica napus*. Check variety BARI Sarisha-14 (*Brassica rapa*) was the earliest (88 days) in maturity among the genotypes as it belongs to the *B. rapa* sp in Gazipur location. Plant height ranged from 88-111 cm. Check variety BARI Sarisha-14 showed the lowest plant height (94 cm). Number of siliqua/plant ranged from 68-99. The highest number of siliqua/plant was recorded in BARI Sarisha-13 (Ch). Number of seeds/siliqua ranged from 21-37 among tested lines. The highest number of seeds/siliqua recorded in BARI Sarisha-14 (37), although its yield was remarkably low. 1000-seed weight recorded in a range of 3.00-3.65 g. However, the variation of seed weight was not significant, yet, the seed size was desirable from the entries used for the trial of advanced lines. Seed yield ranged from 1742-2514 kg/ha. The highest seed yield was recorded in Nap-14010 (2514 kg/ha) and lowest in check variety BARI Sarisha -14 (ch) (1742 kg/ha) at Gazipur location.

Crop and soil management

Effect of irrigation on growth and yield of canola type mustard variety

P. Roy, F. Begum and M.M.Karim

An experiment was conducted at the research field of Oilseed Research Centre (ORC), BARI, Gazipur during the rabi season of 2020-2021. There were five treatments viz. T₁: Irrigation at when necessary, T₂: Irrigation at vegetative and flowering stage, T₃: Irrigation at vegetative and seed development stage, T₄: Irrigation at flowering and seed development stage and T₅: Irrigation at

vegetative, flowering and seed development stage. The experiment was design in RCB with three replications. Seeds were sown in 3 December 2020 at Gazipur with a plot size of 3m x 4m. Fertilizers were applied at the rate of $N_{88}P_{34}K_{80}S_{28}Zn_3B_2$ kg ha⁻¹ in the form of urea, TSP, MOP, gypsum, zinc oxide and boric acid, respectively. Full amount of triple super phosphate, muriate of potash, gypsum, zinc oxide, boric acid and half of urea were broadcasted in the experimental plot at the time of final land preparation. The rest half of urea was applied in equal amounts at 30 & 55 days after sowing (DAS). Irrigation was applied according to the treatment requirement. Plant samples were collected at one month interval starting from 20 DAS to measure the LAI (leaf area index), and total dry weight content. Percentage oil content was estimated for each treatment after harvesting the crop. The maximum seed yield (2.34 t/ha) was recorded in case of T₁ treatment (Irrigation as and when necessary) followed by T₅ (Irrigation at vegetative, flowering and seed development stage) treatment. But the maximum gross margin (Tk. 79100/ha) and BCR (2.00) were obtained from T₅ treatment. From one tear study, it may be revealed that three irrigations at vegetative, flowering and seed development stage would be optimum for canola type mustard.

Determination of fertilizer doses for canola type mustard variety

M. M.Karim, P.Roy and F.Begum

An experiment was conducted at the Research field of oilseed research centre (ORC), BARI, Gazipur during rabi season of 2020-21 to find out the suitable dose of fertilizer for newly developed canola type mustard variety BARI Sarisha-18. The experiment was set up with five treatments viz. T₁: Recommended dose (RD) ($N_{138} P_{35} K_{50} S_{32} Z_{2.5} B_7$) for BARI Sarisha-18. T₂: 20% less than RD, T₃: 20% more than RD. T₄: 30% more than RD, and T₅: 40% more than RD. The experiment was laid out in RCB design with three replications. Before final land preparation the field was arranged according to plot size of (3m×4m). During final land preparation the fertilizer were applied as per treatment combinations in the form of Urea, TSP, MOP, Gypsum, Zinc oxide and boric acid, Where the half of urea and full amount of others fertilizers

were broadcasted in the experimental plot the rest of urea was applied in two equal split at the time of 30 and 50 days after sowing (DAS). All the intercultural operations like irrigation, weeding, pest control etc were done as and when necessary. Harvesting of BARI mustard-18 was done on 22 February, 2021. Randomly five plants from each plot were tagged to take data an different agronomic parameters of BARI Sarisha-18. Seed yield (3.00 t/ha) was maximum in T₄: 30% more than RD and lowest (2.44 t/ha) in T₂: 20% less than RD. From the cost and return analysis, it was revealed that the highest gross return (Tk. 180000/ha) was obtained from T₄ treatment, gross margin (Tk. 100220/ha) was obtained from T₁ treatment and BCR (2.50) was obtained from T₂ treatment.

Growth and maturity pattern of different mustard species

P. Roy and F. Begum

Field experiment was conducted at the research field of Oilseed Research Centre (ORC), BARI, Gazipur during the rabi season of 2020-2021. There were nine treatments which were nine genotypes from three species of mustard viz. T₁: BARI Sarisha-14, T₂: BARI Sarisha-15, T₃: Advance line (*B. campestris*), T₄: BARI Sarisha-11, T₅: BARI Sarisha-16, T₆: Advance line (*B. juncea*), T₇: BARI Sarisha-13, T₈: BARI Sarisha-18 and T₉: Advance line (*B. napus*). The experiment was design in RCB with three replications. Seeds were sown in 4 November 2020 at Gazipur with a plot size of 3m x 4m. Fertilizers were applied at the rate of $N_{88}P_{34}K_{80}S_{28}Zn_3B_2$ kg ha⁻¹ in the form of urea, TSP, MOP, gypsum, zinc oxide and boric acid, respectively. Full amount of triple super phosphate, muriate of potash, gypsum, zinc oxide, boric acid and half of urea were broadcasted in the experimental plot at the time of final land preparation. The rest half of urea was applied in equal amounts at 30 & 55 days after sowing (DAS). Irrigation was applied as per requirement. Number of flower, total siliquae, and matured siliquae was counted at very six days interval from its first flowering. The maximum flowering was observed at 40 to 45 days, 46 to 50 days and 50 to 52 days for the species of *B.campestris*, *B. napus* and *B. juncea* respectively. In case of siliquae formation

genotypes of *B.campestris* took around 52 days whereas *B.juncea* and *B.napus* took around 70 days. Maturity observed at around 80 DAS, 100 DAS and 108 DAS for *B. campestris*, *B.juncea* and *B.napus* respectively. This is first year experiment. So for confirmation of the result need to be repeated next year.

Effect of weeding on mustard-rice mixed cropping system

M.M. Karim, F. Begum and P. Roy

Field experiment was carried out during rabi season on 2020-21 at Gazipur to find out the suitable weed management option of Mustard- Boro mixed cropping system and to calculate the cost and return of mixed cropping system. The experimental area of Gazipur belong to the Madhupur tract (AEZ 28). The experiment was laid out in Randomized Complete Block design with three replications. It was consisted with five treatments as follows: T₁= Pre-emergence herbicide application, T₂= Pre-emergence herbicide + One hand weeding at 25 (DAS), T₃= One hand weeding at 25 (DAS) T₄= Two hand weeding at 25 (DAS) and 35 (DAS), T₅= No weeding and T₆= Sole mustard. After 2 days of emergence herbicide (pendimethyline) application. The seeds of boro rice and mustard were sown in broadcast method in the experimental field. The lands were fertilized according to the treatment wise. Two-third urea and all the fertilizers of entire amount were applied during final land preparation as basal and ½ of rest of the urea was applied as top dress at 25 days after broadcasting. Remaining urea was applied after the weeding and gap filling of the rice seedling. Plant protection measure and all other management practices were done for mustard and boro rice as and when necessary. Mustard was harvested on 2 February 2021, whereas boro rice on 26 April, 2021 at Gazipur. Data on the different crop parameters were collected from the 10 sample plants. Economic analysis were also calculated to ascertain the efficiency of intercropping system. Rice equivalent yield (REY) was calculated by converting yield of component crops to the yield of rice on the basis of prevailing market prices of individual crops (Bandyopadhyay, 1984). Number and dry weight of weeds were recorded carefully. Weed control efficiency (WCE) was calculated according to following formula WCE (%) =

$$\left(\frac{A - B}{A} \right) \times 100 \text{ where. } A = \text{Dry weight of weeds in}$$

no weeding polts and B= Dry weight of weeds in treated plots. From the evidence of research the highest mustard yield (2.28 t/ha) and rice (4.54 t/ha. was of obtained from T₄ (Two hand weeding at 25 (DAS) and 35 (DAS) treatment and the highest gross margin (Tk.76700/ha) was from in the same treatment (T₄). So, Two hand weeding at 25 (DAS) and 35 (DAS) may be the appropriate option in Mustard- Boro mixed cropping system.

Insect pest management

Development of a management approach against flea beetle attacking mustard

M.A. Islam, T.S. Munmun and M.I. Islam

Field experiments were conducted during *rabi* , 2020-21 at ORC research field, BARI, Gazipur and Regional Agricultural Research Station, Jashore to record the incidence and estimate damage severity of flea beetle in mustard. In both location, the experiments were laid out in Randomized Complete Block Design (RCBD) having 3 replications and 6 treatments including control. The treatments were as follows: T₁= White sticky trap + Antario (Bt+abamectin) @ 1.0 ml/L of water, T₂= White sticky trap + Bio-chamak (*Celastrus angulatas* 1% EW) @ 2.5 ml/litre of water, T₃= White sticky trap+ Spraying of Biotrine (0.5% Matrine) @ 1.5ml/L of water, T₄= White sticky trap+ Spraying of Spinosad (Success2.5 SC) @ 1.2 ml/ L of water , T₅= Spraying of Nitro 505 EC (Chlorpyriphos+Cypermethrin) @ 1.0 ml/L of water, T₆= Untreated control. At Gazipur no flea beetle was observed during the cropping season. At Jashore, the treatment, Cypermethrin+ Chlorpyriphos (Nitro 505 EC) were more effective percent infestation reduction (67.58%) against flea beetle with higher yield (1.32 t/ha) and marginal benefit cost ratio(1.98).

Sesame (*Sesamum indicum* L.)

Varietal Improvement

Maintenance and evaluation of germplasm of sesame

M H Rashid and M A Latif Akanda

Sixty six entries including two check varieties of BARI Til-3 and BARI Til-4 were shown without replication each entry two rows with four meter long at Oilseed Research Centre, Gazipur. The seeds were sown on 11th March 2021 Gazipur. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of N P K S Zn, respectively. Intercultural operations were done as and when necessary. Data on days to 50% flowering, days to maturity were taken on plot basis. The seed of all the material collected and kept in cold storage for further use in breeding trial.

Evaluation of F₃, F₅ and F₆ generation of sesame

M H RASHID and M A LATIF AKANDA

F₃ generation of seven cross combinations, F₅ generation thirteen family and F₆ generation twelve family were evaluated at Gazipur during kharif-1, 2021. Seeds of F₃, F₅ and F₆ generations were sown on March 11, 2021. Spacing was 30cm between rows and 8cm between plants. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively. Intercultural operations were done as and when necessary. Data on days to flowering, days to maturity and seed yield/plant were taken. Desired plants from each cross combination were selected.

Considering plant growth, maturity, capsule size and number, seed color, disease and insect reactions, 25 plants from F₃, 65 plant from F₅ and 47 plant from F₆ were selected.

Observation trial of sesame

M H Rashid and M A Latif Akanda

Ten entries of sesame along with BARI Til-4 as check were evaluated at Joydebpur during Kharif-1, 2021. The seeds were sown on March 10, 2021. The lines were laid out in a randomized complete block design with 3 replications. Unit plot size was 3rows 4m long with the spacing of 40cm between rows and 8cm between plants. Recommended doses

of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively. Intercultural operations were done as and when necessary. Data on days to flowering days to maturity and seed yield per plot were taken on plot basis. The other yield contributing characters were recorded from 5 randomly selected plants of each plot. Recorded data were analyzed statistically.

The entries Ses FR-20 (Black) and Ses-MR-20(Black) gave the higher seed yield kg/hectare (1580kg and 1470 kg/ha respectively). Considering seed yield and other yield contributing characters, entries Ses FR-20 (Black) and Ses-MR-20(Black) were selected for the next yield trial.

Preliminary yield trial of sesame

M H Rashid and M A Latif Akanda

Twelve entries of sesame along with BARI Til-4 as check were evaluated at Gazipur during Kharif-1, 2021. The seeds were sown on March 10, 2021. The lines were laid out in a randomized complete block design with 3 replications. Unit plot size was 4rows 4m long with the spacing of 40cm between rows and 8cm between plants. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively. Intercultural operations were done as and when necessary. Data on days to flowering and maturity, and seed yield were taken on plot basis. The other yield contributing characters were recorded from 5 randomly selected plants of each plot. Recorded data were analyzed statistically.

The entries Ses-5 gave the highest seed yield (1498kg/ha) followed by Ses-JP-25(1470 kg/ha) and Ses-0570 (1400 kg/ha). Considering seed yield and other yield contributing characters, Ses-5, Ses-JP-25 and Ses-0570 were selected for regional yield trial.

Regional yield trial of sesame (Set -I)

M H Rashid and M A Latif Akanda

The seeds were sown on March 11, 2021. The lines were laid out in a randomized complete block design with 3 replications. Unit plot size was 4 rows 4m long with the spacing of 40cm between rows and 8cm between plants. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively. Intercultural operations

were done as and when necessary. Data on days to flowering and maturity, and seed yield were taken on plot basis. The other yield contributing characters were recorded from 5 randomly selected plants of each plot. Recorded data were analyzed statistically.

In Gazipur the entries Ses-0570 gave the highest seed yield (1580 kg/ha) followed by Ses-05115 (1567 kg/ha), Ses-05178 (1550 kg/ha) and Ses-79 (1430kg/ha). The over location the entries Ses-05115 gave the highest mean seed yield (1592 kg/ha) followed by Ses-65 (1548 kg/ha) and Ses-79 (1536 kg/ha). Considering seed yield, days to maturity and other yield contributing character the genotype Ses-05115, Ses-65 and Ses-79 were selected for adaptive trial.

Regional yield trial of sesame (Set -II)

M H Rashid and M A Latif Akanda

Nine entries of sesame along with BARI Til-4 as check were evaluated at Joydebpur during Kharif-1, 2021. The seeds were sown on March 12, 2021. The lines were laid out in a randomized complete block design with 2 replications. Unit plot size was 4 rows 4m long with the spacing of 40cm between rows and 8cm between plants. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively. Intercultural operations were done as and when necessary. Data on days to flowering and maturity, and seed yield were taken on plot basis. The other yield contributing characters were recorded from 5 randomly selected plants of each plot. Recorded data were analyzed statistically.

At Gazipur the entries Ses-FR gave the highest seed yield (1520 kg/ha) followed by Ses-MR-20 (1490 kg/ha) and Ses-0256 (1450 kg/ha). Over locations the entries Ses-FR-20, Ses-JP-69Y, Ses-0265 and Ses-MR-20 gave the higher yield than check. Considering seed yield and other yield contributing characters, Ses-FR-20, Ses-JP-69Y, Ses-0265 and Ses-MR-20 may be selected for adaptive trial.

Insect pest management

Development of IPM package against the major insect pests of sesame

M.A. Islam

The experiment was conducted during *kharif*, 2021 at ORC research field, BARI, Gazipur to find out the most effective management package(s) against major insect pests of soybean. The experiment was laid out in Randomized Complete Block Design (RCBD) having 3 replications and 5 treatments including control. The treatments were as follows: T₁(IPM Package 1) = Hand Picking of larvae + Perching + spraying Spinosad (Success 2.5 SC) @ 1.2 ml/L of water, T₂(IPM Package 2) = Hand Picking of larvae + Perching + spraying Bt-Kurstaki @ 0.5ml/L of water, T₃(IPM Package 3) = Hand picking of larvae + Perching +spraying Bio-chamak (*Celastris angulatas* 1% EW) @ 2.5 ml/litre of water, T₄ = Farmers practice (Spraying of Nitro 505 EC (Cypermethrin+ Chlorpyrifos)@ 1.0 ml/L of water,) T₅ = Untreated control. The treatment, Cypermethrin+ Chlorpyrifos (Nitro 505 EC) and also (White sticky trap + Perching+ Bio-chamak (*Celastris angulatas* 1% EW) were more effective against major insect pest of sesame.

Groundnut (*Arachis hypogaea* L.)

Varietal Improvement

Maintenance and evaluation of groundnut germplasm

K C Saha, M M Ali and M S Uddin

A total of 238 genotypes were grown in a non replicated trial at Gazipur to evaluate the collected materials for future use in the breeding program. The sowing date was 22 December, 2020. Seeds were sown in two rows of 4 m long plot with the spacing of line to line 30 cm and plant to plant 15 cm. Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of NPKSZnB respectively.

The ranges for days to 1st flowering, days to maturity, plant height, mature pods/plant, 100 kernel weight (g), shelling % and plot yield were 52-65 days, 124-149 days, 22-56 cm, 12-50, 30-65, 50-79 and 719-3981 kg/ha respectively. The highest coefficient of variation (CV %) was recorded for the character plot yield (35.48%). Minimum variation was observed in the character days to maturity. The seeds of the germplasm will

be grown in the next year and stored for using in the future breeding program.

Creation of genetic variability of groundnut through hybridization

K C Saha, M M Ali and M S Uddin

A total of 259 pods were harvested from 678 pollinated buds out of twenty crosses (Table 2). On an average 38% crosses were successful. The pollinated pods will be grown in the next Rabi season for F₁ confirmation. Two batches of five parental lines were sown on ten days interval in 24 December, 2020 and 03 January, 2021 at Joydebpur. The seeds of individual parents were planted in raised bed of 2 rows x 4 m long with the spacing of 50 and 20 cm between rows and plants respectively. After the flower initiation, the crosses have been attempted. The unopened matured buds were emasculated at afternoon (12.00 pm to 3.00 pm) and the emasculated buds were pollinated in the following morning (6.00 am to 8.00 am.).

Evaluation of segregating generations of groundnut

K C Saha, M M Ali and M S Uddin

Seeds of six cross combinations from F₁, 7 entries from F₂, 21 entries from F₃, 12 entries from F₄, 8 entries from F₅ and 4 entries from F₆ respectively were sown on December 22, 2020 at Joydebpur. Unit plot size was 4m long with required number of rows. Recommended doses of fertilizers were applied and necessary steps were taken to grow the crop uniformly.

On the basis of no. of mature pods, pod bearing nature, diseases and insect resistant 37, 32, 95, 56, 40 and 20 single plants were selected from F₁, F₂, F₃, F₄, F₅ and F₆ generations, respectively. A total of 37, 32, 95, 56, 40 and 20 single plants were selected from F₁, F₂, F₃, F₄, F₅ and F₆ generations respectively. The seeds from selected single plants of F₁ were collected and stored for advancing the generation as F₂ in the next season. On the other hand, the seeds from selected plants of F₂ were collected and stored according to the cross and generation will be advanced as F₃ generation. From the F₃ generation 95 plants were selected from 21 accessions and will be tested their performance as F₄ generation in the next season. From the F₄

generation 56 plants were selected from 12 accessions and will be tested their performance as F₅ generation in the next season. From the F₅ generation 40 plants were selected from 8 accessions and will be tested their performance as F₆ generation in the next season. From the F₆ generation 20 plants were selected from 4 accessions and will be tested their performance as observation trial in the next season.

Observation trial of groundnut (Set-I)

K C Saha, M M Ali and M S Uddin

Sixteen genotypes including two checks Dhaka-1 and BARI Chinabadam-8 were evaluated at Joydebpur during rabi 2020-21. Seeds were sown on 20 December, 2020 in RCBD design with three replications. Unit plot size was 2 rows 4 m long with the spacing of 40cm x 15cm between rows and plants respectively. Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively.

Maximum shelling percent were found in the genotypes ICGV 01105 (70%) and BARI Chinabadam-8 (70%). Highest pod yield (2900 kg/ha) was obtained from the genotype ICGV 07220 followed by the genotype ICGV 00351 (2830 kg/ha), ICGV 92229 (2806 kg/ha), BDGV 9112-2-1-2 (2690 kg/ha), ICGV 284 (2661 kg/ha) and ICGV 01105 (2623 kg/ha) which were 16%, 13%, 12%, 7%, 6% and 5% higher than the check variety BARI Chinabadam-8 respectively. Maximum number of mature pods per plant was observed from the entry ICGV 07220 (24). Highest 100 kernel weight (55 g) was obtained from the variety BARI Chinabadam-8. Considering the pod yield six genotypes ICGV 07220, ICGV 00351, ICGV 92229, BDGV 9112-2-1-2, ICGV 284 and ICGV 01105 have been selected for PYT.

Observation trial of groundnut (Set-II)

K C Saha, M M Ali and M S Uddin

Nineteen genotypes including two checks Dhaka-1 and BARI Chinabadam-8 were evaluated at Joydebpur during Rabi, 2020-21. Seeds were sown on 20 December, 2020 in RCBD design with three replications. Unit plot size was 2 rows 4 m long with the spacing of 40cm x 15cm between rows and plants respectively. Recommended doses of

fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively.

Highest pod yield (2983 kg/ha) was obtained from the genotype ICGV 864017 followed by the genotype BDGV 9112-5-1-1(2860 kg/ha), ICGV 93471(2860 kg/ha), BDGV 9112-2-1-1(2826 kg/ha), ICGV 88409(2740 kg/ha), ICGV 1352(2630 kg/ha), ICGV 07046(2410 kg/ha) and BDGV 7112-2-2-1(2356 kg/ha) which were 31%, 26%, 26%, 24%, 21%, 16%, 6% and 4% higher than the check variety BARI Chinabadam-8 respectively. Among these eight genotypes maximum duration is 139 days. BARI Chinabadam-8 takes 134 days to mature. Highest value for hundred kernel weight were found in the Beijing-3 (63g) followed by ICGV 1352 (61 g), ICGV 07406 (61g), ICGV 93471 (59 g), SM-14, ICGV 910168 (59 g), ICGV 88388 (59 g), ICGV 864017(59 g), TMV-2 (59 g) and BDGV 9112-2-1-1 (58g). Maximum number of mature pods per plant was observed from the entry ICGV 864017 (24). Considering the bold seeded, pod yield and duration eight genotypes ICGV 864017, BDGV 9112-5-1-1, ICGV 93471, BDGV 9112-2-1-1, ICGV 88409, ICGV 1352, ICGV 07406 and BDGV 7112-2-2-1 have been selected for PYT.

Observation yield trial of groundnut (Set-III)

M K Alam, M Kadir and M I Riad

The experiment was conducted at RARS, Jamalpur during Rabi 2020-2021 with 24 lines of groundnut including BARI Chinabadam-8 and BINA Chinabadam-4 as checks. The plot size was 8 rows 4m long. The experiment was laid out in RCBD with three replications. Seeds were sown on the 4th December, 2020 in 15 cm seed to seed and row was 30 cm apart from each. Fertilizers were applied @ 12:32:43:54:1.8 kg/ha of N: P: K: S: and Boron from Urea, TSP, MP, Gypsum and Boric acid.

Significance differences among the genotypes were observed for maximum yield contributing characters except primary branches, immature pod per plant and shelling%. Maturity ranged from 156-157 days. The highest maturity duration recorded in PN-2 line which is 156 day. The highest plant height and maximum primary branches were recorded in PN-04. The highest mature pod was found in check variety BARI Badam-9 (27). Seed

yield ranged from 2151-876 kg/ha. The line G-4 produced the highest nut yield 2151 kg/ha yield followed by NCGV-04096(2145 kg/ha) which was 46% and 44% higher yield than check varieties BARI Badam-9 and BINA Badam-4. Shelling % ranged from 78 to 71.5. The third highest yield was recorded in G5 (1818 kg/ha), which is 24% and 22 % higher yield than BARI Badam-9 and BINA Badam-4, respectively. These lines G-4, NCGV-04096 and G-5 may be selected for PYT in the next year.

Preliminary yield trial of groundnut (Set-I)

K C Saha, M M Ali, M S Uddin and M B Sarker

The experiment was conducted with seventeen groundnut genotypes including 2 checks as Dhaka-1 and BARI Chinabadam-8 at Joydebpur, Gazipur and RARS, Burirhat, Rangpur in a randomized complete block design with 3 replications. The date of sowing was 20 December, 2020 at Joydebpur and 24 November, 2020 at Burirhat. The Unit plot size was 6 rows 4m long with the spacing of 40cm between rows and 15 cm between plants. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKS Zn respectively.

Significant differences were observed among the genotypes for all the characters except days to 1st flowering studied at Joydebpur. Maturity duration ranged from 130-140 days. Highest number of mature pods/plant (29) was obtained by the entry ICGV 38-3. The range of hundred kernel weight was 42-60 g. Highest shelling percentage was recorded in the genotype Galachipa (69 %) and BARI Chinabadam-8 (69%). The genotype ICGV 38-3 produced maximum pod yield (2883 kg/ha) followed by ICGV SL-1 (2823 kg/ha), ISD 2914(2786 kg/ha), Choko 0314(2753 kg/ha), Tridana Cox'sbazar (2710 kg/ha), 14-103 (2573 kg/ha), 702-6-2-1(2426 kg/ha) which were 22%, 19%, 18%, 16%, 14%, 9% and 2% higher than the check variety BARI Chinabadam-8 respectively. Average days to maturity at two locations were almost similar to the check varieties. On an average the entry Tridana Cox'sbazar produced maximum pod yield (2841 kg/ha) followed by Choko 0314(2608 kg/ha), 702-6-2-1(2597 kg/ha), ICGV 38-3(2538 kg/ha), 14-103 (2499 kg/ha) and ISD 2914(2496 kg/ha) which were 15%, 6%, 5%, 3%, 1% and 1% higher than the check varieties.

Preliminary yield trial of groundnut (Set-II)

M K Alam and M Kadir

The experiment was conducted at RARS, Jamalpur during Rabi 2020-2021 with 12 lines of groundnut including BARI Chinabadam-8, BARI Chinabadam-8 and BINA Chinabadam-4 as checks. The plot size was 8 rows 4m long. The experiment was laid out in RCBD with three replications. Seeds were sown on the 3rd December, 2020 in 15 cm seed to seed and row was 30 cm apart from each. Fertilizers were applied @ 12:32:43:54:1.8 kg/ha of N: P: K: S: and Boron from Urea, TSP, MP, Gypsum and Boric acid.

Significance differences among the genotypes were observed for maximum yield contributing characters except plant height, mature pod per plant and immature pods per plant. The highest 50% flowering was recorded in BAG-19008 and required 73 days. Maturity ranged from 153-147 days. The lowest maturity required in BAG-19004(147 days). Seed yield ranged from 1801-1293 kg/ha. The line BAG-19008 produced the highest nut yield 1801 kg/ha yield which was 2%, 12% and 46 % higher yield than check varieties BARI Badam-8, BARI Badam-9 and BINA Badam-4. Shelling % ranged from 79 to 70. The second highest yield was recorded in check variety BARI Badam-8 (1763 kg/ha). The 3rd highest yield was recorded in BAG-19003, which is statistically significant and highest plant height. BAG-19003 produced 2% and 34 % higher yield than BARI Badam-9 and BINA Badam-4, respectively. BAG-19008 and BAG-19003 lines may be selected for RYT in the next year.

Regional yield trial of groundnut (Set-I)

K C Saha, M M Ali, M S Uddin and M B Sarker

The experiment was conducted at Joydebpur during Rabi 2020-21 with 18 promising genotypes of groundnut including 3 checks Dhaka-1, BARI Chinabadam-8 and BINA Chinabadam-4. The experiment was laid out in Randomized Complete Block design having three replications. The date of sowing was 20 December, 2020 at Joydebpur and 23 November, 2020 at Burirhat. The plot size was 4m x 2.4m. Spacing was 15cm seed to seed and 40 cm row to row. Recommended doses of fertilizers

were applied @ 80:65:60:20:4 kg/ha of NPKS Zn respectively.

Significant differences were observed among the genotypes for all the characters except days to 1st flowering studied at Joydebpur. Maturity duration ranged from 132-139 days. Highest number of mature pods/plant (28) was obtained from the entry ICGV 35-1. The range of hundred kernel weight was 42-62g. Highest shelling percentage (70) was recorded in the genotype 14-203, ISD 4114, TG-37 and ICGV-0207. Average days to maturity of two locations were varies from 133 to 138 days. The genotype TG-51 produced the highest yield (2723 kg/ha) followed by ICGV-0704 (2560 kg/ha), ICGV-87073 (2553 kg/ha), ICGV-95090 (2518 kg/ha), 14-203 (2467 kg/ha), ICGV-91176 (2436 kg/ha) and ICGV-0107(2397 kg/ha) over two locations which were higher than the check varieties.

Regional yield trial of groundnut (Set-II)

M K Alam and M Kadir

The experiment was conducted at RARS, Jamalpur during Rabi 2020-2021 with 12 lines of groundnut including BARI Chinabadam-8, Dhaka-1 and BINA Chinabadam-4 as checks. The plot size was 8 rows 4m long. The experiment was laid out in RCBD with three replications. Seeds were sown on the 4th December, 2020 in 15 cm seed to seed and row was 30 cm apart from each. Fertilizers were applied @ 12:32:43:54:1.8 kg/ha of N: P: K: S: and Boron from Urea, TSP, MP, Gypsum and Boric acid.

Significance differences among the genotypes were observed for maximum yield and yield contributing characters like, 50% flowering, days to maturity, plant height, mature pod per plant and immature pods per plant shelling% and seed yield. The highest 50% flowering was recorded in ICGV-93280 and required 72 days. Maturity ranged from 152-146 days. The lowest maturity required in BAG-19011(146 days). The highest plant height was observed in ICGV-07214. Shelling % ranged from 82 to 74. Seed yield ranged from 2057-1013 kg/ha. The line TG-37 produced the highest nut yield 2057 kg/ha yield which was 11%, 31% and 57% higher yield than check varieties BARI Badam-8, Dhaka-1 and BINA Badam-4. The second highest

yield was recorded in check variety BAG-14303 (1981 kg/ha). The 3rd highest yield was recorded in ICGV-07214, which is statistically significant and highest plant height. ICGV-07214 produced 17% and 41 % higher yield than Dhaka-1 and BINA Badam-4, respectively. TG-37, BAG-14303 and ICGV-07214 lines may be selected for adaptive trial of farmer's field in the next year.

Evaluation of large kernel groundnut line in char area in Jamalpur

M K Alam, M Kadir and M I Riad

The experiment was conducted at RARS, Jamalpur during Rabi 2020-2021 with 8 lines of groundnut including BARI Chinabadam-8, BARI Chinabadam-9 and Zhingabadam as checks. The plot size was 8 rows 4m long. The experiment was laid out in RCBD with three replications. Seeds were sown on the 11th November, 2020 in 15 cm seed to seed and row was 30 cm apart from each. Fertilizers were applied @ 12:32:43:54:1.8 kg/ha of N: P: K: S: and Boron from Urea, TSP, MP, Gypsum and Boric acid.

The mean performance of different lines at Jamalpur location is presented in table 04. Significance differences among the genotypes were observed for maximum yield contributing characters except immature pod per. Maturity ranged from 178-172 days. The highest plant height recorded in Zhinga Badam (42 cm) followed by PN-06 (37 cm). The highest primary branches recorded in PN-05 (12) which is followed by PN-08 (10.6). Shelling % ranged from 71 to 68. Seed yield ranged from 2236-1455 kg/ha. The line PN-6 produced the highest nut yield 2236 kg/ha yield as well as highest 100 large kernel weight followed by PN-01(2118 kg/ha) which was 6% , 21 % and 24% higher yield than check varieties BARI Chinabadam-8, BARI Chinabadam- 9 and Zhingabadam. The line PN-06 may be selected for adaptive trial in farmer's field in the next year.

Crop and soil management

Intercropping firingi with groundnut

P.Roy, F.Begum and M.M.Karim

An field experiment was conducted at the research field of Oilseed Research Centre, Bangladesh

Agricultural Research Institute, Gazipur during rabi season of 2020 -2021. There were five treatments viz. T₁ = Sole groundnut, T₂ = One row of firingi (15cmX10cm) in between two normal rows of g.nut (40cmX15cm), T₃ = Two rows of firingi in between two normal rows of g.nut, T₄= Two g.nut rows alternate with two rows of firingi & T₅=Firingi broadcast in between two normal rows of g.nut (40cmX15cm).The experiment was laid out in Randomized Complete Block Design with three replications. The unit plot size was 4m x 5m. Both the seeds of groundnut (BARI Chinabadam-8) and firingi (BARI Firingi-1) were sown on 3 December, 2020. Fertilizers at the rate of N₁₂P₃₁K₄₃S₅₅B_{1.5} kg/ha in the form of urea, TSP, MOP, gypsum and boric acid, respectively were applied for both sole groundnut & intercrop. Full amount of triple super phosphate, muriate of potash (MOP), gypsum, boric acid and half of urea were broadcasted in the experimental plot at the time of final land preparation. The rest half of urea was applied 40 days after seedling emergence. On the other hand, for sole firingi, fertilizers at the rate of N₈₀P₃₄K₆₈S₂₀ kg/ha in the form of urea, TSP, MOP, gypsum, respectively were applied. Full amount of triple super phosphate, muriate of potash and gypsum and half of urea were broadcasted in the experimental plot at the time of final land preparation. The rest half of urea was applied at 30 days after sowing (DAS). At harvest, the yield data was recorded plot wise. Yield of individual crop was converted to groundnut equivalent yield (GEY) considering prevailing market price of the crops according to Bandyopadhyay (1984). Marginal benefit cost analysis was also done.

Although intercropping reduced groundnut yield but total productivity was increased due to addition of firingi yield. Total productivity in terms of groundnut equivalent yield (GEY) (7.68 t/ha) was found to be highest from T₂ (One row of firingi (15cmX10cm) in between two normal rows of g.nut (40cmX15cm)) treatment while the lowest (5.24 t/ha) in T₄ (Two g.nut rows alternate with two rows of firingi). Highest benefit cost ratio (BCR) (9.50) was also recorded in T₂ treatment (one row of firingi in between two normal rows of g.nut).

Effect of seed priming on seed quality of groundnut

P. Roy, F. Begum and M.M. Karim

An experiment was started on 15 December 2020 under laboratory condition of ORC, BARI, Gazipur to study the effect of seed priming on groundnut seeds. Groundnut variety BARI Chinabadam-8 was used as test variety which was subjected to six seed priming treatments namely T₁- Control (No priming), T₂- seeds soaked in water for the period of 6 hours followed by air drying, T₃- seeds soaked in water for the period of 12 hours followed by air drying, T₄- seeds soaked in 1% boron solution (boric acid) for the period of 6 hours followed by air drying, T₅- seeds soaked in 1% KCl solution for the period of 6 hours followed by air drying and T₆- seeds soaked in 1% GA₃ solution for the period of 6 hours followed by air drying. The experiment was conducted in Complete Randomized Design (CRD) with three replications. Prior to the experimentation, about 10 grams of each salt (boric acid and calcium chloride) were dissolved in one litre of distilled water to prepare 1 per cent concentration solutions. On the other hand, one ppm GA₃ was prepared by dissolving 1 mg GA₃ in 1 litre distilled water. Subsequently seeds were soaked in respective salt concentrations at 1:5 ratios for 6 or 12 hours. Further they were decanted and surface dried for their original weight. Then seeds were placed on sand media in the plastic plate to let the seeds to be germinated and emerged. During this time the plastic plates were kept in room temperature. After 15 days, seedlings were counted. The following data were recorded: a. germination % b. root length (cm) c. shoot length (cm) d. Seedling dry weight e. Vigor index.

Among all the seed priming treatments, seed priming with soaking in water (hydro priming) was found to be the best priming treatment which was followed by priming using GA₃. Among all seed priming treatments soaking the seed for 12 hrs in water having more pronounced effect on germination behavior and vigour in groundnut seeds.

Validation of intercropping black cumin with groundnut at Sangu river bank of Bandarban hill district

M. T. Islam, M.T.Rahman and P. Roy

An experiment was conducted in a farmer's field of sangu river bank in Bandarban during the rabi season, 2020-2021. Four treatments viz. T₁: Sole groundnut, T₂: Sole black cumin, T₃: Groundnut + Black cumin (single row) and T₄: Groundnut + Black cumin (double row) were used for the experiment. It was laid out in randomized complete block design (RCBD) with three replications. The unit plot size was 5 m × 4.5 m. Local Groundnut (Tridana Badam) and Black cumin (BARI Black cumin-1) were used as testing material. For groundnut, spacing was 40 cm × 15 cm and in between two line of groundnut, black cumin seed were sown maintaining 10 cm distance from each other for single line. For double row of black cumin (T₄), 15 cm line-line and 10 cm plant-plant distance were maintained. Both seeds were sown on 21 November, 2020. Fertilizers were applied @ 15-35-20-15 kg N-P-K-S ha⁻¹ for groundnut. All fertilizers were applied as basal at the time of final land preparation in the form of urea, triple super phosphate, muriate of potash and gypsum respectively. Two times weeding and earthing up were done. The component crop was harvested on 12 March, 2021 and groundnut was harvested on 04 April, 2021. At harvest, the yield and yield attributes were recorded and analyzed statistically. Groundnut equivalent yield, LER and economic analysis were done for each treatment on a hectare basis considering the farm rate of crop. Groundnut equivalent yield (GEY) was calculated by converting the yield of black cumin to the yield of groundnut. Between intercropped treatments, single row of black cumin within paired rows of groundnut (T₃) showed higher groundnut equivalent yield (2503.69 kg ha⁻¹), highest land equivalent ratio (1.42), gross return (Tk. 125184 ha⁻¹), net return (Tk. 86084 ha⁻¹) and benefit cost ratio (3.20) over sole groundnut crop. The result showed that groundnut + black cumin (single row) intercrop system was most productive and profitable than sole groundnut cultivation in Bandarban region.

Validation of intercropping of chili with groundnut in haor areas

M. I. Nazrul and F. Begum

An experiment was conducted at MLT site, Moulvibazer during the year 2020-21. Three

intercrop combinations, T_1 = Groundnut sole, T_2 = Groundnut (100%) + 1 row of chilli at 40 cm spacing and T_3 = Groundnut + 1 row of chilli at 60 cm spacing were considered. The variety BARI Chinabadamm-8 and local chilli was used in this trial. The experiment was setup in randomized complete block design with three replications. The seed of groundnut were sown with maintaining the spacing of 40 cm \times 15 cm. The crop was fertilized as per fertilizer recommendation guide (FRG, 2018) BARC, Farm gate, Dhaka. The seeds and seedlings of groundnut and chilli were sown and transplanted on 5-9 December, 2020. Intercultural operations were done as and when necessary. There was no remarkable disease and pest attack. The chilli harvest duration was 15 February to 20 April 2021 and groundnut was harvested during 10-15 May, 2021. Data on yield components were collected from 10 plants selected at random in each plot and seed yield was recorded plot wise. Between two combinations, the highest pod yield (2.97 t ha⁻¹) was found in T_2 (Two normal rows groundnut+ 1 row chilli at 40 cm apart). On the contrary, in intercrop situation the yield of chilli 7.40 and 6.30 t ha⁻¹ was obtained in T_2 (Two normal rows groundnut+ 1 row chilli at 40 cm apart). On the contrary, in intercrop situation groundnut+ 1 row of chilli at 40 cm apart) and T_3 (Two normal rows groundnut+ 1 row chilli at 40 cm apart). On the contrary, in intercrop situation Two normal rows groundnut+ 1 row chilli at 40 cm apart). On the contrary, in intercrop situation groundnut + 1 row of chilli at 60 cm apart), respectively. The highest groundnut equivalent yield (9.87 t ha⁻¹) was also recorded in T_2 (groundnut+ 1 row of chilli at 40 cm apart) with maximum gross return (Tk. 592200ha⁻¹), gross margin (Tk. 461300 ha⁻¹) with higher BCR (4.52) than other treatments.

Validation of intercropping black cumin with groundnut in char land area

J. Rahman, F Begum, M Mkadir and M K Alam

A field experiment was conducted at Nawvanger char, sadar, Jamalpur, Bangladesh 24°57' north latitudes and 89°55' east longitudes. The annual average temperature of this district varies from maximum 36.63°C to minimum 9.4°C. Annual average rainfall is 1549.45mm (Regional Research

Report 2019-2020). The experimental site was of medium high land belonging to the agro-ecological zone Old Brahmaputra Floodplain under Agro-Ecological Zone 9 (UNDP & FAO, 1988). The experiment was conducted at the during rabi2020-2021 to identification the suitable row arrangement of black cumin with groundnut for higher productivity and profit in charland area. Design of the experiment was RCB with 03 (three) replications having the unit of plot 3.6m \times 3.2m. BARI Badam-9 and BARI Kalozira-1 were used as a variety in the experiment. Treatments included in the experiment were: T_1 =Sole groundnut, T_2 = One row of black cumin (15cm \times 15cm) in between two normal rows of groundnut (40cm \times 15cm), T_3 = Two rows black cumin in between two normal rows of groundnut, T_4 = Sole black cumin. $\frac{1}{2}$ N and all other fertilizers as basal. Rest N will be applied at 30-35 and 55-60 DAS after irrigation (FRG, 2018). Crops were sown on November 11, 2020 and harvested from April 02, 2021 to April 29, 2021. Intercultural operations like watering, weeding and spraying insecticides were followed as and when necessary. The highest combined yield of the crops (2.78 t ha⁻¹) was obtained two rows black cumin in between two normal rows of groundnut which was statistically similar to another intercropped practice. The highest LER (1.76) was obtained from T_4 (Two rows of black cumin in between two rows of groundnut.) treatment. The total yield of intercropped crops was greater than sole cropping shown by LER>1. The overall advantage of intercropping ranged from 56 to 76%. The highest land equivalent value of 76% was recorded from groundnut and black cumin intercropping arrangements indicated a yield advantage of 76% over sole crop.

Soybean (*Glycine max* L)

Varietal Improvement

Maintenance and evaluation of soybean germplasm

U. Kulsum

A total of one hundred seventeen germplasms were grown in a non-replicated trial at Gazipur to evaluate the materials for future use in the breeding program. Seven germplasms were discarded. The

sowing date was 05 January 2021. Seeds were sown in two rows of 4 m long plot with the spacing line to line 40 cm and plant to plant 10cm. Fertilizers were applied @ 25:35:55:18 kg per ha of NPKS, respectively from Urea, TSP, MP, and Gypsum. Two/three times roughing was done to maintain genetic purity of the germplasms. Other intercultural operations were done properly to obtain optimum plant growth.

A total of one hundred ten soybean germplasms were evaluated. The ranges for days to flowering, days to maturity, plant height, pods per plant, seeds per pod, pod length, hundred seed weight and branches per plant were 48-78 days, 94-142 days, 16-72 cm, 10-80, 2-3, 2-6, 6-18 gm and 1-7 respectively. The percent highest coefficient of variation (CV%) was recorded for the character branches per plant (44) followed by pods per plant (41) and hundred seed weight (38) respectively. Minimum variation was observed in the character days to flowering, days to maturity, and seeds per pod. The character plant height (cm) and pod length (cm) showed moderate variation.

Selection of entries based on the branches per plant, pods per plant, hundred seed weight (gm), plant height (cm) and pod length (cm) would be effective for future breeding programs of soybean.

Observation trial of soybean

U. Kulsum

Eleven entries including one check variety namely BARI Soybean-7 were evaluated in an RCBD design with two replications for seed yield and its components at Gazipur during rabi 2020-21. The unit plot size was 2 rows of 4 m long and the spacing was maintained 40 cm row to row and 10 cm plant to plant. The sowing date was 05 January 2021. Fertilizers were applied @ 25:35:55:18 kg per ha of NPKS respectively, from Urea, TSP, MP, and Gypsum. Intercultural operations were done as and when necessary. Data on days to flowering, days to maturity and seed yield per plot were taken on the plot basis. The other yield contributing characters such as plant height (cm), pod per plant, and hundred seed weight (g) were recorded from 5 randomly selected plants of each plot. Recorded data were analyzed statistically in R tools.

Statistically, a highly significant ($p < 0.01$) genotypic differences were observed for all the characters under studied. The minimum days to mature was observed for Burrun Juk (96 days) and maximum in MTD-453 (113 days). The highest plant height was recorded for USDA-85 (61 cm). The most dwarf entry was Burrun Juk (19 cm). Hundred seed weight was maximal in Burrun Juk (13 gm). The entry ST-1 produced the highest pods per plant (66). Besides, ST-1, MTD-453 and Richmond were over yielded 31%, 31%, and 8% respectively compared to the check variety BARI Soybean-7. So, considering yield and all the yield contributing characteristics, ST-1 and MTD-453 can be used for future trial.

Preliminary yield trial of soybean

U. Kulsum

Ten entries including two check varieties viz. BARI Soybean-6 and BARI Soybean-7 were evaluated in an RCBD design with three replications for seed yield and its component at Gazipur and Cumilla during 2020-21. The unit plot size was 4 rows of 4 m long and the spacing was maintained 40cm x 10cm apart. The sowing date was 05 January 2021 at Gazipur. Fertilizers were applied @ 25:35:55:18 kg per ha of NPKS, respectively from Urea, TSP, MP, and Gypsum. Intercultural operations were done as when necessary. The yield contributing characters were recorded from 5 randomly selected plants of each plot. Seed yield was converted into kg per ha. All the data were analyzed using statistical analysis package software R.

A significant difference was observed for yield and yield contributing characters at Gazipur. Among the entries BARI Soybean-7 was the most early maturing (104 days) and most dwarf one (28 cm). The entry USDA 4 and USDA 53 showed maximum plant height (50 cm). The highest number of pods per plant (63) was found in the entry USDA 53 while the minimum number in GMOT 13 (33). The highest seed yield was obtained from USDA 4 (1912 kg/ha) followed by USDA 95 (1779 kg/ha) which were 12% and 4% over yielded compared to the check variety BARI Soybean-7. Hundred seed weight was highest in BARI Soybean-7 (12 g) and minimum was in USDA 53 and USDA 72.

Regarding the multi-location trial, statistically significant difference was observed among the entries for both maturity and yield. In average maturity range from 103 days to 113 days. The entries GMOT 13 and USDA 40 took least days to mature while USDA 95 took maximum days to mature (113 days) in over location. Yield ranged from 2437-1513 kg/ha. The entry USDA 4 produced the highest yield (2437 kg/ha) which was 114% higher than the check variety BARI Soybean-7 in over location. Considering yield and other yield contributing characters over two locations, USDA 4 can be selected for future trial program.

Insect pest management

Screening of soybean entries against leaf roller and hairy caterpillar under natural field condition

M.A. Islam

Twenty one (21) entries of soybean including check were evaluated against leaf roller and hairy caterpillar infestation during 2020-21 at ORC, BARI, Gazipur to find out the resistant entries. The crop was sown on 30 December 2020. The unit plot size was 3m x 2m. The experiment was laid out in RCB design with 3 replications. Among the 20 entries, 06 (six) entries namely AGS-79, GMOT-17, AGS-95, USDA-92, A6785, Kush-2004 were recorded less infestation by leaf roller (less than 15%) and hairy caterpillar (less than 20%) which can be used in further breeding programs for developing leaf roller and hairy caterpillar resistant soybean varieties.

Development of a management package against major insect pests of soybean

M.A. Islam

Fields experiment were conducted during *rabi*, 2020-21 at ORC research field, BARI, Gazipur and Char Wapda, Subarnachar, Noakhali to determine the best management package and avoid the indiscriminate use of insecticides for controlling insect pest of soybean. In both locations, the experiments were laid out in Randomized Complete Block Design (RCBD) having 3 replications and 5 treatments including control.

The treatments were as follows: T₁(IPM Package 1) = Hand picking of larvae + Perching + Sex pheromone mass trapping of *Spodoptera litura*+ Application of Spinosad (Success 2.5 SC) @ 1.2 ml/litre of water, T₂ (IPM Package 2) = Hand picking of larvae + Perching + Sex pheromone mass trapping of *Spodoptera litura* + Application of SNPV @ 2 g/10 litre of water, T₃(IPM Package 3) = Hand picking of larvae + Perching + Sex pheromone mass trapping of *Spodoptera litura*+ Bio-chamak (*Celastrus angulatas* 1% EW) @ 1.0 ml/litre of water, T₄ = Farmers practice (Application of virtako 40 WG @ 0.5g/litre of water), T₅ = Untreated control.

The treatment, thiamethoxam+ Chlorantraniliprole (Virtako 40WG) and also (Hand picking of larvae + Perching + Sex pheromone mass trapping of *Spodoptera litura*+ Bio-chamak (*Celastrus angulatas* 1% EW) were more effective against major insect pest of soybean.

Relative susceptibility of soybean varieties to sucking pest, hairy caterpillar and leaf roller

M.A. ISLAM

The experiment was conducted during *rabi* season 2020-21 at ORC research field, BARI, Gazipur to identify the resistant soybean variety (ies) to sucking pest, hairy caterpillar and leaf roller. The experiments were laid out in Randomized Complete Block Design (RCBD) having 3 replications and 6 treatments including control. The experiment was laid out in a randomized complete block design with three dispersed replications. Five varieties of soybean were evaluated against sucking pest, leaf roller and hairy caterpillar infestation. The varieties were as follows: V₁ =Shohag, V₂ =Bangladesh soybean-4, V₃ =BARI Soybean-5, V₄ =BARI Soybean-6, V₅ =BARI Soybean-7.

As far as cultivars are concerned, BARI Soybean-5, BARI Soybean-6 were comparatively susceptible, while Bangladesh soybean-4 and BARI Soybean-7 were comparatively resistant, however, Shohag were moderately resistant.

Sunflower (*Helianthus annuus* L.)

Varietal Improvement

Maintenance and evaluation of sunflower germplasms

S H Habib

Forty-three sunflower accessions including two released variety BARI Surjamukhi-2 and BARI Surjamukhi-3 were grown at the research field of ORC, BARI Gazipur on 30th November 2020. Seeds were sown in 2 rows x 4 m long plot, where row to row distance was 50 cm and plant to plant distance was 25 cm. Fertilizers were applied @ 25:35:55:18 kg/ha of NPKS, respectively from Urea, TSP, MP and Gypsum. Half of the Urea and other fertilizers were applied at the time of final land preparation. The remaining half of the Urea was applied as top dress during flower primordial stage. Pollen of each entry within a plot was collected and bulked. Then crossing was done within the genotypes of that plot. After crossing, bagging was done properly. Other intercultural operations were done when necessary to obtain optimum plant growth.

The ranges for days to flower, days to maturity, plant height (cm), stem diameter (cm), head diameter (cm), number of seeds/ heads, seed yield/head (g) and 1000 seed weight (g) were 56-88, 95-137, 61.5-159.6 cm, 0.6 -1.90 cm, 8.2- 18.2 cm, 16-358, 1.4-28.6 and 23-80 g, respectively. The highest CV% was recorded for the character seed yield/head (57.8) followed by number of seeds/head (56.1). Minimum variation was observed for the characters days to flowering and days to maturity

Development of dwarf inbred lines in sunflower

S H Habib

Bulked seeds from each of fourteen S₆ sunflower genotypes were grown separately at ORC research field, BARI, Gazipur during rabi season 2020-21. Seeds of each genotype were sown on 1st December 2020 in a 8 X 4 m long plot where the spacing was 50 cm between the rows and 25 cm between the plants. Fertilizers were applied @ 90:35:80:30:3.6 and 1.8 kg/ha of NPKSZn and B, respectively, from urea, TSP, MP, Gypsum, Zinc sulphate and Boric acid. Half of the Urea and all other fertilizers were

applied at the time of final land preparation. The remaining half of the Urea was applied as top dress during flower primordial stage. To obtain optimum plant growth other intercultural operations were done properly when necessary. Each plot was covered with nylon net to protect out crossing. The plants in each genotype were allowed to intermate by rubbing the pollen collecting within the same genotype. Data was recorded on plant height (cm), head diameter (cm), stem diameter (cm), seeds/head, seed weight/head (g) and 1000 seed weight (g) from ten randomly selected plants in each entry.

The most dwarf genotype was GP04028 (73.80 cm) followed by genotype GP04012 (75.80 cm). While the tallest genotype was GP04016P16 (108.40 cm) followed by genotype GP04016SP (107.10 cm). Highest 1000 seed weight was produced by the genotype GP04015 (83 g) followed by genotype GP04026 (77 g). After discarding the unwanted plants, desirable heads were harvested in bulked which will be grown in the next rabi season and dwarf stature with high yield potential genotype will be selected.

Identification of parental lines for development of hybrid variety in sunflower

S H Habib

S₅ seeds of CN001, CN002, CN003 and S₇ seeds of Hysun-33 were used as experimental material in this experiment. Seeds were sown on 02 December 2020 in ORC research field in two rows of 4 m long plot with the spacing of 50 cm between the rows and 25 cm between plants. Anthers in flowers were observed visually. Plants having prominent anthers along with pollen grain in flowers were identified as pollen fertile plants. On the other hand, plants having rudimentary anthers without pollen grains or absent of anthers in flowers were identified as CMS plants. CMS plants were crossed with selected pollen fertile plant (male parent) and selected male fertile plants were selfed. Data on total number of plants, number of pollen fertile plants, and number of CMS plants were recorded.

In S₅ generation, cross between a CMS plant and a pollen fertile plant of hybrid CN001, CN002, and CN003 failed to produce 100% fertile or CMS plant. The hybrid which were produced more than

90% of CMS plant will be proceed for finding out a fertility restorer or CMS maintainer plant in the next year evaluation. Therefore, the hybrid CN003 will be discarded.

In S7 generation seven lines from different cross combination of hybrid Hysun-33 were evaluated and from the result it was found none of the cross combination could produce 100% fertile or CMS plant. Only three lines (Hysun L1, Hysun L5 and Hysun L6) produced more than 90% CMS plant and which would be evaluated in the next Rabi season for getting a maintainer or restorer plant of this hybrid.

Development of synthetic and composite sunflower variety

I. Development of synthetic sunflower variety

S H Habib

To develop synthetic sunflower variety, four sunflower inbred lines (P1: P-S-2-OP1, P2: P-S-2-OP3, P6: P-S-2-OP2, and P8: P-S-2-OPb) were selected as good general combiner in the rabi season 2018-19. All possible crosses (both cross and reciprocal cross)) were made between the inbreds in rabi season 2019-20. To develop Syn-1 generation, equal amount of seed from each cross and reciprocal cross were mixed and grown at the research field of ORC, BARI Gazipur on 28 November, 2020. Seeds were sown in 40 m x 22 m plot, where row to row distance was 50 cm and plant to plant distance was 25 cm. Fertilizers were applied @ 25:35:55:18 kg/ha of NPKS, respectively from Urea, TSP, MP and Gypsum. Half of the Urea and other fertilizers were applied at the time of final land preparation. The remaining half of the Urea was applied as top dress during flower primordial stage. Other intercultural operations were done when necessary to obtain optimum plant growth. The plants were allowed to intermate. During the crop growth period, the unwanted plants were rouged out to obtain uniformity and homogeneity in various morphological traits. From 20 randomly selected plants data were taken as on days to flower, days to maturity, plant height (cm), stem diameter (cm), head diameter (cm), seeds/ head, seed yield/head (g) and 1000 seed weight (g).

At maturity after discarding the unwanted plants, desirable heads were harvested in bulked which will be grown in the next rabi season as Syn-2 generation.

I) Development of composite sunflower variety

S H HABIB

The seeds from composite-4 were grown at the research field of ORC, BARI Gazipur on 29 November 2020. Seeds were sown in 630 m² plot, maintaining row to row distance 50 cm and plant to plant distance 25 cm. The plants were allowed to intermate by open pollination in isolation. Fertilizers were applied @ 25:35:55:18 kg/ha of NPKS, respectively from Urea, TSP, MP and Gypsum. Half of the Urea and other fertilizers were applied at the time of final land preparation. The remaining half of the Urea was applied as top dress during flower primordial stage. Other intercultural operations were done when necessary to obtain optimum plant growth.

During the growing season, the undesirable types were discarded to achieve uniformity and homogeneity in various morphological traits. The data were taken from 20 randomly selected plants on days to flower, days to maturity, plant height (cm), stem diameter (cm), head diameter (cm), seeds/ head, seed yield/head (g) and 1000 seed weight (g). After discarding the unwanted plants, desirable heads were harvested in bulk and kept for growing as composite-5 in the next rabi season.

Creating new genetic variability in sunflower using induced mutation: I) Evaluation of M_s mutant created by gamma radiation

S H Habib

Gamma radiation treated M5 seeds of sunflower variety BARI Surjamukhi-2 were used in this study. All the M5 seeds along with a total of 150 non-irradiated seeds were sown at the research field of ORC, BARI Gazipur on 30th November, 2020 to generate M5 population. The seed were grown as head to row method in 4 m long plot maintaining 50 cm×25 cm row to row and plant to plant distance, respectively.

Fertilizers were applied @ 25:35:55:18 kg/ha of NPKS, respectively from Urea, TSP, MP and Gypsum. Half of the Urea and other fertilizers were

applied at the time of final land preparation. The remaining half of the Urea was applied as top-dressing during flower primordial stage. Other intercultural operations were done properly to obtain optimum plant growth. Plot of each treatment was covered with nylon net to prevent outcrossing and selfing was done within the treatment. The entire M5 populations were grouped into very dwarf (plant height 45-65 cm), dwarf (plant height 65-100 cm), medium dwarf (plant height 100-120 cm), tall (plant height 120-150 cm), and very tall (plant height >150 cm) compared to the non-treated plants. The note on plant architecture such as big-headed mutant (head diameter greater than 17 cm), branched mutants (more than one head) and robust stem girth (stem diameter thicker than 1.5 cm) also were taken in this study as important criteria. Mature heads of each group were harvested separately and kept for growing as M6 generation in the next *rabi* season.

A total of 188 single mutants from five different groups were harvested and kept separately and will be grown and evaluated as M6 mutants in the next *rabi* season.

Creation of sunflower mutant through EMS: I) Evaluation of M₃ mutants

S H Habib

EMS treated (0.5% EMS treated) M4 seeds of sunflower variety BARI Surjamukhi-2 (obtained from *rabi* season 2019-20) were sown in head to row method at the research field of ORC, BARI Gazipur on 30th November, 2020 to generate M4 population. Along with a total of 150 non-treated seeds of BARI Surjamukhi-2 were also sown. The seed were grown in 4 m long plot in required number of rows maintaining 50 cm×25 cm row to row and plant to plant distance, respectively.

Fertilizers were applied @ 25:35:55:18 kg/ha of NPKS, respectively from Urea, TSP, MP and Gypsum. Half of the Urea and other fertilizers were applied at the time of final land preparation. The remaining half of the Urea was applied as top-dressing during flower primordial stage. Other intercultural operations were done properly to obtain optimum plant growth. Plot of each treatment was covered with nylon net to prevent outcrossing and individual head was self-fertilized using hand pollination by The entire M4

populations were grouped into very dwarf (plant height 45-65 cm), dwarf (plant height 65-100 cm), medium dwarf (plant height 100-120 cm), tall (plant height 120-150 cm), and very tall (plant height >150 cm) compared to the non-treated plants. The mutants with big-headed (head diameter greater than 17 cm), branched (more than one head) and robust stem girth (stem diameter thicker than 1.5 cm) also were selected in this study as important criteria.

A total of 294 single head from medium dwarf, dwarf, tall mutants were harvested and kept separately and will be grown and evaluated as M5 mutants in the next *rabi* season.

Molecular characterization of sunflower dwarf mutants by the expression analysis of *GA2ox1* and *ent-kaurenoic acid oxidase (HaKAO)* gene sequence

S H Habib and Md Motiar Rahman

The total RNA was extracted from gamma rays mutated dwarf sunflower mutant and first strand cDNA was derived from total RNA. To analyze dwarf mutants, *GA2ox1* gene (Michelotti *et al.*, 2009), *ent-kaurenoic acid oxidase* genes *HaKAO1* and *HaKAO2* (Fambrini *et al.*, 2011) were used. Another *KA01 (Hamutdw1)* primer pairs were designed from a gene sequence of *Helianthus annuus* mRNA *ent-kaurenoic acid oxidase* (Gene Bank accession number FR666915) using primer 3 plus software. Primers were designed to yield a 180, 238, 223 and 183 bp fragments for *GA2ox1*, *HaKAO1*, *HaKAO2*, and *Hamutdw1*, respectively.

Semi-quantitative RT-PCR analysis in this experiment revealed that GA-deactivation enzymes, *GA2oxs* and all KAO genes were expressed in Gy treated dwarf sunflower leaf (Figure 1). Expression levels of *GA2oxs*, and different *ent-kaurenoic acid oxidase* gene in Gy treated dwarf plants thus suggesting that these genes might play an important regulating role in transcription level in GA biosynthesis of the dwarf sunflower.

Crop and soil management

Effect of different irrigation level on dwarf type sunflower variety

P Roy, F Begum, M.T. Rahman and M.M.Karim

An experiment was conducted at the research field of Oilseed Research Centre (ORC), BARI, Gazipur during the rabi season of 2020-2021. There were five treatments viz. T₁: Irrigation at when necessary, T₂: Irrigation at vegetative and flowering stage, T₃: Irrigation at vegetative and seed development stage, T₄: Irrigation at flowering and seed development stage and T₅: Irrigation at vegetative, flowering and seed development stage. The experiment was design in RCB with three replications. Seeds were sown in 3 December 2020 at Gazipur with a plot size of 3m x 4m. Fertilizers were applied at the rate of N₈₈P₃₄K₈₀S₂₈Zn₃B₂ kg ha⁻¹ in the form of urea, TSP, MOP, gypsum, zinc oxide and boric acid, respectively. Full amount of triple super phosphate, muriate of potash, gypsum, zinc oxide, boric acid and half of urea were broadcasted in the experimental plot at the time of final land preparation. The rest half of urea was applied in equal amounts at 30 & 55 days after sowing (DAS). Irrigation was applied according to the treatment requirement. Plant samples were collected at one month interval starting from 20 DAS to measure the LAI (leaf area index), and total dry weight content. Percentage oil content was estimated for each treatment after harvesting the crop. The maximum seed yield (1.94t/ha) was recorded in T₁ treatment (Irrigation as and when necessary) which was statistically similar to T₅ treatment (1.91 t/ha) (Irrigation at vegetative, flowering and seed development stage). But the maximum gross margin (Tk126000/ha) and BCR (2.49) were obtained from T₅ treatment. The maximum oil content (38.50) was recorded from T₁ treatment followed by T₅ treatment (38.00).

Effect of different transplanting time on yield and seed quality of sunflower variety

P.Roy and F.Begum

An experiment was conducted at Oilseed Research Centre, BARI, Gazipur during rabi season of 2020-21. The experimental site belongs to the agro-ecological zone Ganges Tidal Floodplain (AEZ-13). The soil type is medium high land and soil texture is loamy. The treatments of the experiment were five dates of transplanting of sunflower seedlings viz., T₁ = 5 November 2020, T₂ = 15 November 2020, T₃ = 25 November 2020, T₄ = 5 December 2020 & T₅ = 15 December 2020. For all

the treatments 15 days old seedlings were transplanted. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 5 m x 4 m. The variety of sunflower was BARI Surjamukhi-3. Seedlings of sunflower were transplanted with spacing 50 cm row to row distance and 25 cm plant to plant distance. Fertilizers were applied in the experiment field at the rate of 200-180-170-170-10-12 kg/ha urea TSP, MOP, gypsum, zinc sulphate and boric acid respectively along with 8-10 t/ha cowdung (FRG, 2012). Half of urea, all other fertilizers and cowdung will be applied as basal. The rest half amount of urea will be applied as side dressing in two equal installments, one at 20-25 days after seedling emergence (DAE) and the other at 40-45 DAE (before flowering). Irrigation was applied for three times and other intercultural operations were done as when necessary following the recommended production technologies of the crops (BARI, 2017). Data were collected on different parameters namely, phenology (days to maturity and field duration), plant population, plant height, head diameter, number of seed/head, seed weight/head, thousand seed weight and plot yield. The plot yields were then converted into ton/hectare. Experimental results showed that transplanting time had significant effect on plant height, head diameter, number of seeds/head and seed yield. Highest seed yield (1.80 t/ha) with higher no. of seed/plant and higher seed weight was found in T₃ treatment (25 November). The lowest yield (1.10 t/ha) was recorded in T₁ treatment (5 November). The maximum matured seed number (1018) and the highest 1000 seed weight (81.1g) were obtained from T₃ (25 November) treatment. Sunflower could be cultivated through transplanting at 25 November just after harvesting of T.aman rice in southern region of Bangladesh.

Intercropping of pea and kheshari as vegetables and fodder crop with dwarf type sunflower variety

P. Roy, F.Begum and M.M.Karim

A field experiment of intercropping pea and kheshari with sunflower was conducted in Oilseed Research Centre, BARI, Gazipur during rabi season of 2020-21 to find out the optimum row arrangement of pea and kheshari as intercrop with sunflower for higher

productivity and return. Six treatments were T_1 = Sole sunflower, T_2 = One row of gardenpea in between two normal rows of sunflower (50cmX25cm), T_3 = Two rows of gardenpea in between two normal rows of sunflower, T_4 = One row of kheshari in between two normal rows of sunflower (50cmX25cm), T_5 = Two rows of kheshari in between two normal rows of sunflower & T_6 = Broadcast kheshari in between two normal rows of sunflower. Although intercropping reduced sunflower yield but total productivity was increased due to addition of pea and kheshari yield. Total productivity in terms of sunflower equivalent yield (SEY) (7.02 t/ha) was found to be highest from T_3 (two rows of pea in between two normal rows of sunflower treatment while the lowest (1.80 t/ha) in T_1 (sole sunflower). Highest benefit cost ratio (BCR) (4.0) was recorded in T_2 treatment (one row of gardenpea in between two normal rows of sunflower) with highest gross margin (Tk.263905/ha).

The experiment was laid out in Randomized Complete Block Design with three replications. Both the seeds of sunflower (BARI Sunflower-3), kheshari (BARI Kheshari-4) and gardenpea (BARI Motor-3) were sown on 1 December, 2020. Fertilizers at the rate of $N_{88}P_{34}K_{80}S_{28}Zn_3B_2$ kg ha⁻¹ in the form of urea, TSP, MOP, gypsum, zinc oxide and boric acid, respectively. Full amount of triple super phosphate, muriate of potash, gypsum, zinc oxide, boric acid and half of urea were broadcasted in the experimental plot at the time of final land preparation. Yield of individual crops was converted to sunflower equivalent yield (SEY) considering prevailing market price of the crops according to Bandyopadhyay (1984). Marginal benefit cost analysis was also done. Total productivity in terms of sunflower equivalent yield (SEY) (7.02 t/ha) was found to be highest from T_3 (two rows of pea in between two normal rows of sunflower treatment while the lowest (1.80 t/ha) in T_1 (sole sunflower). Highest benefit cost ratio (BCR) (4.0) was recorded in T_2 treatment (one row of gardenpea in between two normal rows of sunflower) with highest gross margin (Tk.263905/ha).

Effect of different storage containers on the seed quality of sunflower

P.Roy, F.Begum and M.T.Rahman

Experiment was conducted at the Central laboratory of Oilseed Research Centre, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur-1701 during the period from December to May 2020-21. The experiment was laid out in Factorial Complete Randomized Design (CRD) with three replications. Seeds were stored in ambient condition. Eight storage periods viz. i. October, ii. November, iii. December, iv. January, v. February, vi. March, vii. April and viii. May and six package system viz. One plastic container and five levels of polythene bags with different thickness (0.02mm, 0.04mm, 0.06mm, 0.08mm, and 010 mm) were used as experimental treatment. Storage period commenced on 1 October 2020 and data were taken in every one month interval on different physiological observations. Fresh seeds were collected from field office, Oilseed Research Centre of Bangladesh Agricultural Research Institute. One sunflower variety (BARI Sunflower-2) was used for the experiment. Seeds were stored in different air tight packing system according to the treatments at room temperature (25±1°C) from October 2020 to May 2021. The moisture percentage of experimental seed was 10% at initial stage. Seed moisture percentage was noted in one month interval of each treatment. Seed moisture content was determined by the Farm point Moisture Analyzer.

Seedlings were counted every day up to the completion of germination at ten day. The following data were recorded: a. germination % b. root length (cm) c. shoot length (cm) d. vigor index.

Thicker diameter polythene bag showed the maximum germination capacity with high germination percentage and vigour index; whereas thinner polythene bag showed the lowest seed germination capacity during the testing period. The highest moisture content and abnormal seedlings were recorded in thinner polythene bag; whereas the lowest values of these parameters were recorded in plastic container. The seed moisture content was increased with advanced of storage period. Germination percentage, vigour index, oil content in seed were decreased with the increase of storage periods. Among the six containers, plastic

container and polythene bag with 0.06-0.10 mm diameter polythene bag were the best storage container/bag for sunflower seed storage for long time.

Disease management

Pathogenicity test of *Sclerotium rolfsii* isolates causing collar rot disease of sunflower

N. A. SULTANA

The experiment was conducted at ORC net house of BARI, Gazipur during 2020-21 cropping season to test the pathogenicity of different isolates of *S.rolfsii* causing collar rot of sunflower under in-vivo (pot culture) condition. The isolates were collected in salt affected costal areas of Patuakhali and Khulna district of Bangladesh. Twenty six isolates were considered as a treatment. Isolates were tested for their ability to cause collar rot disease of sunflower by soil inoculation method. Among 26 isolates, 5 caused 100% disease incidence in artificial inoculated condition. So from the above result it was noticed that all the isolates of *S. rolfsii* were found to be pathogenic but in some cases, disease delayed due to their degree of pathogenicity.

Screening of sunflower germplasm/cultivars for tolerant/resistant against *Sclerotium rolfsii* through artificial inoculation

N. A. Sultana

An experiment was conducted at Oilseed Research Centre, Gazipur during 2020-2021 to find out resistant lines of Sunflower against stem rot disease. Thirty four different lines were screened using artificial inoculations under net house and BARI surjomukhi-2 and surjomukhi-3 were used as uninoculated control. No genotype was identified as being immune to the disease. Among the test lines, six lines (Gp-04030, BD 9389, BD931, BHAC-S7-04028, SUN-W-s7-101 and Sunking) showed moderately susceptible reactions (MS) and rest of the genotypes showed susceptible reactions (S) against the disease through artificial inoculation conditions.

Insect pest management

Survey on the insect pests of sunflower and documentation of their natural enemies

M.A. Islam

The survey was conducted during *rabi* 2020-21 at research field and laboratory of Oilseed Research Center BARI, Gazipur, and farmers field of Kuakata, Patuakhali to record the insect pests of sunflower with their natural enemies. At each location, three sunflower fields were taken each of which was about one acre in size. The insects were graded as major and minor on the basis of their population density per plant, nature and extent of damage of the crop and the yield reduction. The insect pests were also grouped as leaf eater, sap sucker, pollinator, natural enemy on the basis of their feeding behavior. Twenty two species of insect pests, five species of natural enemies, three species of pollinators and three species of birds were found to infest sunflower crop at their different growth stages. Among the recorded pest species, four insect species namely, hairy caterpillar, *Spilarctia oblique*; common cutworm, *Spodoptera litura*; whitefly, *Bemisia tabaci*; Thrips, *Frankliniella schultzei* and two birds Rose ringed parakeet, *Psittacula krameri*; Blue rock pigeon, *Columba livia*; were considered as the major pests, while the rests were of minor importance on the basis of population densities per plant, nature and extent of damage and yield reduction. The major beneficial insects are Hover fly, *Syrphus spp.*; Spiders, natural enemies are Coccinellids and the major pollinators are Honey bee, *Aphis mellifera*; Carpenter bee, *Xylocopa spp.* Most of the major and minor pests appeared in the crop during vegetative to flowering stages (30-70 Days after sowing) and the maximum insect population and their infestation occurred during vegetative and flowering stages of the crop.

Minor oilseeds

Linseed (*Linum usitatissimum*)

Varietal Improvement

Maintenance and evaluation of linseed germplasm

M H RASHID and T A MUJAHIDI

The experiment was carried at the research field of ORC, BARI, Joydebpur during rabi 2020-21 with forty genotypes of Linseed including the released variety Neela. Seeds were sown on November 29, 2020. The unit plot size of each genotype/line was 4m long with 4 rows with 40cm x 10cm spacing between rows and plants respectively. Fertilizers were applied @ 120: 80: 60: 40: 4:1 kg/ha of N: P: K: S: Zinc and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Borax. All the fertilizers were applied during the final land preparation except urea. The urea was applied at vegetative (20 days after germination) and reproductive (40 days after germination) stages in two splits. Other intercultural management was done properly and when it was necessary.

The highest % CV was recorded for the parameter 10 plant yield (g) followed by plot yield and number of pods/plant.

Crop and soil management

Performance of selected genotypes of linseed under rainfed condition

F. Begum, M.T. Rahman, P. Roy and M.M. Karim

An experiment was laid out in field semi controlled condition at Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during 2020-21. Sixteen genotypes (BD 7142, Lin 603, Chapi, Lin 1203, Lin 103, JL-3, MEGR, BD 7146, BD 7146, Lin 1507/2, Lin 803, Lin 1308, JL-2, Tangail, BD 10703, Lin 303, Neela) were used. The experiment was laid out in Randomized Complete Block Design with three replication. Seeds were sown on 04 December 2021. Fertilizers at the rate of N₃₆P₂₅K₂₅ kg/ha in the form of urea, TSP and MOP, respectively were applied. Full amount of triple super phosphate, muriate of potash (MOP) and half of urea were broadcasted in the experimental plot at the time of final land preparation. The rest half of urea was applied 30 days after sowing. Soil

moisture measured by soil moisture meter (Model – TDR 200). Rainfed condition was maintained by restricting irrigation and plants were re-irrigated when they showed signs of wilting or leaf rolling. Besides, no rainfall occurred during crop production periods. After germination, plants were counted and excess plants were removed to maintain optimum plants/m² in each plot. The genotypes were harvested at maturity. Data were collected on days to flowering & maturity, total dry matter, yield contributing characters and yield. Rainfed/drought stress showed significant influence on growth, yield contributing characters and yield. Water stress (rainfed condition) had significant effect on the yield components and seed yield of linseed genotypes. The highest seed yield (1165kg/ha) was obtained from Lin103 genotype and the lowest seed yield (775 kg/ha) from BD7146. Among the different genotypes, Lin103, Lin1203, Chapai, Lin303 and Tangail performed better under rainfed condition.

Screening of linseed genotypes against salinity

F. BEGUM, P. ROY and I. M. AHMED

An experiment was conducted from 12 December 2020 to 26 December 2020 (2 weeks) at the laboratory (modified Hoagland solution) of Oilseed Research Centre, Bangladesh Agricultural Research Institute (BARI). Twenty four genotypes of linseed viz., Neela, Lin-1507/2, Lin-1903, Lin-2403, Lin-1703, Lin-603, JL-3, Lin-1203, Lin-503, Lin1403, lin-303, Lin-703, Lin1503/2, Lin-1303, Lin-803, MCGR, lin-103, JL-2, CHADNI, Zin-C-2016, Lin.C-2017, Lin-T-2017, Lin-Bd-2018, Lin-H 2018 were used. The experiment assessed the germination percentage and seedling growth (length and dry weight) of linseed genotypes at various (control, 4, 8 and 12dS/m) salinity levels. The salt solution was prepared by dissolving calculated amount of NaCl in Hogland solutions. The pH of solution was maintained at 6. Plastic pots with a diameter of 10 cm and a height of 9 cm were used. The pots were arranged in a completely randomized design (CRD) with four replications. Each pot was supplied with 500 ml of the respective treatment solution having cotton gauge which covered the lid with small holes through which the roots can reach the solution. Seeds were sown on the lid of the plastic pots. The germination count was performed after 72 hours of sowing of seeds. A seed was considered to be germinated

when both the plumule and the radicle emerged > 0.5cm. After 15 days, the shoot and the root length of ten randomly selected seedlings from each replicate were measured following a draftsman ruler (Azhar and McNeilly, 1987). Seed quality such as percent of germination, root-shoot length and total dry weight were recorded (ISTA, 1999)

$$\text{Germination percentage (GP)} = \frac{a}{b} \times 100$$

Where: a = Number of seeds germinated

b = Total numbers of seeds used

The plants were then collected from the pots and the following parameters were measured

- i. Root Length (cm).
- ii. Shoot Length (cm)
- iii. Total dry matter/plant(mg)

Laboratory screening of 24 linseed genotypes for salt tolerance at germination and early seedling growth indicated a large variation among genotypes. Also, there were differences among the linseed genotypes for salt tolerance and found that, eight lines viz. Lin-2403, Lin 1507/2, Lin103, Lin 1703, Lin 1403, Lin 603, Lin 803 and Lin-703 performed good to high salt concentrations than the others while Lin 1903 and Neela were highly susceptible.

Niger (*Guizotia abyssinica*)

Varietal Improvement

Maintenance and evaluation of niger (*Guizotia abyssinica*) germplasm

M H Rashid and T A Mujahidi

The experiment was carried at research field of ORC, Joydebpur during rabi 2019-20 with twenty genotypes of Niger. Seeds were sown on November 29, 2020. The unit plot size of each genotype/line was 4 rows 4 meter long maintaining 40cm and 10cm spacing between rows and plants respectively. Fertilizers were applied @ 120: 80: 60: 40: 4:1 kg/ha of N: P: K: S: Zinc and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Borax. All the fertilizers were applied during the final land preparation except urea. The urea was applied at vegetative (20 days after germination) and reproductive (40 days after germination) stages in two splits. Other intercultural management was done properly.

The highest % CV was observed for the parameter 10 plant yield followed by branches per plant.

Collected seeds were stored properly to use for research work in the next year.

Observation trial of niger (*Guizotia abyssinica*)

M H Rashid and T A Mujahidi

The trial was carried out at ORC, BARI, Joydebpur during rabi 2020-21 with 6 genotypes including the check variety Shova. Seeds were sown on November 29, 2020. Each genotype/line was grown in a 6 rows 4m long unit plot maintaining 40cm and 10cm spacing between rows and plants respectively. Fertilizers were applied @ 120: 80: 60: 40: 4:1 kg/ha of N: P: K: S: Zinc and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Borax. All the fertilizers were applied during the final land preparation except urea. The urea was applied at vegetative (30 days after germination) and reproductive (70 days after germination) stages in two splits. Other intercultural management was done properly.

Among the genotypes the most dwarf genotypes were Nig-3606 and the tallest entry was check Shova. The maximum yield (kg/ha) were obtained from Nig-3706 followed by check Shova

Safflower (*Carthamus tinctorius*)

Varietal Improvement

Observation trial of safflower (*Carthamus tinctorius*)

M H Rashid and T A Mujahidi

The trial was carried out at ORC, BARI, Joydebpur during rabi 2020-21 with 5 genotypes including the check variety BARI Saff-1. Seeds were sown on November 29, 2020. Each genotype/line was grown in a 4 rows 4m long unit plot maintaining 40cm and 10cm spacing between rows and plants respectively. Fertilizers were applied @ 120: 80: 60: 40: 4:1 kg/ha of N: P: K: S: Zinc and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Borax. All the fertilizers were applied during the final land preparation except urea. The urea was applied at vegetative (30 days after germination) and reproductive (70 days after germination) stages in two splits. Other intercultural management was done properly.

Among the genotypes the most dwarf genotype were SAF-503. The maximum yield (kg/ha) were obtained from SAFF-T-2017.

04

SPICES CROPS



Onion

Varietal development

Collection, conservation and evaluation of onion germplasm

The present experiment was conducted to select superior winter onion germplasm for higher yield at Spices Research Centre, Shibganj, Bogura during 2020-2021. Twenty-three onion genotypes along with BARI Piaz-4 as check were used in this study. The experiment was laid out in alpha lattice design with three replications. Quite a few genotypes out yielded the check entry BARI Piaz-4. Considering yield and other attributing traits the genotypes Ac Bog 418, Ac Bog 415 and Ac Bog 410 were found promising.

Evaluation and selection of poly-crossed onion population

The field experiment was carried on at Regional Spices Research Centre, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during the month from November 2020 to April 2021. Four selected polycrossed third generation onion population were evaluated for bulb production. Variations among onion populations were observed in respect to plant and leaf production, bulb size and bulb yield. The population PC₃Gaz 001 gave the highest bulb yield (10.10 t/ha) while the lowest yield (6.35 t/ha) was obtained from PC₃Gaz 003. But uniformity in respect of color and shape was observed, still several shapes were found in each population. Bulbs from all genotypes need to sort on the basis of phenotypic parameters and further evaluation is required after seed production from the selected desired bulbs maintaining proper isolation with special care. Trial is to be continued.

Improvement of poly crossed onion population through mass selection

Additive and non-additive gene interaction can enhance by poly-crossing and mass selection. Third generation locally polycrossed bulb population of onion were grown in Regional Spices Research Center, Gazipur during 2020-21. Mean heading days of the poly-crossed populations was 77 days. Maximum seed set percentage was recorded from PC₃ Gaz 001 (72.41%) and minimum from PC₃ Gaz 003 (60.14%). Total 1026.23 g seeds were harvested from four different poly-crossed populations.

Development of diverse onion germplasm through hybridization

An experiment was conducted to produce F₂ seeds from F₁ bulbs with the main goal to develop diverse onion germplasm through hybridization at Spices Research Centre, Shibganj, Bogura during 2020-2021. BARI Piaz-1, BARI Piaz-4 and BARI Piaz-6 were used in this study. Diallel mating design was followed for crossing during the season 2018-2019. An amount of approximately 90-440 g seeds were harvested from the F₁ bulbs of six segregating population.

Advance yield trial of winter onion (*Allium cepa* L.)

A field experiment was laid out at Spices Research Sub-Centre (SRSC), Bangladesh Agricultural Research Institute (BARI), Faridpur, Bangladesh during 2020-2021. Three promising onion lines such as AC Bog 413, AC Bog 426 and AC Bog 430 were tested under the study to identify superior line/s for conduction Regional Yield Trial (RYT). The check variety used in the trial was BARI Piaz-1. The advanced yield trial (AYT) was evaluated in

a randomized complete block design with three replications. The results revealed that promising onion lines/variety studied differed significantly on yield attributes, yield and quality of onion. The promising line AC Bog 413 had superior in incidence of bolting (0.00%), disease severity (19.25%), polar diameter of bulb (4.68 cm), equatorial diameter of bulb (4.12 cm), individual bulb weight (35.31 g), split bulb (0.14%) and fresh yield (19.85 t/ha) over the rest promising lines & BARI Piaz-1. The AC Bog 413 was followed by AC Bog 430 in incidence of bolting (8.41%), disease severity (26.77%), polar diameter of bulb (3.20 cm), equatorial diameter of bulb (3.89 cm), individual bulb weight (26.74 g), split bulb (9.65%) and fresh yield (16.74 t/ha). However, the AC Bog 430 showed the minimum maturity date (100.02 days), the highest dry matter content of bulb (20.53%), total soluble solid content (19.88 °brix) and dry yield of bulb (3.43 t/ha). The AC Bog 413 gave around 50% higher fresh bulb yield than that of BARI Piaz-1 while AC Bog 430 obtained 42.32% & 20.77% higher dry bulb yield than that of BARI Piaz-1 and AC Bog 413. Anyway, the BARI Piaz-1 had stronger pungency (5.00) which was followed by AC Bog 426 (4.50). The lowest pungency was observed in the AC Bog 413 (3.50). All promising lines/check variety exhibited similar performance in firmness of bulb (9.00). The AC Bog 413 expressed pink red skin colour and reddish flesh colour of bulb. Moreover, BARI Piaz-1, AC Bog 426 and AC Bog 430 exhibited bronze red skin colour but white flesh colour of bulb. The AC Bog 413 showed torpedo shape of bulb while BARI Piaz-1, AC Bog 426 and AC Bog 430 demonstrated flat shape of bulb. Finally, the promising onion lines AC Bog 430 and AC Bog 413 were found as superior lines for conducting RYT of winter onion.

Searching of male sterile and maintainer lines of onion

An experiment was conducted to search male sterile and maintainer lines of onion at Spices Research Centre, Shibganj, Bogura during 2020-2021. F₁ (AC Gaz 379) were used in this study to make cross with two released variety BARI Piaz-4 and BARI Piaz-6 along with seventeen other onion lines. Approximately 2 g of seed was harvested

from each cross which will be tested in the next season.

Generation advancement of onion for the development of inbred lines

An experiment was conducted to Advance S₀ Bulb to S₁ Seed generation of onion for inbred line development at Regional Spices Research Centre, BARI, Gazipur during 2020-21. Twenty nine collected onion germplasm were characterized and evaluated in this experiment. Each Germplasm were simultaneously allowed for selfing and open pollination. The highest seed set (%) was recorded from Ac Bog 413 (80.2 %). The highest self-seeds was recovered from Ac Bog 413 (10g) which was followed by Ac Gaz 380 (8 g), Ac Gaz 384 (8 g), Ac Bog 417 (8 g), Ac Bog 419 (8 g), Ac Bog 424 (8 g), Ac Bog 425 (8 g). The maximum open-pollinated seeds were recorded from Ac Bog 413 (261 g) whereas the mean open-pollinated seeds per plot were 78.76 g.

Advancing S₁ seed to S₁ bulb generation of onion

An experiment was conducted to Advance S₁ seed to S₁ bulb generation of onion for Inbred line development at Regional Spices Research Centre, BARI, Gazipur during 2020-21. Thirteen collected onion lines were grown for advancing seed to bulb generation. Total 57.35 kg Bulb were collected from thirteen onion lines and preserved for advancing generation in the coming year.

A performance study on the growth, yield and quality of negi onion (*Allium fistulosum*) genotypes

A study was conducted at Spices Research Sub-Centre (SRSC), Bangladesh Agricultural Research Institute (BARI), Faridpur, Bangladesh during 2020-2021 to see the performance on growth, yield and quality of two Negi onion genotypes (AF Far 002 & AF Far 003) in Bangladesh conditions. The genotypes were introduced in Bangladesh from Japan by a group of Scientists under Spices Research Centre (SRC), BARI, Shibganj, Bogura in January, 2020. In the study the BARI Pata Piaz-1 was used as check variety. The performance trial was carried out in randomized complete block design with three replications. The study revealed that both genotypes of Negi onion showed good

performance in Bangladesh conditions on growth, yield and quality aspects. The parameters studied under the trial were also significantly affected by the genotypes/check variety. More or less both genotypes exhibited superior performance over the check variety BARI Pata Piaz-1. The genotype AF Far 002 had the highest plant height (75.07 cm) and length of blanched pseudostem (25.13 cm) followed by the genotypes AF Far 003 (52.45 cm and 14.01 cm), respectively. While the maximum number of leaves (8.85), diameter of pseudostem (25.68 cm), weight of single pseudostem (100.70 g), dry matter content of pseudostem (16.53%), total soluble solid content (12.80 °brix), pungency (4.50) and fresh yield of pseudostem (18.20 t/ha) were recorded in the genotype AF Far 003 followed by the genotype AF Far 003 (8.58, 17.78 cm, 86.25 g, 12.75%, 9.20 °brix, 3.50 and 16.18 t/ha), respectively. The lowest values of plant height (46.43 cm), number of leaves/plant (7.26), length of pseudostem (7.35 cm), diameter of pseudostem (1.92 cm), weight of single pseudostem (11.05 g), dry matter content of pseudostem (11.07%), total soluble solid content of pseudostem (9.02°brix) and fresh yield of pseudostem (11.16 t/ha) were observed from the BARI Pata Piaz-1 except number of tillers/hill and dry matter of leaves. The highest number of leaves/plant (8.86) and dry matter content of leaves (10.38%) were noted from BARI Pata Piaz-1 followed by AF Far 002 (1.05 & 8.78%), respectively.

Regional yield trial of winter onion

The experiment was conducted at Spices Research Centre, Shibganj, Bogura, Regional Spices Research Center Magura and Cumilla, Spices Research Sub-center Faridpur and Lalmonirhat during November 2020 to April 2021 with a view to study the regional adaptability of the selected winter onion lines at different onion growing areas and to select promising winter onion line(s) for releasing variety. The experiment was laid out in randomized complete block design with three replications. Two advance lines of onion (ON0374 & ON0375) with BARI Piaz-1 and BARI Piaz-4 were used as check in the study. In case of location the highest yield (15.77 t/ha) was recorded at Faridpur location and the lowest yield (12.84 t/ha) was recorded at Cumilla location. In case of onion

lines, the highest yield (17.29 t/ha) was found from ON0375 while the lowest (11.27 t/ha) was found from BARI Piaz-1. The Combined effect of location × onion lines gave significant effect on yield and other parameters. The highest yield (19.58 t/ha) was obtained from ON0375 at Faridpur location, while the lowest yield (10.15 t/ha) was obtained from BARI Piaz-1 at Bogura location. Considering all the characters, ON0375 was found promising for variety release.

Regional yield trial of winter onion against thrips

The study was conducted at Spices Research Centre, Shibganj, Bogura, Regional Spices Research Center Magura and Cumilla and Spices Research Sub-center Faridpur during November 2020 to April 2021 with a view to study the regional adaptability of the selected winter onion lines against thrips at different onion growing areas and to select promising winter onion line(s) for releasing as a thrips tolerant variety. Two onion lines ON0326, ON0332 with BARI Piaz-1 and BARI Piaz-4 were used in this study. The experiment was laid out in randomized complete block design with four replications. It was found that significantly the highest number of thrips and IYSV per plant (11.80 and 13.58, respectively) was recorded at Bogura location and the lowest (9.97 and 12.10, respectively) was found at Magura location. In case of bulb yield, the highest yield (13.43 t/ha) was obtained at Magura location and the lowest (11.47 t/ha) was recorded at Cumilla location. The line ON0332 showed the lowest number of thrips and IYSV per plant (4.09 and 4.29, respectively) and the highest number of thrips and IYSV per plant (17.36 and 20.31, respectively) was found from BARI Piaz-4. Significantly the highest bulb yield (14.51 t/ha) was found from ON0332 while the lowest (10.78 t/ha) was found from BARI Piaz-1. The Combined effect of location × onion lines gave significant effect on yield and other parameters. The highest number of thrips and IYSV per plant (20.12 and 25.18, respectively) was found from BARI Piaz-4 at Bogura location and the lowest number of thrips and IYSV per plant (4.20 and 3.20, respectively) was recorded from ON0332 at same location. The highest bulb yield (5.46 kg/plot and 15.16 t/ha) was

found from ON0332 at Magura location and the lowest (3.66 kg/plot and 10.17 t/ha) was recorded from ON0326 at Cumilla. Considering thrips population and bulb yield, the line ON0332 performed better in all location. In respect of soil health, environmental issue and other yield contributing traits, ON0332 was found promising for variety release.

Purification of BARI released onion varieties

An experiment was conducted to purify existing onion varieties at Spices Research Centre, Shibganj, Bogura during 2020-2021. BARI Piaz-1 and BARI Piaz-4 were used in this study. Approximately 700 and 1000 g seeds of BARI Piaz-1 and BARI Piaz-4 varieties, respectively were harvested from selected plants and conserved as true to type.

Cultural management

Effects of planting date and bulb size on the growth, quality and yield of bulb onion

Onion bulbs of different sizes (4-6g, 8-10g and 12-14g) under small bulb size were planted at different early planting dates viz. 30 September, 10 October and 20 October to observe their growth, quality and bulb yield. The experiment was laid out in a Randomized Complete Block Design with three replications during *Rabi* season 2020. The land was high having sandy loam textured soil with pH 5.5. The planting dates and mother bulb size showed significant influence on growth, quality and bulb yield of onion. The large mother bulb (12-14g) under small bulb size and 20 October planting were responded higher performance in respect of all parameters except plant height and marketable bulb (%) than that of other treatment combination. The treatment combination (12-14g × 20 October) were getting higher bulb yield (18.505 t/ha) which was statistically similar to treatment combination (12-14g × 10 October. The lowest bulb yield (6.401 t ha⁻¹) was recorded from the treatment combination (4-6g × 30 September).

Effects of set size and plant population density on the yield attributes, yield and quality of onion (*Allium cepa* L.)

The present research work was conducted at Spices Research Sub-Centre (SRSC), Bangladesh

Agricultural Research Institute (BARI), Faridpur during winter season of 2020-2021 to study the influences of plant population densities and set sizes on the growth, yield and quality of onion bulb through set method (bulb to bulb) method with the variety BARI Piaz-1. Three levels of plant population densities were: P₁. 100 plants/m² (10cm x 10cm), P₂. 66 plants/m² (15cm x 10cm) and P₃. 44 plants/m² (15cm x 15cm) and five levels of onion set sizes were: S₁. <1.5g, S₂. 2±0.5g, S₃. 4±0.5g, S₄. 6±0.5g and S₅. 8±0.5g) in the study. Hence, the treatment combination was 45 (P₁S₁, P₁S₂, P₁S₃, P₁S₄, P₁S₅, P₂S₁, P₂S₂, P₂S₃, P₂S₄, P₂S₅, P₃S₁, P₃S₂, P₃S₃, P₃S₄ and P₃S₅). The field study was carried out in randomized complete block design with three replications. The study revealed that plant population density, set size and their combined effects had significant on the characters studied except only days to 50% plant emergence for plant density. The highest incidence of bolting (19.09%), incidence of multiplier bulb (42.50%), bulb diameter (3.64cm) and bulb weight (26.66g) were recorded from lower plant density (P₃) but the treatment P₃ showed the lowest TSS content (19.76 °brix), bulb dry matter content (18.09g) and yield (13.48t/ha). The highest plant density (P₁) gave the maximum TSS content (21.74 °brix), bulb dry matter (19.36%) and yield (18.96 t/ha). Hence, though the maximum bulb yield was obtained from the highest plant population density (P₁) but marketable bulb yield of those bulbs was lower due to their smaller size of bulb. On the other hand, total bulb yield was much lower in the lowest density (P₃) than other ones and quality of their bulb was also inferior as well due to maximum bolting, multiplier bulb, TSS content & dry matter content. The largest set size (S₅) produced the maximum incidence of bolting (22.68%), incidence of multiplier bulb (45.45%), bulb diameter (3.71cm), bulb weight (26.57g) & yield (19.09t/ha) but the minimum TSS content (20.09 °brix). However, the lowest incidence of bolting (3.43%), incidence of multiplier bulb (22.21%), bulb diameter (2.73cm), bulb weight (19.46g) & yield (13.41t/ha) were observed in the smallest set size (S₁). Besides, the set size S₁ and S₂ performed better in respect of bolting, multiplier bulb, TSS content & dry matter content but they produced inferior bulb weight, bulb diameter and yield as

well. The combined effect of P₃S₅ registered the highest incidence of bolting (30.07%), incidence of multiplier bulb (61.80%), bulb diameter (4.16cm) & bulb weight (31.22g) and the lowest TSS content (19.20 °brix) & bulb dry matter content (17.36%). The combined effect of P₁S₁ demonstrated the minimum incidence of bolting (1.93%), incidence of multiplier bulb (11.40%), bulb diameter (2.46cm) & bulb weight (17.49g) and the maximum TSS content (22.62 °brix) & bulb dry matter content (20.33%). However, the maximum (20.64t/ha) and minimum (10.24t/ha) yield were recorded from the combination of P₁S₁ and P₃S₁, respectively. In conclusion, moderate plant population density along with medium set size (from 4±0.5g to 6±0.5g) would be the suitable options for growing early onion crops through set planting (bulb to bulb) method.

Effect of weed management practices on the growth, yield, quality and economic of onion (*Allium cepa* L.)

A field study was conducted at Spices Research Sub-Centre (SRSC), Bangladesh Agricultural Research Institute (BARI), Faridpur, Bangladesh during winter season of 2020-2021 to find out the efficacy of weed management practices on the growth, yield, quality and economics of onion with the variety BARI Piaz-6. In the study thirteen treatments such as: T₁-control as check (no weeding), T₂-weed free, T₃-one hand weeding (HW) at 45 days after transplanting (DAT), T₄-two HW at 25 and 45 DAT, T₅-three HW at 25, 45 and 65 DAT, T₆-pre-emergence (PE) spray of pendimethalin 33 EC @ 330g a.i./litre + one HW at 45 DAT, T₇- PE spray of pendimethalin 33 EC @ 330g a.i./litre + two HW at 45 and 65 DAT, T₈- post emergence (POE) spray of pendimethalin 33 EC @ 330g a.i./litre at 25 DAT + one HW at 65 DAT, T₉- PE spray of oxyfluorfen 23.5 EC @ 235g a.i./litre + one HW at 45 DAT, T₁₀- PE spray of oxyfluorfen 23.5 EC @ 235g a.i./litre + two HW at 45 & 65 DAT, T₁₁- POE spray of oxyfluorfen 23.5 EC @ 235g a.i./litre at 25 DAT + one HW at 65 DAT, T₁₂- PE spray of pendimethalin 33 EC @ 330g a.i./litre + POE spray of oxyfluorfen 23.5 EC @ 235g a.i./litre at 45 DAT + one HW at 65 DAT and T₁₃- PE spray of oxyfluorfen 23.5 EC @ 235g a.i./litre + POE spray of pendimethalin 33 EC @

330g a.i./litre at 45 DAT + one HW at 65 DAT were compared. The research work was designed in a randomized complete block design with three replications. The study revealed that the weed management treatments under the study significantly influenced the parameters of weed growth and parameters of growth, development, yield, quality & economics of onion except total soluble solid content of onion bulb. Among the weeds infested in the experimental field, *Cyperus rotundus* (55-60%), *Echinochloa crusgalli* (10-15%) and *Chenopodium album* (8-10%) were predominant. The highest weed density (137.25 weeds/m²), weed dry weight (120.31 g/m²) and weed index (51.31%) were recorded from the T₁. The lowest weed density (15.23 weeds/m²), weed dry weight (13.05 g/m²) and weed index (6.19%) were observed from T₁₃, T₁₂ and T₁₀, respectively. The treatment T₁₂ performed the best (89.15%) for controlling the weeds insignificantly followed by T₁₃ (87.81%). The T₃ had the least weed control efficacy (23.56%). The maximum bulb diameter (4.18 cm), bulb weight (28.31 g), bulb dry matter content (17.70%) and fresh yield (17.39 t/ha) of onion bulb were obtained from T₂ followed by T₁₃ (4.13 cm, 27.55 g, 17.67% & 16.81 t/ha) and T₁₂ (4.09 cm, 26.40 g, 17.41% & 19.18 t/ha), respectively. The highest net return (Tk. 160253.00), gross margin (Tk. 185253.00) and benefit-cost ratio (1.91) were calculated from the T₁₃ closely followed by T₁₂ (Tk. 157653.00, 182653.00 & 1.90), respectively.

Observation trial of selected spices, fruits and vegetables for roof top gardening

The experiment was conducted at Spices Research Centre, Shibganj, Bogura during 2020-2021 with a view to studying the performance of some selected spices, fruits and vegetable crops for roof top gardening, to ensure year round supply of fresh spices, fruits and vegetables, effective utilization of space, to increase the monetary value of land/apartment and to facilitate clean environment. Different spices, vegetables and fruit crops were used in this study. It was found that round the year summer onion production is very much encouraging the met up the family demand as well as minimize the short fall of onion. Intercropping system of roof top gardening performance is also

good in respect of effective utilization of space, yield and profitability.

Nutrient and water management

Effect of different organic fertilizers on yield and quality of onion

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the rabi season of 2020 - 2021 to know the effect of different organic fertilizers on yield and quality of onion. There were four treatment combinations viz T₁: 100% recommended dose of chemical fertilizer (RDCF) + 5 t/ha compost (control), T₂: 75% RDCF + 2.50 t/ha vermicompost, T₃: 75% RDCF + 0.50 t/ha trichovermicompost and T₄: 75% RDCF + 2.0 t/ha trichovermicompost studied in a randomized complete block design with three replications. Positive effects of different treatments were recorded on yield and yield contributing characters of onion. Along with major yield contributing traits, highest onion yield was recorded in T₃ (15.34 t/ha) with maximum level of BCR (1.74).

Effect of irrigation and nitrogen on yield and keeping quality of onion

This study investigated the effects of different nitrogen (N) levels and irrigation regimes on yield and yield components of onion (*Allium cepa* L.) cv. BARI Piaz-4 at Regional Spices Research Centre, Gazipur and Spices Research Sub-Centre, Lalmonirhat in 2020-2021. It was a factorial experiment laid out in Randomized Complete Block Design with three replications of three irrigation regimes and three N levels. Application of N at different levels and irrigation regime increased total and marketable bulb yield and their interaction showed a significant effect on vegetative and yield parameters and of water consumption of onion. Application of 100 kg N/ha and irrigation at 10% depletion of field capacity the highest bulb yield (18.0 t/ha and 20.0 t/ha in Gazipur and Lalmonirhat Location, respectively). Therefore, 100 kg N/ha and irrigation at 10% depletion of field capacity could be the tentatively recommended for onion cultivation in the studied area.

Effect of irrigation and nutrient management on seed yield of onion

This study investigated the effects of different irrigation regimes and nutrient management on seed yield and yield components of onion (*Allium cepa* L.) cv. BARI Piaz-1 at Regional Spices Research Centre, Gazipur in 2020-2021. It was a factorial experiment laid out in Randomized Complete Block Design with three replications of three irrigation regimes and three nutrient management packages. Application of nutrient management and irrigation regime increased the seed yield and their interaction showed a significant effect on vegetative, reproductive and yield components and of water consumption of onion. Application of 75% RDCF + 6 t/ha of Cowdung and irrigation at 10% depletion of field capacity gave the highest seed yield (1161.3 kg/ha) and the minimum seed yield (887.0 kg/ha) was noted at application of 75% RDCF + 3 t/ha of Cowdung and irrigation at 10% depletion of field capacity. Therefore, 75% RDCF + 6 t/ha of vermicompost with irrigation at 30% depletion of field capacity could be the tentatively recommended for onion cultivation in the studied area.

Optimization of NPKS fertilizers for yield maximization of onion (*Allium cepa* L.)

The present study was initiated with the objective to identify the optimum rate of NPKS fertilizer for maximum bulb yield of onion (BARI Piaz-1) under AEZ-28. The study was conducted in Regional Spices Research Centre, BARI, Gazipur during the growing season of 2020-2021. Twelve NPKS fertilizer treatments were laid down on Randomized Complete Block Design (RCBD) with three replications. The results of the experiment revealed that most of the growth and yield parameters of onion were significantly affected by NPKS fertilizer. Onion plants supplied with 100-60-120-30 kg NPKS/ha gave the highest marketable yield (13.6 t/ha) and total bulb yield (14.2 t/ha). Similarly, onion plants supplied with 100-60-80-20 kg NPKS/ha recorded the highest marginal rate of return (53.14%). Considering the yield, application of 100-60-80-20 kg NPKS/ha could be recommended for economical production of onion in the study area.

Insect and disease management

Effect of different chemical and biological agent for controlling fusarium basal rot of summer onion

The experiment was conducted at Regional Spices Research Centre, BARI, Magura during 2019-20 and 2020-21 to find out the effect of different chemical and biological agent for controlling fusarium basal rot disease of onion. BARI piaz-5 was used as the test variety. The experiment was laid out in randomized complete block design with three replications and nine different treatments viz significant differences regarding yield and yield attributes were observed among different treatments. The highest yield (11.78 t/ha in 2019-20 and 13.03 t/ha in 2020-21) was found from T₇ (Trichoderma mixed compost @ 50 kg/ha) which was significantly higher than those of other treatments. The lowest yield (7.85 t/ha in 2019-20 and 9.07 t/ha in 2020-21) was found from control plot T₉. Significantly higher Plant height (cm), number of leaves/plant, bulb diameter (cm), individual bulb weight, lowest disease incidence (6.60 %) were observed from treatment T₇ (Trichoderma mixed compost @ 50 kg/ha) and the highest disease incidence (25.78 %) was observed from in T₉ (control).

Post-harvest technology

Storability study of different exotic and native onion (*Allium cepa* L.) genotypes/varieties

A total of 25 short-day onion genotypes from different sources including two recommended varieties viz. BARI Piaz-1 and BARI Piaz-2 (as check) were evaluated at the ambient storage of Spices Research Sub-Centre, Bangladesh Agricultural Research Institute, Faridpur, Bangladesh in 2020 for testing their storability. All genotypes in the trial were evaluated under 25 accession lines such as AC Bog 409, AC Bog 410, AC Bog 411, AC Bog 412, AC Bog 413, AC Bog 414, AC Bog 415, AC Bog 416, AC Bog 417, AC Bog 419, AC Bog 420, AC Bog 421, AC Bog 422, AC Bog 423, AC Bog 424, AC Bog 425, AC Bog 426, AC Bog 427, AC Bog 428, AC Bog 429, AC Bog 430, AC Bog 431, AC Bog 433, AC Bog 434 and AC Bog 435. The experiment was placed down

under a completely randomized design (CRD) with three replications. The storage data were recorded periodically at 20 days interval (20 May, 08 June, 27 June, 16 July, 04 August, 23 August, 11 September, 30 September and 19 October) on rotting (%), sprouting (%), physiological loss in weight (PLW, %) and total loss (%) of bulbs. The results revealed that the genotypes/varieties had significant difference on the rotting, sprouting, PLW and total loss of bulbs. The genotype AC Bog showed the lowest cumulative rotting loss (10.47%) but AC Bog 429 exhibited the highest cumulative rotting loss (39.47%). The maximum and minimum cumulative sprouting losses were recorded from AC Bog 434 (23.03%) and AC Bog 429 (1.47%). The BARI Piaz-1 had the lowest cumulative PLW (19.39%). However, The AC Bog 420 had the highest cumulative PLW (44.68%). The highest and the lowest cumulative total losses were calculated from the AC Bog 433 (79.99%) and AC Bog 430 (44.62%). The rotting, sprouting, PLW and total losses were increased with the increase of the onion storage period. The average rotting, sprouting, PLW and total losses were 20.71%, 13.71%, 29.87% and 64.29%, respectively for 5 and ½ months storage of onion under the study. Finally, under the present storability study, AC Bog 430 (44.62%), AC Bog 426 (45.28%), AC Bog 413 (47.13%) and BARI Piaz-1 (45.31%) showed good performance on the basis of total weight loss.

Socio-economic study

Studies on post-harvest losses of onion and factors affecting for such losses in selected areas in Bangladesh

Post-harvest losses have been accounted as one of the major problem of onion in Bangladesh. This study was conducted to quantify the post-harvest losses of Rajshahi, Pabna and Rajbari districts at various stages of supply chain viz. farm, wholesale market and retail market levels. Descriptive statistics and multiple regression model were used for data analysis. Maximum aggregate post-harvest losses (31.22 kg/q) have been found at producer level due to faulty storage, lack of adequate transportation, drying, improper handling of the produce at the time of marketing, rotted bulbs, doubles, bolters, poor packing facilities, injury at

the time of harvesting and de-topping. Total losses in the supply chain were estimated to be 37.18 kg/q in which 83.96 percent losses were observed at farm level and rest were contributed at wholesale and retail level. The total financial losses were estimated to be 809 Tk/q from farm to retailer level of which 83.87 percent occupied by the farmers. The econometric estimation revealed that total production, onion price, higher education, more farming experience, spraying pesticides/fungicides, harvesting at matured stage, proper storage, favourable weather and adequate transportation facilities had significant effect on losses at farm level whereas onion price, more business experience, proper storage, structured selling place, adequate transportation facilities, proper loading and unloading method, favourable weather and market distance showed significant effect on losses at wholesale market level. Factors such as onion price, more business experience, proper storage, retailer as a shopkeeper and favourable weather were the significant determinants of losses at retail level. The study suggests there is an urgent need of training on all the activities of production, harvesting and marketing to minimize post-harvest losses and to fetch maximum gains, if the onion production is to be sustained on a profitable basis in the study areas.

Assessment of onion production trend in onion growing area of Bangladesh through remote sensing technique

This present research work mainly focused on the integrated application of satellite Remote Sensing (RS) and Geographic Information System (GIS) for identifying and estimating of onion cultivated areas in the top onion growing areas (Rajshahi and Pabna district) of Bangladesh for the time period of 2019, 2020, and 2021. Cloud free along with freely accessible of high spectral and temporal Sentinel-2 satellite images were acquired from the archives of USGS Earth Explorer website. This methodological framework directly computed the onion cultivated area through pixel-by-pixel based ISO cluster unsupervised classification algorithm using ArcGIS software. The satellite imagery datasets have generally 10mx10m spatial resolution that makes difficult to classify crop types where field sizes are smaller than the resolution of imaging sensor. The

five different land cover land classes texture features produced from classification namely water body, onion field, agricultural land and settlement were computed. Overall classification accuracies when considering all land cover land class was accounted of 66% and 69% and Kappa values of 0.55 and 0.58 for Rajshahi and Pabna district, respectively. Then, the satellite data based estimated area was compiled and compared later with government official statistics which accounted for 29.06% over-estimation to government field measured statistics. However, the findings highlight that classification of high-resolution satellite imagery is a feasible way to estimate crop area over large geographic areas in Bangladesh with complex crop planting system that are roughly as accurate as survey-based measures traditionally used in research and policy applications. The results also suggest future work that will be needed to both improve results and validation in the next season.

Garlic

Varietal development

Evaluation of garlic germplasm

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura during Rabi Season 2020-2021 to select the promising garlic germplasm for releasing a variety. Fifteen different garlic germplasm (GC0043, GC0013, GC0027, GC0031, GC001, GC0050, GC0012, GC0055, GC0029, GC0030, GC0017, GC0042, GC0036, GC0048, GC0040) and BARI Rashun-3 check as) were collected and evaluated based on their yield and other desirable characters. The experiment was laid out in RCB design with three replications. Among the germplasm, the highest yield (12.97 t/ha) was obtained from GC0050 and the lowest (7.20 t/ha) was found from GC0030. Disease severity was also lower in GC0050. Significantly all the yield contributing characters found better from GC0050.

Advance yield trial of garlic line

The study was conducted at the farm of Spices Research Centre, BARI, Shibganj, Bougra during rabi Season 2020-2021 to select the promising garlic germplasm for releasing a variety. The experiment

was laid out in RCB design with three replications. Six different garlic germplasm (GC0047, GC0054, GC0045, GC0046, GC005 and GC0018) including BARI Rashun-3 as check were evaluated based on their yield and other desirable characters. Among the germplasm, the highest yield (12.30 t/ha) was obtained from GC0054 and the lowest (5.83 t/ha) was found from GC0018. Disease severity was also lower in GC0054. The significant variation was found in plant height, number of leaves/plant, bulb length, bulb width, clove length, clove width, no. of cloves/bulb, yield /plant and yield t/ha. Considering all the characters, the germplasm GC0054, GC005, and GC0046 were found promising and selected for next year RYT trial.

Regional yield trial of promising garlic line

The experiment was conducted at Spices Research center, Bogra, Spices Research Sub-center Lalmonirhat, Regional Spices Research Center Magura and Spices Research Sub-center Faridpur during November 2020 to March 2021. Four advance lines of garlic (GC0035, GC0038, GC0044, and GC0049) and BARI Rashun-3 as check were included in the study. In case of location the highest yield (9.24 t/ha) was recorded in SRC, Bogra and Regional Spices Research Center Magura. On the other hand the lowest yield was recorded (7.32 t/ha) in Spices Research Sub-center Faridpur. In case of germplasm/line, the highest yield (11.72 t/ha) was found from GC0049 while the lowest (7.08 t/ha) was found from BARI Rashun-3. The Combined effect of location × advance line gave significant effect on yield and other parameters. The highest yield (12.38 t/ha) was obtained from GC0049 at Bogra location, while the lowest yield (5.9 t/ha) was obtained from BARI Rashun-3 at Faridpur location. Significantly higher plant height, number of leaves/plant, bulb length, bulb width, clove length, clove width, yield /plant and yield (t/ha) was highest from GC0049 with each location. Considering all the characters, two lines (GC0049 and GC0035) were found promising. For more confirmation further trial will be needed next year.

Regional yield trial of garlic (*Allium sativum*)

The yield trial is one of the most common and important experiments in agricultural research,

typically testing a number of genotypes in a number of environments, often for additional traits as well as yield. For that issue a regional yield trial was conducted at the farm of SRSC, Faridpur, SRC, Bogura, RSRC, Magura and SRSC, Lalmonirhat and RSRC, Gazipur during rabi season of 2020-21. The experiment was laid out in RCB design over location with three replications. Two different garlic lines (AS Far 004 and AS Far 005) and BARI Rashun – 3 as check variety was used as treatments. They were evaluated based on their yield and other desirable characters. Among the lines, highest average yield (8.84 t/ha) was obtained from AS Far 005 and lowest average was obtained (6.21 t/ha) from check variety. But in Faridpur highest yield was obtained from AS Far 004 (12.97 t/ha). Plant height (77.38cm) at 110 DAS, Leaves per plant (9.68) at 110 DAS, Leaf length (45.98 cm), Number of cloves per bulb (28.45) bulb length (32.27 mm) and individual bulb weight (21.82g) found highest in AS Far 005 genotype. Individual Clove Weight (0.74 g), clove length and breadth (23.77 and 10.09mm) were found highest in AS Far 004. Total soluble solid showed highest in BARI Rashun-3 (37.08% °brix). Combined effect of location and garlic lines showed significant results.

Cultural management

Development of a power tiller operated garlic planter

The aim of this investigation is to locally manufacturing and evaluates a six-row garlic cloves planter. This work focused on the development of modified garlic clove planting machine that is cheap, easily affordable, easy to maintain and less laborious to use. A Power tiller driven garlic clove planter was fabricated with locally available materials in FMPE Divisional workshop, BARI, Gazipur during 2020-21. The fabrication work could not be completed due to the pandemic COVID-19 situation. Detailed performance of the planter and modification will be evaluated after completion of fabrication in the next season.

Nutrient and water management

Effect of foliar application of different micronutrients on reducing tip burn of garlic

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the rabi season of 2020 - 2021 to know the effect of foliar application of different micronutrients on reducing tip burn of garlic. There were twelve treatment combinations viz. T₁ = ZnSO₄ 0.2% (2 g/L), T₂ = ZnSO₄ 0.35% (3.5 g/L), T₃ = ZnSO₄ 0.55% (5.5 g/L), T₄ = H₃BO₃ 0.1% (1 g/L), T₅ = H₃BO₃ 0.2% (2 g/L), T₆ = H₃BO₃ 0.3% (3 g/L), T₇ = CuSO₄ 5 H₂O 0.1 % (1 g/L), T₈ = CuSO₄ 5 H₂O 0.25 % (2.5 g/L), T₉ = CuSO₄ 5 H₂O 0.5 % (5 g/L), T₁₀ = ZnSO₄ 0.1% + H₃BO₃ 0.1% + CuSO₄ 5 H₂O 0.1 %, T₁₁ = ZnSO₄ 0.25% + H₃BO₃ 0.2% + CuSO₄ 5 H₂O 0.25 % and T₁₂ = ZnSO₄ 0.5% + H₃BO₃ 0.3% + CuSO₄ 5 H₂O 0.5 % studied in a randomized complete block design with three replications. Positive effects of different foliar applications were recorded on yield and yield contributing characters of garlic. Highest yield was recorded in T₁₁ (11.41 t/ha) including highest level of BCR (3.51).

Post-harvest technology

Studies on the processing and preservation of garlic paste

This experiment was undertaken to study the paste behavior of treated and untreated garlic paste under room and refrigerated temperature. The fresh, peel garlic cloves were crushed in blender. The garlic paste was prepared using 100 ml water per kg sliced garlic. Among thirteen treatments, eleven samples of garlic pastes were treated with salt, sodium benzoate, potassium metabisulphide, citric acid and mastered oil singly or in combination. Among other two, one sample was treated with steam and another was non treated garlic paste. All the samples of prepared garlic paste were stored in glass container and kept in room and refrigerated temperature. The color, flavor, texture and overall acceptability of all the samples (treated and untreated) of garlic paste were observed at 15 days interval up to 180 days of storage. The color, flavor and texture of the garlic pastes, treated with citric acid plus sodium benzoate or sodium chloride plus

citric acid plus sodium benzoate or sodium chloride plus citric acid plus KMS and stored in glass container at room and refrigerated temperature were acceptable up to 150 and 180 days of storage. But garlic paste rendered more excellent shelf life up to 180 days of storage when treated with only citric acid. The study has shown that garlic paste without any preservative (control) could not be stored more than 60 days at room temperature and 90 days at refrigeration temperature.

Studies on quality of developed ginger-garlic mix paste during storage

This experiment was carried out to investigate the effect of preservatives, storage conditions and time on the keeping quality of ginger-garlic mix paste. The fresh peel ginger sliced and garlic cloves were crushed in blender. The mix paste was prepared using 50:50 of ginger sliced and garlic cloves. Among thirteen treatments, eleven samples of mix pastes was treated with salt, sodium benzoate, potassium metabisulphide, citric acid and mastered oil singly or in combination. Among other two, one sample was treated with steam and another was non treated ginger-garlic paste. All the prepared samples (mix paste) were stored in glass container and kept in room temperature and refrigerated temperature. The colour, flavor, texture and overall acceptability of all the samples (treated and untreated) were observed at 15 days interval up to 180 days storage. The color, flavor, texture and overall acceptability of the ginger-garlic pastes, treated with citric acid plus sodium benzoate (T₅), citric acid plus KMS (T₆), sodium chloride plus citric acid plus sodium benzoate (T₇), sodium chloride plus citric acid plus KMS (T₈), citric acid (T₁₃) and stored in glass container at room temperature (RT) were acceptable up to 150 days of storage. The refrigerated storage rendered excellent shelf life of ginger-garlic paste up to 180 days of storage. The color and flavor were more acceptable in refrigerated temperature compared to ambient temperature storage.

Chilli

Varietal development

Evaluation of winter chilli lines

The experiment was conducted at Spices Research Centre, Shibganj, Bogura during 2020-2021 with a view to identify suitable winter chilli line (s) and to develop good breeding line(s) for improvement of chilli. Nine chilli lines viz., C0758, C0759, C0760, C0761, C0762, C0763, C0764, C0765, C0766 and BARI Morich-3 were used in this study. The experiment was laid out in a randomized complete block design with three replications. In case of days to 50% flowering, it was observed that C0762 produced 50% flowers within 63 days. The highest days was needed to 50% flowering (84 days) by C0761. The minimum days were needed to produce 50% mature fruits (116 days) by C0762 and the highest days were needed to produce 50% mature fruits (133 days) by C0761. It was observed that C0762 given higher number of fruits and the highest fruit weight per plant (357 and 407.73 g, respectively) and the lowest (288 and 242.07 g, respectively) were found from BARI Morich-3. The highest single fruit weight (3.07 g) was found in C0762 followed by C0758 (2.70 g) and C0763 (2.48 g) and the lowest single fruit weight (2.02 g) was found from BARI Morich-3. The highest fruit length (7.20 cm) was recorded from BARI Morich-3 and the lowest fruit length (4.77 cm) was found from C0759. The highest green chilli yield (15.80 t/ha) was found from C0761 followed by C0758 (13.60 t/ha) and C0763 (11.70 t/ha) the lowest was recorded from C0753 (8.00 t/ha).

Evaluation of local germplasm of chilli in cumilla region

A total of thirteen germplasm of chilli were collected from different upazilla of Cumilla district. The trial was conducted during rabi season of 2020-2021 at RSRC, BARI, Cumilla to study the performance of different chilli lines for developing variety having higher yield. The highest green yield (8.18 t/ha) was in CA Cum-009 and the lowest (1.86 t/ha) from the line CA Cum-008.

Characterization and evaluation of ornamental chilli germplasm

The research was carried out at the experimental field of Spices Research Centre, Shibganj, Bogura

during rabi season, 2020-21 to identify chilli germplasm suitable for kitchen and rooftop garden as ornamental and table purpose. The land was medium-high and the soil was clay loam in texture. The unit plot size was 1.5m x 3m. Ten ornamental chilli germplasm were characterized and evaluated for their performance against BARI Ornamental Morich-2 as check. The characterization was done according to "Descriptors for capsicum" by IPGRI, AVRDC and CATIE (1995). The yield and yield contributing characters varied significantly among the different ornamental chilli germplasm. The highest amount of fruit (1.069 kg/plant) was harvested from the germplasm OC18 because of its biggest-sized fruit and heaviest single fruit weigh. The lower amount of fruit (0.053 kg /plant) was harvested from the germplasm OC 006 which was identical to OC 014 (0.081 kg/plant). Among the ornamental chilli germplasm, OC 018 showed better performance in terms of yield potentiality. But the other germplasm also gave impressive results due to their different colored fruit and attractive canopy structure. However, OC 006, OC 011 (as an alternative of BARI Ornamental Morich-1) and OC 004, OC 005, OC 007 (as an alternative of BARI Ornamental Morich-2) will be evaluated for Advance Yield Trial in the next year.

Collection, evaluation of perennial chilli germplasm

Morphology based characterization and evaluation of chilli was undertaken to identify characteristics which could be helpful in chilli breeding programs. This study was of great significance in determining the distinctiveness, uniformity of various chilli genotypes. In the present investigation, 14 genotypes of perennial chilli collected from different region of Bangladesh were evaluated for their qualitative morphological characterization using a Randomized block experimental design at Regional Spices Research Center (RSRC), BARI, Gazipur during winter 2021. A fair amount of variation was found in the morphological characterization analysis. Among the different traits assessed perennial life cycle, intermediate growth habit, Plant Height, flattened stem shape, entire leaf margin, leaf pubescence, Green with white filament anther color, dentate calyx margin, Calyx Annular Constriction, Number of Flower per axile, Fruit

Calyx cover, Fruit Shape at pedicel attachment, and Blossom end fruit showed 100% frequency, a higher frequency was also observed for Dense branching habit, dense stem pubescence, ovate leaf shape, Dark green leaf color, white corolla color, intermediate flower position, same level stigma exertion, green fruit color at intermediate stage, elongate fruit shape and pointed fruit shape at blossom end, and the study suggested these genotypes can be used for breeding purpose after further testing.

Searching of CMS and maintainer lines of chilli

The experiment was conducted at Spices Research Centre, Shibganj, Bogura during 2020-2021 with a view to increasing the seeds of A and B line, to searching the maintainer line of chilli and to make CMS & maintainer line from indigenous sources. For increasing seeds, seeds of five A & B lines (2nd generation) were used in this study. After ripening ripe fruits were collected separately. For making CMS and maintainer lines from indigenous sources, seeds of A lines and BARI Morich-2 were planted on 20 June 2021. Now they are at vegetative stage. At the time of flowering crossing will be done.

Study of heterosis in chilli

The field experiment was conducted at Spices Research Center, Shibganj, Bogura during 2020-2021 with a view to determine the magnitude of heterosis over mid parent and better parent and to identify & select superior F₁ hybrids for yield and quality improvements. F₁ seeds of six cross combinations viz., BARI Morich-1 x BARI Morich -2, BARI Morich -1 x BARI Morich -3, BARI Morich -2 x BARI Morich -3, C0721 x BARI Morich -1, C0721 x BARI Morich -2, and C0721 x BARI Morich -3 including five parents (BARI Morich -1, BARI Morich -2, BARI Morich -3 and C0721) were used in this study. The experiment was laid out in a randomized complete block design with three replications. It was found that most of the crosses showed desirable heterosis over mid and better parent for days to 50% flowering and days to 50% mature fruits. For single fruit weight, it was found that Morich-1 x BARI Morich-3 expressed the highest mid-parent (34.26) and better parent (heterobeltiosis) heterosis values (25.16%).

In respect of number of fruit, C0721 x BARI Morich-2 performed the highest mid-parent heterosis (216.61) and heterobeltiosis values (201.86%) followed by BARI Morich-2 x BARI Morich-3 (208.05 and 173.02%, respectively). In case of number of fruit, C0721 x BARI Morich-2 performed the highest mid-parent heterosis (216.61) and heterobeltiosis values (201.86%) followed by BARI Morich-2 x BARI Morich-3 (208.05 and 173.02%, respectively). In respect of yield, the highest estimate mid and better parent heterosis values (257.87 and 219.00%, respectively) were also recorded in the cross of BM-1 x BM-3 followed by BARI Morich-2 x BARI Morich-3 (175.59 and 139.10%, respectively), C0721 x BARI Morich -2 (141.82 and 106.45%, respectively).

Production of single cross chilli hybrids through diallel mating design

Single sets of crosses following half diallel fashion were made to produce F₁s hybrid seeds. Total 21 cross combinations were produced in a single set of half diallel crosses. In the set total 25 successful crosses were obtained from 9 cross combinations. the produced F₁ seeds of each hybrid were stored separately after selection and would be evaluated in the coming rabi season.

Development of chilli hybrids for higher yield, more edible dry powder, higher color and oleoresin content with improved nutritional quality

The present experiment was conducted to select superior winter chilli germplasm for higher yield at Spices Research Centre, Shibganj, Bogura during 2020-2021. Thirty-nine chilli genotypes including BARI Morich-3 as check were used in this study. The experiment was laid out in alpha lattice design with two replications. Two genotypes namely BGCMA-17 and BGCMA-14 out yielded the check entry BARI Morich-3, while some other genotypes yielded similar to BARI Morich-3. Considering yield and other attributing traits promising genotypes need to evaluate in next season.

Advance yield trial of chilli

The present experiment was conducted to select superior chilli germplasm for higher yield at Spices

Research Centre, Shibganj, Bogura during 2020-2021. Ten chilli genotypes including BARI Morich-3 as check were used in this study. The experiment was laid out in alpha lattice design with three replications. Quite a few genotypes out yielded the check entry BARI Morich-3. Considering yield and other attributing traits the genotype INDCH-39 found top yielder followed by AVPP-1236 and AVPP-1111. The promising genotypes will be evaluated at multiple locations in next season.

Regional yield trial of chilli (Set-I)

The experiment was conducted at Spices Research Centre, Shibganj, Bogura; Spices Research Sub-Centre, Faridpur and Spices Research Sub-Centre, Lalmonirhat during 2020-2021. Six chilli genotypes including BARI Morich-2 and BARI Morich-3 as check were used in this study. BARI Morich-3 was found as highest yielder whereas FIHC produced similar yield. The experiment needs to be repeated one more season with more environments to confirm the present performance of the genotypes.

Regional yield trial of winter chilli (Set-II)

The study was conducted at Spices Research Centre Shibganj, Bogura and Regional Spices Research Cumilla during November 2020 to June 2021 with a view to observing the regional adaptability of the selected chilli lines at different chilli growing areas and to select promising winter chilli lines for releasing variety. Three advance lines of chilli (C0649, C0650 & C0701) with BARI Morich-3 as check were used in the study. The experiment was laid out in a randomized complete block design with four replications. Among the location, it was found that the highest weight of fruits per plant and per hectare yield (277.01 g and 10.48 tons, respectively) was found at Bogura location and the lowest (241.61 g and 8.51 t/ha, respectively) was recorded from Cumilla location. In case of lines, C0721 gave the highest fruits weight per plant and green chilli yield (292.88 g and 10.77 t/ha, respectively) followed by C0650 (287.66 g and 10.46 t/ha, respectively) and the lowest (206.10 g and 7.82 t/ha) was found from BARI Morich-3. In case of combined effect of location and chilli advanced lines, it was observed that C0701 gave

the maximum gave the maximum fruits weight per plant and green chilli yield (314.16 g and 12.26 t/ha, respectively) in Bogura location followed by C0650 (295.20 g and 10.83 t/ha, respectively) in same location. The lowest (201.13 g and 6.74 t/ha, respectively) was found from BARI Morich-3 in Cumilla location. Regarding yield, the lines C0701 and C0650 performed better across the location.

Regional yield trial of chilli (Set-III)

The present study was conducted with six Chilli genotypes across four environments in randomized complete block design with three replications during 2020-21 to evaluate the performance of Chilli genotypes with higher yield and stability. The AMMI (Additive main effect and Multiplicative Interaction) model was used to estimate the genotype-environment interaction. Genotypes and environments were significantly varied for all the traits except plant height, fruit diameter and thousand seed weight against environment, which revealed the presence of genetic variability in the materials under study. The analysis of variance revealed that GEI accounted for 24.92 % of the total variation for yield while genotype explained 15.28 % and environments explained 59.80 % for the same. GGE biplot methodology was used for graphical display of yield data after subjecting the genotypic means of each environment to GGE biplot software. The first two principle components (PC1 and PC2) were used to display two-dimensional GGE biplot. Genotype Co631 and Co632 were found to be high yielding and stable in all environments.

Stress breeding

Screening of waterlogging stress tolerance chilli germplasm

One of the effective ways to address the effects of abnormal climate change on plant is to find germplasms that have better resistance to adverse environments. Hence, waterlogging experiment on chilli was conducted in the Regional Spices Research Center during kharif-1 season of 2021 to find out waterlog tolerant genotype. Twenty-six chilli genotypes were evaluated under waterlog and normal condition. Waterlog was imposed at 30 days after transplanting by transferring the pots in a

water tub where water was maintained about 5 cm above the soil surface of pots. After two days (48 h-set I) and three days (72 h-set II), pots were removed from waterlogging and kept in normal condition until maturity. Our results showed that SPAD (soil-plant analyses development analyses, based on chlorophyll meter readings), plant height, and biomass of shoot/root were significantly reduced in chilli plants exposed to waterlogg stress. Fifteen and one genotypes alone survived in 48 and 72 h of waterlogging, respectively. On the basis of survival percentage, SPAD value, dry matter production and STI, the genotype G7, G12, G16, G21, G22, G24, G13, G17, G23, G20, G3, G2, G11, G15 and G11 can be selected as relatively tolerant against waterlogging.

Cultural management

Intercropping of spices with chilli in cumilla region

An experiment was conducted at the research field of Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Cumilla during 2020-21 to find out the suitable crop combination of onion, garlic and coriander with chilli for increasing total productivity, economic return and maximize land utilization through intercropping system. Seven treatments viz., T₁ = Sole chilli (50 cm × 50 cm), T₂ = Two rows of onion in between two rows of chilli (15 cm × 10 cm), T₃ = Two rows of garlic in between two rows of chilli (15 cm × 10 cm), T₄ = 100% coriander (leaf) in between two rows of chilli, T₅ = Sole onion (15 cm × 10 cm), T₆ = Sole garlic (15 cm × 10 cm), T₇ = Sole coriander. The trial was set up in a randomized complete block design with three replications. The unit plot size was 3.0 m × 3.0 m. The Chilli was (Var. BARI Marich 3) a main crop and onion (Var. BARI Piaj 6), garlic (Var. BARI Rashun 2) and coriander (BARI Dhonia 1) were used as intercrops in the study. The sole crop of chilli was planted at a spacing of 50 cm × 50 cm, the sole crop of onion and garlic was planted at a spacing of 15 cm × 10 cm. As intercropping system two rows of onion and two rows of garlic were planted as in between two lines of chilli and coriander (100%) was broadcast in between two lines of chilli. Results showed that different

intercropping combination significantly influenced yield and yield contributing characters of chilli. The yield of chilli was comparatively lower in intercropping than sole chilli but total productivity was increased due to additional yield of onion, garlic and coriander. Increased total productivity in terms of chilli equivalent yield (CEY) was 14.05 to 16.88 t ha⁻¹ in intercrop combination compared to sole chilli 9.13 t ha⁻¹ (main crop). All the intercropping combinations showed better performance in terms of chilli equivalent yield, gross return and benefit cost ratio (BCR) over sole crops. Among the intercropping combination two rows of onion in between two rows of chilli was the most feasible and profitable intercropping system in respect of chilli equivalent yield (16.88 tha⁻¹), gross return (Tk.675200), gross margin (Tk. 526800) and benefit cost ratio (4.32).

Effect of spacing on the yield of naga chili

The experiment was conducted during December 2020 to April 2021 at spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet to determine the effect of spacing on chili production under acidic soil of north eastern region of Bangladesh. The experiment was laid out in randomized complete block design with three replications. Six different levels of spacing were used as treatments viz. T₁ (50×60 cm), T₂ (60×70 cm), T₃ (70×60 cm), T₄ (80×60 cm), T₅ (90×75 cm) and T₆ (100×60 cm). There were significant variations among the treatments. Among the treatments maximum stem diameter (1.83 cm), heaviest fruit weight (5.36 g), and highest yield (12.53 t ha⁻¹) were recorded at T₆. On the other hand, treatment T₁ recorded the least amount of yield contributing characters and lowest yield (6.67 t ha⁻¹). Therefore, the results obtained from the study suggested that 100×60 cm spacing has a great effect for increasing yield of naga chili and its yield attributes, and can be recommended for farmers' use in the north eastern region of Bangladesh.

Nutrient and water management

Effect of different organic fertilizers on yield and quality of chilli

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura

during the rabi season of 2020 - 2021 to know the effect of different organic fertilizers on yield and quality of chilli. There were four treatment combinations viz T₁: 100% recommended dose of chemical fertilizer (RDCF) + 5 t/ha compost (control), T₂: 75% RDCF + 2.50 t/ha vermicompost, T₃: 75% RDCF + 0.50 t/ha tricho-vermicompost and T₄: 75% RDCF + 2.0 t/ha tricho-vermicompost studied in a randomized complete block design with three replications. Positive effects of different treatments were recorded on yield and yield contributing characters of chilli. Along with major yield contributing traits, highest green chilli yield was recorded in T₃ (10.09 t/ha) with highest level of BCR (3.72).

Effect of different sources of nitrogen on the growth and yield of chilli

An experiment was conducted at the research field of Regional Spices Research Centre, Bangladesh Agricultural Research Institute, Gazipur during 2020- 2021 to evaluate the effect of different sources of nitrogen on growth and yield of chilli (BARI Morich-1). The experiment was arranged in a Randomized Complete Block Design (RCBD) with three replications having five treatments combinations. Different sources of nitrogen fertilizers had significant influenced on the plant height, days to anthesis, number of branches plant⁻¹, number of fruits plant⁻¹, fruit size, fruit yield plant⁻¹, single fruit weight, fresh fruit yield, number of seed fruit⁻¹, 1000 seed weight and seed yield except fruit size, dry fruit yield and percentage germination days to fruit setting of chilli. The highest ripen fruit (8.50 tha⁻¹), dry fruit (2.4 tha⁻¹) and seed (233.7 kgha⁻¹) yield of chilli was obtained from N₁₀₀K₁₀₀S₃₀Zn₃B₁kg ha⁻¹ (N from DAP) in the AEZ-28 (Madhupur Tract).

Effect of nitrogen on blossom drop in chilli lines

A field experiment was carried out at Regional Spices Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during the month from November 2020 to May 2021 to find out optimum doses of nitrogen to reduce blossom drop and to select a chilli line which retains maximum blossom. Four different levels of nitrogen, viz., N₁= 50, N₂ = 100, N₃= 150 and N₄= 200 kg/ha and two chilli lines along with BARI

Chilli -1 were considered in the experiment. Plot size was 3.0 m × 1.0 m and plot to plot distance was 50 cm. Seedlings of 35-40 days were transplanted on November 25, 2020 maintaining a spacing of 50 cm × 50 cm in RCB design (factorial) with three replications. The single and combined effect of chilli lines and nitrogen doses showed significant variations on days to 1st and 50% flower, number of dropped buds and flower, plant height, number and weight of fruit. The minimum number of dropped buds (34.33) and flowers (44.00) were recorded in chilli line L₁ (C0517) though L₃ (BARI Morich - 1) gave the maximum number (77.50) and heavier fruit (143.83 g) followed by L₁ (C0517). The dropped buds (33.78) and flowers (46.22) were recorded minimum and the maximum number (75.11) with heavier fruits (167.11 g) were harvested when 100 kg nitrogen /ha (N₂) was applied followed by N₃ (150 kg N/ha).

Effect of naphthylene acitic acid on blossom drop in chilli

A three-year field experiment was carried out at Regional Spices Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during the month from November 2018 to April 2019, November 2019 to April 2020 and November 2020 to April 2021 to standardize the optimum doses and time of spraying of NAA as foliar spray in reducing blossom drop. The experiment included five different levels of NAA viz., 0 ppm (D₁), 10 ppm (D₂), 20 ppm (D₃), 30 ppm (D₄) and 40 ppm (D₅) and three spraying time viz, 25 DAP (S₁), 10 days after 1st flowering (S₂) and 25 days after 1st flowering (S₃). Seedlings of 35-40 days were transplanted on November 14, 2018, November 22, 2019 and 2020 maintaining a spacing of 50 cm × 50 cm in 3.0 m × 1.0m sized plot following RCB design (factorial) with three replications. Freshly prepared aqueous solution of NAA was sprayed three times according to treatments. The minimum number of flowers 12.61 in 2020-21, 83.33 in 2019-20 and 54.58 in 2018-19 were counted with the application of 10 ppm (D₂) followed by 20 ppm (D₃). The lowest number of buds 12.06 in 2020-21, 51.56 and 8.5 in 2018-19 were counted with the application of 10 ppm (D₂) followed by 20 ppm (D₃). Similarly, considering time of spraying NAA, minimum number of dropped buds 12.53 in 2020-

21, 83.33 in 2019-2020 and 9.25 in 2018-19 where as minimum number of flowers 18.50 in 2020-21, 71.40 in 2019-20 and 66.5 in 2018-19 were recorded at 10 days after 1st flowering. Application of 10 ppm NAA (D₂) and spraying at 10 days after 1st flowering (S₂) resulted minimum number of dropped flowers 10.0 in 2020-21, 71.3 in 2019-20 and 55 in 2018-19 whereas buds 9.3 in 2020-21, 33 in 2019-20 and 12.5 in 2018-19 followed by 20 ppm (D₃) NAA in three years trial. The maximum number of fruit 45.17 in 2020-21, 75.89 in 2019-20 and 65.35 in 2018-19 with heavier fruits 88.33g in 2020-21, 210.5g in 2019-20 and 133.6g in 2018-19 were harvested with the application of D₂ (10 ppm) followed by 33.50 in 2020-21, 56.78 in 2019-20 and 62.15 in 2018-19 maximum number of fruit and maximum number of heavier fruit 50.67g in 2020-21, 137.44 g in 2019-20 and 128.8 g in 2018-19 in D₃ (20 ppm) at 10 days after 1st flowering (S₂) in the trial.

Effect of organic fertilizer for safe naga chili production

An increase in the application of inorganic fertilizers in the agricultural field deteriorated the soil quality. As a result, organic farming is now popular as it is eco-friendly. Organic fertilizers from plant and animal origin release vital nutrients to the plant for its development. The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet during the period from December 2020 to April 2021 to check the significance and importance of organic manures for Naga chili cultivation. Therefore, this work examines the effect of cow dung, vermicompost, poultry manure, and mustard oil cake on the growth and yield characteristics of Naga chili. After investigation, it was found that the application of cow dung compost recorded maximum fruit length (4.57cm), fruit breadth (2.20cm), fruit weight (4.29g), fruits plant⁻¹ (44.33), and ultimately fruits yield (2.55 t ha⁻¹) than no usage (0.51 t ha⁻¹).

Effect of lime on the growth and yield of naga chili

The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet during the period from January

2020 to June 2020 and December 2020 to April 2021 to determine the effect of lime for Naga chili production under acidic soil of north eastern region of Bangladesh. The experiment was laid out in randomized complete block design with three replications. Six different levels of lime were used as treatments viz. 0, 0.5, 1.0, 1.5, 2.0 and 2.5 t/ha. Among the treatments, number of primary branches, stem diameter, fruit length, fruit breadth, fruit weight, fruits plant⁻¹, fruit weight and ultimately yield found maximum at T₆ in both the years of 2020 and 2021. On the other hand, treatment T₁ recorded least amount of yield contributing characteristics and lowest yield in two years. Therefore, the results obtained from the study suggested that application of 2.5 t ha⁻¹ lime has great effect on Naga chili increasing the yield attributes and can be recommended for farmers use in north eastern region of Bangladesh.

Insect and disease management

Management of choanephora blight of chilli

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during Rabi season of 2020-2021 to find out the effective control measures against Choanephora blight or wet rot disease of chilli. BARI Morich 4 was used in this experiment. Seven fungicides and one untreated control were used as treatment. Amistar Top 325 SC (0.1%) resulted the lowest disease incidence (6.77%) which was followed by Ridomil Gold (0.2%) and Autostin (0.15%), and untreated control showed the highest incidence (22.27%). The highest single fruit weight (3.93 g), fruit length (10.65 cm), number of fruits/plant (310.69) and weight of fruits/plant (702.40 g) were recorded in Amistar Top 325 SC (0.1%) sprayed plots which was followed by Ridomil Gold (0.2%) and Autostin (0.15%), and the lowest of these parameters were found in the untreated control plots. Amistar Top 325 SC (0.1%) sprayed plots showed the highest fresh yield (18.91 t/ha) which was also followed by Ridomil Gold (0.2%) and Autostin (0.15%), and untreated control showed the lowest yield (10.81 t/ha) of chilli. So, Amistar Top 325 SC (0.1%) or Ridomil Gold (0.2%) or Autostin (0.15%) may be used to control choanephora disease and increase yield of chilli.

Control of foot and root rot disease of chilli

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during Rabi season of 2020-21 to find out the effective control measures against foot and root rot disease of chilli. The test variety was BARI Morich 4. Eleven different treatments were used in this experiment. Foot and root rot incidence under different treatments ranged from 5.75 to 19.55%, while Poultry refuse @5 t/ha + T₁ (Autostin @0.2%) treated plots resulted the lowest disease incidence which was followed by Companion 75 WP @0.2% with 6.45% and Cabriotop @0.3% with 7.88%, where untreated control plot showed the highest incidence. The highest plant height (95.47 cm), single fruit weight (3.11 g), fruit length (11.11 cm), number of fruits/plant (357.44) and weight of fruits/plant (1020.81 g) were recorded in Poultry refuse @5 t/ha + T₁ (Autostin @0.2%) treated plots which was followed by Companion 75 WP @0.2% and Cabriotop @0.3% treated plots, and the lowest of these parameters were found in the untreated control plots. Poultry refuse @5 t/ha + T₁ (Autostin @0.2%) showed the highest fresh yield (19.60 t/ha) which was statistically similar to Companion 75 WP @0.2%, but untreated control showed the lowest fresh yield (6.85 t/ha) of chilli.

Ginger

Varietal development

Evaluation of ginger germplasm

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura during April 2020 to February 2021 to select the promising ginger germplasm for releasing a variety. Twenty different ginger germplasm (G0020, G0021, G0022, G0023, G0033, G0044, G0025, G0026, G0034, G0041, G0042, G0046, G0045, G0043, G004, G0010, G0036, G0031, G0040, and G0032) with BARI Ada-1 as check were evaluated based on their yield and other characters. The experiment was laid out in randomized complete block design with three replications. Significantly the highest plant height, number of tillers/plant, number of leaves/plant, weight of primary and secondary rhizome was observed in the line G0044. The highest yield (32.45 t/ha) was also obtained from G0044 and the

lowest yield (16.10 t/ha) was found from G0021 line.

Evaluation of exotic ginger germplasm

The experiment was conducted at Regional Spices Research Centre, Gazipur during April, 2020 to January, 2021. Sixteen ginger germplasm were collected from different countries from 2014, considered in the trial. Each entry was planted on 13 April 2020 in two rows plot of 2.5 m x 1.0 m without following any design. The inter row and intra row spacing were 50 cm and 25 cm respectively. The crop was harvested on 12 January, 2021. The rhizomes were evaluated by characterization in this year. Among 17, only nine characters were evaluated viz., plant growth habit, plant height (cm), number of shoots/ tillers, height of shoot/ tiller, shoot diameter, number of leaves, rhizome thickness, rhizome shape, clump weight (g). Different plant and rhizome characters of ginger varied in different germplasm. Among the germplasm, GO GAZ 005 possessed of heavier clump (530.0 g) followed by GO GAZ 001, GO GAZ 003 and GO GAZ 007.

Regional yield trial of promising ginger line

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura and Spices Research Sub Center Lalmonirhat during April 2020 to March 2021. Four promising ginger germplasm (G005, G0028, G001 and G0027) were included in the study with BARI Ada-1 as check. The experiment was laid out in randomized complete block design with three replications. Significant differences among the ginger germplasm were observed in both the location regarding different parameters. Significantly the highest rhizome yield was found from G005 in Bogra (28.20 t/ha) and Lalmonirhat (31.25 t/ha) while the lowest rhizome yield was found from BARI Ginger-1 in both location (17.70 t/ha and 19.00 t/ha respectively). Significantly higher plant height, number of tillers/plant, number of leaves/plant, weight of primary and secondary rhizome, dry matter (%) and yield along with better yield contributing characters were observed from the line G005. The highest dry matter (%) of 26.50 and 28.00 was found from G005 in Bogura and Lalmonirhat location, respectively. The lowest dry

matter 17.91% and 18.90% was obtained from BARI Ada-1 at Bogura and Lalmonirhat location, respectively.

Cultural management

Effect of different growing media for ginger seedling production under pro-tray technique

The study was conducted at Spices Research Centre, BARI, Shibganj, Bogura during Kharif season of 2021 to identify suitable growing media for producing ginger seedlings under pro-tray technique and to ensure sustainable ginger production. BARI Ada-1 was used as the test crop. The experiment was laid out in a Completely Randomized Design (CRD) for raising ginger seedlings in pro-tray and Randomized Complete Block Design (RCBD) to establish produced seedlings in the main field. Eight different growing media (viz. coco dust, saw dust, rice husk, rice bran, vermicompost, tricho-compost, ash and sand) were considered as the treatment for this trial. It was found that the different parameters for quality seedling were statistically significant due to different growing media. Saw dust, ash and tricho-compost may be a good alternative to coco dust for producing quality ginger seedlings. However, the produced seedlings have been transplanted in the main field to evaluate the final performance of rhizome production.

Effect of different rhizome size for ginger seedling production under pro-tray technique

The study was conducted at Spices Research Centre, BARI, Shibganj, Bogura during Kharif season of 2021 to identify suitable rhizome size for producing ginger seedlings under the pro-tray technique and to ensure sustainable ginger production. BARI Ada-1 was used as the test crop. The experiment was laid out in a Completely Randomized Design (CRD) for raising ginger seedlings in pro-tray and Randomized Complete Block Design (RCBD) to establish produced seedlings in the main field. Nine different rhizome sizes (viz. 2g, 3g, 4g, 5g, 6g, 7g, 8g, 9g and 10g) were considered as the treatment for this trial. It was found that the different parameters for quality seedlings were statistically significant due to different rhizome size. 9g and 6g rhizome were

more capable of producing quality seedlings than the other rhizome size. However, the produced seedlings have been transplanted in the main field to evaluate the final performance of rhizome production.

Nutrient and water management

Effect of different organic fertilizers on yield and quality of ginger

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the rabi season of 2020 - 2021 to know the effect of different organic fertilizers on yield and quality of ginger. There were four treatment combinations viz T₁: 100% recommended dose of chemical fertilizer (RDCF) + 5 t/ha compost (control), T₂: 75% RDCF + 2.50 t/ha vermicompost, T₃: 75% RDCF + 0.50 t/ha tricho-vermicompost and T₄: 75% RDCF + 2.0 t/ha tricho-compost studied in a randomized complete block design with three replications. Positive effects of different treatments were recorded on yield and yield contributing characters of ginger. Along with major yield contributing traits, highest ginger yield was recorded in T₃ (10.09 t/ha) including highest level of BCR (1.79).

Insect and disease management

Fungicidal management of leaf spot disease of ginger

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during 2020-21 to find out the effective fungicides to control leaf spot of ginger. BARI Ada 1 was used in this experiment. Eight different treatments were used. The lowest leaf spot (5.61%) was recorded in T₁ (Rhizome treatment and foliar spraying with Ridomil gold @0.2%) which was followed by T₅ (Rhizome treatment and foliar spraying with Companion 75 @0.2%) and T₂ (Rhizome treatment and foliar spraying with Autostin @0.15%), and the highest leaf spot (20.18%) was recorded in untreated control. T₁ gave the highest weight of rhizome per plant (750.95 g) which was followed by T₅ and T₂, and control resulted the lowest weight of rhizome per

plant (545.37 g). Yield was varied from 17.15 to 26.91 t/ha, while T₁ showed the highest yield which was followed by T₅ and T₂, and control treatment showed the lowest yield which was statistically dissimilar to other treatments. The highest yield increased over control (56.91%) was recorded in T₁ which was followed by T₅ and T₂, and the lowest yield increased over control (11.43%) was recorded in T₃ (Rhizome treatment and foliar spraying with Homai 80 WP @0.2%).

Turmeric

Varietal development

Evaluation of turmeric germplasm

The present experiment was conducted to select superior turmeric lines for higher yield at Spices Research Centre, Shibganj, Bogura during 2020-2021. Fifty-five turmeric genotypes including five BARI released turmeric varieties as checks were used in this study. The experiment was laid out in alpha lattice design with two replications. Five genotypes were out yielded the best check entry BARI Holud-4. The promising genotypes needed to be evaluated in a large plot under advanced yield trial in next season.

Characterization and evaluation of turmeric lines

The experiment was conducted at Hill Agricultural Research Station, Khagrachari during May, 2020 to February, 2021. Four turmeric lines were considered for evaluation in RCB design with three replications. The highest leaf length (48.26 cm) was found in CL Kha 006 followed by CL Kha 002 (43.98 cm) which was statistically similar to CL Kha 003 (42.92 cm). The highest number of primary fingers / clump (13) and secondary fingers / clump (22.00) was obtained from CL Kha 002 which was statistically similar to CL Kha 006. Weight of primary fingers (221.00 g) and mother rhizomes per clump (93.16 g) were highest in CL kha002 and that were statistically similar to CL Kha 006. CL Kha 002 possessed the highest finger breadth (2.73 cm) which was statistically similar to CL Kha 009 (2.43 cm) followed by CL Kha 003 and CL Kha 006. Weight of secondary finger/clump (116.73 g) and rhizome yield /clump was highest (430.83 g) in CL Kha 002 followed.

Advanced yield trial of turmeric

The present experiment was conducted to select superior turmeric lines for higher yield at Spices Research Centre, Shibganj, Bogura during 2020-2021. Eight turmeric genotypes including BARI Holud-4 and BARI Holud-5 as check were used in this study. The experiment was laid out in alpha lattice design with three replications. Genotype T0098 out yielded both the check entries, while genotype T0095 out yielded the check BARI Holud-5. The trial needed to be continued including a new set of promising genotypes in next season.

Cultural management

Yield performance of turmeric in mango orchard

The experiment was conducted at the Regional Agricultural Research Station, BARI, Cumilla during April, 2020 to February 2021 to the yield performance of turmeric in mango orchard as intercrop. Three turmeric variety viz. BARI Holud-3, BARI Holud-4 and BARI Holud-5 were used in the experiment. The experiment was laid out in randomized complete block design with three replications. It was observed that the highest plant height (155.83 cm), number of tillers clump-1 (3.53), population plot-1(51), yield of rhizomes clump-1 (349.97g) and yield (23.14 t/ha) were found in BARI Holud-4. So, the result suggest that BARI Holud-4 performed well in mango orchard regarding higher yield and yield contributing characters.

Coriander

Varietal development

Evaluation of coriander germplasm

The experiment was conducted to select superior coriander germplasm for higher yield at Spices Research Centre, BARI, Shibganj, Bogura during rabi 2020-2021. Twenty five different coriander genotypes were evaluated based on their yield attributes and yield. The experiment was laid out in RCB design with three replications. All traits are significant considering among the genotypes. The genotype COR 15 performed better in case of umbel/plant (104.60), umbellate/umbel (6.50),

seeds/plant (1769.93) and seed yield (1.89 t/ha) over others. The highest 1000 seed weight was found in COR-04 (14.0 g) and the lowest (8.00 g) was COR-28. Considering yield and other attributing traits the genotype BARI Dhonia-2 was found promising.

Regional yield trial of coriander genotype(s) for leaf production

The experiment was conducted at Spices Research Centre-Bogura during 15 December, 2020 to 12 February, 2021. Three promising coriander lines COR-01, COR-11 and COR-20 was included in the study with check BARI Dhonia-2. The experiment was laid out in RCB design with five replications. All the yield contributing characters among the genotype were shown significant except plant per m². Among the genotype COR11 (7.87 t/ha) gave highest yield. The lowest yield was recorded from COR01 (4.92 t/ha). In this study, the genotypes COR11 had the best performance than the other genotypes.

Technology validation and transfer

Performance of BARI Dhania-2, BARI Kalozira-1 and BARI Piazi-1 at char land

The performance trial was conducted at Char Bangram, Chilmari, Kurigram, district during November 2020 to March 2021. Two minor spices BARI Dhania-2 and BARI Kalozira-1 were included in the study. Spices seed with required chemical fertilizers had supplied to one farmer for cultivation of BARI Dhania-2 and BARI Kalozira-1 with each 30 decimal land. The results revealed that excellent crop condition occurred during growing season. The average yield of BARI Dhania-2 and BARI Kalozira-1 were 7.28 and 4.8 kg/decimal, respectively.

Black cumin

Varietal development

Evaluation of black cumin germplasm

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during rabi season 2020-2021 to evaluate different black cumin germplasm collected from different sources and to identify the

best germplasm with higher yield and other desirable characters. The land was medium-high and the soil was clay loam in texture. The experiment was laid out in a Randomized Complete Block Design with three replications. Twenty different black cumin germplasm (viz. BC 013, BC 015-1, BC 015-2, BC 016, BC 018, BC 019-1, BC 019-2, BC 019-3, BC 019-4, BC 019-5, BC 019-6, BC 020-2, BC 022, BC 023, BC 024, BC 025, BC 026, BC 028, BC 029 and BC 030) were evaluated against BARI Kalozira-1 as check. Seed yield and other yield contributing characters were significantly different except capsule length and capsule diameter. The higher amount of seed 1.135 t/ha was harvested from the germplasm BC 030 followed by BC 019-4 (1.067 t/ha) and BC 019-5 (0.964 t/ha). The lower amount of seed 0.559 t/ha was harvested from the germplasm BC 029. The check variety BARI Kalozira-1 produced 0.723 t/ha seed. BC 030, BC 019-4 and BC 019-5 showed better performance among the germplasm. The trial will be repeated in the next year for confirmation of the results.

Regional yield trial of black cumin

The trial was conducted during rabi season 2020-21 to evaluate the performance of advanced black cumin germplasm at the different agro-ecological zones and to select the promising one(s) for releasing a variety. The experiment was laid out in a Randomized Complete Block Design with four replications. Three advanced black cumin germplasm BC011, BC012 and BC014 were evaluated against recommended variety BARI Kalozira-1 as check. The trial was conducted at three different locations viz. SRC, Bogura, RSRC, Gazipur and RSRC, Magura. Seed yield and other yield contributing characters were varied significantly among the germplasm in different locations. Among the locations, the higher amount of seed (0.979 t/ha) was harvested in Magura location which was identical to Bogura location (0.971 t/ha). The lower amount of seed (0.730 t/ha) was harvested in Gazipur location. Among the germplasm, the highest seed yield (1.048 t/ha) was obtained from BC014 and the lowest amount of seed (0.773 t/ha) was harvested from the check variety BARI Kalozira-1. In case of combined effect of location and black cumin germplasm, the

highest amount of seed (1.270 t/ha) was harvested from BC014 in Magura location and the lower amount of seed (0.683 t/ha) was harvested from the check variety BARI Kalozira-1 in Gazipur location. It was found that the advanced black cumin germplasm BC014 performed better in all locations. This trial will be repeated in the next year for confirmation of the results.

Stress breeding

Screening of black cumin germplasm for salinity tolerance

The experiment was conducted at Agricultural Research Station, BARI, Benarpota, Satkhira during December 2020-2021 to find out salinity tolerance of some black cumin germplasm. Nine black cumin line were studied viz. BC 11, BC 12, BC 14, BC 16, BC 19-2, BC 19-6, BC 26, BC 28, BC 29 along with BARI Kalozira-1. The experiment was laid out in Randomized complete block design with three replications. BC-14 (0.40 t/ha) gave the highest yield and BC-29 (0.24 t/ha) gave the lowest yield. The lowest level of soil salinity was recorded in sowing time (5.45 dS/m) and the highest level of salinity was recorded at the harvesting stage (13.28 dS/m).

Technology validation and transfer

Effect of varieties and sowing methods on yield of black cumin under charland condition

An experiment was conducted in the farmer's field at charlads of Char Gonai, Kaunia, Rangpur and Mahishkocha, Aditmari, Lalmonirhat during Rabi season of 2020-21 with BARI Kalozira-1 & Local black cumin variety to find out suitable black cumin variety and sowing methods under charland condition. The trial was conducted in a randomized complete block design (RCBD) with three replications. The highest seed yield of 590.72 kg ha⁻¹ and 667.53 kg ha⁻¹ was obtained in the interaction of BARI Kalozira-1 × Broadcast respectively at Charland of Kaunia, Rangpur and at Charland of Aditmari, Lalmonirhat. The lowest of 216.32 kg ha⁻¹ and 500.08 kg ha⁻¹ was harvested from Local × Line sowing respectively. Broadcast method is more suitable compared to line sowing for black cumin

cultivation under Charland situations. Moreover, BARI Kalozira-1 should be introduced in Char areas of Rangpur region to get higher yield and productivity. This is one year trial. For more confirmations, the experiment should be repeated in the next year.

Fenugreek

Varietal development

Evaluation of fenugreek germplasm

The trial was conducted at Spices Research Centre, BARI Shibganj, Bogura during the rabi season of 2020-21 to evaluate the fenugreek germplasm collected from different sources in terms of their seed size & yield potential and to identify the best one(s). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Nine different fenugreek germplasm (FK 025, FK 032-1, FK 032-2, FK 033, FK 034, FK 035, FK 036, FK 039 and FK 040) were evaluated against recommended variety BARI Methi-3. Seed yield and other yield contributing characters were significantly varied among the germplasm. The higher amount of seed (2.07 t/ha) was harvested from the germplasm FK 025 followed by FK 035 (1.88 t/ha), BARI Methi-3 (1.85 t/ha), FK 036 (1.82 t/ha) and FK 034 (1.75 t/ha). The lower amount of seed (1.31 t/ha) was harvested from FK 032-2. Among the germplasm, FK 025 and FK 035 performed better than the check variety BARI Methi-3. This is the first-year trial and will be repeated in the next year for confirmation of the results.

Advance yield trial of fenugreek

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during rabi season 2020-2021 to evaluate six advanced fenugreek germplasm and to identify the superior one(s) for regional yield trial. The land was medium-high and the soil was clay loam in texture. The experiment was laid out in a Randomized Complete Block Design with three replications. Six advanced fenugreek germplasm (viz. FK 027, FK 028, FK 029, FK 030, FK 031 and FK 037) were evaluated against BARI Methi-3 as check. The advanced germplasm was selected prior to its boldness of

seeds, crop duration and yield potentiality. Significant variations were observed among the different germplasm in respect of yield and yield contributing characteristics. All the germplasm were capable of producing a higher amount of seeds than the check variety except FK 031. The higher amount of seeds 2.66 t/ha was harvested from the germplasm FK 029 which was identical to FK 037 (2.60 t/ha) followed by FK 028 (2.48 t/ha), FK 027 (2.42 t/ha) and FK 030 (2.38 t/ha). The lower amount of seeds 1.82 t/ha was harvested from FK 031. The check variety BARI Methi-3 were produced 2.10 t/ha seeds. However, FK 028, FK 029 and FK 037 will be selected for Regional Yield Trial in the next year.

Insect and disease management

Fungicidal management of rust disease of fenugreek

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during Rabi season of 2020-21 to find out the control measures of rust of Fenugreek. BARI Methi 1 was used in this experiment. Seven fungicides and one control were used as treatments. Rust of fenugreek under different treatments ranged from 8.33 - 29.35%, while the lowest incidence was observed in Tilt 250 EC (0.05%) sprayed plot which was statistically similar to Folicure (0.1%) sprayed plot and the highest incidence was observed in untreated control. The highest number of pods/plant (55.68) was counted in Tilt 250 EC (0.05%) sprayed plots which was statistically similar to Folicure (0.1%) and the lowest (39.45) was counted in untreated control which was not statistically similar to all other treatments. Tilt 250 EC (0.05%) sprayed plots resulted the highest number of seeds per pod (20.93) and weight of seeds per pod (0.40 g) which was followed by Folicure (0.1%) and Contaf 5 EC (0.1%) treated plots, and the lowest of these parameters were recorded in untreated control. Tilt 250 EC (0.05%) sprayed plots gave the highest number of seeds per plant (680.35), weight of seeds per plant (8.13 g) and seed yield (2.25 t/ha) which was followed by Folicure (0.1%) and Contaf 5 EC (0.1%) treated plots, and the lowest of these parameters were obtained from Control. So, Tilt 250 EC (0.05%) or Folicure (0.1%) or Contaf 5 EC (0.1%) may be

used to control rust disease and increase yield of Fenugreek.

Cumin

Varietal development

Evaluation of cumin germplasm2

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during rabi season of 2020-2021 to evaluate the germplasm which was collected from different sources and to identify the best germplasm with higher yield and other desirable characters for variety release. The experiment was laid out in RCB design with three replications. Twenty different cumin genotypes (CN001, CN019, CN020, CN021, CN022, CN024, CN030, CN034, CN035, CN036, CN039, CN040, CN041, CN042, CN043, CN045, CN046, CN047, CN048 and CN050) were evaluated for yield and yield contributing characters. Seed yield and yield contributing characters were significantly different among the germplasm. The maximum germination (79.18%) was recorded from CN020 and the minimum germination (46.83%) was recorded in CN024 genotype. The highest number (98.35) of umbels/plant was recorded from CN022 and the lowest (54.82) was recorded in CN047 genotype. In case of disease severity, the lowest disease severity (PDI value, 16.57) was observed in CN024 and the highest disease severity (PDI value, 49.23) was recorded from CN045. The highest seed yield was obtained from CN24 (393.61 kg/ha) and the lowest seed yield was recorded from CN045 (173.06kg/ha).

Regional yield trial of cumin

The trial was conducted during rabi season of 2020-21 to evaluate the performance of advance cumin lines at different agro ecological zone and to select the promising one for releasing a variety. The experiment was laid out in RCB design with four replications. Four advanced cumin lines viz., CN026, CN028, CN031 and CN038 were evaluated in this study. The trial was conducted at five different location viz., SRC, Bogura; RSRC, Gazipur; RSRC, Magura; SRSC, Faridpur and SRSC, Lalmonirhat. But the trial of cumin in Regional Spices Research Centre (RSRC), Gazipur;

RSRC, Magura; SRSC, Faridpur and SRSC, Lalmonirhat was totally destroyed by infection of *Alternaria* blight disease due to unfavorable weather condition for crop during vegetative stages. So no data was generated from those locations. Seed yield and other yield contributing characters were significantly different among the germplasm in SRC, Bogura. Among the four lines, the highest seed yield (650.31 kg/ha) was obtained from the cumin line CN026 which was statistically different from other lines and the lowest seed yield (395.36 kg/ha) was obtained from CN031.

Isabgul

Varietal development

Advance yield trail of isabgul (*Plantago ovata*)

The experiment was conducted at the research field of Regional Spices Research Centre, Magura during rabi season, 2020-21 to evaluate the performance of different Isabgul (*Plantago ovata*) germplasm and to select the promising one(s) for releasing a variety. Four germplasm were collected from different parts of Bangladesh. The experiment was laid out in randomized complete block design with three replications. The highest plant height (45 cm), number of tillers per plant (9), number of leaves per plant (84), length of leaf (34.66 cm), number of spikes per plant (150.0), length of spike (4.33cm), number of seeds per plant (6712), thousand seeds weight (2.0g) and seed yield (873kg/ha) was found from the Isabgul line P0mag-001 and the lowest plant height (41.33 cm), number of tillers per plant (7), number of leaves per plant (77), Length of leaf (29.33 cm), number of spikes per plant (110), length of spike (2.93cm), number of seeds per plant (5687), thousand seeds weight (1.86g) and seed yield (782kg/ha) was found from the Isabgul line P0gaz-004.

Fennel

Nutrient and water management

Effect of N, P, K and S for yield on growth and yield of fennel

A field experiment was conducted to study the response of N, P, K and S to yield and quality of

fennel cv. BARI Mouri-2, conducted during 2020-2021 at experimental field of Regional Spices Research Centre, BARI, Gazipur. It comprised of twelve fertilizers treatment of fennel cumin in randomized complete block design with three replications. The growth and yield parameters of fennel cumin were significantly affected by the different fertilizer treatments. The maximum seed yield (1.88 t/ha) of fennel was obtained in 130-70-80-30 kg NPKS ha⁻¹ and the maximum harvest index (34.46%) was noted in 180-70-80-30 kg NPKS ha⁻¹. The fennel fertilized by 130-70-80-30 kg NPKS ha⁻¹ might be the recommended nutrient package for satisfactory seed yield in the study area.

Dill

Insect and disease management

Management of *Alternaria* leaf and umbel blight of dill

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during Rabi season of 2020-21 to find out the effective fungicides in controlling *Alternaria* leaf and umbel blight of Dill. BARI Sholuk-1 was used in this experiment. Seven fungicides and one control were used as treatments. *Alternaria* leaf and umbel blight incidence of Dill under different treatments varied from 6.47 - 80.75%, while the lowest incidence was recorded in Seed treatment and foliar spraying with Amistar Top 325 SC (0.1%) and the highest incidence was obtained from control plot. Seed treatment and foliar spraying with Amistar Top 325 SC (0.1%) gave the highest number of umbels per plant (91.07), number of umbel lets per umbel (63.19), number of umbel lets per plant (6451), number of seeds per umbel (108.16), weight of seeds per umbel (0.61 g), number of seeds per plant (2622), weight of seeds per plant (22.61 g) and seed yield (2.31 t/ha) which was followed by seed treatment and foliar spraying with Rovral 50 WP (0.2%) and seed treatment and foliar spraying with Secure 600 WG (0.15%), and the lowest of these parameters were recorded in untreated control plots. So, Amistar Top 325 SC (0.1%) or Secure 600 WG (0.15%) or Rovral 50 WP (0.2%) may be used to control

Alternaria leaf and umbel blight and increase yield of Dill.

Ajown

Varietal development

Regional yield trial of ajown (*Allium sativum*)

The experiment was conducted at three different locations of Bangladesh during robi season of 2020-2021 to evaluate the performance of advance Ajowan line based on agronomical and morphological characteristics. Three advance line were evaluated against a local line and evaluated on various agronomical and morphological characters. The line TC GAZ 002 gave higher seed yield (1.1 t/ha) and the local line and TC GAZ 001 gave insignificantly lower seed yield (1.03 t/ha and 1.02 t/ha).

Cultural management

Effect of seed rate on growth and yield of ajowan

A field experiment was conducted at Spices Research Sub-Centre, Faridpur during rabi season, 2019-20 and 2020-21 to find out the optimum seed rate for growth and yield of Ajowan. The trial was set at high land of Low Ganges River Floodplain (AEZ 12). The experiment was laid out in a Randomized Complete Block Design with three replications and comprised of different five seed rate viz. 3.0, 3.5, 4.0, 4.5 and 5.0 kg/ha. Seeds were sown in line. The results revealed that different treatments had significant effect on yield and others parameters. The highest seed yield (1051.44 kg/ha and 985.55 kg/ha) were recorded from the treatment of 4.5 kg seed/ha by the 2019-20 and 2020-21 respectively followed by the seed rate 4.0 kg/ha (1020.62 kg/ha) in 2019-20 and seed rate 5.0 kg/ha (832.22 kg/ha) in 2020-21. The lowest seed yield (925.46 kg/ha) was observed at 3.00 kg seed/ha in 2019-20 and 681.67 kg/ha at 4.0 kg seed/ha in 2020-21.

Mint

Varietal development

Advanced yield trial of mint

The experiment was conducted at Spices Research Centre, Shibganj, Bogura, during October 2020 to March 2021 with a view to study the performance of advanced mint lines and to select promising mint line (s). Three advance lines of mint (Ms Bog 002, Ms Bog 003, Ms Bog 005) and BARI Pudina-1 & BARI Pudina-2 were used in the study. The experiment was laid out in a randomized complete block design with three replications. It was found that Ms Bog 003 gave the highest number of leaves per twig (33.80) and the lowest (27.60) was found from Ms Bog 002. The line Ms Bog 002 gave the highest leaf length (7.60 cm) and the lowest (3.72 cm) was found from BARI Pudina-1. The highest leaf breadth (2.57 cm) was observed from Ms Bog 003 and the lowest (2.23 cm) was found from Ms Bog 002. Significantly the highest leaves with twig yield (13.96 t/ha) was recorded from Ms Bog 003 followed by Ms Bog 005 (13.63 t/ha) and the lowest (10.08 t/ha) was found from BARI Pudina-1.

Cardamom

Varietal development

Collection, conservation, and characterization of small and large cardamom germplasm

Twenty one germplasm of cardamom (*Amomum subulatum* Roxb.) were collected from spices Research Center (SRC), Bogra, and planted at Citrus Research Station (CRS), Jaintapur, Sylhet in November 2020. The highest plant height was recorded in AS Jai-006 (67.5 cm), which was followed by AS Jai-58 (58.3 cm) while AS Jai-004 (35.2 cm) showed the lowest height. The maximum number of tillers/clump was found in AS Jai-006 (6.3) while the minimum was in AS Jai-004 (3.2). AS Jai-005 produced the highest (25.8 cm) number of leaves per plant while the lowest (9.8) number of leaves/plant produced in AS Jai-004.

Black pepper

Cultural management

Standardization of single node cutting for quick multiplication of black pepper

The experiment was conducted at spices Research Sub-station, Citrus Research Station, BARI, Jaintapur, Sylhet from July 2020 to October 2020 under lath house condition. There were three treatments viz. (a) single-node cuttings, (b) double-node cuttings, (c) triple-node cuttings. Previously standardized potting media (Cocopeat + vermicompost 1:1) was used for planting the cuttings. Commercial rooting hormone cutting aid was used before planting the cuttings. There were variations among the treatments regarding days taken to first sprouting, number of shoots per cuttings, number of leaves per cuttings, length and diameter of shoots. Among the treatments, maximum success and survivability were obtained from both single and double node cuttings respectively, while the lowest success and survivability found in triple node cutting. Maximum number of shoots per cuttings, number of leaves per shoot, and shoot length were found in triple node cuttings while maximum shoot diameter (0.35 cm) was found in double node cuttings. The result revealed that both single and double node cuttings can be occupied for rapid multiplication of black pepper under nursery conditions.

Effect of different potting media on the success and survivability of black pepper cutting in nursery

The experiment was conducted at Spices Research Sub-station, Citrus research station, Bangladesh Agricultural Research Institute, Jaintiapur, Sylhet during the period from April 2021 to July 2021 to select suitable potting media for quality planting materials production. Nine treatments. viz. T₁ = Soil, T₂ = Coco dust, T₃ = Soil + Coco dust (1:1), T₄ = Soil + Vermicompost soil (1:1), T₅ = Soil + FYM (1:1), T₆ = Coco dust + Vermicompost (1:1), T₇ = Coco dust + FYM (1:1), T₈ = Soil + Coco dust + Vermicompost (1:1:1), T₉ = Soil + Coco dust + FYM (1:1:1) were tested with three replications. The study revealed that, among the different growth media Coco dust + Vermicompost (1:1) helped in early sprouting, maximum cutting success and survivality, maximum

number of newly emerged leaves, maximum number of primary roots/ cutting. Maximum root and shoot length, root and shoot fresh and dry weight found promising in media consisting Coco dust + Vermicompost (1:1). Hence the study proved that, the cuttings grown in the media of Coco dust + Vermicompost (1:1) were proven best for propagating of Black pepper cuttings.

Effect of different living and non-living standards on the establishment, growth and yield of black pepper cv. BARI Golmorich-1

An experiment was conducted to study different living and non-living standards on the establishment, growth and yield of black pepper var. BARI Golmorich-1 at Spices Research Sub-station, BARI, Jaintapur, Sylhet from September' 2018 to May' 2019. The experiment consists of three different living and non-living standards as treatment viz. T₁= Reinforced concrete posts, T₂=Bhadi tree (*Lanneacoramandela* (Houtt.) Merr.) and T₃= Mandar tree (*Erythrina variegata*L.). The experiment was conducted in Randomized Complete Block Design with four replications. The vines in Bhadi tree exhibited superior performance with respect to average height of vine (470.6 cm), average number of branches/vine (56.52), number of spikes per vine (163.5) and yield(1.3 kg/plant).

Effect of different standard on growth and yield of black pepper (*P. nigrum*)

The experiment was conducted at Hill Agricultural Research Station, khagrachari during May, 2019 to February, 2024 BARI Golmorich-1 was considered for evaluation in RCB design with three replications. The highest plant height was found in *Sesbania grandifolia* (7 fit). Similarly the highest Leaf width was found 6.33cm in *Sesbania grandifolia*. The highest internode length was found in Iron standard surrounding by half inch iron mesh.

Chaba

Varietal development

Advance yield trial of chaba (*Piper chaba*)

The experiment was conducted at the research field of Regional Spices Research Centre, Magura

during 2018-19 and 2019-20 to evaluate the performance of different Chaba germplasm and to select the promising one(s) for releasing as a variety. Six germplasm namely PCmag-001, PCmag-002, PCmag-003, PCmag-004, PCmag-005 and PCmag-006 were collected from khulna region of Bangladesh and transplanted on different tree species of Regional Spices Research Centre, Magura. Among the six germplasm in 2018-19 highest plant height (4.5 m), number of branches per plant (35), number of leaves per plant (350), internodes length (16 cm) and vine diameter (2.5 cm) was recorded from PCmag-001 line followed by PCmag-002. In 2019-20, highest plant height (10.50 m), number of branches per plant (75), number of leaves per plant (310), internodes length (15 cm) and vine diameter (5.70 cm) was recorded from PCmag-001 line followed by PCmag-002. In 2019-20, from two years old plant, highest yield (6.07 kg/plant, edible stem) was recorded from PCmag-001 line followed by PCmag-002.

Plum

Post-harvest technology

Development of shelf stable value added pickles from plum (*Prunus domestica*)

The present study was concerned with the different ingredients of developed plum pickles depending on the processing techniques used. The acceptability of processed pickles was organoleptically evaluated by the panelists using 1-9 hedonic scale. The panelists were selected at random from different class of people. The panelists tasted the products and assigned marks for color, flavor, texture, pungency, taste and overall acceptability. The mean score for color, flavor, texture, pungency, taste and overall acceptability showed that all samples secured score within the acceptable limit ranging from 7.5 to 8.10, ranking 'like moderately to 'like very much'. The test score indicated that among three samples, the pickle which was processed with puncturing was most acceptable. Storage studies were carried out for up to twelve months at room temperature (25-30°C) at an interval of one month up to first 4months and at an interval of 2 month for the consecutive 8 months. Organoleptic taste testing showed that all

the developed products were accepted by the panelists. Among three samples the chemical composition of best sample 315 (evaluated by the panelists) was determined and it was observed that the qualities of pickles were satisfactory. The study thus shows that high quality shelf-stable plum pickle can be developed utilizing available low cost processing processes and thereby, post-harvest losses of plum can be reduced to an acceptable level.

Development of shelf stable value added candy from plum (*Prunus domestica*)

The present study was concerned with the different ingredients of developed plum candy depending on the processing techniques used. The acceptability of processed candies was organoleptically evaluated by the panelists using 1-9 hedonic scale. The panelists were selected at random from different class of people such as scientist, Ph. D and M.S student, office staff and general people. The panelists tasted the products and assigned marks for color, flavor, texture, pungency, taste and overall acceptability. The mean score for color, flavor, texture, pungency, taste and overall acceptability showed that all samples secured score within the acceptable limit ranging from 6.6 to 8.50, ranking 'like very much to 'like slightly'. Storage studies were carried out for up to twelve months at room temperature (25-30°C) at an interval of one month up to first 4months and at an interval of 2 month for the consecutive 8 months. Organoleptic taste testing showed that all the developed candies were accepted by the panelists. Among three samples the chemical composition of best sample S₂ (evaluated by the panelists) was determined and it was observed that the qualities of candy were satisfactory. The study thus shows that high quality shelf-stable plum candy can be developed utilizing available low cost processing processes and thereby, post-harvest losses of plum can be reduced to an acceptable level.

Development of shelf stable value added bar from plum (*Prunus domestica*)

The present study was concerned with the different ingredients of developed plum bars depending on the processing techniques used. The acceptability

of processed bars was organoleptically evaluated by the panelists using 1-9 hedonic scale. The panelists were selected at random from different class of people. The panelists tasted the products and assigned marks for color, flavor, texture, pungency, taste and overall acceptability. The mean score for color, flavor, texture, pungency, taste and overall acceptability showed that all samples secured score within the acceptable limit ranging from 6.7 to 8.10, ranking 'like very much' to 'like slightly'. Storage studies were carried out for up to twelve months at room temperature (25-30°C) at an interval of one month up to first 4 months and at an interval of 2 month for the consecutive 8 months. Organoleptic taste testing showed that all the developed bars were accepted by the panelists. Among three samples the chemical composition of best sample S₃ (evaluated by the panelists) was determined and it was observed that the qualities of bar was satisfactory. The study thus shows that high quality shelf-stable plum bar can be developed utilizing available low cost processing processes and thereby, post-harvest losses of plum can be reduced to an acceptable level.

Bay leaf

Varietal development

Evaluation of bay leaf germplasm

The study was conducted at spices research sub-station, BARI, Jaintapur, Sylhet during July, 2020 to May, 2021. Three bay leaf germplasm were selected for the study. A wide variability was observed in different parameters such as pungency and size of leaf, yield, pest and diseases infestation among the germplasm studied. TM Jai-001 was superior with biggest leaf followed by TM Jai-003. Among the accessions TM Jai-001 also gave the highest yield but leaf aroma was highest in TM Jai-003.

Nutrient and water management

Effect of nutrient management on growth and leaf yield of bay leaf

A field experiment was conducted to study the response of different nutrient management packages on growth and leaf yield of bay leaf at Experimental bay leaf garden of Regional Spices

Research Centre, BARI, Gazipur. It comprised of five nutrient management treatments of bay leaf in randomized complete block design with two replications. The growth parameters of bay leaf were significantly affected by the different management packages. The maximum increase of plant height (23cm), the plant height (4.63m), annual shoot growth (21.0cm), leaf area (31.33 cm²), number of leaves per feet of shoot (19.33), leaf dry weight (1.73g) and leaf yield (8.53 kg tree⁻¹ year⁻¹) were recorded in application of nutrients 165-70-150-40-5-3g NPKSZnB + 4 kg mustard oil cake tree⁻¹ year⁻¹. The application of nutrients 165-70-150-40-5-3g NPKSZnB + 4 kg mustard oil cake tree⁻¹ year⁻¹ is recommended the best suitable nutrient management packages for bay leaf cultivation in the study area.

Cinnamon

Varietal development

Evaluation of cinnamon genotypes

The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet during the period from May 2020 to May 2021 to identify the best genotypes of cinnamon. Three cinnamon genotypes viz. CC Jai-001, CC Jai-002, and CC Jai-003 were evaluated. There were no significant variations among the germplasm tested except quill thickness. Almost all the qualitative parameters found maximum in CC Jai-002 and the minimum in CC Jai-003. The maximum quill fresh and thickness and weight were recorded in CC Jai-002 while minimum in CC Jai-003. The genotype CC Jai-002 performed best among the treatments under study.

Collection and evaluation of indigenous spices crop under sylhet region

The study was conducted at Citrus research Station (CRS), Jaintapur, Sylhet. Eleven different indigenous spices crop were collected from different location of Sylhet region. These germplasm were kept in controlled condition in net house for evaluation.



Genetic diversity of eggplant germplasm

AKM Quamruzzaman, S.R. Mallick, Ferdouse Islam and Md. Nazim Uddin

The study was conducted at the experimental field of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur during 2020-21 to assess the extent of genetic diversity among 28 eggplant germplasm. The collected germplasm originating from local and exotic sources were subjected to cluster analysis. The germplasm was constellated into six distinct groups with the range of 2 germplasm in cluster V to 6 germplasm in cluster I and cluster IV. The inter-cluster distance in all cases was larger than the intra-cluster distance. The intra cluster distance was maximum in cluster I (1.986) and minimum in cluster VI (0.437). Regarding inter cluster distance, cluster V showed maximum genetic distance with cluster VI (11.317) followed by the genetic distance from cluster I and VI (11.177), cluster I and cluster III (10.696) and cluster I and cluster II (10.427). Considering the group distance and inter-genotypic crosses between the members of cluster V and VI, cluster I and IV and cluster I and III would exhibit high heterosis and was also likely to produce new recombinants with desired traits. But in case of the cluster means values and yield contributing performance cluster I, cluster III, cluster IV, cluster V performed well. Therefore, inbreeds belong to cluster I, cluster III, cluster IV, cluster V will be given higher priority for crossing in future eggplant hybridization programme.

Performance of bacterial wilt tolerant white colored eggplant lines

AKM Quamruzzaman, S.R. Mallick, Md. Nazim Uddin and Ferdouse Islam

A study on the performance of five bacterial wilt tolerant white colored eggplant lines was conducted at the experimental farm of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur, during the winter season of 2020-21 to observe the performance in relation of yield potentiality, pest and disease tolerance. There was diverged variability observed among the 5 white colored eggplant lines. The range of number of marketable fruit/ plant was 22-28 while average fruit weight was 130-201g. Significant variation was observed in fruit length and fruit diameter and these were 9.8-26.6 cm and 3.6-7.0 cm, respectively. The range of eggplant fruit and shoot borer (EFSB) infection was 12.48 % (SM 312) -15.96 % (SM 314), while less than 15% infestation was observed in other lines. Bacterial wilt infection was zero percent was in all lines except one line. The range of fruit yield (t/ha) was 43.93-52.39 t/ha, while the maximum was in SM 312 (52.39 t/ha) which was statistically similar with SM 310 (51.76 t/ha), SM 318 (46.84 t/ha), while the minimum was in SM 314 (43.93 t/ha). Considering earliness, high yield, EFSB infestation, BW infection tolerance, fruit shape the bacterial wilt tolerant white colored eggplant lines SM 310, SM 312, SM 314, SM 318 were found promising and may be recommended for AYT.

Evaluation of eggplant lines in jamalpur region during summer season

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K Mazed

The experiment was conducted at the research field of Horticulture Research Centre, Regional Agricultural Research Station, BARI, Jamalpur during the summer season of 2020 to develop high yielding OP eggplant variety. Nine collected

eggplant lines viz. SM Jam-001, SM Jam-002, SM Jam-003, SM Jam-015, SM Jam-017, SM Jam-018, SM Jam-019, SM Jam-021 and BARI Begun-8 as a check were evaluated. The highest (94.8) number of fruits per plant was obtained from SM Jam-013 and the lowest (21.5) number of fruits per plant was obtained from SM Jam-015. The maximum yield (34.00 t/ha) was produced by BARI Begun-8 and the minimum yield (16.29 t/ha) was produced by SM Jam-019. Considering yield and yield contributing characters SM Jam-001, SM Jam-015, SM Jam-017, SM Jam-018 and SM Jam-021 can be selected for next year evaluation.

Preliminary yield trial of purple coloured eggplant lines

AKM Quamruzzaman, Ferdouse Islam, Md. Nazim Uddin and S.R. Mallick

A study on the performance of thirty-eight purple colored eggplant lines with BARI Begun-4 (as check) was conducted at the experimental farm of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur, during the winter season of 2020-21 to observe the performance in relation of yield potentiality, pest and disease tolerance. There was diverged variability observed among the 39 purple colored eggplant lines. The range of days to first harvest was 98-110 days, while the number of marketable fruit/plant was 12-35 and average fruit weight was 69-233 g. Significant variation was observed in fruit length and fruit diameter and these were 8.3 cm (SM 398) - 27.3 cm (SM 373) and 2.7 cm (SM 398) - 8.5 cm (SM 337), respectively. The range of eggplant fruit and shoot borer (EFSB) infection was 10.0% (SM 222D5)-28.1% (SM 482), while less than 12% infestation was observed in 7 lines, which is very much optimistic. Bacterial wilt infection zero percent in 29 lines/ variety. The range of fruit yield (t/ha) was 15.12-58.30 t/ha, while the significant higher yield was produced by SM 222D5 (58.30 t/ha), SM 222D4 (53.98 t/ha), SM 222A (53.71 t/ha), SM 216A (53.09 t/ha), SM 82 (52.70 t/ha), SM 222D2 (51.55 t/ha), SM 50 (49.32 t/ha), SM 222D1 (47.88 t/ha), SM 217A (47.11 t/ha), SM 337 (47.11 t/ha). Considering earliness, high yield, EFSB infestation, BW infection tolerance, fruit shape and color the lines SM 222D5, SM 222D4, SM 222A, SM 216A, SM

82, SM 222D2, SM 50, SM 222D1, SM 217A, SM 337 were found promising and may be recommended for AYT.

Advanced yield trial of green coloured eggplant lines in relation to insect and diseases

Ferdouse Islam, AKM Quamruzzaman, Md. Nazim Uddin and S.R. Mallick

A performance trial study with of twenty-eight green colored eggplant lines along with BARI Begun-6 (as check) was conducted at the experimental farm of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur, during the winter season of 2020-21 to observe the performance in relation of yield potentiality, pest and disease tolerance. There was diverged variability observed among the 29 green colored eggplant lines. The range of days to first harvest was 96-105 days, while the number of marketable fruit/ plant was 7-44 and average fruit weight was 58-315g. Significant variation was observed in fruit length and fruit diameter and these were 7.6- 22.5 cm and 3.7-12.0 cm, respectively. The range of eggplant fruit and shoot borer (EFSB) infection was 9.1% (SM 221B) -33.6% (SM 330), while bacterial wilt infection zero percent was in 24 lines/ variety. The range of fruit yield (t/ha) was 25.75-64.06 t/ha, while the higher yielder lines were SM 291B (64.06 t/ha) followed by SM 83E (53.79 t/ha), SM 83A (49.59 t/ha), SM 464 (48.21 t/ha), SM 484 (47.06 t/ha), SM 369 (46.68 t/ha), SM 385 (46.41 t/ha). Considering earliness, high yield, EFSB infestation, BW infection tolerance, fruit shape and color the lines SM 291B, SM 83E, SM 83A, SM 464, SM 484, SM 369, SM 385 were found promising and may be recommended for RYT.

Advanced yield trial of white coloured eggplant lines

M.R. Karim, E. Mahmud, N. Akter and M. I. A. Howlader

Five white colored eggplant lines was selected from preliminary evaluation and planted at Regional Horticulture Research Station, Lebukhali, Patuakhali during winter season of 2020-21 for advanced yield trial. There was wide range of variability among the genotypes. The lowest days were required for germplasm SMP 38 and highest

days required for germplasm SMP 15. The longest fruit was found (24.93 cm) in SMP 48 and the shortest fruit (10.73 cm) in SMP 54. Fruit breadth was minimum in SMP 54 (4.73 cm) and maximum in SMP 38 (7.87 cm). Maximum number of fruit per plant was 39.63 in SMP 54 and minimum 12.88 was in germplasm SMP 41. Average fruit weight ranged from 106.67 g in SMP 54 germplasm to 334.67 g in SMP 15. Fruit weight per plant varied from 3.21 kg in germplasm SMP 38 to 6.92 kg in SMP 48.

Advanced yield trial of eggplant lines at Jamalpur region

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

The study was conducted at the research field of Horticulture Research Centre, Regional Agricultural Research Station, BARI, Jamalpur during the winter season of 2020-2021 to develop new high yielding OP variety. Six eggplant lines viz. SM Jam-003, SM Jam-008, SM Jam-011, SM Jam-015, SM Jam-017, SM Jam-018 and BARI Begun-6 as check were evaluated. The highest (15.9) number of fruits per plant was counted from the line SM Jam-008 and the lowest (9.2) number of fruits from BARI Begun-6. The heaviest fruit was found in SM Jam-015 (242.0 g) and the smallest fruit was observed in SM Jam-008 (68.3 g). The maximum yield (2.57 kg/plant and 36.67 t/ha) was produced by the line SM Jam-015 and the minimum yield (1.09 kg/plant and 15.53 t/ha) was produced by SM Jam-008. Considering yield and yield contributing characters the lines SM Jam-015, SM Jam-003, SM Jam-011 and SM Jam-017 were found promising and might be recommended for regional yield trial.

Regional yield trial of eggplant lines resistance to pest and diseases

AKM Quamruzzaman, S. R. Mallick, M. Nazim Uddin and Ferdouse Islam

The study was conducted with nine green colored viz., ISD 23, ISD 35, SM 220, SM 253B, SM 262, SM 275, SM 332, SM 334, BARI Begun-6 and ten purple colored eggplant lines viz., SM 216, SM 217, SM 222D, SM 233, SM 286B, SM 488, SM 405, SM 181B, SM 181E, BARI Begun-4 at the farm of Olericulture Division, HRC, BARI,

Gazipur along with different RARS (Akbarpur, Hathazari, Ishwardi and Jamalpur) of BARI during the winter season of 2020-21 to develop new high yielding variety having tolerance to eggplant fruit and shoot borer and bacterial wilt. Significant variation was observed in nine green colored and ten purple colored eggplant lines. The higher green colored fruit yielder lines were SM 275 (57.07 t/ha), SM 332, SM 334 (53.51 t/ha), ISD 35 (51.67 t/ha), while higher purple colored fruit yielder lines were SM 216 (56.58 t/ha), SM 233 (55.36 t/ha), SM 222D (54.17 t/ha), SM 181E (52.14 t/ha), SM 286B (51.90 t/ha). In case of green colored lines, the range of EFSB infestation was 0.0-3.3 %, while five lines showed less than 15% infestation. Though the bacterial wilt infection was not significant, but five lines displayed zero percent infection. In purple colored lines all the lines showed less than 15% EFSB infestation except SM 405, while six lines showed zero percent BW infection. Considering earliness, tolerance to fruit infection by EFSB, bacterial wilt infestation, attractive fruit shape and fruit color, the green colored lines SM 275, SM 332, ISD 35 and three purple colored lines SM 216, SM 233, SM 222D were found promising. So, these three green colored and three purple colored lines might be selected for releasing as new green and purple colored eggplant variety.

Regional yield trial of high temperature tolerant eggplant lines

AKM Quamruzzaman, S. R. Mallick, M. Nazim Uddin and Ferdouse Islam

The study was conducted with five eggplant lines viz., SM 216, SM 220, SM 233, SM 275, SM 405 and BARI Begun-6 (check variety) at the farm of Olericulture Division, HRC, BARI, Gazipur during the summer season of 2020 to develop new high yielding OP variety having tolerance to high temperature, eggplant fruit and shoot borer and bacterial wilt. The highest number of marketable fruits/ plant was counted in SM 216 (90), while heaviest fruit was produced in BARI Begun-6 (182g) followed by SM 405 (177g). The range of fruit length and fruit diameter was observed in 16.0-17.3 cm and 2.8-5.2 cm, respectively. The range of EFSB infestation was 12.2% (SM 220)-25.4 (BARI Begun-6). The range of fruit yield

(t/ha) was 35.20-47.60 t/ha, while maximum yield was calculated in SM 216 (47.60 t/ha), followed by SM 233 (45.65 t/ha), SM 275 (41.39 t/ha), while minimum was in BARI Begun-6 (35.20 t/ha). Considering earliness, high yield and maximum tolerance level to fruit and shoot borer, bacterial wilt, fruit shape and color the lines SM216, SM233 (Purple colored) and SM 275, SM 220 (Green colored) were found promising and may be recommended as new eggplant varieties for cultivation during summer season.

Evaluation of tomato germplasm

M. A. Goffar, M. S. Alam and M.M. R. Salim

The study was conducted with 17 tomato germplasm at research field of Olericulture Division of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2020-21 to identify promising tomato lines in respect of high yielding resistant breeding sources. There were 17 lines included in this study. All the lines showed difference in the most of the parameters studied. There were 10 lines- SL0705, SL0707, SL0712, SL0714, SL0715, SL0721, SL0722, SL0723RT, SL0724RT and SL0732RT possess table purpose found to be promising with yield more than 2.0 kg fruit per plant having average fruit weight 62.0-78.0g. The wild type seven lines- SL0701, SL0702, SL0703, SL0704, SL0708, SL0709 and SL0710 exhibited profuse fruit bearing habit with 1.9-2.0kg fruit yield per plant having 3.0-8.0g average fruit weight. No virus infection found to occur in the wild type lines. Therefore, considering the plant growth habit, flowering trends and other horticultural traits, all table type lines may be selected for preliminary yield trial in the next year, while wild type lines may be maintained as resistant breeding materials for further tomato improvement program.

Performance of semi determinate tomato lines

M. A. Goffar, M.S. Alam and M.R. Ali

A performance trial with selected semi determinate tomato lines was conducted at Olericulture Division of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2020-21. There were six lines included in this study with check

variety BARI Tomato-15 for selecting superior semi determinate tomato lines. All the lines showed statistically significant difference in all the parameters studied. The line SL0419 contributed the highest per plant yield (3.05 kg) with good shelf life (14.0 days) having 29 days' harvestable period. The highest yield per hectare was recorded in GT017 (73.54t). The second highest yield was obtained from the line SL0419 (71.88t). Remaining other lines contributed more than 60 tons yield. It indicated all lines are good yielding tomato lines. The keeping quality attribute showed that a good keeping quality (shelf life) was recorded and it was marketable up to 9.0-15.67 days under ambient condition prevailing 27-28°C temperature. Number of seeds per fruit varied ranged from 79.0 to 98.0. Virus infection was recorded up to 0-7.00% at 75 days after sowing (DAS) under field condition. Based on different traits, all the lines found to be promising. All these tomato lines may be selected for advance yield trial in the next year to confirm the results.

Evaluation and characterization of afaci tomato germplasm

Ferdouse Islam, AKM Quamruzzaman and S. R. Mallick

The study was conducted with 75 tomato germplasm/ varieties at the farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute, Gazipur, Bangladesh during the winter season of 2020-21 to evaluate the WorldVeg tomato germplasm. The days to first harvest was varied from 106 to 116 days while twelve lines were harvested within 106-108 days. The number of fruits per plant varied from 11.7 to 71.3, while the range of single fruit weight was 16.4-186.6g. Fruit yield per hectare was 15.7-150.4 t/ha where the highest fruit yield per hectare was obtained from the lines AVTO 1702 (150.40 t/ha), followed by AVTO 1409 (126.54 t/ha), AVTO 1010 (120.60 t/ha), AVTO 1712 (111.33 t/ha), AVTO 1711 (107.23 t/ha). The range of fruit length was observed 2.07 to 6.8 cm, while the fruit diameter was 1.9 to 7.4 cm. The range of pericarp thickness was 0.14 to 0.8cm, while the range of number of locule was 2.0 to 8.2. The range of TSS level was 2.0-8.2%, while the shelf life of the tomato lines

was recorded 5.2 to 10.3 days. The TYLCV infection was observed 0 to 27 % infection, while 47 lines showed zero percent infection. The range of bacterial wilt infection was 0 to 10% and zero percent infection was observed in 62 lines. In case of leaf miner infestation and fruit borer infestation was 0 to 43 % and 0 to 10 %, respectively. Considering earliness, quantitative and qualitative characters, tolerance to late blight, TYLCV, bacterial wilt infection and leaf miner, fruit borer infestation, eleven WorldVeg Center tomato lines AVTO 1010, AVTO 1315, AVTO 1409, AVTO 1711, AVTO 1712, AVTO 1713, AVTO 1717, AVTO 1907, AVTO 1911, AVTO 1915 and AVTO 1921 were found promising. So, these eleven lines can be selected for further confirmation.

Regional yield trial of insect and disease tolerant tomato lines

M.A. Goffar, M. R. Ali, M. A. Sarker and P. Hanson

A regional yield trial was conducted on WVC (The World Vegetable Centre-former AVRDC) supplied tomato lines to study the yield, pest and diseases resistance and quality attributes at the experimental field and laboratory of Olericulture Division of Horticulture Research Centre (HRC), BARI, Gazipur, Bangladesh along with four regional stations (covering different AEZs) of BARI during the winter season of the year 2020-21. There were four selected tomato lines viz., SL0403 (CLN3900D-18B); SL0405 (CLN3902D); SL0411 (CLN3961C) and SL0413 (CLN3853C) along with one local check BARI Tomato-19 were included in this study. The findings of major parameters revealed that, days to 50% flowering was observed uniform that was confined to 51.0-57.0 days. In respect of marketable fruit number per plant, the highest number of fruit (25.0) was counted in the line SL0413 and the lowest number of fruits was counted in SL0411 (23.0). In the case of average fruit weight, the largest fruit was harvested from the line SL0403 (86.81g) followed by SL0413 (81.45g) and the lowest average fruit weight were obtained from the line SL0411 (62.45g). The marketable fruit yield per plant varied from 2.30 to 1.86kg. The highest marketable fruit yield (55.38 t) was obtained from the entry SL0413. Though the line SL0411 is low yielding (47.11 t) among the

lines but due to its earliness, this line may be used in cropping pattern to increase cropping intensity. The length and width of fruits, TSS, P^H, pericarp thickness and locules number per fruit of different lines varied significantly. The line SL0413 exhibited the highest (10.0 days) shelf life at the ambient temperature of 26-27°C. Number of seeds per fruit showed significantly difference among the lines studied which was ranged from 79.0 to 100.0. Most of the lines showed better performance in terms of pest and disease tolerance. Regarding other qualitative traits, all the lines found to be promising. The experiment may be repeated to confirm the results aiming to release as new dual purpose tomato variety(s) for Bangladesh.

Regional yield trial of bacterial wilt and tylev disease tolerant tomato lines

M S Alam, M A Goffar, M M R Salim and Ferdouse Islam

Regional yield trial was conducted with selected advance disease tolerant tomato lines with BARI Tomato-14 and BARI Tomato-15 as check at the experimental field of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur, Bangladesh during the winter season of 2020-21 to observe the performance of the selected lines. Significant variation was observed among the lines in respect of different characters studied. A wide range of variation in number of fruits (24-42) per plant was observed. Maximum fruit yield per hectare obtained from the line AVTO 1317 (102.4 tones) followed by AVTO 1229 (94.2 tones). There was no bacterial wilt infection found in all the lines. No virus infection was found in the lines AVTO1317, AVTO1316 and AVTO1229. The highest virus infection was observed from BARI Tomato-14 (64%). The result revealed that considering high yield and disease tolerance the tomato lines AVTO 1317 and AVTO 1229 found to be promising and may be released as OP variety.

Evaluation of sweet pepper germplasm

AKM Quamruzzaman, Ferdouse Islam, S.R. Mallick and Limu Akter

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during the winter season of 2020-21 to

evaluate five sweet pepper germplasm with a view to search a new variety. From this trial it was found that most of the germplasm showed good performance in respect of yield and yield contributing characters. Earlier flowering was recorded from AVPP 0118 (40 days), which was at par to the check variety BARI Mistimorich-1 (40 days). The highest number of fruits per plant was recorded from the line AVPP 0301 (9.4). The highest average fruit weight was found in the line AVPP 0913 (138 g). The highest fruit yield (34.51 t/ha) was recorded from AVPP 0912 followed by the line AVPP 0913 (32.17 t/ha). The lowest yield was obtained by AVPP 0118 (20.76 t/ha). In respect of yield, fruit shape, colour and size all the lines were found excellent in Bangladesh condition.

Advanced yield trial of sweet pepper lines

Limu Akter, Ferdouse Islam and AKM Quamruzzaman

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during the winter season of 2020-21 to evaluate the selected sweet pepper lines collected from different sources with a view to search a new variety and their adoptability. From this trial it was found that most of the lines showed good performance in respect of yield and yield contributing characters. Earlier flowering was recorded from the line CA 0032 and CA 0026. The highest number of fruits per plant was recorded from the line CA 0020 (9.30). The highest average fruit weight was found in the line CA 0017 (140.4g). The line CA 0030 was the highest fruit yielder (33.51t/ha) among the evaluated lines, which was followed by the line CA 0017 (31.17/ha). The lowest yield was obtained by the line CA 0039 (15.10t/ha). But all the lines were found excellent for their yield and other traits. It was observed that tunnel cover with nylon net with polythene is required for growing capsicum during winter.

Performance of selected summer radish lines

M. S. Alam and Bahauddin Ahmed

The study was conducted at the experimental field of Olericulture Division, Horticulture Research Center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during the months of June

2020 to July 2020. Selected summer radish line RS 004 and commercial variety Everest, Quick-40 with BARI Mula-1 were evaluated. The highest (440g) plant weight obtained from the variety Everest followed by the line RS 004 (436g) and the lowest (345g) from the variety BARI Mula-1. The maximum (5.02 cm) diameter was measured from the variety Everest and the minimum (4.11cm) from the variety Quick-40. Root weight (g) showed significant differences among the tested radish lines/varieties. The highest value (321g) was obtained from the variety Everest followed by the line RS 004 (316g) while the lowest (245g) was found in the variety BARI Mula-1. Significantly the highest 25.38 tons yield were produced by the variety Everest followed by the line RS 004 (24.55 ton) which are statistically at par and the lowest 15.40 tons were produced by the variety BARI Mula-1. Considering growth and yield the performance of tested line was satisfactory.

Advanced yield trial of selected broccoli lines

Md Razzab Ali and Ferdouse Islam

The experiment was conducted at research field of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2020 - 21 with two selected OP broccoli lines and BARI Broccoli-1 was used as check to evaluate the yield potentiality. The line BOI 018 took minimum days (34 days) and the variety BARI Broccoli-1 (42) and BOI 015 (44 days) took the maximum days to 50% curd initiation. The line BOI 018 took the minimum days (48 Days) to harvest which was identical to BARI Broccoli-1. The highest curd length (17.66 cm) was recorded from the variety BARI Broccoli-1 and the lowest was from BOI 018 (16.33 cm). The highest whole plant weight (2.1 kg), highest only curd weight/ plant (720.78 g), the highest marketable curd weight/ plant (844.55 g) and the highest curd yield per hectare (16.95 t) was recorded from the line BOI 018. The lowest only curd weight/ plant (376.00 g), the lowest marketable curd weight/ plant (476.00 g) and curd yield per hectare (9.55 t) was obtained from the BARI Broccoli-1. All lines produced slightly cerate type green and light green leaf. All lines/variety were produced medium and compact curd while BARI Broccoli-1 produced small curd. The BARI

Broccoli-1 produced green color curd while other two lines produced light green color curd. On the basis of uniform curd shape, compactness and yield the line BOI 018 and BOI 015 were selected for regional yield trial.

Evaluation of turnip lines

AKM Ariful Hoque and AKM Quamruzzaman

The study was conducted at Olericulture research field of Horticulture Research Centre in Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2020-21. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Among the germplasm significant variation were observed. In case of number of leaves per plant the highest number of leaves per plant (39.05) was noted from BR Joy-002 germplasm and the lowest (22.33) in BR Joy-003. Plant height at last harvest recorded maximum (45.75 cm) in BR Joy-001 whereas it was recorded minimum (41.23 cm) in BR Joy-003. In case of root length, the highest length (22.45 cm) was measured from BR Joy-003 germplasm and the lowest (8.83 cm) was from BR Joy-001. Root diameter found maximum (9.65 cm) from germplasm BR Joy-002 and minimum (6.71 cm) from BR Joy-001. The highest fresh root weight (625.36 g) was recorded from BR Joy-002 germplasm and the lowest weight (375.14 g) was recorded from BR Joy-001. Yield per plot found highest (7.51 t/ha) from BR Joy-002 turnip germplasm and lowest (4.50 t/ha) from BR Joy-001 germplasm.

Evaluation of bottle gourd germplasm

AKM Quamruzzaman, M.M.R. Salim and S.R. Mallick

The study was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during 2020-21 to assess the yield potentiality of collected six bottle gourd germplasm. There was diverged variability observed among the six bottle gourd germplasm. The range of number of fruit/plant and average fruit weight was 7-10 fruits and 1.81-2.30 kg, respectively. The range of fruit length and diameter was 18.50- 35.00 cm and 15.00 - 10.50 cm, respectively. The highest fruit yield was produced by LS231 (38.67 t/ha), followed by LS232 (36.80 t/ha), BARI Lau-4 (34.93 t/ha).

Among the germplasm 2 types of fruit shape and 2 types of fruit color were observed. Considering yield contributing characters, fruit shape and color the germplasm LS231 and LS232 were found promising and may be recommended for PYT.

Regional yield trial of bottle gourd lines

AKM Quamruzzaman, Mmr. Salim and S.R. Mallick

A study on the performance of four bottle gourd lines with BARI Lau-4 was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur along with different RARS/RHRS (Akbarpur, Hathazari, Ishwardi, Rahmatpur) of Bangladesh during the winter season of 2020-21 to develop new high yielding OP varieties. Significant variation was observed in average fruit weight, yield /plant, fruit length, fruit yield. Maximum average fruit weight was produced by LS 154 (2.23 kg), while LS 162 produced the lowest 1.77 kg. The highest yield/ plant was produced by LS 154 (41.93 t/ha), followed by BARI Lau-4 (41.73 t/ha), while lowest yield was produced by LS 162 (30.73 t/ha). The highest mean average fruit yield was obtained by LS171 (49.18 t/ha) and LS154 (46.89 t/ha) over 5 locations. Considering yield potentiality over 5 locations, fruit color, acceptable fruit shape two advanced lines viz., LS154 and LS 171 were found promising and may be released as new bottle gourd variety.

Evaluation of pumpkin lines

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

The experiment was conducted at the research field of Horticulture Research Centre, Regional Agricultural Research Station, BARI, Jamalpur during winter season of 20120-2021 to develop new high yielding OP variety. Eleven collected pumpkin lines and BARI Mistikumra-2 as a check were evaluated. The highest number of fruits per plant was obtained from CM-Jam-005 (5.5) and CM-Jam-023 (5.5). The line CM-Jam-009 gave the highest average fruit weight (4.39 kg) as against the lowest (2.23 kg) in CM-Jam-026. Flesh thickness was the maximum (5.0 cm) in the line CM-Jam-005 and CM-Jam-022 and the minimum (3.0 cm) in CM-Jam-006, CM-Jam-012 and CM-Jam-023. The line CM-Jam-009 produced the highest yield (19.95

kg/plant and 39.89 t/ha) and the line CM-Jam-023 produced the 2nd highest yield (18.90 kg/plant and 37.79 t/ha), while CM-Jam-007 had the least yield (9.45 kg/plant and 18.90 t/ha). Considering yield and yield contributing characters the lines CM-Jam-005, CM-Jam-005, CM-Jam-012, CM Jam-020, CM Jam-022 and CM Jam-023 performed better. It might be selected for next year evaluation with a view to develop a new pumpkin variety.

Advanced yield trial of ash gourd lines

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

The experiment was conducted at the experimental field of Horticulture Research Centre, Regional Agricultural Research Station, BARI, Jamalpur during the summer season of 2020 to develop high yielding OP ash gourd variety. Five collected ash gourd lines viz. BH Jam-001, BH Jam-002, BH Jam-003, BH Jam-004, BH Jam-005 and BARI Chalkumra-1 as check were evaluated. The maximum number of marketable fruits (13.83) per plant was recorded from BH Jam-005 followed by the BH Jam-001 (10.73) and the minimum number of fruits (7.0) was observed in BH Jam-004. The highest yield was obtained from BH Jam-005 (36.43 t/ha) followed by BH Jam-001 (29.07 t/ha), while the line BH Jam-004 produced the lowest yield (16.26 t/ha). Considering yield and yield contributing characters the lines BH Jam-005, BH Jam-001 and BH Jam-003 gave better performance. Therefore, these lines can be recommended for RYT in next year.

Regional yield trial of ash gourd lines

MMR Salim and M. Razzab Ali

An experiment was conducted at Olericulture Division, HRC, Bangladesh Agricultural Research Institute, Gazipur during the summer season of 2020 to assess yield potentiality and quality of three ash gourd advance lines viz., BH-01, BH-02 and BH-29 along with BARI Chalkumra-1 as check variety. The experiment was laid out in RCBD design with three replications. Wide ranges of variability were found in the studied characters among the lines. The days to 1st female flower opening varied among the lines. Earlier harvest was done in BH-02 and BARI Chalkumra-1 (65.33 days) followed by BH-01 (67.67 days). The number

of fruits/plant was the highest in BARI Chalkumra-1 (11.30), BH-02 (11.19) and the lowest in BH-29 (8.30). Fruit length as well as average fruit weight was higher in BH-29 ((21.28 cm, 1.45 kg) and lower in BARI Chalkumra-1 (18.98 cm, 1.30 kg). Fruit diameter was highest in BARI Chalkumra-1 (13.31 cm) followed by BH-02 (12.70 cm). The yield (t/ha) was the highest in BH-02 (30.48 t/ha) followed by BH-01 (30.19 t/ha), which was significantly similar to BARI Chalkumra-1 (29.44 t/ha) and lowest in BH-29 (24.11 t/ha).

Evaluation of cucumber germplasm

S Sultana, M H Rahman and M O Kaisar

The present study was designed to characterize and evaluate twenty-six indigenous cucumber lines obtained from Cumilla and two accessions from PGRC with respect to agro-morphological traits and reaction to different biotic stresses. The experiment was conducted at the experimental field of RARS, BARI, Cumilla during rabi season of 2021. There was less diversity found after evaluation among the collected germplasm. Yield per plant varies from 0.28-13.0 kg, where some lines exhibited heavy bearing in nature viz. CS Cum-15. This line was extremely vigorous and found free from virus infection symptoms such as leaf curling, mosaic and also stunting diseases or wilting. Thus, it can be used as important breeding material for developing cucumber variety. In terms of fruit fly infestation, the range was found from 0-100%. However, fruits obtained from most of the lines were very good in taste, size and shape, attractive in skin and flesh color. From this study, out of twenty-eight materials only six genotypes were selected primarily as distinct genotypes depending on all the selection criteria. Selected materials are being maintained at RARS, Cumilla and further evaluation will be conducted in summer season of 2021.

Evaluation of ridge gourd germplasm

T. Tasmima, M H Rahman and M. O. Kaisar

This experiment was conducted during the Kharif season of 2020 in the experimental field of RARS, Cumilla. A total of thirty germplasm of ridge gourd were collected from PGRC to develop new high yielding OP variety. Result revealed that the longest fruit was observed in BD-8912 (28.6 cm)

followed by BD-8927 (28 cm) and the shortest was observed in BD-8896 (14.2 cm) followed by BD-8905 and BD-8497 (14.8 cm). The widest fruit was found from BD-8912 (5.40 cm) followed by BD-8893 (5.22 cm). Number of fruits per plant was also statistically varied among the ridge gourd germplasm. Maximum number of fruit per plant was produced by BD-8893 (65) and minimum was produced by BD-8918 (12). Individual fruit weight was found highest in BD-8915 (170 g) followed by BD-8912 (169 g) and BD-3054 (165 g) and it was found the lowest in BD-8930 (97 g). Maximum yield per plant was produced by BD-8893 (7.71 kg) followed by BD-8919, BD-8915 and BD-3050 (5.8 kg) and minimum yield per plant was produced by BD-8896 (1.5 kg). BD-8893 produced the highest yield (21.49 t/ha) followed by BD-3050 (16.40 t/ha), BD-8919 (16.06 t/ha) and BD-8915 (16.06 t/ha) and the lowest yield was produced by BD-8896 (4.30 t/ha) followed by BD-8918 (4.33 t/ha) and BD-3053 (4.44 t/ha).

Evaluation of sponge gourd lines in summer

A Akter, M A Hossain, M S Rahman, R Sultana and Hemk Mazed

A study was conducted to evaluate sponge gourd lines in respect of yield and quality at HRC field, RARS, Jamalpur during the summer season of 2020 to develop sponge gourd variety. Five sponge gourd lines viz. LC Jam-001, LC Jam-002, LC Jam-004, LC Jam-007 and LC Jam-008 were evaluated to investigate the yield and yield contributing characters. The higher number of fruits per plant (45.00) was produced by the line LC Jam-001, whereas the lower number of fruits (39.0) was noted from LC Jam-004. The higher individual fruit weight (132.67 g) was noted in the line LC Jam-008 and lower (115 g) in the line LC Jam-007. The more fruit yield per plant (5.87 kg) and per hectare (19.55 t) was produced by the line LC Jam-001 and the less 4.64 kg & 15.46 t was found by the line LC Jam-007. Therefore, the line LC Jam-001, LC Jam-002 and LC Jam-008 can be continued in the next year for the confirmation of the result.

Evaluation of teasle gourd lines in jamalpur region

A Akter, M A Hossain, M S Rahman, R Sultana and Hemk Mazed

A study was conducted to evaluate teasle gourd lines in respect of yield and quality at HRC field, RARS, Jamalpur during the summer season of 2020 to release a teasle gourd variety. Five teasle gourd lines viz. MD Jam-001, MD Jam-002, MD Jam-003, MD Jam-004 and MD Jam-005 were evaluated to investigate the yield and yield contributing characters. The higher number of fruits per plant (121.0) was produced by the line MD Jam-001, whereas the lower number of fruits (70.0) was noted from the MD Jam-003. The higher individual fruit weight (50.33 g) was noted in the line MD Jam-001 and lower (46.33 g) in the line MD Jam-002. The more fruit yield per plant (6.07 kg) and per hectare (15.19 t) was produced by the line MD Jam-001 and the lower yield (3.48 kg/plant and 8.71 t/ha) was found from line MD Jam-003. Therefore, the line MD Jam-001 and MD Jam-004 can be continued in the next year for the confirmation of the result.

Preliminary yield trial of teasle gourd

M Nazim Uddin, AKM Quamruzzaman and Ferdouse Islam

Six selected genotypes were evaluated at Olericulture Division, HRC, BARI Gazipur during summer 2020 to assess the yield and quality of less-seeded teasle gourd. Data were recorded on days to first harvest, number of fruits per plant, individual fruit weight, fruit color, days to edible maturity, fruit length, fruit breadth, yield per plant, new sucker from each plant. Seed number and hardness are the main objection from the consumer side and these lines less seeded and yield is considerable. A significant variation was found in plant and fruit characters. Maturity was determined where 10-12th days after anthesis found optimum to consume. The lines are proposed for advanced yield trial.

Advanced yield trial of teasle gourd lines

Ferdouse Islam And Md. Razzab Ali

The study was carried out at the experimental field of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agriculture Research Institute (BARI), Gazipur, Bangladesh to evaluate the selected teasle gourd lines for variety development and future breeding program. Four advanced lines were evaluated during the summer season of 2020. Different morphological and yield

attributing characters were recorded from three randomly selected plants from each treatment. The maximum days required to harvest was recorded was the line MD-0021 (166) while the shortest days (117) was required from the line MD-0020 which was identical to MD-0015. The highest number of fruits per plant (156.0), individual average fruit weight (68.28) and the highest fruit weight per plant (11.62 kg) were recorded from the line MD-0020. The longest fruit was observed from MD-0020 (7.73 cm) followed by MD-0021 and MD-0022 while the shortest was from MD-0015 (6.33). The line MD-0020 produced the highest flesh thickness (0.64cm) and the lowest 0.43 (cm) was recorded from MD-0022. Maximum exocarp TSS (4.07) was found from the line MD-0020 while the lowest was from MD-0022(3.1). On the other hand, maximum mesocarp TSS (8.2) was obtained from the line MD-0015 and the lowest was found from MD-0021(5.36). The highest yield (23.9 t/ha) was obtained from the line MD-0020 and the lowest was recorded from MD-0015. In case of fruit color, most of the lines produced green color fruit except MD-0021, which produced light green colored fruit. Considering the yield contributing characters, color and size the lines MD-0020, MD-0021, MD-0022 and MD-0015 may be selected for RYT

Advanced yield trial of musk melon lines

Md. Razzab Ali and Ferdouse Islam

Three advanced muskmelon lines were selected and conducted a trial at the research field of Olericulture Division, Horticulture Research Centre, BARI, Gazipur during the Kharif 1 season of 2021 with a view to develop a new variety. Significant variation was observed almost in all traits. The highest number of fruits per plant (11.33) was recorded from the line CM-15-3-4-2-4-2-3-1 and the lowest from the line CM-11-5-3-4-2-4-1-3 (7.33). The highest identical fruit weight was observed from the line CM-11-5-3-4-2-1-1-2 (2.71kg) and CM-15-3-4-2-4-2-3-1(2.47kg) whereas, the lowest fruit weight was recorded from the line CM-11-5-3-4-2-4-1-3 (2.45 kg). There was no variation observed in fruit length and breadth. The line CM-11-5-3-4-2-1-1-2 produced the highest fruit yield per plant (27.42 kg) and the lowest was produced by CM-11-5-3-4-2-4-1-3 (19.98 kg). The highest identical cavity length

CM-15-3-4-2-4-2-3-1 (32.66 cm) and CM-11-5-3-4-2-1-1-2 (30.33 cm) were recorded while the lowest (27.83 cm) was from CM-11-5-3-4-2-4-1-3. The maximum flesh thickness (3.26 cm) was obtained from CM-15-3-4-2-4-2-3-1, while the minimum (2.66 cm) was recorded from CM-11-5-3-4-2-1-1-2 line. The highest (TSS %) was recorded from CM-11-5-3-4-2-1-1-2 (6.5) and the lowest was obtained from CM-11-5-3-4-2-4-1-3 (4.66) which was identical to CM-15-3-4-2-4-2-3-1(4.83) . In case of texture, one lines showed sandy and 2 lines showed crispy texture. Considering qualitative and quantitative parameters the line CM-15-3-4-2-4-2-3-1, and CM-11-5-3-4-2-1-1-2 may be selected for conducting regional yield trial (RYT).

Advanced yield trial of netted melon lines

Ferdouse Islam, Md Razzab Ali and AKM Ariful Haque

The study was conducted with 100 netted melon plants at the research field of Olericulture Division, HRC, BARI, Gazipur during 2020-2021 with a view to develop a variety of netted melon. Finally, twenty-six plants were evaluated under family selection for F₅ generation. Among the plants ranges of individual fruit weight 490-1000 g was recorded. There were no plants below 5% of TSS, 21 plants showed 5-8% of TSS and 05 plants showed more than 8% of TSS respectively. On the basis of individual fruit weight, 12 plants produced less than 600 g individual fruit weight, 11 plants produced 600-750 g and 03 plants produced more than 750 g. In case of pigmentation, all plants showed white color fruit. According to the intensity of net forming, all the plants were categorized in 3 groups. Nine plants showed light netting, 02 plants showed medium netting and 15 plants dense netting. On the basis of fruit flesh color, 22 plants showed orange and 04 showed green. From the study it may be concluded that on the basis of qualitative and quantitative characters five plants CMR-1-37-46-12-6-9-1, CMR-1-37-46-11-45-1-1, CMR-1-37-46-11-45-2-1, CMR-1-37-46-11-45-3-1 and CMR-1-37-46-11-45-41-1 were selected for further evaluation.

Regional yield trial of squash lines

Bahauddin Ahmed, R Islam, T Tasmima and M S Alam

A study on the performance of two squash lines with BARI Squash -1 as check at different regional locations of BARI during winter season of 2020-21 was conducted to select suitable squash lines for release as high yielding OP variety. Two usually different shape squash lines (CP007-2 and CP007-5) along with BARI squash -1 was used in this experiment. The range of fruits/plant was 2.88 – 4.80 and means value 3.91. From the average data, the fruits/plant was higher in CP007-2 (4.80) and in check variety it was 3.82. But individual fruit weight was higher in check variety (1.50kg) compared to the tested lines in over three locations. From the average data, it was observed that the yield/plant was highest (6.0kg) in the check variety (BARI Squash -1) and it was lowest in CP007-2 (5.09kg). But the yield (t/ha) was also highest in check variety (42.22 t/ha) compared to the tested lines. Among the tested lines, the CP007-5 was better in respect of yield/hectare (39.05t). The tested lines were round/high round and the check variety was elliptical in shape. In the tested lines, powdery mildew infection was less (15% and 20 %) compared to the check variety (45%). Based on quantitative characters, visual observation of fruit colour, shape, size and powdery mildew reactions the line CP007-5 was found promising which may be released as a new squash variety.

Evaluation of different country bean genotypes in winter under high rain fall areas of north-eastern region of Bangladesh

M.Samsuzzaman, S.M.L. Rahman, M.A.M. Miah, M.R. Uddin and Z.A. Firoz

An experiment was conducted to study the performance of six inbred country bean genotypes and variety viz. LP. Akb.001, LP. Akb.002, LP. Akb.003, LP. Akb.004, LP. Akb.005, LP. Akb.006 and BARI Sheem-9 as check at vegetable research field, RARS, BARI, Akbarpur, Moulvibazar during the winter season of 2020-2021. Considering days to 50% flowering, LP. Akb.002 was the early flowering genotypes (42 days). For fresh pod, the variety BARI Sheem-9 was superior yield (34.7 t/ha). For dry seed yield, the genotype LP. Akb.001 (7.8 t/ha) was better at all. It is first year observation and it will be conducted in next year for confirmation of the results.

Evaluation of country bean lines at chattogram region

M. G. Azam, S.M.K.H. Chowdhury and A.S.M.H. Rashid

The experiment was conducted at Agricultural Research station, Pahartali, Khulshi, Chattogram during Rabi season 2020-2021. Thirty-four genotypes were evaluated for higher yield. The shortest duration (48 DAT) for flowering was observed from LP Pah018 followed by LP Pah037 and LP Pah013. The longest duration (81 DAT) was recorded from LP Pah032 followed by LP Pah002 and LP Pah001. LP Pah015, LP Pah024 and LP Pah025 produced maximum number of pod per panicle (09) followed by LP Pah001, LP Pah021, LP Pah024 and LP Pah031 that were 8.0 each. The highest pod weight (15.69 g) was obtained from LP Pah001 followed by LP Pah024 and LP Pah019 that were 15.17 g and 14.71 g respectively. The lowest (4.66 g) was from LP Pah039 followed by LP Pah026 that was 5.21 g. LP Pah001 gave the highest yield (14.36 kg) followed by LP Pah024 and LP Pah033 that were 12.36 t ha⁻¹ and 12.0 t ha⁻¹ respectively. LP Pah039 gave the lowest yield (3.73 kg) followed by LP Pah026 and LP Pah021 that were 5.92 t ha⁻¹ and 6.1 t ha⁻¹ respectively. Considering pod size, pod shape, pod color, seed size, seed shape and yield Pah001, LP Pah002, LP Pah005, LP Pah006, LP Pah008, LP Pah011, LP Pah012, LP Pah013, LP Pah015, LP Pah016, LP Pah019, LP Pah020, LP Pah024, LP Pah025, LP Pah027, LP Pah032, LP Pah033, LP Pah034, LP Pah035, LP Pah040 and LP Pah041) were found promising and can be recommend for further trials.

Evaluation of country bean lines at Ishwardi region

MF Hossain

The study was conducted at Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2020-21 to evaluate the performance of nine country bean lines for yield and other desirable characters. The experiment was laid out in RCB design with three replications. The highest number of fruits per plant (292) was recorded in LP Isd-029 and the lowest number of fruits per plant (14) was recorded from LP Isd-014. The highest marketable yield (29.33 t/ha) was obtained from LP

Isd-018 followed by LP Isd-007 (26.97 t/ha) and the lowest (8.57 t/ha) was in LP Isd-014. Pod borer infestation was also the lowest (4.13%) in LP Isd-029 and the highest (20.86 %) in LP Isd-014. Considering yield, shape and size, appearance and borer infestation, the line LP Isd-18, LP Isd-07, LP Isd-004, Isd-001 and Isd-017 were found promising. These lines may be selected for preliminary yield trial.

Advanced yield trial of country bean lines

M S Alam, B Ahmed, M A Goffar and Ferdouse Islam

Advanced yield trial of selected country bean lines was conducted at the Olericulture Division, HRC, BARI, Joydebpur, Gazipur during winter season of 2020-21. The selected superior lines of country bean were LP (St)-002, LP (St)-024, LP (St)-032 and BARI Sheem-1 as check variety. The lines varied significantly for their response to all the characters studied. The line LP (St)-024 required minimum days (62) for flowering while maximum days required by LP (St)-002 (92). The earliest (74 days) harvest was done in LP (St)-024. The line LP (St)-032 produced the maximum number of pods per plant (462). The single pod weight was the highest in LP (St)-032 (22.35 g) whereas the lowest in LP (St)-002 (10.18 g). The highest pod yield per plant was recorded from LP (St)-032 (8.15 kg). No mosaic virus infection was found in the line LP (St)-032. Very low mosaic virus infection was observed this year in other lines and in check variety. Based on yield and qualitative parameters the genotypes LP (St)-024 and LP (St)-032 were found promising.

Advanced yield trial of selected country bean lines in Jamalpur region

A Akter, M A Hossain, M S Rahman, R Sultana and Hemk Mazed

An experiment was conducted at the HRC field, Regional Agricultural Research Station, Jamalpur during 2020-2021 to observe the performance of yield and yield contributing characters of six country bean lines i.e. LP Jam-001, LP Jam-002, LP Jam-003, LP Jam-004, LP Jam-005 and LP Jam-006 with BARI Sheem-1 and BARI Sheem-6 as check to release a new country bean variety. Maximum number of pod per plant (769) was

observed from LP Jam-001 and minimum (314) from LP Jam-005. BARI Sheem-6 gained maximum individual pod weight (19.67 g), whereas; minimum observed in LP Jam-003 (8.0 g). Maximum pod yield per plant (9.39 kg), per plot (28.16 kg) and per hectare (23.46 t) gained from LP Jam-006 and minimum pod yield per plant (4.57 kg), per plot (13.72 kg) and per hectare (11.43 t) obtained from LP Jam-003. Considering yield and yield contributing characters the line LP Jam-002, LP Jam-004 and LP Jam-006 were found promising. LP Jam-001 and LP Jam-003 might be selected for its lateness and LP Jam-004, LP Jam-005 and LP Jam-006 may be selected for their earliness. This trial might be continued for further evaluation for confirmation of the results.

Advanced yield trial of yard long bean

AKM Quamruzzaman, S.R. Mallick, AKM Ariful Haque and Ferdouse Islam

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during the summer season of 2020 to evaluate the selected yard long bean lines with a view to search a new variety and their adoptability. There was diverged variability observed among the nine-yard-long bean lines/variety. The range of number of fruit/plant and single fruit weight were 21-83 and 6.6-18.2 g, respectively, while the range of fruit length and fruit diameter were 26.6-47.5 cm and 0.53-0.67cm, respectively. The range of fruit yield/ hectare was 9.41-16.03 t/ha, while the higher yielder lines were VS 46 (16.03 t/ha), VS 49 (14.40 t/ha), VS 21 (14.39 t/ha), VS 43 (14.27 t/ha). Among the germplasm two types of fruit color viz., green and violet were observed. Considering earliness, yield contributing characters, fruit shape and color the lines VS 46, VS 49 and VS 21 were found promising and may be recommended for RYT at different location for agro ecological assessment.

Preliminary yield trial of garden pea germplasm

M.M.R Salim and A. Rob Gazi

An evaluation of garden pea germplasm was conducted at Olericulture Division, Joydebpur, Gazipur during 2019-20 to develop a variety having high yield potentiality. The experiment comprised of 10 different genotypes of garden pea namely;

GP-01, GP-15, GP-23, GP-25, GP-28, GP-31, GP-33, GP-34, GP-35, GP-51 including BARI Motorsuti -1 and BARI Motorsuti -3 were used as check. The production performance was evaluated in a completely randomized block design with three replications. Seeds of all treatment were sown in November 28, 2020. The longest green pod was obtained from the BARI Motorshuti-1 (8.86 cm) followed by GP-23 and GP-34 (7.74 cm) and (7.55 cm) respectively. The highest number of pods/plant was recorded in the genotype GP-34 (10.94) followed by GP-51 with (10.81) and BARI Motorshuti-1 (10.51) while, the lowest number of pods was harvested from GP-25 (7.43). The highest number of seeds/pod was obtained from BARI Motorshuti-1 (7.09) and lowest from GP-23, GP-51 and GP-25 having seeds per pod 4.91, 4.91 and 4.94 respectively. The 100 green seed weight was maximum weight from BARI Motorshuti-1 (47.40 g), GP-35 (47.03 g) and BARI Motorshuti-3 (45.0 g) while the minimum was from GP-34 (39.21 g), GP-01 (39.44 g) and GP-15 (39.43 g). The highest pod yield was observed with BARI Motorshuti-1 (17.01), BARI Motorshuti-3 (15.39 t/ha) followed by GP-25 (12.31 t/ha), while GP-51 (9.95 t/ha) and GP-33 (8.29 t/ha) showed the lowest pod yield. Therefore, elite genotypes GP-25 and GP-35 may select for further utilization by the breeders.

Evaluation of okra germplasm in cumilla region

T. Tasmima, M H Rahman and M. O. Kaisar

This experiment was conducted during kharif season of 2020 in the experimental field of RARS, Cumilla. A total of thirteen germplasm of okra were collected from different location of Cumilla region to evaluate yield and tolerance to YVMV. Result revealed that maximum plant height was observed in AE Cum-002 (174.12 cm) followed by BARI Dherosh-2 (172.50 cm). The longest fruit was observed in AE Cum-004 (17.40 cm) and the shortest was observed in AE Cum-013 (11.05 cm) followed by AE Cum-012 (11.08 cm). The widest fruit was found from AE Cum-012 (2.40 cm) followed by AE Cum-007 (2.10 cm) and BARI Dherosh-2 (2.10 cm). Number of fruits per plant was also statistically varied among the okra germplasm. Maximum number of fruits per plant was produced by AE Cum-002 (35.23) followed by BARI Dherosh-2 (32.45) and minimum was

produced by AE Cum-011 (5.16). Individual fruit weight was highest in AE Cum-008 (24.55 g) followed by AE Cum-005 (22.40 g) and it was found lowest in AE Cum-003 (15.12 g). AE Cum-009 produced the highest yield (25.17 t/ha) and the lowest yield was produced by AE Cum-011 (5.23 t/ha). Among the thirteen germplasm, AE Cum-005 (4.0%) and AE Cum-009 (9%) showed minimum YVMV infestation and others were susceptible to YVMV. This trial will be continued for confirmation.

Regional yield trial of selected okra lines

M.M.R Salim, Razzab Ali, M S Rahman, A Akter, Hemk Mazed and R Sultana

Four advanced okra lines AE-018, AE-086, AE-122, and BARI Dherosh-2 as a check variety were evaluated at two locations viz., Joydebpur, and Jamalpur of BARI research stations during 2020 to observed yield and reaction to YVMV at different locations. On an average over location the advance lines AE -122 possessed highest number of marketable fruit (34.45) per plant followed by BARI Dherosh -2 (33.4). But avg. fruit weight over location higher weight was in BARI Dherosh -2 (21.3 g) nearest was AE -122 (19.8g). The mean over location yield were also highest in the line BARI Dherosh -2 (17.26 t/ha) which was at par with AE -122 (16.95 t/ha). All lines found infected 25% to 41% of the total population at 90 days after sowing. Considering number of fruit per plant, avg. fruit weight and yield (t/ha) only one advance lines viz., AE-122 found promising. So, lines AE 122 may selected for next year regional yield trial (RYT) to confirm the results.

Evaluation of stem amaranth genotypes for growing during winter season

S Sultana, M H Rahman and M O Kaisar

A field experiment was conducted at the RARS, Cumilla during winter season. In this study, two genotypes of stem amaranth were included along with BARI Danta-1 as a check. Significant differences were observed in all parameters of stem amaranth genotypes except primary branches per plant. This variation might be due to differences in genotype. In the present study, plant height ranged from 49.6 to 79.8 cm. The highest plant height was recorded in the genotype BARI Danta-1 (79.8 cm)

and the lowest plant height was recorded in the genotype Jessore local (49.6 cm). The maximum number of leaves per plant was recorded in the genotype Jessore local (31.2) which was statistically identical to the genotypes BARI Danta-1 (30.4) and the lowest leaves per plant was recorded in Cumilla local (24.4). The highest stem weight per plant was found in the genotype Cumilla local (140.77 g) which was much higher than that of two other genotypes. This variation was due to difference of genotypes and harvesting duration as this local line took longer time (101.00 days) to flower and remain tender in prevailing climatic (low temperature in winter season) condition, leading to the highest yield production (103.42 t/ha) in winter season, which was almost double to the check (54.75 t/ha) of this experiment. Thus, late flowering genotypes may be preferred for main cropping season especially for stem purpose. The highest core: peel ratio was recorded also in the genotype Cumilla local (2.16) which was statistically unlike to Jessore local (1.03) and BARI Danta-1 (1.25). The highest edible portion was found in the genotype Cumilla local (68.35 %) which was closely followed by BARI Danta-1 (55.61%) and Jessore local (50.65%). Also, this promising line remained almost fibre free upto 120 DAT followed by BARI Danta-1 (upto 70 DAT) in this particular season. Green tender stem has the highest demand which was the character of Cumilla local. Considering the above mentioned characteristics, Cumilla local can be recommended for cultivation in winter season of Bangladesh.

Evaluation of stem amaranth lines in jamalpur region

A Akter, M A Hossain, M S Rahman, R Sultana and Hemk Mazed

A study was conducted to evaluate stem amaranth lines in respect of yield and quality at HRC field, RARS, Jamalpur during the summer season of 2021 with a view to release stem amaranth variety. Eleven stem amaranth lines viz. AT Jam -002, AT Jam -003, AT Jam -006, AT Jam -007, AT Jam -008, AT Jam -011, AT Jam -0016, AT Jam -0018, AT Jam -0019, AT Jam -0020 and BARI Data-1 as check were evaluated to investigate the yield and yield contributing characters. In case of days to flowering, 66 days required for the line AT Jam-

0016 (late) and 55 days was required by AT Jam-020 (early). The maximum individual stem weight (461 g) noted in the line AT Jam -007 and minimum (226 g) in the line AT Jam-002. The highest yield per plot (34.60 kg) and per hectare (40.7 t) was produced by the line AT Jam-007 and second highest yield per plot (32 kg) and per hectare (37.65 t) was produced by the line AT Jam-0018 while comparatively lower yield was recorded in AT Jam-002 (16.93 kg/plot and 19.91 t/ha). Results of this study revealed that AT Jam-003, AT Jam-007, AT Jam-008 and AT Jam-0018 gave higher yield while AT Jam-002, AT Jam-003, AT Jam-006, AT Jam-007, AT Jam-0011 and AT Jam-016 showed longer edible stage which is very important for stem amaranth cultivation. In the following year, these selected materials will be evaluated as preliminary yield trials towards variety development program.

Advanced yield trial of stem amaranth lines

Md Razzab Ali And Ferdouse Islam

The study was conducted with 05 selected stem amaranth lines at the research field of Olericulture Division, HRC, BARI, Gazipur during Kharif 1 season of 2021 with a view to develop summer, early and late summer and high fiber containing variety of stem amaranth. The line AM-0053 took the minimum days (40 days) and the line AT-0047(54 days) took the longest days to 50% flowering. The tallest plant was exhibited from AT-0015 (109.78 cm) and smallest plant were observed from AT-0053 (72.33 cm).The longest leaf length (20.0 cm) was obtained from the line of AT-0047, while the shortest (12.89 cm) leaf length by AT-0015.The highest leaf breadth (10.78 cm) was obtained by AT-0048,while the shortest leaf breadth by AT-0015(8.09 cm).The heaviest stem was obtained from the line AT-0047 (257.89 g), whereas the lightest stem was observed from BARI Data 1 (171.0 g).The longest stem length was obtained by AT-0015 (100.22 cm), while the shortest stem length by AT-0053 (62.33 cm).The widest stem breadth (1.83 cm) was obtained by AT-0047, while the shortest stem breadth by AT-0015(1.0 cm).AT-0015, AT-0047, AT-0048 were showed green and AT-0053, BARI Data 1 red. On the basis of branching nature, AT-0015 had no branch, BARI Data 1 showed few branches and

AT-0047, AT-0048, AT-0053 had all along branches. All the lines showed erect nature, stem was conspicuous. Depending on the fiberness all lines divided into three groups viz., Early= At 25 days, Mid= At 35 days, Late= At 45 days. Among all the lines 1 was in early fiberness (AT-0047), 3 lines were in mid fiberness (AT-0015, AM-0053, BARI Data-1) and 1 was in late fiberness (AT-0048). From the study it may be concluded that on the basis of qualitative and quantitative characters three lines AT-0047, AT-0048, AT-0053, were selected for RYT.

Advanced yield trial of carrot lines

Md. Razzab Ali and Ferdouse Islam

A field trial was conducted at the experimental field of Olericulture Division, Horticultural Research Centre, Bangladesh Agricultural Research Institute, Gazipur during the winter season of 2020-21 to evaluate the performance of eight carrot lines were selected from 16 germplasm which were collected locally from different sources in 2019-20. The objective was to select the superior lines having seed production potentiality. Maximum marketable root yields were recorded from DC-0035 (13.4 t/ha), while the minimum yield was obtained from DC-0028 (6.90 t/ha). The highest individual fresh root weight was found from DC-0035 (123.33 g) and while the minimum was recorded from DC-0028 (63.67 g). The maximum root length (20.92 cm) was recorded from DC-0035 followed by DC-0040 (19.99 cm), DC-0027 (19.78 cm) and DC-0030 (19.0), while the minimum was BA-2018 (17.0 cm) on the other hand, the maximum diameter was observed in DC-0040 (3.47 cm) followed by DC-0035 (3.32 cm) whereas, the minimum diameter 2.7 cm was recorded from DC-0041 which was similar to DC-0028 and DC-0030. Two types of root color were observed among the lines viz., deep orange (2) and orange (6) and among these 8 lines no branching were showed. All lines had seed production ability in local climate. Depending on all the parameters the lines DC-0027, DC-0028, DC-0035 and DC-0040 may be selected for future trial for further confirmation.

Advanced yield trial of carrot lines in Jamalpur region

H. E. M. K. Mazed, M. A. Hossain, M. S. Rahman, A. Akter and R. Sultana

A field trial was conducted at the experimental field of Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during the winter season of 2020-21 to evaluate the yield performance and seed production potentiality of nine carrot lines. The selected lines include DC-0027, DC-0028, DC-0029, DC-0031, DC-0032, DC-0033, DC-0035, D-0037, and DC-0040. Comparatively higher marketable root yields were recorded from DC-0031 (16.70 t/ha), DC-0032 (15.90 t/ha) and DC-0037 (16.70 t/ha) which are statistically identical while the minimum yield was obtained from DC-0040 (9.50 t/ha). The highest individual fresh root weight was recorded from DC-0037 (177.5 g) which was statistically similar to DC-0031 (175.0 g) whereas, the minimum was recorded from DC-0028 (88.0 g). The maximum root length was recorded from DC-0032 (20.3 cm) which was statistically identical to DC-0033 (20.1 cm) and followed by DC-0033 (19.6 cm), DC-0035 (18.6 cm) and DC-0037 (18.6 cm), respectively on the other hand the maximum diameter was observed in DC-0032 (4.66 cm). Three types of root color were observed among the lines viz., deep orange (1 line), orange (7 lines) and red (1 line). Branching was not observed in the selected carrot lines and all lines showed seed production ability under local climate. Considering the studied parameters, DC-0031, DC-0032, DC-0033 and DC-0037 might be selected for future trial.

Advanced yield trial of lettuce lines

Md Razzab Ali and Frdouse Islam

Two advanced lettuce lines with check (var. BARI Lettuce-1) were included in trial at the horticultural field of Horticulture Research Centre, BARI, Joydebpur, Gazipur during Rabi season of 20120-2021. Maximum number of edible leaves per plant was counted from BARI Lettuce 1 (11.67) and minimum were from LT-10 (7.66). The tallest plant was recorded from the line BARI Lettuce 1 (30.33 cm), followed by LT-12 (27.33) while the shortest plant was recorded from LT-10 (26.33 cm). The highest per hectare marketable leaf yield was recorded from BARI Lettuce 1 (8.9 t), while the lowest identical yield was recorded from LT-12 (5.3 t) and LT-10 (4.6 t). The variety BARI Lettuce

1 produced deep green leaves and the line LT-10 and LT-12 produced attractive maroon colored leaves (Table 2.). All the lines able to produced seed in local climatic condition. Considering marketable yield, leaf color and seed producing ability, the lines LT-10 and LT-12 were selected for next year trial for further confirmation.

Evaluation of drumstick lines

M.A. Goffar, M. R. Ali and Ferdouse Islam

A study on evaluation of selected seven drumstick entries was conducted at the experimental field of Olericulture Division of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during 2019-20 (initiated 2011-12 onward). The drumstick entry MO 0025 found to be as seasonal natured having good quality pod with average weight (61.53g) and obtained 16.25kg yield per plant, while four lines viz MO 0001(1), MO 0007, MO-0008, MO-0011 and MO-0012 are considered as off-seasonal promising lines having 40-50g average pod weight. Yearly average per plant yield indicated that the lines MO 0001(1) exhibited maximum yield (13.75 kg) followed by line MO 0012 (15.23 kg). These off-season lines are capable to produce flower two to three times in a year. No major pest and diseases found to attack in the Moringa lines. For further use, five plants of entry have been multiplied.

Collection, evaluation and conservation of indigenous vegetables

M.A. Goffar, M.S. Alam and M. R. Ali

Twenty eight types of underutilized indigenous vegetable (12 vegetable and 16 medicinal) were put under observational trial to assess their performance in respect of yield, seed production and agronomic practice for growing different time of the year during 2020-21. The yield potentiality of Bathua - green (17.32 t/ha), Bathua - red (19.70 t/ha), Thankuni (1.60 t/ha), NafaShak (5.20 t/ha), Pudina (3.15 t/ha), Nunia (16.75 t/ha), Malancha (7.90 t/ha), Helencha (5.60 t/ha), Shialmutra Shak (16.85 t/ha), Shaknotey (21.30 t/ha), Katanotey (23.10 t/ha) and Pat Shak (1.25 t/ha). Effort on growing of telakucha through seed and vine cutting at three times of the year was under trial. It was observed that means of propagation as seed is not feasible but vine cutting as means of propagation is

suitable for year round production of telakucha. However, further studies are required for the standardization of their production practices. More, fifteen types of indigenous medicinal herbs have been collected and are being multiplying for further study.

Evaluation of purple coloured eggplant hybrids

AKM Quamruzzaman, F. Islam, Md. Nazim Uddin and S.R. Mallick

Nineteen purple colored eggplant hybrids with BARI Hybrid Begun-3 (as check) were field tested at the experimental farm of Olericulture Division, HRC, BARI, Gazipur, during the winter season of 2020-21 to assess their performance in relation of yield potentiality, pest and disease tolerance. There had diverged variability observed among the 20 purple colored eggplant hybrids, while all parameters were significant except days to first harvest and bacterial wilt infection. The range of number of marketable fruit and single fruit weight were 21- 65 and 71-195 g, respectively. The range of fruit length and fruit diameter were 14.0-31.0 cm and 3.1-9.2cm, respectively. The range of EFSB infestation was 8.8-16.8 %. The range of fruit yield/hectare was 30.87 - 57.83 t/ha, while higher yielder hybrids were F₁ 14x363 (57.83 t/ha), F₁ 14x216 (55.56 t/ha), BARI Hybrid Begun-3 (53.27 t/ha), F₁ 4x359 (52.80 t/ha), F₁ 1x217 (52.18 t/ha), F₁ 233x359 (51.44 t/ha), F₁ 1x19 (51.35 t/ha), F₁ 14x20 (51.08 t/ha), F₁ 233x216 (50.99 t/ha), F₁ 20x11 (50.69 t/ha), F₁ 233x20 (50.38 t/ha). Considering earliness, high yield, EFSB infestation, BW infection tolerance, fruit shape and color the hybrids F₁ 14x363, F₁ 14x216, F₁ 4x359, F₁ 1x217, F₁ 233x359, F₁ 1x19, F₁ 14x20, F₁ 233x216, F₁ 20x11, F₁ 233x20 were found promising and may be recommended for AYT.

Performance of green coloured eggplant hybrids

Md. Nazim Uddin, AKM Quamruzzaman, S.R. Mallick and F. Islam

Eleven green colored eggplant hybrids with BARI Hybrid Begun-3 (as check) was conducted at the experimental farm of Olericulture Division, Horticulture Research Centre(HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, during the winter season of 2020-21 to observe the performance in relation of yield potentiality, pest

and disease tolerance. There was diverged variability observed among the eggplant hybrids. number of marketable fruit and single fruit weight were 19-36 and 83-214g, respectively, while the range of fruit length and fruit diameter were 9.5-16.8 cm and 3.6-7.4 cm, respectively. The range of eggplant fruit and shoot borer (EFSB) infection was 11.1-20.0 %. The range of fruit yield/ hectare was 26.35-50.84 t/ha, while the higher fruit yielder hybrids were produced by F₁ 12x253B (50.84 t/ha), F₁ 12x253B (49.70 t/ha), BARI Hybrid Begun-4 (48.75 t/ha), F₁ 13x221B (48.46 t/ha), F₁ 11x353A (48.11 t/ha). Considering earliness, high yield, EFSB infestation, BW infection tolerance, fruit shape and color the hybrids F₁ 12x253B, F₁ 12x253B, F₁ 13x221B, F₁ 11x353A were found promising and may be recommended for RYT for different agro ecological performances.

Regional yield trial of green and purple colored eggplant hybrids

AKM Quamruzzaman, S. R. Mallick, M. Nazim Uddin and Ferdouse Islam

The study was conducted with four green colored eggplant hybrid/ varieties viz., F₁ 12x11, F₁ 21x11, F₁ 220x221B, BARI Hybrid Begun-4 (check variety) and three purple colored eggplant hybrid/ varieties viz., F₁ 14x233, F₁ 18x233, BARI Hybrid Begun-3 (check variety) at the farm of Olericulture Division, HRC, BARI, Gazipur along with different RARS (Hathazari, Ishwardi, Jamalpur, Rahmatpur) of BARI during the winter season of 2020-21 to develop new high yielding hybrids having tolerance to eggplant fruit and shoot borer and bacterial wilt. All parameters were significant in the study except days to 1st harvest and bacterial wilt infection. The range of EFSB infestation was 9.3-17.3% and 11.7-17.6% in green and purple colored hybrids, respectively, while the bacterial wilt infection was observed below 4% in both colored hybrids. The higher fruit yield/ hectare was produced in F₁ 12x11 (51.28 t/ha), F₁ 21x11 (51.03 t/ha) for green colored hybrids, while in F₁ 18x233 (53.44 t/ha), BARI Hybrid Begun-3 (53.27 t/ha) for purple colored hybrids, respectively. Considering mean fruit yield over 5 locations, earliness, tolerance to fruit infection by EFSB, bacterial wilt infestation, attractive fruit shape and fruit color, the green colored hybrids F₁ 12x11, F₁ 21x11 and purple colored hybrid F₁ 5x216, F₁ 14x233

were found promising. So, these two green colored and one purple colored hybrids viz., F₁ 12x11, F₁ 21x11 and F₁ 5x216, F₁ 14x233 might be selected for releasing as new green and purple colored eggplant hybrid variety.

Regional yield trial of high temperature tolerant eggplant hybrids

AKM Quamruzzaman, S. R. Mallick, M. Nazim Uddin and Ferdouse Islam

The study was conducted with three green colored eggplant hybrid/ varieties viz., F₁ 21x11, F₁ 13x12 and BARI Hybrid Begun-4 (check variety) and five purple colored eggplant hybrid/ varieties viz., F₁ 14X5, F₁ 18X233, F₁ 203X5, F₁ 203X233 and BARI Hybrid Begun- 3 (check variety) at the farm of Olericulture Division, HRC, BARI, Gazipur during the summer season of 2020 to develop new high yielding hybrids having tolerance to eggplant fruit and shoot borer (EFSB) and bacterial wilt. The range of EFSB infestation was 12.3-20.0 % and 13.0-19.7% in green and purple colored hybrids, respectively, while the bacterial wilt infection was observed below 7% in both colored hybrids. The highest fruit yield/ hectare was produced in check variety BARI Hybrid Begun-4 (40.22 t/ha), followed by F₁ 21x11 (33.31 t/ha) for green colored hybrids, while in F₁ 14X5 (42.5 t/ha) followed by F₁ 203X233 (40.43 t/ha) for purple colored hybrids, respectively. Considering earliness, tolerance to fruit infection by EFSB, bacterial wilt infestation, attractive fruit shape and fruit color, the green colored hybrid F₁ 21x11 and purple colored hybrids F₁ 14X5, F₁ 203X233 were found promising. So, these one green colored and two purple colored hybrids viz., F₁ 21x11, F₁ 14X5, F₁ 203X233 might be selected for releasing as new purple colored eggplant hybrid variety.

Estimation of heterosis of summer tomato in relation to virus infection, quality and yield

M Nazim Usdin, G.A. Rob, AKM Quamruzzaman and Ferdouse Islam

The study Seeds of the 7 parental lines, 21 hybrids, were sown at the olericulture division of HRC, BARI 6 May 2020. The seedlings were transplanted to main field in plastic houses on 2 June 2020. There were 12 plants per row per genotype, the plant spacing was 60 cm, and the row

spacing was 50 cm. Eighteen traits were investigated including the first ripening stage and storage time was recorded. The plant height was measured at the time of last harvest, and the early yield after the harvest, representing another early-maturation-related trait, was measured, along with three yield-related traits (total yield, fruit number per plant, and fruit weight) and two quality traits (thickness and soluble solid content). The overall characteristics were higher plant height, virus infection, early maturity, water loss, lycopene, fruit thickness etc. The best crosses for yield per plot and fruit number per plant was fruit ripening stage and soluble solid content, lycopene was 3125-O-19xC11, 3125-O-19x3324 A, 3150-A-5xWP7. 31-25-O-19xC51 and 3125-O-19xC11 were selected primary yield trial.

Preliminary yeield trial of summer tomato hybrids

M. A. Goffar, M. M. R. Salim and P. Hanson

A trial was conducted with eight summer hybrid tomato entries to evaluate yield potentials and tolerance level against bacterial wilt (BW) and virus under field condition at the experiment field of Olericulture Division of HRC, BARI, Gazipur during summer season of the year 2020. All the parameters were found to be significantly differed. There were four hybrid combinations (T_3 - $P_4 \times P_6$, T_5 - $P_1 \times P_8$, T_7 - $P_5 \times P_8$ and T_8 - $P_7 \times P_8$) showed good yield which was confined to 33.00-38.0 tones. The incidence of wilt infection was the highest in T_2 (10.0%). The other entries were confined between 6.0-8.0% only. The highest virus infection was recorded in treatment T_4 (12.0%), while other treatments comprise between 8.0-10.0% virus. Among the hybrid tomato entries, above mentioned combinations (T_3 - $P_4 \times P_6$, T_5 - $P_1 \times P_8$, T_7 - $P_5 \times P_8$ and T_8 - $P_7 \times P_8$) were considered to be suitable in terms of yield, pest and diseases tolerance. It will be worthwhile to verify the performance of these promising entries as regional yield trial in the next year to confirm the results and for confirming the results and for studying adaptability in the different agro-ecological zones of Bangladesh adaptability capability in the different parts of the country.

Regional yield trial of tomato hybrids

M. A. Goffar, M. R. Ali and M. M. R Salim

A study on regional yield trial with six tomato hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at three outer Regional Agricultural Research Stations (RARS) viz.- Akbarpur, Burirhat and Jamalpur during the winter season of 2020-2021 to assess the regional adaptability and yield potentiality. The most of the parameters were significantly differed among the tomato entries. The treatment T_6 produced the largest average fruit weight (58.56g). The same entry exhibited maximum yield per plant (2.69 kg) followed by 2.31 kg fruit harvested from the treatment T_4 ($P_2 \times P_7$). The Maximum marketable yield per ha was obtained from T_6 ($P_3 \times P_5$) (81.21 t) followed 69.73 t contributed by the hybrid line T_4 ($P_2 \times P_7$).. The mean value of virus infection under field condition at 75 DAS was counted 6.00 to 10.00%. The magnitude of virus infection at this stage was not so harmful for commercial harvest. Considering the yield performance, uniformity and other attributes, all the entries found to be promising. As this is first year result, therefore, the experiment may be repeated for confirming the results.

Regional yield trial of semi determinate tomato hybrids

M. A. Goffar, M. R. Ali and M. M. R Salim

A study on regional yield trial with five semi determinate hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at four Regional Agricultural Research Station (RARS) viz.- Akbarpur, Burirhat, Jamalpur and Rahmatpur during the winter season of 2020-2021 to assess the regional adaptability and yield potentiality. In this report, results of Gazipur experiment have been mentioned. There were maximum (13) parameters significantly differed among the tomato entries. The treatment T_5 ($P_7 \times P_8$) produced the largest average fruit weight (94.89g). The same entry exhibited maximum yield per plant (4.73 kg) followed by 4.53 kg fruit harvested from the treatment T_3 . The Maximum marketable yield per ha was obtained from the treatment T_5 (96.66 t) followed 94.80 t contributed by the hybrid line T_3 ($P_5 \times P_8$). Tomato fruit may be harvest about 45 days from the most of the entries. Considering the adaptability, yield performance, uniformity and other attributes, the entries T_3 ($P_5 \times P_8$) and T_5

(P₇xP₈) found to be promising. As this is second year result, therefore the experiment may be repeated in different agro-ecological zones of Bangladesh for confirming the results.

Regional yield trial of determinate tomato hybrids

M. A. Goffar and M. M. R Salim

A study on regional yield trial with four determinate hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at four other Regional Agricultural Research Stations (RARS/RHRS) viz.- Akbarpur, Burirhat, Jamalpur and Rahmatpur during the winter season of 2020-21 to assess the regional adaptability and yield potentiality of these entries. In this report, results of Gazipur experiment have been mentioned. The most of the parameters were significantly differed among the tomato entries. The treatment T₁ produced the largest average fruit weight (67.00g). The T₂ (P₁xP₅) treatment exhibited maximum yield per plant (2.94 kg) followed by 2.93 kg harvested from the control. Maximum yield per ha was obtained from the treatment T₂ (P₁xP₅) (69.58 t) followed 63.77 t contributed by the treatment T₄ (P₆xP₇). Considering the adaptability, yield performance, uniformity and other attributes, the entries T₂ (P₁xP₅) and T₄ (P₆xP₇) found to be promising. The main feature of these entries is harvestable within short period of time that leads to fit in the cropping pattern for increasing cropping intensity. As this is second year result, therefore the experiment may be repeated in different agro-ecological zones of Bangladesh for confirming the results.

Regional yield trial of saline tolerant tomato hybrids

M. A. Goffar, M. S. Alam and Afms Ahsan

A study on regional yield trial with four saline tolerant hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at three Regional Agricultural Research Station (RARS/RHRS/ARS) viz., Patuakhali, Shatkhira and Rahmatpur during the winter season of 2020-2021 to assess the regional adaptability and yield potentiality. The lines (P₁xP₂, P₁xP₃, P₁xP₆, P₄xP₅) were considered to be relatively saline tolerant (tasted at physiology Division, BARI in 2019). The most of the

parameters were significantly differed among the tomato entries. The treatment T₀ (control) produced the largest average fruit weight (56.12 g). The same entry exhibited maximum yield per plant (2.31kg) followed by 2.29 kg fruit harvested from the treatment T₂(P₁xP₃). The Maximum marketable yield per ha was obtained from T₄ (P₄xP₅)(67.33 t) followed 66.43 t contributed by the hybrid line T₀. The mean value of virus infection under field condition at 75 DAS was counted 0.0 to 4.0%. The magnitude of virus infection at this stage was not so harmful for commercial harvest. Considering the yield performance (during harvesting, soil salinity was 10.18 ds/m), uniformity and other attributes, all the entries found to be promising. The experiment may be repeated at saline prone area for confirming the results.

Regional yield trial of summer tomato hybrids

M.A.T. Masud and T. Hasan

The trial was conducted at the experimental field of olericulture Division, HRC, BARI, Joydebpur in the summer season of 2020. Four hybrids of summer tomato and two check varieties BARI Hybrid Tomato-8 and 11 were included in the study to evaluate and select superior hybrids of tomato for release as variety. Hybrid genotypes varied significantly for their response to two important characters of which average fruit weight (AvFwt) varied from 52.7-72.5g and locule per fruit (Loc/Ft) 3-5 (P<0.05). Genotypes were similar for rest of the characters studied (P>0.05). Three hybrids WS19Hybrid-71, 73 and 76 produced heavier fruits (62.0-72.5g). All the test hybrids produced higher fruit (28-34/plant) and yield (1.4-1.5kg/plant; 45.0-49.0 t/ha) compare to check variety BARI Hybrid Tomato-8. Virus incidence in the genotypes ranged from 0.0-17.8%. Three hybrids WS19 Hybrid-71, 75 and 76 had no virus incidence (0.0%). Incidence of bacterial wilt ranged from 0.0-4.3%. Two hybrids WS19Hybrid-75 and 76 had no bacterial wilt (BW) incidence (0.0%). Considering major yield contributing characters and disease reaction, three hybrids WS19Hybrid-71, 75 and 76 were found promising for release as summer hybrid tomato varieties.

Evaluation of sweet pepper hybrids

AKM Quamruzzaman, Ferdouse Islam and S.R. Mallick

Five selected F_1 's of sweet pepper ($P_1 \times P_2$, $P_1 \times P_3$, $P_2 \times P_3$, $P_1 \times P_7$ and $P_3 \times P_4$) with a check (BARI Mistimorich-1) were evaluated at the farm of Olericulture Division, HRC, BARI, Gazipur during the winter season of 2020-21. The $P_2 \times P_3$ took the minimum days to 1st harvest (68.00 days). The highest number of fruits per plant (7.95) was recorded from $P_2 \times P_3$. The heaviest fruits (176.67g) were obtained from $P_1 \times P_2$. Fruit weight per plant was found maximum (1.30kg) in $P_2 \times P_3$ followed by the $P_1 \times P_2$ (1.06kg) and $P_1 \times P_3$ (1.02kg). The highest yield was produced by $P_2 \times P_3$ (36.24 t/ha). The hybrids $P_2 \times P_3$, $P_1 \times P_3$ and $P_1 \times P_7$ were found promising for earliness, high yield and other characters. So, these lines may be recommended for further evaluation for their yield and quality.

Regional yield trial of bottle gourd hybrids

AKM Quamruzzaman, Mmr Salim and S.R. Mallick

The performance study of six bottle gourd hybrids was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur along with different RARS/RHRS (Akbarpur, Hathazari, Ishwardi, Jamalpur, Rahmatpur, Patuakhali) of Bangladesh during the winter season of 2020-21 to develop new high yielding bottle gourd hybrid varieties. Significant variation was observed in number of fruit/ plant, average fruit weight, yield /plant, fruit length, fruit diameter, fruit yield. In Joydebpur, highest number of fruits per plant was produced by F_1 B3xB4 (10.0), maximum average fruit weight was produced by F_1 B3xB4 (2.30 kg), and F_1 B1xB2 produced the lowest 1.63 kg. The range of fruit length and fruit diameter were 22.77 - 46.00 cm and 10.00 - 15.50 cm, respectively. The highest fruit yield per hectare was produced by F_1 B3xB4 (46.07 t/ha), statistically similar to F_1 B4xB3 (40.93 t/ha) and followed by F_1 B2XB4 (32.80 t/ha), while lowest yield was produced by F_1 B1xB2 (25.00 t/ha). The mean fruit yield range of bottle gourd hybrids was 36.86-63.26t/ha, while the highest per hectare fruit yield was recorded F_1 B4xB3 (63.26t t/ha), followed by check variety Diana (59.61 t/ha), F_1 B3x B4 (47.67 t/ha) over 4 locations. Considering yield potentiality, fruit color, acceptable fruit shape two hybrids viz., F_1 B4xB3 and F_1 B3xB4 were found promising and may be released as new bottle gourd hybrid variety.

Inbred development of pumpkin

Bahauddin Ahmed and M.A.T. Masud

Nine pumpkin genotypes were collected from PGRC and different location of Bangladesh on the basis of individual fruit weight which was evaluated in Olericulture Division, HRC, BARI, Gazipur during the winter season of 2019 - 20 to identify the bigger size pumpkin. Among them, five promising lines were planted in this year (2020 -21) to develop inbred lines. The genotypes varied for their response of some characters studied. Most of the genotypes beared their male and female flower earlier and lowest node. The flesh thickness, average fruit weight, fruits per plant, yield per plant and yield (t/ha) was ranged from 3.50 to 4.00cm, 3.67 to 5.83 kg, 3.42 to 5.17, 17.02 to 21.95 kg and 35.43 to 43.90 ton, respectively. The TSS ranged from 9.03 to 11.17 %. The genotypes were in different shapes such as round, high round, elliptical and bumble. The orange type flesh color was dominant among the genotypes. Fruit fly infestation and virus incidence was also observed in these genotypes. All the collected lines were above 3.67 kg and among them one genotype (BD10063-1) showed more than 5 kg average fruit weight. So, these lines may be used for breeding purpose for developing bigger size pumpkin variety.

Inbred development in pumpkin (SET-1: S_1 To S_2)

S Sultana, M H Rahman and M O Kaisar

The trial was conducted at the experimental field of Regional Agricultural Research Station, BARI, Cumilla in winter 2020. Fifteen of pumpkin lines were advanced from S_1 generation to S_2 generation to develop variable inbred lines for the development of hybrid varieties. Variations were found among the lines for the characters studied. The genotype CM Cum 008.3.3 required the fewer days to female flower opening (40 DAS) compared to BARI Mistikumra -2 which took the maximum days (60 DAS). The node order of first male and female flower was recorded as 4 (CM Cum 007.2.1 and CM Cum 007.2.3), 12 (CM Cum 003.2.2), 11 (CM Cum 004.1.1 and CM Cum 019.3) and 26 (CM Cum 005.1.1). However, the node order did not show any relation to days to flowering in most cases. The largest fruit was found in CM Cum

009.2 (30 cm × 18 cm), which leads to the heaviest weighed fruit (6.78 kg) culminated to the maximum yield of 55.64 t/ha. CM Cum 003.2.1, CM Cum 004.2.3, CM Cum 016.1.3, CM Cum 019.3 and BARI Mistikumra-2 produced comparatively smaller sized fruits (1.40-3.34 kg). In case of fruit number, BARI Mistikumra-2 produced the maximum (11) yielding average fruit weight of 21.34 kg per plant. On the other hand, CM Cum 007.2.3 and CM Cum 004.2.2 gave the satisfactory yield (54.04 t/ha and 49.87 t/ha, respectively) with good numbers of fruits (6 and 7, respectively) compared to check (35.64 t/ha). The TSS% ranged from 4-7% in the studied pumpkin lines. CM Cum 004.1.1, CM Cum 004.2.3, CM Cum 008.3.3 and CM Cum 019.3 possessed the highest TSS content (7%). Furthermore, the highest virus incidence about 50% was found among the genotypes. Some genotypes were found apparently virus free viz. CM Cum 004.1.3, CM Cum 007.2.1 and CM Cum 007.2.3 and BARI Mistikumra-2. Best individuals from every line of pumpkin were selected and selfed. Seeds of S₁ to S₂ progenies of pumpkin lines were stored for advancing S₂ to S₃ progenies in the next year.

Hybridization in pumpkin

N. Akter, E. Mahmud, M.R. Karim and M.I.A. Howlader

The experiment was conducted at the research field of Regional Horticulture Research Station, Leukhali, dumki, Patuakhali during *Rabi* 2020-2021 to develop year round high yielding pumpkin variety. A total of 15 crosses were done using 6 advanced lines following half diallel fasion. Among 15 cross combinations, 14 crosses successfully produced seeds. The seeds of each cross were dried and stored. These seed will be used to observe the F₁ performance in summer season 2021.

Regional yield trial of pumpkin hybrids

M.A.T. Masud

Two hybrids of pumpkin were evaluated with two check varieties BARI Hybrid Mistikumra-1 and Sweety at the experimental field of Vegetable Division, HRC, BARI, Gazipur during winter season of 2020-21 to select suitable hybrid for release as variety. Hybrids showed significant variation for their response to five important

characters of which days to 1st female flowering (DFF) varied from 64-74, fruits/ plant 5-7, average fruit weight (AvFwt) 2.1-2.8 kg, flesh thickness (FlThick) 2.6-3.5 cm and TSS 8.7-11.1% (P<0.05). Hybrid genotypes were similar for rest of the characters studied (P>0.05). Both the test hybrids produced higher fruits/plant (6) compare to one check variety Sweety (5). Hybrid CM15Hybrid-35 showed excellent performance for yield per hectare (35.8 tons/ha) and TSS content (11.1%) than the check varieties and other hybrid. Low virus incidence and minimum fruit fly infestation was observed in the test hybrids. Based on all the parameters studied including insect-disease reactions hybrid CM15Hybrid-35 was found promising for release as variety of pumpkin.

Regional yield trial of bitter gourd hybrids

M. A. T. Masud

Four hybrids of bitter gourd were evaluated with two check varieties BARI Hybrid Karala-3 and Hybrid Tia at the experimental field of Vegetable Division, HRC, BARI, Gazipur in the summer season of 2020 to select suitable hybrid for release as variety. Hybrid genotypes showed significant variation for their response to three important characters of which fruits per plant varied from 39-127, average fruit weight (AvFtWt) 53-163.5g and fruit length (FL) 12.7-28.8cm (P<0.05). Genotypes were similar for rest of the characters studied (P>0.05). Hybrid-34 and 37 produced quite higher fruits per plant (90-127) compare to check varieties (39-77). Hybrid-34, 35 and 39 were medium in size for fruit length (FL) (16.4-20.5cm) and fruit weight (72.4-90.6g) which is mostly liked by the consumers. Hybrid-34 and 39 showed excellent performance for yield per hectare (30.9-42.0 tons) compare to Hybrid Tia (28.6 tons). These two hybrids had low bitterness and fruit fly infestation (FflyInfest), and no infection of powdery mildew (0.0) and virus disease (0.0). Based on the quantitative characters and insect-disease reactions two hybrids Hybrid-34 and 39 were found promising for release as variety of bitter gourd.

Regional yield trial of cucumber hybrids

Bahauddin Ahmed, Mr Islam, A Akter and M.A.T. Masud

A regional yield trial of four cucumber hybrid (Viz., H1: CS25 x CS12, H2: CS44 x CS17, H3: CS80 x CS06, H4: CS79 x CS06) were evaluated with a commercial check variety (Alavy) at different regional locations of BARI during the kharif season of 2021 to select suitable hybrids for release as hybrid variety. Fruits per plant of almost all the hybrids were higher at individual locations and combined data except hybrid 3 over the check variety. Maximum individual fruit weight was observed in the hybrid 2 which ranged from 228.57 to 267.67g in different locations and in combined data it was 251.42 g. Yield/plant was also highest in hybrid 2 in all the locations (except Jamalpur) and in combined data it was 4.30kg. The highest yield/hectare was recorded in hybrid 2 at different locations (except Jamalpur) and also in combined data (40.09t/ha). Overall performances of the two hybrids (hybrid 2 and hybrid 1) were good across the locations (9.80 – 65.63 and 10.68 – 50.45 tons, respectively) and combined data (40.09 and 34.13 tons). Based on quantitative characters, visual observation of fruit color, shape, size, virus and angular leaf spot reactions the two hybrids (hybrid 2 and hybrid 1) was found promising. Thus considering the all parameters and visitor preferences hybrid 2 and hybrid 1 may be released as hybrid variety of cucumber.

Regional yield trial of sponge gourd hybrids

Bahauddin Ahmed, A Akter, A Habib and M. A.T. Masud

A regional yield trial of four sponge gourd hybrids (Viz., Hybrid 1, Hybrid 2, Hybrid 3, Hybrid 4) were evaluated with a commercial check variety (Fujian) at different regional locations of BARI during the kharif season of 2020 to select suitable hybrids for release as hybrid variety. Fruits per plant of almost all the hybrids were higher at individual locations and also combined data at over the locations compared to the check variety. Maximum individual fruit weight was observed in hybrid 4 which ranged from 180-254g over the locations and in combined data. Maximum yield/plant was observed in hybrid 2 which ranged from 9.51-35.97 at different locations and in combined data it was 20.98 kg. Overall performance of three hybrids (Hybrid 3, Hybrid 2 and Hybrid 4) were good for yield/hectare across

the locations (21.60-72.27, 25.37-71.85, 12.95-68.09 tons respectively) compare to the check variety. Very minimum virus infection (2-5%) was observed in the tested hybrids at later stage but in check variety it was higher (25%). Thus considering all the parameters, visitor preferences and virus reaction two hybrids (hybrid 2 and hybrid 4) may be released as hybrid sponge gourd variety.

Hybridization of watermelon

E. Mahmud, M.R. Karim, N. Akter and M. I. A. Howlader

A total of 25 cross combination of watermelon were evaluated at Regional Horticulture Research Station, BARI, Patuakhali to get a better hybrid variety. The experiment was conducted in *Kharif* 2 season of 2020. A randomized complete block design (RLPD) with three replications was used. Considering all yield and quality parameters, cross combination 63×29 , 51×63 , 18×29 , 51×29 , 144×63 , 144×18 , 18×63 , 51×18 , 18×144 , 21×18 and 51×21 can be selected for further evaluation.

Performance of watermelon hybrids

AKM Quamruzzaman, Mmr Salim, S.R. Mallick and Ferdouse Islam

The experiment was conducted at the Olericulture Division of Horticulture Research Centre, BARI during 2020-21 with seven watermelon hybrids viz., $F_1 1 \times 2$, $F_1 4 \times 2$, $F_1 5 \times 3$, $F_1 5 \times 4$, $F_1 8 \times 7$, $F_1 8 \times 21$, $F_1 21 \times 8$ along with commercial variety Jianhuai (Check) to assess the yield potentiality. There was significant variability observed among the eight watermelon hybrids. Maximum individual fruit weight was counted in $F_1 21 \times 8$ (5.03 kg), while the range of fruit length was 15.50 cm ($F_1 8 \times 7$) - 25.90 cm ($F_1 21 \times 8$) and the fruit diameter was 14.33 cm ($F_1 8 \times 7$) - 20.95 cm ($F_1 21 \times 8$). The highest TSS was observed in $F_1 8 \times 21$ (9.38%), while the highest fruit yield was produced by $F_1 21 \times 8$ (32.12 t/ha) followed by $F_1 8 \times 21$ (29.48 t/ha), $F_1 5 \times 3$ (27.70 t/ha). Among the eight hybrids, 'Excellent' taste and 'Crispiness' was reported in five hybrids, while three types of fruit shape viz., round, high round, oblong; three types of flesh color viz., red, orange red, yellow; four types of fruit skin color viz., deep green, light green, deep green + stripe, light green + stripe were observed.

Considering yield contributing characters, taste, crispiness, fruit shape, flesh color, skin color the hybrids F₁ 21×8, F₁ 8×2, F₁ 5×3 were found promising and may be recommended for AYT.

Year round performance of BARI released tomato varieties

M S Alam, M A Goffar, M R Salim, M A T Masud And F Islam

The experiment was conducted at the experimental field of Olericulture Division, Bangladesh Agricultural Research Institute, Gazipur during 2019-20. Eight tomato varieties viz. BARI Tomato-14, BARI Tomato-15, BARI Tomato-17, BARI Tomato-18, BARI Tomato-20, BARI Hybrid Tomato-4, BARI Hybrid Tomato-8 and BARI Hybrid Tomato-11 were selected for the trial. Six sowing dates were September 1; November 1; January 1; March 1; May 1 and July 1. Significant variation was observed among the varieties for different sowing dates in respect of different characters studied. Average days to 50% flowering was the highest (62.6 days) in November sowing. The highest percent fruit set was observed in BARI Hybrid Tomato-11 for most of the sowing dates. The OP varieties produced almost no fruit in March, May and July sowing. Yield performance of BARI Hybrid Tomato-4, BARI Hybrid Tomato-8 and BARI Hybrid Tomato-11 showed their potentiality to grow in all sowing dates. The result revealed that considering yield the varieties BARI Tomato-14, BARI Tomato-15 and BARI Tomato-18 may be recommended for early and late winter cultivation and BARI Hybrid Tomato-4, BARI Hybrid Tomato-8 and BARI Hybrid Tomato-11 may be produced for round the year.

Performance of BARI released tomato varieties in early and late winter at Dinajpur

M. S. Huda, M. Khanom and M.M.R. Salim

An experiment was conducted at ARS, Rajbari, Dinajpur to observe the effect of planting date and variety on the yield of early and late planting tomato. Four planting dates viz. 15 Sep. 2020, 15 Oct. 2020, 15 January, 2021 and 15 February, 2021 were used as main factor and six tomato varieties viz. BARI Tomato-4, BARI Tomato-8, BARI Tomato-11, BARI Hybrid Tomato-15, BARI Hybrid Tomato-16 and Rani (Local) were used as

sub-factor. A combination of January 15 planting with BARI Tomato-4 variety performed better in respect of yield (35.4 t/ha). The variety BARI Tomato-4 also showed potential fruiting capability during late winter season and February 15 planting produced 26.3 t/ha of potential yield. Late planting at 15 February planting of BARI Tomato-4 is suitable for maximum economical return.

Effect of transplanting dates and mulching on growth and yield of tomato

M. R. Islam, S. D. Setu, S. Hasna, M. G. Kibria, and M. R. Uddin

The experiment was conducted at Regional Agricultural Research Station, Rahmatpur, Barishal during 2020-21. The experiment comprised with two factors including two planting dates viz. 20th December and 30th December with three mulching condition viz. plastic mulch (black polyethene), bio-mulch (water hyacinth) and no mulch (control). There was a significant interaction effect of different mulching and planting date on plant height. At harvest, the plant height varied from 101.0 - 127.6 cm. The tallest plant (127.6 cm) was recorded in the treatment combination of earlier planting with black polythene mulch and the lowest (101.0 cm) in the combination of no mulch with late planting. The interaction effect of mulching and planting date was found to have significant in number of fruits per plant ranging from 20.3 - 29.0. The height number of fruits per plant (29.0) was obtained from earlier planting with bio-mulch treatment and the lowest number of fruits per plant was obtained from late planting with no mulch. The results showed the interaction between different planting dates and mulching had significant effect on yield of fruit per plant. It ranges from 1.71 kg to 2.45 kg. The height yield per plant (2.45 kg) was found from earlier planting with bio-mulch, this was probably because of the higher nutrient and moisture absorption from soil. The lowest (1.71 kg) was obtained from late planting date and no mulch. The interaction effect of mulching and planting date on the yield of fruit per hectare was statistically significant. It was found that maximum yield (97.80 t/ha) was recorded from the combination different mulch material with earlier planting date, because of maximum yield of fruit per plant. The minimum (68.20 t/ha) was recorded

from no mulch and late planting date due to minimum yield of fruit per plant.

Standardization of growing media of sweet pepper on rooftop

Md Abdur Rab Gazi, Md Abdul Goffer and Ferdouse Islum

An experiment was carried out on the rooftop of the Horticulture Research Center Building of Bangladesh Agriculture Research Institute, Gazipur during the year 2020-21 with a view to standardize the growing media suitable for rooftop gardening of sweet pepper. The experiment was laid out in a completely randomized block design (RLPD) with 3 replications. The measured parameters include the Soil Plant Analysis Development (SPAD) value, plant height, number of fruit, individual fruit weight, yield, fruit length and fruit breadth. The crops were grown in 6 growing media comprising of different components by volume. The media compositions were T0 = 60 % soil + 40 % Cowdung, T1 = 60 % soil + 30 % Cowdung + 10 % Vermicompost (VC), T2 = 60 % soil + 30 % Cowdung + 10 % Trichocompost (TC), T3 = 60 % soil + 30 % Cowdung + 10 % Coco-dust (CD), T4 = 60 % soil + 30 % Cowdung + 10 % Biochar (BC), T5 = 60% soil + 8 % CM + 8% VC + 8 % TC + 8 % CD + 8 % BC. The highest SPAD value (71.3), plant height (30.3 cm), number of fruits per plant (6.0), individual fruit weight (109 g), yield (372.7 g), fruit length (6.8 cm) and fruit breadth (6.6 cm) was recorded in the media composition of T2 = 60 % soil + 30 % Cowdung + 10 % Trichocompost (TC) which could be considered as ideal for rooftop cultivation of fruit vegetable including sweet pepper.

Effect of different mulching materials on broccoli cultivation

S Mahmud, M A A Malek and M R Ahmad

The experiment was conducted at Hill Agricultural Research Station, Khagrachari during December, 2020 to February, 2021 to find out suitable mulching material for BARI Broccoli-1. There are five types of mulching, viz. dried moringa leaf, straw, sungrass, polythene and no mulch (control). The experiment was laid out in a randomized complete block design with three replications. The highest plant height, number of leaves per plant,

crown length, diameter and weight of primary curd per plant and yield (12.69 t/ha) were obtained from dried Moringa leaf, while the lowest (8.94 t/ha) from no mulch. Therefore, it can be recommended that dried moringa leaf mulch is suitable for broccoli cultivation.

Effect of intercropping pumpkin with dragon fruit in semi hilly Sylhet region

M.A. Sumi And M.A. Habib

A field experiment was conducted at Regional Agricultural Research Station, BARI, Moulvibazar during January 2020 to April 2021 to find out effect of intercropping sweet-gourd with dragonfruit at Moulvibazar region. The highest yield was obtained from D1S1 treatment which was sweet-gourd intercropped with dragonfruit where dragonfruit yield was 1039.07 kg/ha and sweet-gourd yield was 10145.54 kg/ha.

Evaluation of watermelon germplasm and identify the suitable rootstocks to combat soil borne diseases

M.M.R Salim and B Ahmed

A field experiment was conducted on watermelon at olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Joydebpur during winter season of 2020-21. The purpose of this study was to determine whether grafting could improve plant growth and fruit quality of watermelon induced by different rootstock-scion combinations. Watermelon (*Citrullus lanatus*) cv. Black Jumbo F₁ was grafted into four rootstocks Bottle gourd, Pumpkin, Ash gourd and Snake gourd. Highest vegetative growth and fruit yield were obtained by 'bottle gourd' as a rootstock using the single cotyledon method. Grafting reduced significantly sex ratio by reducing the number of male flowers. Grafting increased significantly highest yield was obtained when grafted onto bottle gourd, pumpkin and ash gourd and 'snake gourd' rootstocks (15.45, 14.69, 13.62 and 12.72 kg/plant respectively) were used. Also, fruit yield per hectare increased by 33.69%, 30.29%, 24.79 and 19.47% when 'black jumbo F₁' watermelon seeLPing grafted onto 'bottle gourd', 'pumpkin', 'ash gourd' and 'snake gourd', respectively. 62.20% of the control non-grafted plants showed wilt incidence whereas grafting

reduced it (38.20% to 51.00%). These results indicate that grafting watermelon onto bottle gourd and pumpkin rootstock influences growth, productivity, and quality of the fruit as well as reduce disease incidence. Grafting can be suggested as an alternative method to control of *Fusarium* wilt and improve plant growth and fruit yield in watermelon production.

Effect of spacing and population density on growth and yield of country bean var. Bari sheem 8

S. M. K.H. Chowdhury, M. G. Azam and A. S. M. Harunor Rashid

A two factorial experiment with 24 treatment combinations was conducted at Agricultural Research station, Pahartali, Khulshi, Chattogram during Rabi season 2020-2021 to find out the best production practice of country bean. The factors were four plant population namely three plants in a pit, four plants in a pit, five plants in a pit and six plants in a pit; and six plant spacing namely 150 cm × 30 cm, 150 cm × 45 cm, 150 cm × 60 cm, 100 cm × 30 cm, 100 cm × 45 cm and 100 cm × 60 cm. In case of plant population, the highest number panicle/ plot (426.5), pod/plant (41.9) and pod yield/ ha (31.95 t) was obtained from five plants in a pit. Considering the single effect of spacing the highest number panicle/ plot (468.8), pod/ plant (55.8) and pod yield (34.31 t/ha) was obtained from 100 cm × 30 cm. In interaction effect, the maximum number of pod/ plant (70.84) and the maximum yield (38.58 t/ha) was obtained from five plants in a pit with 100 cm × 30 cm. Therefore, five plants per pit with as spacing of 100 cm × 30 cm can be recommended for obtaining optimum growth and yield of country bean.

Effect of different sowing dates on growth and yield of garden pea in Moulvibazar

M. A. Habib, M.A. Hossain, M.A. Sumi, and Z. A.Firoz

An experiment on effect of sowing dates on growth and yield of garden pea was conducted at RARS, Akbarpur, Moulvibazar, during *Rabi* season 2020-2021. The purpose of this study was to observe the influence of sowing dates on the growth and yield attributes of garden pea. There were four different sowing dates viz. 1 November, 16 November, 1

December, and 16 December were considered for this study. It was found that, 16 November sowing produced the highest green seed yield (4416.3 kg/ha) and showed low disease reaction which was followed by 1 December (4060.7 kg/ha) sowing. Therefore, 16 November planting can be recommended for growing garden pea with minimum disease infection in the Moulvibazar region of Bangladesh.

Impact of plant spacing on the growth, fruit quality and yield of okra in southern region of Bangladesh

S. Hasna, M. R. Islam, S. D. Setu, M. G. Kibria and R. Uddin

The experiment was conducted at Regional Agricultural Research Station, Rahmatpur, Barishal during 2020-21 to find out the most optimum plant spacing for achieving higher yield and quality seed of okra. The experiment comprised with five plant spacing such as 45 cm × 30 cm, 45 cm × 40 cm, 60 cm × 30 cm, 60 cm × 40 cm and 60 cm × 50 cm. The highest plant height (107.5 cm) was recorded from the widest spacing (60 cm × 50 cm) having maximum length (17.26 cm) and diameter of fruit (2.23 cm). The lowest plant height (84.0 cm) was recorded from closest spacing (45 cm × 30 cm) and (45 cm × 40 cm). The highest number of fruits per plant (1068.7) was recorded in the spacing (60 cm × 40 cm). The lowest number of fruits (790.0) was recorded (45 cm × 30 cm). Widest spacing (60 cm × 50 cm) was obtained highest individual fruit weight (33.13 g) and lowest individual fruit weight (24.02 g) was obtained from closet spacing (45 cm × 30 cm). The highest weight of fruit per plot (14.64 kg) and fruit yield per hectare (13.92 t/ha) was obtained from the widest spacing (60 cm × 50 cm) which statistically similar to spacing (60 cm × 50 cm) in both two parameters (14.10 kg) and (13.46 t/ha). Therefore, plant spacing of 60 cm × 50 cm can be recommended for cultivating okra having optimum yield in the Southern region of Bangladesh.

Standardization of growing media of year-round vegetable production technique on rooftop

S. Hasna, M.R. Islam, S.D. Setu, M.G. Kibria and M. R. Uddin

An experiment was conducted at rooftop of the Farm Division Building of Regional Agricultural Research Station, Rahmatpur, Barishal during 2020-2021 to standardize growing media through their effect on growth and yield of tomato, brinjal and chilli crop. Four growing media combinations were used in this study. The following growing media were tested in this study including garden soil + vermicompost (1:1), garden soil + coco-dust (1:1), garden soil + cow-dung (1:1), and garden soil + coco-dust + cow-dung + vermicompost (1:1:1:1). Growth and yield of tomato, brinjal and chilli was significantly influenced by growing media applied. The highest yield of tomato and chilli (89.52 t/ha and 8.50 t/ha, respectively) was recorded from garden soil + coco-dust + cow-dung + vermicompost (1:1:1:1) and for brinjal highest yield was observed from garden soil + coco-dust (1:1) (49.74 t/ha). The lowest yield was obtained either in garden soil + vermicompost (1:1) or garden soil + coco-dust (1:1) for all the three studies vegetable species. Therefore, for tomato and chilli, garden soil + coco-dust + cow-dung + vermicompost (1:1:1:1) and while for brinjal garden soil + coco-dust (1:1) can be recommended for ideal growing media under roof top condition.

Development of leaves production techniques of drumstick

M.A. Goffar, M. R. Ali, M. S. Alam and F. Islam

An experiment was sat up to find out the techniques of leaves production of drumstick at vegetable research field (field-2) of HRC, BARI, Joydebpur during the year 2020. The study has helped to generate primary information and indication on drumstick leaf production. The mean leaves yield indicated that the higher is the stem and leaf number the higher is the yield. As this a first year results, therefore, the study may be repeated to draw a precession on drumstick leaves production in Bangladesh.

Standardization of hydroponic nutrient solution for growing vegetables

Md Asaduzzaman, Md Razzab Ali, Ferdouse Islam and Md Rezaul Karim

A study was conducted in the Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division,

Horticulture Research Center (HRC) of Bangladesh Agricultural Research Institution (BARI), Gazipur, Bangladesh to standardize the hydroponic solution developed by Olericulture Division. Research activities such as nutrient solution preparation, analysis for physical properties determination and bioassay using three commercial cucumber cultivars viz., Alavi, Good luck and Green beauty were done during September 2020 to May 2021. Physical properties of the test nutrient solution were like water having no flammability and toxicity. In Modified Coopers solution-2, the growth performance of the test cucumber varieties showed significantly higher performance in term of growth and fruit yield compared to the other two test nutrient solution. The chemical composition such as N, P, K, Ca, Mg, S, Fe, Mn, B, Cu, Na, Zn and Mo will be determined in the following year for the recommendation and proposal for standardization as BARI Hydroponic Solution-2.

Development of micro-garden model for medium-size urban family through soilless culture

Md Abdur Rab Gazi, Md Asaduzzaman and Ferdouse Islam

A trial was conducted in the net house of Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, Horticulture Research Center (HRC), Bangladesh Agricultural Research Institution (BARI), Gazipur, Bangladesh to produce fresh and nutrient rich vegetables and herbs throughout the year at individual family level consumption. A number of vegetables and herbs including lettuce, radish, carrot, sweet pepper, tomato, cucumber, sweet basil, and spear mints were grown in small plastic buckets, styrofoam box, and wooden box using coco-coir substrate following soilless culture. Modified Coopers solution-1 (1.5 dS/m) was supplied to nourish the plant. Results indicate that leafy vegetable and herbs can be grown successfully having optimum yield (3374.6 g from 6 sft.) for several cycles. On the other hand, fruit vegetable such as sweet pepper (1179.0 – 1442.0 g per plant) and tomato (413.5 - 536.0 g per plant; low average in this trial) can be obtained from this micro-garden model. Therefore, results of this trial indicate that micro-model can be used to provide

fresh, nutrient and antioxidant rich vegetables for individual family level consumption.

Year round production of selected vegetable crops through hydroponic culture

Md Asaduzzaman and Ferdouse Islam

A number of trials were conducted in the Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, Horticulture Research Center (HRC), Bangladesh Agricultural Research Institution (BARI), Gazipur, Bangladesh to investigate the growth and yield performance, varieties, and time of planting for yield round production. The selected vegetables were grown in either deep water culture or coco-coir based soilless culture. Modified Cooper's solution-1 was used for nourishing the vegetables. It found that leafy vegetables including gimakalmi can be grown hydroponically having higher yield for several cycles. Yield of netted melon is higher in coco-coir based soilless (1007.6 g fruit fresh weight) compared to plants grown in deep water culture methods. The open pollinated tomato varieties grown in hydroponics showed different level of performance which should be re-investigated for an appropriate recommendation. On the other hand hybrid tomato varieties produced satisfactory yield in the summer season through soilless culture. Overall, the performance of the vegetables is recommended to further investigated in the future.

Performance of lettuce, cucumber, strawberry, tomato, sweet pepper and netted melon in hydroponics

AKM Ariful Hoque, Md Asaduzzaman and Ferdouse Islam

A trial was conducted in the net house of Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, Horticulture Research Center (HRC), Bangladesh Agricultural Research Institution (BARI), Gazipur, Bangladesh to determine the production cost and profit comes from this cultivation system. A number of vegetables including lettuce, spinach, pak-choi, mizuna, and tomato were grown in small plastic buckets, styrofoam box, and wooden box using coco-coir substrate following soilless culture. Modified

Coopers solution-1 (1.5 dS/m) was supplied to nourish the plant. Results indicate that leafy vegetables can be grown successfully having optimum yield (41.0 – 100.3 g from 3' 4"× 6' 6" × 8" sized wooden framed plastic box) for several cycles. On the other hand, fruit vegetable such as two varieties of tomato obtained average yield (1387.1 g per plant) and (482.5 g per plan) from iron framed tray (3' 4"×7'× 8") for this culture method. Economic analysis revealed that the highest gross return (2166 BDT/bed/season), growth margin (1046 BDT/bed/season) and BCR (1.93) calculated from leafy vegetable mizuna. In case of fruit vegetable such tomato, the economic analyses showed that the highest gross return (4161 BDT/bed/season), growth margin (2384 BDT/bed/season) and BCR (2.43) for BARI Tomato-11. This trial would be further investigated in order recommend their suitability of growing through hydroponics in Bangladesh.

Performance of different cultivars of sweet pepper in coconut coir substrate

Md Asaduzzaman and Ferdouse Islam

This trial was conducted at the Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, Horticulture Research Center (HRC), Bangladesh Agricultural Research Institution (BARI), Gazipur, Bangladesh to investigate the growth and yield performance of four sweet pepper hybrids grown in soilless culture under greenhouse condition. Four sweet pepper hybrids such as California Wonder, Inspiration RZ F1, Passarella RZ F1 and Bachata RZ F1 were used for this trial. The selected cultivars were grown in coco-coir based soilless culture. Modified Cooper's solution-1 (1.5 dS/m) was used throughout the culture. Nutrient solutions were supplied through drip irrigation using an automatic timer (30 sec/2 hrs.; run/stop). It found that there were no significant variation on the plant height of the four cultivar used but shoot fresh and dry weights were significantly higher in California Wonder and Inspiration RZ F1 than Passarella RZ F1 and Bachata RZ F1. In case of fruit, comparatively higher fruit yield was obtained from Inspiration RZ F1 and Passarella RZ F1 than from California Wonder and Bachata RZ F1. However, for larger fruits sweet paper cultivar such as

California Wonder and Bachata RZ F1 can be grown.

Performance of indigenous and exotic leafy vegetables in two hydroponic nutrient solutions

Md Asaduzzaman, Md Razzab Ali and Ferdouse Islam

The study conducted in the glass house of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI) during the period from 26 November 2020 to 31 January 2021 to investigate the performance of eleven indigenous and exotic leafy vegetables in three types of hydroponic nutrient solution. The selected leafy vegetables includes Lettuce var. BARI lettuce-1, BARI Palongshak-1, BARI Batishak-1, BARI Palongshak-2, Mizuna var. Late White Stem, - var. Mustard Green, - var. Salad Kyomizuna, Green Wave Lettuce, New Red Fire Lettuce, Rocket Salad and Chard. The test nutrient solutions used were Modified Cooper's solution-1 (1.5 dS/m), Modified Cooper's solution-2 (1.5 dS/m) and Enshi-shoo solution (50% standard). Results showed that growth of selected leafy vegetables was varied significantly in three types of hydroponics nutrient solution in deep water culture system. In general, it was evident that the overall growth performances of tested vegetables were found greater in Modified Cooper's solution-1 than other two nutrient solutions. This result was followed Modified Cooper's solution-2 and comparatively lower performance was obtained from Enshi-shoo nutrient solution. In case of quality characteristics such as total soluble solids, pH and tritrate acidity were found higher in Modified Cooper's solution-1 followed by Modified Cooper's solution-2. Results revealed that comparatively lower chlorophyll pigments and carotenoid content obtained in plants grown in Modified Cooper's solution-2 than other two nutrient solutions. Therefore, choice of leafy vegetable for both growth and quality characteristics is variable and can be selected according the above results.

Development of simplified hydroponic system for growing mineral enriched vegetables providing human health benefits

Md Asaduzzaman and Ferdouse Islam

Investigation on the development of simplified hydroponic using locally available low cost materials was carried out at Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, Horticulture Research Center (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh. Two types of simplified hydroponic systems such as Deep Water Culture (DWC) and Nutrient Film Technique (NFT) was developed using locally available materials such as wooden box, plastic sheets, urethane foam, cork sheets, plastic polythene, uPVC pipes. The developed hydroponics systems were used for growing leafy vegetables and it was evident that yield of all the test lettuce cultivars were higher in Modified Cooper's nutrient solution-1 which was followed by Enshi-shoo nutrient solution. Among the test lettuce cultivars, Green Wave Lettuce-1 and -2, and New Red Fire Lettuce produced higher shoot fresh weights indicating higher yield under Deep Water Culture hydroponics. Performance of different leafy vegetables was not followed a definite pattern and need to be repeated for further inference.

Production of selected vegetables through automatic hydroponic system

H. E. M. K. Mazed, M. A. Hossain, M. S. Rahman, A. Akter and R. Sultana

The experiment was conducted at the Hydroponic net house at Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during the winter season of 2020-2021 to evaluate the performance of cucumber with hydroponic solution. "Low cost Hydroponic solution-A, B and C" were used to culture the plants and the system was NFT or circulating system. Three commercial cucumber varieties were selected for the experiment. They were "Nayantara", "Alavi" and "Shufola". The significant difference was found in plant height among the three varieties. The highest plant height obtained from Shufola (185.37cm) and the lowest from Nayantara (176.37 cm). The Minimum days required to 1st female flowering in Alavi (55.33 days) on the other hand the maximum found in Nayantara (58.40 days). Days to 1st harvest was the minimum in Alavi (55.40 days) and the maximum in Nayantara (58.40 days) which is a desirable character. Number of fruit/plant was

higher in Nayantara treatment (8.13) and found lower in Shufola (6.20) variety. The highest fruit length and volume was found in Nayantara (11.06 cm × 5.31 cm) and the lowest in at Shufola (10.56 cm × 4.73 cm). The maximum average individual fruit weight was found in Alavi (192.40 g) and the minimum in Shufola (183.37 g). The maximum yield was obtained from Alavi (1.53 kg/plant) treatment and followed by Nayantara (1.51) and the minimum was in Shufola (1.20 kg) variety.

Demonstration trial of hydroponic culture at RARS Jamalpur

H. E. M. K. Mazed, M. A. Hossain, M. S. Rahman, A. Akter and R. Sultana

The experiment was conducted at the Hydroponic net house-2 at Horticulture Research Centre, Regional Agricultural Research Station, BARI, Jamalpur on October-April, 2020-21 to evaluate the performance of different tomato and lettuce varieties in hydroponic system using hydroponic stock solutions A, B, C. Two tomato varieties such as “BARI Tomato-14” and “Beautiful” and two lettuce varieties viz., “BARI Lettuce-1” and “Green leaf” were used in this experiment. Hydroponic solution-A, B and C were used in this experiment. The maximum yield for lettuce was 8.15 kg from two culture tray (30 plants) and BCR was 2.17 and for tomato, the maximum yield of tomato was 72.75 kg from 30 pots for consecutive 2.5 months and BCR was 2.11. This high BCR value denotes that hydroponic cultivation is more profitable than field cultivation.

Effect of different shade house on quality seeping raising of high value vegetables

AKM Quamruzzaman, Ferdouse Islam and S.R. Mallick

An experiment was undertaken to identify suitable shade house for different high value vegetables during the winter season of 2019 -20 at the research farm of Olericulture Division, HRC, BARI, Gazipur. The experiment was randomized complete block design with 3 replications. Four vegetables varieties viz., tomato (V1), eggplant (V2), capsicum (V3), broccoli (V4) and 4 shading treatments [i) UV stabilized polyethylene film with 60 mesh insect net along with green shade net (T1); ii) UV stabilized polyethylene film with 60 mesh

insect net (T2); iii) 60 mesh insect net (T3) and iv) Open field (control) (T4)] were included in this study. Different vegetables responded differently with the changes of shade house irrespective of different characters. Eggplant (V2) resulted the maximum seed germination (93.58%) with lowest mortality (5.58 %), in case of shading treatment, UV stabilized polyethylene film with 60 mesh insect net along with green shade net (T1) exhibited the maximum seed germination (94.83%) with lower mortality (3.33 %). In case of combined effect, maximum seed germination (93.58%) and lowest mortality (2.08 %) was observed in V2T1. The tallest seedlings were produced in V3T1 at every growth stage (15 days, 20 days, 25 days, 30 days). The maximum no. of leaves was produced in V3T2. The minimum insect infestation was observed in V1T1, V1T2, V2T1, V2T2, V3T1, V3T2, V4T1, V4T2 (0.67% at 15 days and 20 days).

Effect of different mulch paper on growth and yield of different high value vegetables

Ferdouse Islam, AKM Quamruzzaman, and S.R. Mallick

The study was undertaken to identify the suitable mulch paper for different high-value vegetables during the winter season of November 2019 to March 2020 at the Olericulture research field of Bangladesh Agricultural Research Institute, Gazipur, Bangladesh. The study was a randomized complete block design with 3 replications. Four vegetable varieties viz., tomato, eggplant, sweet pepper and broccoli and 3 mulch treatments viz., T1=Silver over black mulch; T2= Black mulch; T3= No mulch were included in this study. Different vegetables responded differently with the changes of mulches irrespective of different characters. it was clear that fruit number, average fruit weight, fruit length, fruit diameter were strongly related to soil moisture content. The effect of different plastic mulches on fruit weight per plant and yield (t/ha) was significant. Mulching produced higher fruit yield per plant and fruit yield per hectare than for the control, indicating that the mulch had a positive effect in generating increased fruit yield. Silver over black plastic mulch produced the highest fruit yield viz., 98.05 t/ha (tomato), 54.11 t/ha (eggplant), 34.33 t/ha (sweet

pepper), 26.09 t/ha (broccoli) followed by black and no mulches, while the control plot produced the lowest fruit yield.

Application of multiple treatments for safe eggplant production

A. K. M. Ariful Hoque, A K M Quamruzzaman and Ferdouse Islam

Safe cultivation is the comprehensive action of multiple cultivation techniques where new guidelines are interpolated to produce safe agricultural product. The experiment was accomplished due to evaluate the performance of different BARI varieties against mulch paper, tricho-compost with IPM and recommended fertilizer doses. During kharif season in 2020, the experiment was conducted at Olericulture research field of Bangladesh Agricultural Research Institute (BARI), Gazipur. It was a factorial experiment which followed by RLPD design. In case of factor one which included varieties showed the highest yield (47.95 t/ha) for BARI Hybrid Begun-4. For factor two among different treatments combination mulch paper with IPM and recommended fertilizer doses exhibited the maximum yield (50.26 t/ha). Moreover, for interaction effect BARI Hybrid Begun-4 with mulch paper, IPM and recommended fertilizer doses noted significant result (48.53 t/ha) and that was the highest among all other treatment combinations.

Performance of 4th generation magic population of tomato under organic practices

M Nazim Uddin, Md Ariful Haque, AKM Quamruzzaman and F Islam

This study has been carried out at organic field of Olericulture Division under Horticulture Research Center (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during winter 2020-21 in order to develop self-population of MAGIC lines and evaluation of 4th generation lines. Twenty-seven sets of 4th generation tomato lines namely, 4G₁ - 4G₂₇ were evaluated with three replications. The maximum no. of fruits/plant (36) was in 4G₁ and 4G₁₄. Single fruit wt (g) was recorded the highest in 4G₁₃ (220.6 g) while the lowest in 4G₂₇ (63g). The highest number of clusters were appeared at the sets of generation 4G₉ (10) while the lowest number of clusters (5) produced at 4G₂₂,

4G₂₄ and 4G₂₅. TSS is an important quality criteria and crosses were varied significantly. It was varied from 4.6 to 6.5 (⁰ brix). the highest yield was contributed from the genetaion 4G₅ (97.0 t/ha) and the lowest was obtained from 4G₃ (34.1t/ha).MAGIC breeding is an effective approach for improving the genotypes upto desired goal and in this study positive improvement has made over 1st generation population for the yield and its qualitative traits. Final generation preparation and evaluation might conclude the improvement adequately.

Evaluation of tomato genotypes under organic condition at pest exclusion net (pen)

M Nazim Uddin, AKM Quamruzzaman and Ferdouse Islam

This study has been carried out at organic field at Olericulture Division under Horticulture Research Center (HRC), Bangladesh Agricultural Research Institute (BARI) during November 2020 to April 2021. Ten crosses of tomato namely, BARI Tomato-15xNew-23 (CR1) , AVTO Tomato-1258xKurian Red (CR 2) BARI Tomato-11x BARI Tomato-15 (CR 3), AVTO-1248xNew-9 (CR 4), New-22 x BARI Tomato-17 (CR 5), New-9 x New-101 (CR 6), Kurian Yellow x Bhutan (CR 7), New-5xNew-6 (CR 8), Kurian RedxNew-7(CR 9), and New-6xKurian Yellow (CR 10) were evaluated in three conditions pest exclusion net with mulch (P+M+), mulch without PEN(P- M+), control (P-M-) with three replications. Single fruit weight found variation among the tested cross. The weightiest fruits recorded at CR 8 (106-123 g) followed by CR 3, CR 4 and CR 5 and the lightest fruits were in CR7 (12 g) followed by CR 10 CR 2. The fruits size, flesh thickness did not affect by mulch and PEN. More than 7 °brix was observed at the cross CR 7, CR 9 10 and around 6 recorded in CR 3, CR 6, the other line showed 5 or less. The highest plant height was recorded at the cross CR 6 and CR 10. Yield per plant were calculated the highest in CR 1, CR2 CR 5 and CR 10. Inside the PEN with mulch showed the more yield in most of the crosses. Lycopene and β-carotene amount found different among the crosses. the cross CR 2, CR 5 and CR 9 showed the maximum amount of lycopene and β-carotene. Net and mulching did not

influenced significantly on lycopene and β -carotene content.

Application of multiple treatments for safe bitter gourd production

Ferdouse Islam, A K M Ariful Hoque and AKM Quamruzzaman

The experiment was accomplished due to evaluate the performance of different BARI varieties against mulch paper, tricho-compost with IPM and recommended fertilizer doses. During kharif season in 2020, the experiment was conducted at Olericulture research field of Bangladesh Agricultural Research Institute (BARI), Gazipur. It was a factorial experiment which followed by RLPD design. In case of factor one which included varieties showed the highest yield (29.85 t/ha) for BARI Hybrid Karola-2. For factor two among different treatments combination, mulch paper with IPM and recommended fertilizer doses exhibited the maximum yield (25.53 t/ha). Moreover, for interaction effect BARI Hybrid Karola-2 with mulch paper, IPM and recommended fertilizer doses noted significant result (28.53 t/ha) and that was the highest among all other treatment combinations.

Advanced carrot genotypes under organic condition

M. Nazim Uddin, A.K.M Quamruzzaman, G A Rab and F Islam

The experiment was carried out at organic field under olericulture division, Horticulture Research Center, BARI, Gazipur during winter 2020-21 to find out the suitable genotypes of carrot for organic cultivation and capable to produce seeds. A total 23 lines of carrot seeds were collected from USDA, Netherlands, Thailand's and local market and designated the accession number as per IPGMR instructions. The experiment was set at B block which was converted to organic. Eleven genotypes induced flower under field condition and 12 failed to produce flower. However, DCO 20, DCO 25, DCO 26, DCO 27, DCO 28 and DCO 29 also produced flower but took longer time. Considering the seed production ability and the quality parameter the lines DCO 20, DCO 25, DCO 26, DCO 27, DCO 28, DCO 17, DCO 4 were selected for further improvement.

Screening of eggplant varieties against different salinity

Sharmila Rani Mallick, AKM Quamruzzaman and Ferdouse Islam

The experiment was conducted with six eggplant varieties viz. V1: BARI Bt Begun-2, V2: Bari Bt Begun-4, V3: Bari Hybrid Begun-5, V4: Bari Hybrid Begun-6, V5: Bari Begun-11 and V6: Bari Begun-12 was evaluated at 3 salinity levels viz. S2: 4 ds/m, S3: 8 ds/m and S4: 12ds/m and S1: Control (Only tap water no salt). The experiment laid out in a completely randomized design with three replications at the laboratory of Olericulture Division, HRC, BARI Gazipur. From the result of the study it can be revealed that, germination and growth attributes of different varieties significantly varied in increasing salinity level. A considerable decrease in growth parameters (root and shoot length, root and shoot fresh weight) was observed with the increase in salinity level. Though the percent germination of these two varieties Bari Bt Begun-2 and BARI Hybrid Begun-6 recorded highest at 12 ds/m. Among the six varieties the Bari Bt Begun-2 was least affected by different salinity level which followed by Bari Hybrid Begun-6 while the variety Bari Hybrid Begun-5 was highly affected. So, it might be suggested that, the Bari Bt Begun-2 and Bari Hybrid Begun-6 have the potentially to tolerant the salt stress and might perform better in the salt affected area.

Screening of tomato hybrids against different level of salinity

Ma Goffar, Afms Ahsan, Ahmm Rahman, B Ahmed, F Ahmed and M S Alam

An experiment with newly developed tomato lines was conducted at the hydroponic site of Plant Physiology Division, BARI, Gazipur during 2020-21 winter season to find out the suitable salt tolerant lines. Eight selected tomato lines (4 hybrids and 3 parents along with BARI Hybrid Tomato-10 as a check) were evaluated to determine their tolerance levels against two salinity levels (0 and 15 dS/m). Salinity was initiated at the late vegetative stage and maintained up to the maturity stage. The results showed that the plants exposed to salt stress presented a significant decline in yield and yield contributing characters except for root

parameters, but the reduction rate was significantly lower in $P_3 \times P_4$ which was identical with $P_2 \times P_5$ hybrid. Salinity stress significantly reduced the Chlorophyll content, relative water content (RWC), cell membrane stability index (CMSI), and K^+ ion uptake in leaf tissues with the least reduction in $P_3 \times P_4$ and $P_2 \times P_5$ hybrids. Moreover, $P_3 \times P_4$ and $P_2 \times P_5$ hybrids showed lower accumulation of malondialdehyde (MDA), and Na^+ ion in comparison with other tomato lines at salinity stress. These results suggested that $P_3 \times P_4$ and $P_2 \times P_5$ hybrids can be used as saline tolerant hybrid tomato varieties.

Evaluation of summer tomato hybrids at satkhira region

AKM Quamruzzaman, Ferdouse Islam, M. M. Hossain and O. A. Fakir

An experiment was conducted with four summer tomato hybrids viz. BARI Hybrid Tomato-4, BARI Hybrid Tomato-8, BARI Hybrid Tomato-10 and BARI Hybrid Tomato-11 at the Agricultural Research Station (ARS), BARI, Benarpota, Satkhira during summer season, 2020 to find out the suitable summer tomato variety for cultivation in saline area. During crop growing period soil salinity ranged from 2.95 to 10.24 dS/m. Considering the fruit yield and yield contributing parameters, BARI Hybrid Tomato-10 (52.00 t/ha) and BARI Hybrid Tomato-11 (51.54 t/ha) produced higher yield, along with higher BCR 5.76, 5.71, respectively. BARI Hybrid Tomato-10 and BARI Hybrid Tomato-11 could be salt tolerant and high yielding tomato variety for the coastal belt. This was the second year of the experiment. It should be replicated next 3 years for final recommendation.

Evaluation of sweet pepper against salinity

F. Islam, AKM Quamruzzaman, M. M. Hossain and O. A. Fakir

The experiment was conducted at the Agricultural Research Station (ARS), BARI, Benarpota, Satkhira during winter season, 2020-21 to find out the suitable sweet pepper variety for cultivation in saline area. Three sweet pepper varieties viz., BARI Mistimorich-1, BARI Mistimorich-2 and Local Hybrid taken as treatment in this study. During crop growing period soil salinity ranged from 2.65 to 9.78 dS/m. The highest fruit yield per

hectare was produced by Local Hybrid (29.42 t/ha) followed by BARI Mistimorich-1 (19.65 t/ha), while the minimum yield was produced by (12.75 t/ha). Considering yield of sweet pepper varieties, it seemed that Local Hybrid performed better followed by BARI Mistimorich-1. However, this the results of first year experiment it needs to further trial for consecutive two years for draw conclusive comment.

Screening of bottle gourd against salinity

AKM Quamruzzaman, F. Islam, M. M. Hossain and O. A. Fakir

An experiment was conducted at the Agricultural Research Station (ARS), BARI, Benarpota, Satkhira during winter season, 2020-2021 to find out the suitable bottle gourd varieties for cultivation in saline area. There were five bottle gourd varieties (BARI Lau-1, BARI Lau-2, BARI Lau-3, BARI Lau-4 and BARI Lau-5). During crop growing period soil salinity ranged from 1.95 to 7.02 dS/m. BARI Lau-4 produced the maximum number of fruit per plant (21.00) as well as fruit length (45.20 cm) and fruit yield (78.43 t/ha) compare to other varieties. Considering yield and yield contributing parameters, BARI Lau-4 could be salt tolerant and high yielding promising variety for the coastal belt. This was the second year of the experiment. It should be replicated next 3 years for final recommendation.

Screening of eggplant genotypes against salinity at germination and early seedling growth stage

M. Moniruzzaman and R. Khatoon

The impact of three levels of sodium salt (NaCl) (0.0, 8.0 and 12.0 dS/m) on 11 eggplant varieties (BARI Begun-1, BARI Begun-4, BARI Begun-5, BARI Begun-6, BARI Begun-7, BARI Begun-8, BARI Begun-10, BARI Bt Begun-1, V BARI Bt Begun-2, BARI Bt Begun-3 and BARI Bt Begun-4) was studied at the laboratory of Plant, t Physiology Section, HRC, BARI, Gazipur to find out the salt tolerant eggplant genotypes at germination and early seedling growth stage. Among 11 varieties, BARI Begun-6, BARI Begun-8 and BARI Begun-10 failed to germinate. Growth and germination parameters of eggplant varieties were investigated under salt stress. Results of this study showed a considerable decrease in growth criteria (seedling

length, root length., seeLPing fresh weight and dry weight with the increase in salinity levels. In conclusion, eggplant genotypes showed variation in their response to salt tolerance and the three varieties BARI Bt begun-2, BARI Begun-1 and BARI Bt Beugun-3 performed better at 8 dS/m salinity level compared to other varieties.

Germination and growth of eggplant seedling as influenced by seed priming agents

M. Moniruzzaman and R. Khatoon

An experiment was conducted in the laboratory of Plant Physiology Section of Horticulture Research centre, BARI during the period from 13 February 2021 to 26 February 2021 to investigate the effect of different priming agents on seed germination and seeLPing growth of eggplant. The experiment consisted of two eggplant varieties, namely BARI Begun-6 and BARI Begun-10 and seven priming agents viz., gibberellic acid (GA_3) (289 μ M), distilled water, potassium chloride (KCl (134 mM), urea (167 mM), sodium chloride (NaCl (40 mM), ammonium phosphate (DAP) (70 mM), PEG-6000 (5%) with no priming as control. The experiment was laid out following CRD design where each treatment replicated three times. Germination percentage of seeds of two eggplant varieties treated with all priming agents was significantly higher over control. Seed germination, germination index, germination rate index and coefficient velocity of germination were enhanced significantly in both the varieties at 289 μ M of GA_3 . SeeLPing growth (shoot length, root length and seeLPing dry weight) and seeLPing vigour index also increased at 289 μ MM of GA_3 . From this study it was suggested that GA_3 priming had important to enhance the seed germination as well as seeLPing vigour. Before sowing seed should be primed with GA_3 for obtaining maximum %germination and vigorous seeLPing that survive under adverse condition.

Effect of drought stress on growth and yield of bari released tomato varieties under field condition

M. Moniruzzaman and R. Khatoon

The experiment was conducted at the Plant Physiology field of Horticulture Research Center, BARI during November 2020 to March 2021 to

study the responses of BARI released tomato varieties to drought stress. Tomato plants of eight varieties, namely BARI Tomato-2, BARI Tomato-14, BARI Tomato-16, BARI Tomato-17, BARI Tomato-18, BARI Tomato-19, BARI Tomato-20, BARI Tomato-21 were grown under two different conditions of water availability i.e. controlled and drought. The parameters studied were plant height, (SPAD value, relative water content (RWC) (%), number of fruits/plant, individual fruit weight, fruit set% and yield/plant. All the parameters are negatively affected by drought due to less water availability. In respect of the parameters RWC and fruit yield/plant/ha, it might be concluded that BARI Tomato-18 and BARI Tomato-20 performed better at drought condition

Effect of seed priming agents on germination and early seedling growth of tomato (var. Bari tomato-17)

M. Moniruzzaman and R. Khatoon

The experiment was conducted with seeds of tomato var. BARI Tomato-17 were primed with seven important priming agents viz. gibberellic acid (GA_3) (289.0 μ M), distilled water, potassium chloride (KCl (134.0 mM), urea (167.0 mM), sodium chloride (NaCl (40.0 mM), ammonium phosphate (DAP) (70.0 mM), PEG-6000 (5%) with no priming as control. For each treatment seeds were soaked in priming chemicals for 24 hrs before putting for the germination test. Fifteen seeds in three replications were germinated on top of blotting paper in petri dish at $22\pm 2^\circ$ C in normal condition of laboratory for 14 days. Normally germinated seeds were counted which gave an estimation of germination percentage. Data was recorded on the Germination percentage, Germination Index, Germination Rate Index, Coefficient Velocity of Germination, shoot length, root length, seeLPing dry weight and seeLPing vigour index. Most of the treatments had significant positive effect on all the quality parameters. PEG had showed adverse effect on the root length while other treatments were found to be significant role to improve the root length. Maximum seed germination (100%), Germination Index (133.0), Germination Rate Index (59.90), Coefficient Velocity Of Germination (57.80) was observed at 289.0 μ M GA_3 and 40.0 mM NaCl. Highest shoot

length (7.83 cm), root length (5.50 cm), seeLPing vigor index-I (31.1), seeLPing vigour index-II (1599.0) and seeLPing dry weight (120 mg) was found at 289.0 μM GA₃. From this study it was suggested that GA₃ priming had important to enhance seed germination as well as seed vigour. Before sowing seed should be primed with GA₃ @ 289.0 μM for obtaining high % germination and vigorous seeLPing that survive under adverse condition.

Screening of bottle gourd genotypes against salinity at germination and early seedling growth stages

M. Moniruzzaman and R. Khatoon

The impact of three levels of sodium salt (NaCl) (0.0, 8.0 and 12.0 dS/m) was tested on 28 bottle gourd genotypes/varieties at the laboratory of Plant Physiology Section, HRC, BARI from 24 December 2020 to 06 January 2021. The genotypes consisted of five BARI released varieties and 23 bottle gourd lines. The experiment was studied to find out the salt tolerant bottle gourd genotypes at germination and early seedling growth stage. Growth and germination parameters of bottle gourd genotypes/varieties were investigated under salt stress. Results of this study showed a considerable decrease in growth criteria (shoot length) but increase in root length the increase in salinity levels. Among 28 lines two lines/genotypes LS206 and LS216 performed better in terms of germination percentage, germination index, germination rate index, coefficient of velocity of germination, shoot length, root length and seeLPing vigour index. In conclusion, bottle gourd genotypes showed variation in their response to salt tolerance and the two genotypes LS206 and LS216 performed better at 8 dS/m salinity level compared to other genotypes.

Evaluation of country bean varieties for drought tolerance through yield-based selection indices

M. Moniruzzaman and R. Khatoon

A field trial with 9 hyacinth bean varieties viz., BARI Shim-1, BARI Shim-2, BARI Shim-3, BARI Shim-4, BARI Shim-6, BARI Shim-7, BARI Shim-8, BARI Shim-9, and BARI Shim-10 was conducted at the Research field of Plant Physiology section, HRC, BARI to determine drought

tolerance of a set of hyacinth bean varieties and to identify promising drought tolerant varieties for direct production or breeding. The study was carried out using a 9×2 factorial experiment involving 9 hyacinth bean varieties under drought-stressed (DS) and non-stressed (NS) conditions. Significant differences were observed among hyacinth bean varieties with respect to pod yield under drought stress (DS) and non-stress (NS) conditions. The mean fruit yield under DS and NS conditions was 2.45 and 3.33 kg/plant, respectively. Drought stress reduced fruit yield by 23.71% on average. The four varieties BARI SHIM-6, BARI Shim-4, BARI SHIM-1 and BARI Shim-10 were identified as drought tolerant varieties for drought tolerance breeding.

Effect of plant growth regulators on the performance of okra

M. Moniruzzaman and R. Khatoon

A field experiment on okra was conducted at the Plant Physiology Field of Horticulture Research Center, Bangladesh Agricultural research Institute, Gazipur during the summer season of 2020 to study the effect of plant growth regulators on growth and yield of the crop. The experiment consisted of seven PGR treatments viz., two NAA concentrations (100 and 200 ppm), two GA₃ concentrations (100 and 200 ppm), two CCC concentrations (200, and 400 ppm) and tap water as control, and two okra varieties viz, BARI Dheros-2 and OK-1820. All growth regulators performed well in respect of all characters studied over control. Among all foliar agents, the response of GA₃ was found better. The results revealed that plant height at harvest, fruit length, single fruit weight and number of green fruits/plant, were found maximum from GA₃ 200 ppm followed by NAA 100 ppm and CCC 400 ppm. Maximum green fruit yield/plant was obtained from the application of GA₃ 200 ppm (717.5 g in BARI Dheros-2 and 746.2 g in OK-1820) followed by NAA 100 ppm (716.7 g in BARI Dheros-2 and 709.10 g in OK-1820). The result indicated that the highest green fruit yield per hectare (21.62 t in BARI Dheros-2 and 22.51 g in OK-1820) was recorded with the application of GA₃ 200 ppm.

Effect of gibberellic acid on growth, flowering and yield of okra genotypes during off-season

M. Moniruzzaman and R. Khatoon

A field experiment was conducted at the Plant Physiology Field of Horticulture Research Center, Bangladesh Agricultural research Institute, Gazipur during the period from October 2020 to February 2021 to study the effect of GA₃ on growth and yield of off-season okra. The experiment consisted of four GA₃ concentrations viz., 0.0, 100, 200 and 300 ppm, and three okra varieties viz, BARI Dheros-2, OK-1820 and Ananda 777. All growth regulators performed well in respect of all characters studied over control. The experiment was laid out in 3x 4 factorial randomized complete block design with three replications. The variety OK-1820 and GA₃ @ 200 ppm independently produced maximum plant height at last harvest, fruit length, number of fruits/plant, weight of fruits/plant, % fruit set and green fruit yield/ha. The variety Ok-1820 and GA₃ @ 200 ppm in combination also gave the highest plant height at last harvest, fruit length, weight of fruits/plant, plant dry weight and green fruit yield/ha.

Screening of eggplant germplasm for resistant against bacterial wilt

M. Afroz, L. Yasmin and M. M. Rahman

Twenty-six eggplant accessions were evaluated for resistance to *Ralstonia solanacearum* grown under artificial epiphytotic conditions during 2020-2021 cropping seasons. Among them, single line i.e. 233 gave highly resistant reaction under field condition in Gazipur. Seventeen lines of eggplant i.e. SM-301, SM-272, SM-293, SM-355, SM-181, SM-273, SM-220, SM-358, SM-232, SM-221, SM-222, SM-288, SM-236, SM-291, 272, EG-203 and BARI Begun-8 showed resistant reaction. Six lines such as SM-373, SM-216, 222, SM-275, SM-236 and SM-259 showed moderately resistant reaction. Two lines showed moderately susceptible reaction to *R. solanacearum*.

Screening of eggplant germplasm against root-knot nematode

L. Yasmin, M. Afroz And M. M. Rahman

Twenty five eggplant varieties/lines were tested in a nematode infested sick bed for their resistance to

root-knot nematode during 2020-2021 cropping season. Among them, five lines SM-221, SM-291, SM-288, SM-301 and SM-216 were found resistant, eleven lines SM-181, SM-273, 233, 203, SM-262, SM-355, SM-236, SM-293, SM-272, 272 and SM-220 showed moderately resistant, four lines SM-232, SM-330, SM-275 and SM-359 showed moderately susceptible, five lines 222, SM-373, SM-222, SM -236 and SM-358 were found susceptible to root knot nematode.

Screening of tomato germplasm for resistant to bacterial wilt

Eighteen tomato accessions were screened to find out bacterial wilt resistant source grown under artificial epiphytotic field conditions during 2020-2021 cropping seasons. Among the accessions, two accessions namely AVTO-1229 and AVTO-1316 gave highly resistant reaction against bacterial wilt. Fourteen accessions of tomato were showed resistant reaction to *R. solanacearum*. BARI Tomato-14 and BARI Tomato-15 showed moderately resistant reaction reaction to *R. solanacearum*,

Screening of tomato germplasm against root-knot nematode

L. Yasmin, M. Afroz And M. M. Rahman

Twenty tomato varieties/lines were tested in a nematode infested sick bed for their resistance to root- knot nematode during 2020-2021 cropping season. Among them, four lines (GP-0099, SL-0403, SL-0416 and AVTO-1229) showed resistant, nine lines (SL-0405, GP-4069, GP-3109, GP-0389, AVTO-1317, AVTO-1316, SL-0411, GP-4059 and GP-4039) showed moderately resistant, two lines (GP-3119 and BARI Tomato-14) showed moderately susceptible, three lines (BARI Tomato-19, BARI Tomato-15 and SL-0413) showed susceptible, two lines (GP-0039 and 0089) gave highly susceptible reaction to root knot nematode .

Screening of tomato germplasm for resistance to tomato yellow leaf curl virus

M. Mahfuzur. Rahman, L. Yasmin, M. Afroz and M. S. Nahar

The experiment was conducted in Horticulture research field, BARI, Gazipur during winter 2020-21 cropping season with some promising variety

and lines of tomato to find out resistant sources against Tomato Yellow Leaf Curl Virus (TYLCV) disease. A total of 45 tomato variety/ lines were evaluated including susceptible check. Seventeen lines were showed resistant and twelve lines were found moderately resistant to disease. The highest yield was observed in GP-0089 (2.28 kg/plant) with 27% disease incidence followed by SL-3119 and AVTO-1316 with 10% and 14%, respectively disease incidence. No lines have been found immune to TYLCV in tomato.

Management of bacterial wilt of tomato through biological agents

M. Afroz, L. Yasmin and M. M. Rahman

The experiment was conducted at Horticulture Research Centre, Joydebpur, Gazipur during November, 2020 to May, 2021. Five treatments, viz. T₁= (i) *Pseudomonas* spp. 1, T₂= (ii) *Pseudomonas* spp. 2, T₃= (iii) *Bacillus* spp. 38, T₄= (iv) *Bacillus* spp. 18 and T₅ = (v) Control were used. Among the treatment, *Bacillus* spp. 38 reduced the maximum wilt incidence followed by T₁ (*Pseudomonas* spp. 1), T₄ (*Bacillus* spp. 38) and T₂ (*Pseudomonas* spp. 2). Yield of tomato was significantly increased due to application of biological agents.

Management of tomato yellow leaf curl virus of tomato through chemical and cultural means

M. Mahfuzur. Rahman, L. Yasmin, M. Afroz and M. S. Nahar

The experiment was conducted at Horticulture research field, BARI, Gazipur during winter 2020-21 cropping season to select suitable management practice (s) for Tomato Yellow Leaf Curl Virus (TYLCV) disease of tomato. BARI tomato-8 variety was used as susceptible in the experiment. Five treatments viz: yellow polyethylene mulch, yellow polythene mulch with neem extract spray, yellow trap, Barrier crops (Marigold) and control (Admire) were evaluated. Among them, yellow polyethylene mulch with neem extract spray reduced the disease incidence and severity, and increased yield of tomato. Therefore, yellow plastic mulch with neem extract spray may recommend controlling whitefly population and management of TYLCV disease in tomato.

Survey on occurrence and severity of bacterial wilt of solanaceous vegetable crops especially eggplant and tomato

M. Afroz, L. Yasmin and M. M. Rahman

A comprehensive survey was conducted during January-May, 2021 cropping season throughout in three major eggplant and tomato growing districts such as, Narsingdi, Bogura and Thakurgaon to record the incidence of bacterial wilt of eggplant and tomato. Two “Upazillas” under each district, three major eggplant and tomato growing “villages” from each Upazila were selected. During reporting period, three districts were surveyed that covered 128 farmers field and trial sites. Data on area surveyed, variety grown, wilt incidence (%), etc. were recorded at the time of survey. As many as 9.68 and 5.68 hectares were surveyed respectively, from eggplant and tomato. It was observed that the disease incidence was higher in eggplant compared to tomato. The mean highest incidence of 13.26% was recorded in eggplant and 3.0% in tomato. As many as 80 isolates of *R. solanacearum* from 110 wilted samples were purified and preserved in laboratory for future research work.

Standardization of talc base formulation of *Trichoderma harzianum* for disease management of broccoli

L. Yasmin, M. S. Nahar and M. Afroz

The experiment was conducted in Horticulture research field, BARI, Gazipur during November 2020-21 cropping season with broccoli (Green crown) for standardization of talc based formulation of *Trichoderma harzianum* and maize bran mixing ratio before application to control soil borne pathogens. Five ratio of talc *Trichoderma*: maize bran (1:2, 1:3, 1:4, 1:5 and 1:6) was tested. Control was maintained without any *Trichoderma* application. All *Trichoderma* treatment reduced disease incidence over control. The highest disease incidence was recorded in control treatment. Talc *Trichoderma* and maize bran ratio 1:5 reduced the maximum disease incidence (77.83%) over control. Cabbage diameter, single head weight and yield was the highest in 1:5 ratio of talc *Trichoderma* and maize bran. Yield increased over control was 38.52% in 1:5 ratios of talc *Trichoderma* and maize bran mixture. Considering disease incidence and

yield 1:5 ratio of talc Trichoderma and maize bran mixing may recommend for soil application.

Development of ipm package for gummy stem blight disease management of bottle gourd

M. Afroz and L. Yasmin

The experiment was conducted at vegetable research field in HRC, BARI, Gazipur during the winter, 2020-2021. Three treatments, viz. T₁= IPM package I: Soil application of Tricho-compost @ 2.5 t/ha + Bordeaux paste at 12 inch from soil level + foliar spray of Tricho-leachate @ 0.2% at 15 days interval, T₂= IPM package II: Soil application of Talc base Trichoderma @ 50 kg/ha + mustard oil extract cake @ 600 kg/ha + foliar spray of Tricho-leachate @ 0.2% at 15 days interval and T₃= Control (regular practices) were used. Among the treatment, IPM package II: Soil application of Talc base Trichoderma @ 50 kg/ha + mustard oil extract cake @ 600 kg/ha + foliar spray of Tricho-leachate @ 0.2% at 15 days interval reduced the maximum disease incidence of gummy stem blight and increased the yield of bottle gourd followed by IPM package I: Soil application of Tricho-compost @ 2.5 t/ha + Bordeaux paste at 12 inch from soil level + foliar spray of Tricho-leachate @ 0.2% at 15 days interval was also found satisfactory to control the disease. In case of Marginal Benefit Cost Ratio, the highest value was obtained from T₂ (5.25) which was followed by T₁ (2.36).

Screening country bean germplasm for resistance to bean yellow mosaic virus

M. Mahfuzur. Rahman, L. Yasmin and M. Afroz

The experiment was conducted in Horticulture research field, BARI, Gazipur during winter 2020-21 cropping season with some promising variety and lines of country bean to find out resistant sources against country bean yellow mosaic virus (YMV) disease. A total of 22 country bean variety/lines were evaluated including susceptible check. No lines have been performed as immune or resistance to the mosaic virus disease. However, eight lines were showed moderately resistant and rest of the lines were susceptible to highly susceptible to disease. LD-004 germplasm produced the highest yield (17.2 to/ha) with 8.33% disease incidence followed by BD-10513 (16.8 ton/ha), BD-10508 (15.6 ton/ha) and BARI Sheem-

1 (14 ton/ha) with disease incidence 8.33%, 33.33%, 25%, and 16.66% respectively.

Field screening of different BARI released tomato varieties against major insect pests

Ms. Hossain and A. Mohammad

Twelve BARI released tomato varieties were screened against major insect pest infestation during 2020-21 at research field of Horticulture Research Centre, BARI, Gazipur. Of these, five varieties namely, BARI Tomato-2, BARI Tomato-11, BARI Tomato-17, BARI Tomato-19, BARI Tomato-20, BARI Tomato-21, varieties were found as less susceptible against major insect pests like whitefly, fruit borer and leafminer and high yielding varieties as well.

Dissemination of Bio-rational IPM package against tomato pinworm, *phthorimaea absoluta* in Panchagarh regions of Bangladesh

Ms Hossain and A. Mohammad

Field experiment was started at three Farmer's fields of Chaklarhatvillage of Tunir Hat union under Panchagarhsadarupazila, Panchagarh district during February 2021 to disseminate and popularize developed IPM package and to motivate the farmers to adopt IPM package through field day and Training program. Bipul plus tomato variety was used as test crop. Total three IPM package, viz, Package₁=Foliar spray of Azadirachtin (Bio-Neem plus 1EC @ 1ml/L of water) thrice at 7 days interval+ Mass trapping through installation of Delta sex pheromone trap+Application of Metarrhiziumanisolpiaebiopesticide in soil @ 5kg/ha during land preparation, Package₂= Farmers' practice (spraying of Chlorantraniliprole (Corazen 18.5 SC@ 0.5ml/L of water) and Package₃=untreated control were evaluated against tomato pinworm following dispersed RLP design with three replications where each farmer was considered as a replication. Applications of different treatments in a package was started in February 20, 2021. Among three IPM packages, package₁(Foliar spray of Azadirachtin (Bio-Neem plus 1EC @ 1ml/L of water) thrice at 7 days interval+ Mass trapping through installation of Delta sex pheromone trap+Application of Metarrhiziumanisolpiaebiopesticide in soil @ 5kg/ha during land preparation) showed the best

performance in reducing infestation (77.15%), increasing marketable yield (46.96%) and higher marginal benefit cost ratio (12.78). Two farmers' training program were conducted on Management of tomato pinworm, *Phthorimaea absoluta* through IPM Technology at Chaklar hat village of Tunirhat union under Panchagarh Sadar upazila, Panchagarh district on 20 and 21 February, 2021 where 100 farmers (male 85 and female 15) were present as participants. We had plan to conduct field day on management of tuta through biorational IPM package but could not conduct due to COVID-19 pandemic situation.

On-farm validation and upscaling of biorational integrated pest and disease management packages for quality and safe country bean production

Ms Hossain, A. Ali, L. Yasmin, A. Mohammad, S. Rahman and N. Akhter

The experiment was carried out at farmer's field of Two Upazillas of Mymensingh district (Sadar and Nandail), two upazillas of Netrakona District (Durgapur & Kalmakanda) and Two Upazillas of Sherpur district (Nalitabari and Nakla) during July 2020 to March 2021. BARI Seem-1 was used as test crop. Total three IPM + IDM packages viz, Package 1 = Seed treatment with Bordeaux mixture @ 10g per kg of seeds + Application of Trichocompost in pit + Foliar spray of Tricholectate (Trichomax @ 10ml/L) + Hand picking and destruction of infested flower/pods and shoot at 5 days interval + Installation of yellow sticky trap and sex pheromone trap for Maruca + Alternate spraying of Azadirachtin (Fytomax @ 1.5ml/L) and Bt + Abamectin (Antario @ 2g/L) of water at weekly interval Package 2 = Farmers' practice: Spraying of Emamectin benzoate (Proclaim 5SG) and Chlorantraniliprole (Coragen 18.5SC) + Spraying of Amistertop 325SC and Tilt 250EC and Package 3 = Untreated control were evaluated against major insect pests of country bean following RLP design with ten replications. Results revealed that P₂ package (Hand picking and destruction of infested flower/pods and shoot at 5 days interval + Installation of yellow sticky trap and sex pheromone trap + Alternate spraying of Azadirachtin (Phytomax) and Anterio @ 1g/L of water at weekly interval) treated plots showed the

best performance considering reduction of insect pest and disease infestation (70.92% and 63.86%), increase of marketable yield (68.85%) and marginal benefit cost ratio (10.11).

Survey and monitoring of fall armyworm (*Spodoptera frugiperda*) on maize and vegetable crops at different regions of Bangladesh

Ms Hossain and A. Mohammad

The survey and Monitoring on Fall Armyworm were done in Research and growers' maize, tomato, cauliflower and cabbage fields of eight locations, such as Bogura, Cumilla, Gazipur, Manikgonj and Rangpur from December 2020 to April 2021. Results revealed that Fall armyworm infestation was observed only on Maize but not on tomato, cauliflower and cabbage. The highest infestation and capture were observed during summer season as compared to winter season. The highest plant infestation was recorded at Bogura both in winter (23.5%) and summer season (100%) and the maximum capture was recorded at Manikgonj (12.50 moth per week) at March

Evaluation of eggplant varieties/lines to waterlogging under changing climate

K.K. Sarker, A.K.M. Quamruzzaman, M.A. Rahman, M.A. Quddus, M. J. Hussain, M.N. Uddin, S. K. Biswas

The waterlogging is one of the limiting factors for reducing vegetables crop production due to unpredicted excess rainfall and flooding events. Global climate change is also strongly associated in various excess rainfall which negatively affects the development periods of plant lifecycle. Generally, vegetable crops are sensitive to waterlog. Therefore, the aim of this study to evaluate and identify the waterlogged tolerant eggplant variety/line and the response of yield of eggplant variety/line at different waterlogged level. Therefore, a factorial experiment was laid out in randomized complete block design with thirty treatments replicated twice at the research field of Vegetable Division of Horticulture Research Centre under Bangladesh Agricultural Research Institute in Gazipur during summer season in 2021. The treatments consisted of factor A (waterlogged level): (i) I₀ : No waterlogging (control: Normal irrigation and drainage), (ii) I₁ : Waterlogging for

48 hours maintained by 25 mm constant standing water depth, (iii) I₂: Waterlogging for 96 hours maintained by 25 mm constant standing water depth and factor B (Variety/Line): Ten eggplant materials were V₁: BARI Begun-8, V₂: BARI Begun-10, V₃: BARI Hybrid Begun-4, V₄: BARI Hybrid Begun-5, V₅: BARI Hybrid Begun-6, V₆: BARI Adv. Line-SM216, V₇: BARI Adv. Line-SM233, V₈: BARI Adv. Line-SM253B, V₉: BARI Adv. Line-SM275, V₁₀: BARI Adv. Line-SM286B. The results revealed that the eggplant variety/line was found more sensitive to waterlogging level at flowering/fruiting stage (46 days after planting, DAP). Among the varieties and lines, the variety V₅ (BARI Hybrid Begun-6) showed better performance than the other varieties and lines. The variety V₅ was found significantly ($P < 0.001$) lower damage (20%) and greater survive (80%) of plants under 48 hours of waterlogging (I₁) at 65 DAP while the other variety and line observed significantly ($P < 0.001$) greater damage and lower survive. The variety V₅ only significantly survived (30%) of plants under 48 hours of waterlogging (I₁) at 80 DAP while the other all varieties and lines showed damage. All the varieties and lines damaged at 80 DAP under 96 hours of waterlogging (I₂). The effect of waterlogging on SPAD value and root biomass had significantly difference among the treatments. The variety V₅ showed significantly ($P < 0.001$) greater root biomass under 48 hours (I₁) and 96 hours (I₂) of waterlogging at 70 DAP while the other variety/line observed significantly ($P < 0.001$) lower root biomass. The identified waterlogged tolerant eggplant variety may be helpful to physiologist/breeders for developing mechanisms related to morphology and metabolism. The farmers/growers would be benefited to cultivate the waterlogged variety to waterlogging stress prone areas of Bangladesh.

Growth and yield performance of tomato varieties at different plastic mulch

M. A. Rahman, M. J. Hussain, M. A. Quddus and K. K. Sarker

The experiment was conducted followed by factorial in RLPD with 3 replications. Two variety of tomato factor A: V₁: BARI Tomato-18 and V₂: BARI Tomato-21 and four types of plastic mulch

as factor B: PM₁: Control, PM₂: Black PM, PM₃: Yellow PM and PM₄: White transparent PM was used to form treatment combination. A blanket dose of all other fertilizer (STB) was applied as per recommendation followed by FRG., BARC, 2018. It was observed that yield (plot based) was found maximum in black polythene mulch with both the variety BARI tomato-18 and BARI Tomato-21 (56.945 and 50.977 t/ha) followed by yellow polythene mulch, respectively. Highest TSS was also found in black polythene mulch with the variety BARI tomato-21 and BARI Tomato-18 (75.453 and 72.303 t/ha) followed by yellow polythene mulch, respectively. Due to suppression of weed and Fertilizer and water sharing is less in black polythene mulch condition followed by yellow polythene mulch. From one year study it was found that black polythene mulch followed by yellow polythene mulch is more suitable to produce higher amount of tomato in winter season. The experiment will be repeated for the next year for further evaluation.

Influence of zinc and boron as foliar application on the growth, yield and quality of summer tomato

M. J. Hussain, M. A. Rahman, M. A. Quddus, and M. M. R. Salim

The experiment was conducted at the research field of HRC, BARI during summer season of 2018, 2019 and 2020 to evaluate the effect of foliar application of zinc and boron on growth, flowering and fruit setting of summer tomato and to determine the suitable foliar application doses of Zn and B for higher growth, yield and quality of summer tomato production. The experiment was designed followed by RLP with three replications. Four foliar sprays with one control and one soil applied (check) treatments viz. T₁: Control; T₂: 90 ppm Zn (250-ppm ZnSO₄); T₃: 50 ppm B (294-ppm H₃BO₃); T₄: 45-ppm Zn (125-ppm ZnSO₄) + 25 ppm B (147-ppm H₃BO₃); T₅: 90 ppm Zn + 50 ppm B (250-ppm ZnSO₄ + 294-ppm H₃BO₃) and T₆: 4 kg Zn + 2 kg B as soil application (check) were used in the experiment. From three years study it was observed that foliar application of Zn and B application has significant effects on summer tomato production. Treatment T₄ with foliar application of 45 ppm Zn (125-ppm ZnSO₄) + 25

ppm B (147-ppm H_3BO_3) showed the best performance in terms of both yield and economic profitability. Maximum yields of 31.93, 33.33 and 29.29 ton ha^{-1} were recorded with the treatment T_4 for the years, respectively followed by T_6 (31.15, 31.65 and 29.08 ton ha^{-1}). Also the higher fruit setting (17.1, 17.6 and 23.7 fruit $plant^{-1}$), individual fruit weight (67.7 and 65.8 and 53.0 g) were found with T_4 treatment. Maximum gross margin (Tk. 589162, 311862 and 483162) was found in T_4 treatment followed by T_6 (Tk. 556920, 260420 and 474120) and T_3 (Tk. 480130, 260130 and 473330). Maximum BCR (1.86, 1.45 and 1.70) and MBCR (20.53, 9.71 and 14.11) were found from T_4 followed by T_6 and T_3 , respectively. Therefore, foliar application of Zn and B @ 45 ppm Zn (125-ppm $ZnSO_4$) + 25 ppm B (147-ppm H_3BO_3) is more profitable than soil application in respect of yield as well as economic profitability of summer tomato production.

Growth and yield performance of summer tomato as influenced by planting time and plastic mulch under agroclimatic condition of bangladesh

M. J. Hussain, M. Sultana, M. A. Rahman, M. A. Quddus and K. K. Sarker

The experiment was conducted at the research field of Horticulture Research Centre of BARI, Gazipur during summer season of 2020 and 2021 to identify the best planting time for better flowering, fruit setting and yield of summer tomato under plastic mulch condition. Another objective was to develop an off season low cost production technology under the prevailing agro-climatic conditions in Bangladesh. The experiment was designed followed by RLPD with three replications. Four transplanting dates as T_1 : 1st week of April; T_2 : 1st week of June; T_3 : 1st week of August and T_4 : 1st week of October and four plastic mulches as PM_1 : Black polythene mulch; PM_2 : Yellow polythene mulch; PM_3 : Double layer (black + Yellow) polythene mulch and PM_4 : Transparent polythene mulch (control) were tested in the experiment. From one year's study it was observed that polythene mulch has significant positive effects on summer tomato yield and production. Treatment T_3 with double layer polythene mulch followed by black polythene mulch (T_1) showed the best performance

in terms of both yield and economic profitability. Maximum yields of 34.823 were recorded with the treatment T_3 for the years, followed by T_1 (32.907 ton ha^{-1}) respectively. Also the higher fruit setting (25 and 24 fruit $plant^{-1}$), individual fruit weight (47.0 and 45.7 g) were found with the same treatment. Maximum gross margin (Tk. 607320 and Tk. 540600) was found in T_3 treatment followed by T_1 respectively. Maximum BCR (2.86 and 2.66) were found from T_3 followed by T_1 , respectively. Therefore, double layer (black + yellow) followed by black polythene mulch is more suitable than transparent polythene in respect of yield as well as economic profitability of summer tomato production.

Effect of boron and magnesium on growth, yield and quality of cauliflower

M. A. Quddus, M. A. Rahman, M. J. Hussain, K. K. Sarker, and M. S. Arfin

Cauliflower (*Brassica oleracea* var. botrytis L.) is very responsive to applied boron and magnesium fertilizers when soil is deficit in boron and manganese. An experiment was conducted in winter season of 2020-21 to evaluate the effect of boron and magnesium application on growth, yield traits and yields of cauliflower. The experiment was planned with 16 treatment combinations involving four levels each of boron (0, 1, 2 and 3 $kg\ ha^{-1}$) and four levels magnesium (0, 4, 8 and 12 $kg\ ha^{-1}$) following split plot design with three replications. The result indicated that application of B @ 2 $kg\ ha^{-1}$ and Mg @ 12 $kg\ ha^{-1}$ produced highest number of leaves (23.2) and the maximum fresh curd yield (18.4 t ha^{-1}) with higher individual curd weight (1078 g). The interaction effect of boron and magnesium was superior than single effect. The result suggests that combined application of B 2 $kg\ ha^{-1}$ and Mg 12 $kg\ ha^{-1}$ can increase the curd yield of cauliflower. The present findings may have potential in improving the yield and production of cauliflower in the areas where soils are deficit in boron and magnesium.

Effect of vermicompost and chemical fertilizers on growth, yield and nutritional quality of cabbage

Marufa Sultana, M. A. Quddus, M. A. Siddiky, M. J. Hussain and M. A. Rahman

A field experiment was carried out at the research field of Bangladesh Agricultural Research Institute, Soil and water management section, HRC, Gazipur during 2019-20 and 2020-21 to assess the effect of vermicompost on growth, yield and quality of cabbage as compare to inorganic fertilizer. The treatments used were: $T_1 = 100\%$ RD ($N_{115}P_{70}K_{125}S_{20}Zn_2$ kg ha⁻¹), $T_2 = 75\%$ RD + 4 t ha⁻¹ VC, $T_3 = 100\%$ RD+ 3t ha⁻¹ VC, $T_4 = 75\%$ RD + 3 t ha⁻¹ VC, $T_5 =$ Native fertility. The tested variety was Atlas 70. The experimental treatments were arranged in randomized complete block design with three replicates. Results revealed that the T_3 (100% RD+ 3 t ha⁻¹ VC) produced the highest mean yield (105 t ha⁻¹), Vit-C (40.0 mg 100g⁻¹) and Firmness (1.96 kgf). Integrated use of VC at the rate of 3 t ha⁻¹ with 100% RD was found as the best combinations for improving cabbage yield and quality.

Effect of prilled urea, usg and neem coated urea on the growth, yield and n-use efficiency of broccoli

M. J. Hussain, M. A. Rahman, M. A. Quddus and K. K. Sarker

The experiment was conducted followed by RLPD with three replications during 2018-19 to 2019-21 cropping season. There were 8 treatments as- T_1 : Control; T_2 : 100% Recommended PU (broadcasted); T_3 : 100% Recommended USG (Deep placed); T_4 : 100% Recommended neem coated urea (broadcasted); T_5 : 100% Recommended neem coated urea (Deep placed); T_6 : 85% recommended USG (deep placed); T_7 : 85% Recommended neem coated urea (broadcasted) and T_8 : 85% Recommended neem coated urea (Deep placed). The experiment was conducted in winter season of 2018-19 to 2020-21. From three years result it was observed that deep placed USG as well as deep placed neem coated urea (NCU) performed better than that of prilled urea. But in broadcasted condition performance of NCU was not up to the mark. Maximum broccoli yield (32.25, 32.59 and 31.68 ton ha⁻¹) was obtained from T_6 (85% recommended USG, deep placed) treatment followed by T_3 (100% Recommended USG, deep placed). Results showed that USG as well as neem coated urea performed better as compared to prilled urea. Highest N use

efficiency (72.48, 69.07 and 74.76%) was also found with T_6 (85% recommended USG). Maximum economic benefit (BCR 4.35, 4.4 and 4.3) for broccoli against the gross margin (Tk. 498130, 502970 and 484730, respectively) was obtained with 85% recommended USG. But performance of NCU under broadcasted condition was not satisfactory for the crop. Therefore, application of 85% recommended USG with other recommended fertilizer could be suggested for broccoli production.

Effect of prilled urea, usg and neem coated urea on the growth, yield and n-use efficiency of ash gourd

M. J. Hussain, M. A. Rahman, M. A. Quddus And K. K. Sarker

The experiment was conducted followed by RLPD with three replications during 2019 to 2021 cropping season. There were 8 treatments as- T_1 : Control; T_2 : 100% Recommended PU (broadcasted); T_3 : 100% Recommended USG (Deep placed); T_4 : 100% Recommended neem coated urea (broadcasted); T_5 : 100% Recommended neem coated urea (Deep placed); T_6 : 85% recommended USG (deep placed); T_7 : 85% Recommended neem coated urea (broadcasted) and T_8 : 85% Recommended neem coated urea (Deep placed). The experiment was conducted on ash gourd in summer season during 2019 to 2021. From three years results it was observed that deep placed USG as well as deep placed neem coated urea (NCU) performed better than that of prilled urea. But in broadcasted condition performance of NCU was not up to the mark. Highest ash gourd yield (49.575, 46.583 and 37.250 ton ha⁻¹) was obtained in T_5 (100% Recommended neem coated urea (Deep placed) followed by T_6 (85% Recommended USG). Results showed that USG as well as neem coated urea performed better as compared to prilled urea. Highest N use efficiency (82.70, 62.79 and 76.78 %) was also found with T_5 (100% Reco. NCU, deep placed) treatment. Maximum economic benefit with highest BCR (5.1, 4.8 and 5.1) found from T_5 treatment (100% Reco. NCU, deep placed) followed by T_6 (85% recommended USG, deep placed) treatment (BCR 4.4, 4.5 and 4.1) with gross margin of Tk. 598310, 553430 and 592310,

respectively. But performance of NCU under broadcasted condition was not satisfactory for the crop. Therefore, application of 100% recommended NCU with other recommended fertilizer could be suggested for ash gourd production.

Response of sponge gourd to zinc, boron and magnesium application

M. A. Quddus, M. J. Hussain, M. A. Siddiky, M.A. Rahman And M. S. Arfin

A study was conducted at the research field of HRC, BARI, Gazipur during 2020 to determine the effective doses of zinc (Zn), boron (B) and magnesium (Mg) for yield maximization of sponge gourd (*Luffa cylindrica* L). There were 9 treatment combinations consisting of three levels each of Zn (0, 3, 4 kg ha⁻¹), B (0, 1.5, 2 kg ha⁻¹) and Mg (0, 4, 8 kg ha⁻¹) along with the blanket dose of N₁₀₀P₃₀K₈₀S₂₀ kg ha⁻¹ and cow dung 10 t ha⁻¹. The experiment was designed randomized complete block with three replications. The treatment combinations were T₁ = Zn₀B₀Mg₀, T₂ = Zn₃B_{1.5}Mg₄ kg ha⁻¹, T₃ = Zn₃B₂Mg₄ kg ha⁻¹, T₄ = Zn₄B_{1.5}Mg₄ kg ha⁻¹, T₅ = Zn₄B₂Mg₄ kg ha⁻¹, T₆ = Zn₃B_{1.5}Mg₈ kg ha⁻¹, T₇ = Zn₃B₂Mg₈ kg ha⁻¹, T₈ = Zn₄B_{1.5}Mg₈ kg ha⁻¹ and T₉ = Zn₄B₂Mg₈ kg ha⁻¹. The results exhibited that the marketable yields of sponge gourd was highest (52.6 t ha⁻¹) in T₉ treatment followed by T₈. The lowest yield was found in control plot. The percent yield increment over control was achieved highest (16.1%) in T₉ treatment. Most of the yield attributes of sponge gourd was performed better in T₉ followed by T₈ treatment. The highest net return (Tk.837229 ha⁻¹) was counted from T₉ treatment followed by T₈. The highest benefit cost ratio (4.89) was also counted from the treatment T₉ followed T₈ treatment. Considering the yield and benefit cost ratio T₉ = Zn₄B₂Mg₈ kg ha⁻¹ including N₁₀₀P₃₀K₈₀S₂₀ kg ha⁻¹ may be used for sponge gourd cultivation.

Yield and quality of netted melon influenced by organic and inorganic fertilizer

M. J. Hussain, M. A. Quddus, M. A. Rahman and M. M. R. Salim

The experiment was conducted at the research field of HRC, BARI, Gazipur during 2020-21. The experiment was laid out in a split plot followed by RLP design with three replications. Three levels of

vermi-compost as factor A were VC₁ = 3 ton ha⁻¹, VC₂ = 4 ton ha⁻¹, and VC₃ = 5 ton ha⁻¹ and four levels of NPK fertilizer as factor B: F₁ = Control (0-0-0 kg), F₂ = 50% of recommended NPK @ 160 : 80 : 70 kg ha⁻¹, F₃ = 75% of recommended NPK @ 245 : 115 : 105 kg ha⁻¹, and F₄ = 100% of recommended NPK @ 330 : 150 : 140 kg ha⁻¹ were considered as treatment. The three vermi-compost rates (3, 4 and 5 ton ha⁻¹) were assigned in the main plots, whereas, the four levels of NPK fertilizers (0, 50, 75 and 100% of recommended NPK doses) were randomly distributed within the subplots. A blanket dose of S, Zn and B will be used @ 30, 4 and 1.5 kg ha⁻¹. From one year's study it was found that all the parameters showed higher performance in vermi-compost 5 ton/ha with 75% recommended NPK fertilizer. Maximum fruit weight (794 g) was recorded with 75% recommended NPK fertilize under 5 ton/ha vermi-compost application followed by 4 ton vermi-compost. Flesh thickness (3.9 cm), TSS (7.3%) and Vitamin C content (25.2 mg/100g F.W) was also found higher in the same treatment.

Response of bush bean varieties to boron fertilization

M. J. Hussain, M. A. Rahman, M. A. Quddus and M. M. R. Salim

The experiment was conducted at the research field of Horticulture Research Centre of BARI, Gazipur during winter season of 2020-21 to evaluate the effects of B on seed and pod yield of different bush bean variety and to develop a boron fertilizer recommendation for BARI bush bean varieties. The experiment was designed followed by factorial in RLPD with three replications. Three variety of bush bean as V₁: BARI bush bean-1; V₂: BARI bush bean-2 and V₃: BARI bush bean-3 and Four levels of boron viz. B₁: 0 kg B (control); B₂: 1 kg B; B₃: 2 kg B and B₄: 3 kg B ha⁻¹ were used in the experiment. From one year study it was observed that application of B has significant effects on bush bean production. Maximum seed yield was recorded in BARI Bushbean-1 with 2 kg B/ha followed by 1 kg B. Similar results were also observed in other parameters of bush bean. Highest plant boron content was found with 2 kg B/ha under BARI bush bean-3. From one year study it was observed that the variety BARI bushbean-1 followed by BARI bushbean-3 is more productive

with 2 kg boron/ha for quality seed and pod yield of bush bean.

Effect of micronutrient and rhizobium inoculation on productivity and quality of garden pea

M. A. Quddus, M. J. Hussain, M. A. Siddiky, M. A. Rahman, K.K. Sarker, M. Eyakub Ali and M. S. Arfin

An experiment was carried out in the research field of HRC, BARI, Gazipur during Rabi season of 2019-20 and 2020-21 to estimate the suitable combination of Zn, B and Mo with Rhizobium for nodulation, quality and yield maximization of garden pea (*Pisum sativum*). The experiment was planned with seven treatments viz. T_1 = Control, T_2 = Rhizobium inoculation, T_3 = Zn_3Mo_1 + Rhizobium, T_4 = B_2Mo_1 + Rhizobium, T_5 = Zn_3B_2 + Rhizobium, T_6 = $Zn_3B_2Mo_1$ + Rhizobium and T_7 = $Zn_3B_2Mo_1$ along with the blanket dose of $N_{40}K_{50}P_{24}S_{10}$ kg ha⁻¹ and cowdung 5 t ha⁻¹. The experiment was laid out in randomized complete block design with three replications. Results revealed that the highest mean green pod (8691 kg ha⁻¹) and seed yield (1870 kg ha⁻¹) were found in T_6 treatment and the lowest were found in control plot. The maximum nodulation (25.4) and protein content (23.1%) were found in T_6 treatment. The greatest gross return was recorded from the treatment T_6 . Considering the yield, quality and economics, the combined application of Zn 3 kg ha⁻¹, B 2 kg ha⁻¹ and Mo 1 kg ha⁻¹ with Rhizobium 50 g kg⁻¹ seed can be recommended for garden pea cultivation.

Price variation and cost-return analysis of BARI Hybreed tomato-8 at farm level

S. M. Abdullah Shiblee And Rafiqul Islam

This study aims to know the real situation of BARI Hybreed Tomato-8 at farm level e.g. how the farmers see this variety, how much benefit they received, what is their problem in cultivating this variety. Data were collected from 27 sample farmers Ramrail and Mojlishpur union of Sadar upazilla of Brahmanbaria district. Respondent farmers' summer tomato land was found 28.12% of total cultivated land. The range of harvesting period varied from three and half months to six and half months. Four to five months was found as the

highest (44% farmers) followed by six to six and half months (26%). Transplanting started at the 3rd week of June month (1st Ashar) and last transplanting time was 3rd week of September month (1st Ashshin). Highest transplanting was done in the 3rd week of August (1st Bhadro) which was 40.74% followed by 3rd week of July (1st Srabon) which was 29.63%. Cultivation of summer tomato lasted up to mid-April. The average yield was calculated at 79 ton/ha. The price of tomato varies over the season ranging from 90 Tk/kg to 5 Tk/kg. At the starting, the price was high and gradually it declined and the declining rate was 3.35/- Tk/kg. Gross return was found Tk 39.5 lakh/ha. Farmers incurred on full cost basis a total of Tk 22.3 lakh/ha. Therefore, farmers earned net return of Tk 17.17 lakh/ha with BCR 1.77. Switching over from rice to BARI Hybreed Tomato-8 farmers gained a net return of Tk 15.6 lakh per hectare and societal gain was Tk 37 lakh per hectare. In sensitivity analysis, given the cost, assuming highest price (Tk 55 per kg) and yield (82 ton/ha), net return was estimated Tk 22.7 lakh/ha with BCR 2.02 and on the other hand, assuming lowest price (Tk 45 per kg) and yield (66 ton/ha) net return was estimated Tk 7.37 lakh/ha with 1.33 as BCR. There was another Hybreed tomato variety named 'Raja F1' found in the study area. Farmers opined that they found BARI Hybreed Tomato-8 better than Raja in terms of yield and taste. However, the price of Raja is higher than that of BARI Hybreed Tomato-8 because of its attractive color and size though being less taste. Farmers apprised to have received higher profit from BARI Hybreed Tomato-8 than Raja due to its high yield though being less price. Farmers informed that they did not get adequate seed of BARI Hybreed Tomato-8 as per requirement. If they get adequate seed of BARI Hybreed Tomato-8, they will not cultivate Raja F1. Because of being highly profitable and well acceptance in the farmers' field, adequate seed of the BARI Hybreed Tomato-8 should be made available to the farmers through BADC and different seed companies.

Effect of mulch and days storage prior to seed extraction system on quality seed production of eggplant

AKM Quamruzzaman, S.R. Mallick, Ferdouse and Islam M Nazim Uddin

The experiment was conducted at the research field of Olericulture division of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during October 2020 to April 2021 to find out the effect of quality seed production as influence by mulch and days storage prior to seed extraction support system in BARI Begun-4, BARI Begun-6, BARI Begun-8 eggplant varieties. The experiment comprised of three factors viz., Factor A: V1= BARI Begun-4, V2= BARI Begun-6, V3= BARI Begun-8; Factor B: M1=No Mulch, M2 = straw mulch, M3=Bi-color plastic mulch and Factor C: E1=0 days storage prior to seed extraction, E2=4 days storage prior to seed extraction, E3=8 days storage prior to seed extraction. The result indicated a significant interaction was observed between Bi-color plastic mulch and days storage prior to seed extraction with different eggplant varieties. In terms of effect of mulch, the results revealed that Bi-color plastic mulch (M3) showed the highest positive impact on eggplant seed yield, while effect of 8 days storage prior to seed extraction system (E3) showed the highest positive impact on quality seed yield of BARI Begun-4; BARI Begun-6; BARI Begun-8. The interaction effect of Bi-color plastic mulch and days storage prior to seed extraction system, treatment V2M2E2 produced the highest seed yield (19.64 g), but in terms of seed yield and seed quality, the seed yield/ fruit and seed germination were higher in V1M3E3 (3.97 g, 87.7 %, respectively), V2M3E3 (18.46 g, 87.7 %, respectively), V3M3E3 (4.00 g, 87.3 %, respectively). Considering seed yield and seed yield quality contributing parameters, the treatments V1M3E3, V2M3E3, V3M3E3 performed better for BARI Begun-4, BARI Begun-6, BARI Begun-8 eggplant varieties.

Maintenance of bari released tomato varieties (op & hybrid)

M.A. Goffar

A study was carried out at the experimented field of Olericulture Division of HRC, BARI, Gazipur during winter season of 2020-21. In this study, parents/inbred of four tomato hybrid varieties (BARI Hybrid Tomato-4, Hybrid Tomato-5, Hybrid Tomato-8, & Hybrid Tomato-9) and three OP tomato varieties (BARI Tomato-2, BARI

Tomato-14 and BARI Tomato-15) were included. Seeds of selfed fruits have been preserved in the cold storage at 8°C temperature. This procedure will be done in the next year with the preserved seed.

Effect of plant spacing and support system on quality seed production of dwarf yard long bean

AKM Quamruzzaman, S.R. Mallick, Ferdouse Islam, AKM Ariful Haque and M Nazim Uddin

The experiment was conducted at the research field of Olericulture division of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during July to October 2020 to find out the effect of quality seed production as influence by planting spacing and support system in dwarf yard long bean var. BARI Barboti-2. The experiment comprised of two factors viz., Factor A: planting spacing (S1= 45 cm × 50 cm spacing, S2= 45 cm × 40 cm spacing and S3= 45 cm × 30 cm spacing) and Factor B: supporting system (T1= Bamboo stick, T2= Rope, T3=Net, T4= without support). The experiment was conducted following factorial design with three replications. The result indicated a significant interaction between planting spacing and supporting system for the growth, seed yield of dwarf yard long bean. In terms of effect of planting spacing, the results revealed that 45 cm × 50 cm spacing planting (S1) showed the highest positive impact on the seed yield, while effect of supporting system bamboo stick planting (T1) showed the highest positive impact on the seed yield of dwarf yard long bean. The interaction effect of planting spacing and supporting system, treatment S1T1 had recorded the highest plant height at 50% flowering (61.3 cm), earliest days of harvest (55 days), average green pod weight (19.3 g), seed number/ pod (12.0), seed yield (2.07 t/ha), seed germination (80.9 %). Considering seed yield and yield contributing parameters, the treatment S1T1 (45 cm × 50 cm spacing + Bamboo stick) can be chosen for quality seed production with higher seed yield for the farmers.

Screening eggplant germplasm for resistant against bacterial wilt

M. Afroz, L. Yasmin and M. M. Rahman

Twenty-six eggplant accessions were evaluated for resistance to *Ralstonia solanacearum* grown under

artificial epiphytotic conditions during 2020-2021 cropping seasons. Among them, single line i.e. 233 gave highly resistant reaction under field condition in Gazipur. Seventeen lines of eggplant i.e. SM-301, SM-272, SM-293, SM-355, SM-181, SM-273, SM-220, SM-358, SM-232, SM-221, SM-222, SM-288, SM-236, SM-291, 272, EG-203 and BARI Begun-8 showed resistant reaction. Six lines such as SM-373, SM-216, 222, SM-275, SM-236 and SM-259 showed moderately resistant reaction. Two lines showed moderately susceptible reaction to *R. solanacearum*.

Screening tomato germplasm for resistant to bacterial wilt

M. Afroz, L. Yasmin and M. M. Rahman

Eighteen tomato accessions were screened to find out bacterial wilt resistant source grown under artificial epiphytotic field conditions during 2020-2021 cropping seasons. Among the accessions, two accessions namely AVTO-1229 and AVTO-1316 gave highly resistant reaction against bacterial wilt. Fourteen accessions of tomato were showed resistant reaction to *R. solanacearum*. BARI Tomato-14 and BARI Tomato-15 showed moderately resistant reaction reaction to *R. solanacearum*,

Screening eggplant germplasm against root-knot nematode

L. Yasmin, M. Afroz and M. M. Rahman

Twenty five eggplant varieties/lines were tested in a nematode infested sick bed for their resistance to root-knot nematode during 2020-2021 cropping season. Among them, five lines SM-221, SM-291, SM-288, SM-301 and SM-216 were found resistant, eleven lines SM-181, SM-273, 233, 203, SM-262, SM-355, SM-236, SM-293, SM-272, 272 and SM-220 showed moderately resistant, four lines SM-232, SM-330, SM-275 and SM-359 showed moderately susceptible, five lines 222, SM-373, SM-222, SM -236 and SM-358 were found susceptible to root knot nematode.

Screening tomato germplasm against root-knot nematode

L. Yasmin, M. Afroz and M. M. Rahman

Twenty tomato varieties/lines were tested in a nematode infested sick bed for their resistance to

root- knot nematode during 2020-2021 cropping season. Among them, four lines (GP-0099, SL-0403, SL-0416 and AVTO-1229) showed resistant, nine lines (SL-0405, GP-4069, GP-3109, GP-0389, AVTO-1317, AVTO-1316, SL-0411, GP-4059 and GP-4039) showed moderately resistant, two lines (GP-3119 and BARI Tomato-14) showed moderately susceptible, three lines (BARI Tomato-19, BARI Tomato-15 and SL-0413) showed susceptible, two lines (GP-0039 and 0089) gave highly susceptible reaction to root knot nematode.

Screening tomato germplasm for resistance to tomato yellow leaf curl virus

M. Mahfuzur. Rahman, L. Yasmin, M. Afroz and M. S. Nahar

The experiment was conducted in Horticulture research field, BARI, Gazipur during winter 2020-21 cropping season with some promising variety and lines of tomato to find out resistant sources against Tomato Yellow Leaf Curl Virus (TYLCV) disease. A total of 45 tomato variety/ lines were evaluated including susceptible check. Seventeen lines were showed resistant and twelve lines were found moderately resistant to disease. The highest yield was observed in GP-0089 (2.28 kg/plant) with 27% disease incidence followed by SL-3119 and AVTO-1316 with 10% and 14%, respectively disease incidence. No lines have been found immune to TYLCV in tomato.

Screening country bean germplasm for resistance to bean yellow mosaic virus

M. Mahfuzur. Rahman, L. Yasmin and M. Afroz

The experiment was conducted in Horticulture research field, BARI, Gazipur during winter 2020-21 cropping season with some promising variety and lines of country bean to find out resistant sources against country bean yellow mosaic virus (YMV) disease. A total of 22 country bean variety/ lines were evaluated including susceptible check. No lines have been performed as immune or resistance to the mosaic virus disease. However, eight lines were showed moderately resistant and rest of the lines were susceptible to highly susceptible to disease. LD-004 germplasm produced the highest yield (17.2 to/ha) with 8.33% disease incidence followed by BD-10513 (16.8 ton/ha), BD-10508 (15.6 ton/ha)

and BARI Sheem-1 (14 ton/ha) with disease incidence 8.33%, 33.33%, 25%, and 16.66% respectively.

Development of IPM Package for Gummy stem blight disease Management of Bottle Gourd

M. Afroz and L. Yasmin

The experiment was conducted at vegetable research field in HRC, BARI, Gazipur during the winter, 2020-2021. Three treatments, viz. T₁= IPM package I: Soil application of Tricho-compost @ 2.5 t/ha + Bordeaux paste at 12 inch from soil level + foliar spray of Tricho-leachate @ 0.2% at 15 days interval, T₂= IPM package II: Soil application of Talc base *Trichoderma* @ 50 kg/ha + mustard oil extract cake @ 600 kg/ha + foliar spray of Tricho-leachate @ 0.2% at 15 days interval and T₃= Control (regular practices) were used. Among the treatment, IPM package II: Soil application of Talc base *Trichoderma* @ 50 kg/ha + mustard oil extract cake @ 600 kg/ha + foliar spray of Tricho-leachate @ 0.2% at 15 days interval reduced the maximum disease incidence of gummy stem blight and increased the yield of bottle gourd followed by IPM package I: Soil application of Tricho-compost @ 2.5 t/ha + Bordeaux paste at 12 inch from soil level + foliar spray of Tricho-leachate @ 0.2% at 15 days interval was also found satisfactory to control the disease. In case of Marginal Benefit Cost Ratio, the highest value was obtained from T₂ (5.25) which was followed by T₁ (2.36).

Management of bacterial wilt of tomato through biological agents

M. Afroz, L. Yasmin and M. M. Rahman

The experiment was conducted at Horticulture Research Centre, Joydebpur, Gazipur during November, 2020 to May, 2021. Five treatments, viz. T₁= (i) *Pseudomonas* spp. 1, T₂= (ii) *Pseudomonas* spp. 2, T₃= (iii) *Bacillus* spp. 38, T₄= (iv) *Bacillus* spp. 18 and T₅= (v) Control were used. Among the treatment, *Bacillus* spp. 38 reduced the maximum wilt incidence followed by T₁ (*Pseudomonas* spp. 1), T₄ (*Bacillus* spp. 38) and T₂ (*Pseudomonas* spp. 2). Yield of tomato was significantly increased due to application of biological agents.

Yellow leaf curl virus of tomato through chemical and cultural means

M. Mahfuzur. Rahman, L. Yasmin, M. Afroz and M. S. Nahar

The experiment was conducted at Horticulture research field, BARI, Gazipur during winter 2020-21 cropping season to select suitable management practice (s) for Tomato Yellow Leaf Curl Virus (TYLCV) disease of tomato. BARI tomato-8 variety was used as susceptible in the experiment. Five treatments viz: yellow polyethylene mulch, yellow polythene mulch with neem extract spray, yellow trap, Barrier crops (Marigold) and control (Admire) were evaluated. Among them, yellow polyethylene mulch with neem extract spray reduced the disease incidence and severity, and increased yield of tomato. Therefore, yellow plastic mulch with neem extract spray may recommend controlling whitefly population and management of TYLCV disease in tomato.

Standardization of talc base formulation of *trichoderma harzianum* for disease management of broccoli

L. Yasmin, M. S. Nahar and M. Afroz

The experiment was conducted in Horticulture research field, BARI, Gazipur during November 2020-21 cropping season with broccoli (Green crown) for standardization of talc based formulation of *Trichoderma harzianum* and maize bran mixing ratio before application to control soil borne pathogens. Five ratio of talc *Trichoderma*: maize bran (1:2, 1:3, 1:4, 1:5 and 1:6) was tested. Control was maintained without any *Trichoderma* application. All *Trichoderma* treatment reduced disease incidence over control. The highest disease incidence was recorded in control treatment. Talc *Trichoderma* and maize bran ratio 1:5 reduced the maximum disease incidence (77.83%) over control. Cabbage diameter, single head weight and yield was the highest in 1:5 ratio of talc *Trichoderma* and maize bran. Yield increased over control was 38.52% in 1:5 ratios of talc *Trichoderma* and maize bran mixture. Considering disease incidence and yield 1:5 ratio of talc *Trichoderma* and maize bran mixing may recommend for soil application.

Survey on occurrence and severity of bacterial wilt of solanaceous vegetable crops especially eggplant and tomato

M. Afroz, L. Yasmin and M. M. Rahman

A comprehensive survey was conducted during January-May, 2021 cropping season throughout in three major eggplant and tomato growing districts such as, Narsingdi, Bogura and Thakurgaon to record the incidence of bacterial wilt of eggplant and tomato. Two “Upazillas” under each district, three major eggplant and tomato growing “villages” from each Upazila were selected. During

reporting period, three districts were surveyed that covered 128 farmers field and trial sites. Data on area surveyed, variety grown, wilt incidence (%), etc. were recorded at the time of survey. As many as 9.68 and 5.68 hectares were surveyed respectively, from eggplant and tomato. It was observed that the disease incidence was higher in eggplant compared to tomato. The mean highest incidence of 13.26% was recorded in eggplant and 3.0% in tomato. As many as 80 isolates of *R. solanacearum* from 110 wilted samples were purified and preserved in laboratory for future research work.

06 FRUIT CROPS



Project: Varietal development

Evaluation of jackfruit germplasm

M. J. Rahman, M. Z. Rahman and M. A. Islam

Ten jackfruit germplasm viz., AH Joy-027, AH Joy-034, AH Joy-078, AH Joy-089, AH Joy-099, AH Joy-115, AH Joy-201, AH Joy-202, AH Joy-210 and AH Joy-215 planted in 2008 were evaluated to select the superior ones at the Fruit Research Farm of HRC, BARI, Gazipur. Wide range of diversity was manifested in the tree characters, number of fruits per plant, fruit characters and pulp characters of jackfruit. Maximum plant height was recorded to be 9.0 m in AH Joy-089 and minimum plant height in AH Joy-115 (4.3 m). Base girth ranged from 72 in AH Joy-201 to 113 cm in AH Joy-078. Trunk height varied from 0.95 to 2.03 m. Number of fruits ranged from 8 to 45. The fruit weight ranged from 5.32 to 10.58 kg. Fruit length varied from 27.0 to 51.0 cm whether diameter varied from 17.0 to 30.0 cm. Maximum bulb weights were recorded to be 5.8 kg in AH Joy-027 and AH Joy-115 and minimum bulb weight was observed 2.31 kg in AH Joy-0201. Number of bulb per fruit varied from 69 in AH Joy-089 to 181 in AH Joy-201. Maximum and minimum edible portions were manifested to be 63.7 and 44.73 % in AH Joy-210 and AH Joy-099, respectively. TSS content was noticed to vary from 16.0 to 24.0 ° Brix. With respect to the number of fruit per plant, fruit weight, edible portion, TSS content and pulp quality, the germplasm AH Joy-202, AH Joy-215, AH Joy-115 and AH Joy-078 were found auspicious. The Experiment Will Be Continued For Further Evaluation.

Evaluation of jackfruit germplasm

M. Z. Uddin, M. K. Islam, M. M. Hossain, A. S. M. Yousuf Ali, M. Y. Abida and H. C. Mohanta

An experiment with two jackfruit germplasm namely AH Cha-001 and AH Cha-002 was carried out at RHRS, Chapainawabganj during the fruiting season in order to know the detailed information on plant growth, fruit characteristics and fruit yield. The germplasm were collected from Chapainawabganj in 2012. Tree volume was recorded to be 195.01 m³ in AH Cha-002 and 172.05 m³ in AH Cha-001. Fruit weight was noted higher in AH Cha-002 (7.00 kg) while lower fruit weight was noticed in AH Cha-001 (5.25 kg). Higher fruit yield was recorded in AH Cha-001 (273.00 kg) while lower fruit yield was recorded in AH Cha-002 (154.00 kg). Maximum bulb weight was manifested in AH Cha-002(44.50 g) while minimum bulb weight was noted in AH Cha-001(40.80 g). Higher TSS (20.30 %) was recorded in AH Cha-002, while lower (18.45 %) TSS was observed in AH Cha-001. Diseases and insect-pests were absent in both the jackfruit germplasm. The experiment will be continued for further evaluation to get a concrete result.

Performance of BARI developed jackfruit varieties at Joydebpur

M. J. Rahman, S. M. M. Rahman, M. A. Islam and M. A. Siddiky

An experiment was performed at the Fruit Research Farm, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to observe the performance of BARI developed jackfruit varieties viz. BARI Kanthal-1 (harvested during mid-May to June); BARI Kanthal-2 (harvested during January to March) and BARI Kanthal-3 (harvested during September to June).

Saplings of jackfruit varieties were planted in July 2018. Total number of grafted saplings was 36. Spacing was 5 x 4.5 m. Pit size was 1 m x 1 m x 1 m. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 12 replications. Plant heights in June 2020 of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were recorded 3.04 m, 2.91 m and 2.92 m, respectively and in June, 2021 plant heights of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were recorded 4.03 m, 4.00 m and 3.96 m, respectively. From June, 2020 to June, 2021, plant height increased 32.5 % in BARI Kanthal-1, 37.4 % in BARI Kanthal-2 and 35.6% in BARI Kanthal-3, respectively. At the same time, base girth increased from 17.6 cm in June, 2020 to 30.9 cm in June, 2021 in the case of BARI Kanthal-1; 20.6 cm in June, 2020 to 34.0 cm in June, 2021 in the case of BARI Kanthal-2 and 20.3 cm in June, 2020 to 34.0 cm in June, 2021 in the case of BARI Kanthal-3. From June, 2020 to June, 2021, base girth increased 75.5 % in BARI Kanthal-1, 73.3 % in BARI Kanthal-2 and 67.4 % in BARI Kanthal-3. Plant spread in north-south and east-west direction increased simultaneously. Male inflorescences were observed in most of the grafted plants of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3. Female inflorescences were borne in BARI Kanthal-1 in February, 2021. Thus the vegetative growth of jackfruit varieties was noted satisfactory. The experiment will be carried out in the next year.

Evaluation of jackfruit germplasm in the hill region

M. G. Rahman, M. A. A. Malek and M. R. Ahmad

Ten jackfruit germplasm was evaluated at the fruit farm of HARS, Khagrachari to identify the superior small sized jackfruit germplasm with high yield potentiality and edible qualities. Fruit yield and yield components of the jackfruit germplasm were studied. Five fruits from each plant were randomly selected for collecting the individual fruit parameters and the yield per plant were calculated considering all the fruits. Fruit yield and yield components of jackfruit germplasm revealed that the number of fruits per plant ranged from 59 to 102. AH Kha-006 produced maximum number of fruits (102) followed by AH Kha-005 (95) and minimum number of fruits was recorded in AH

Kha-003 (59). Single fruit weight ranged from 3.10 to 3.90 kg where AH Kha-009 produced the highest (3.9 kg) individual fruit weight and the lowest fruit weight was recorded in AH Kha-010 (3.10 Kg). TSS content of the fruits varied from 16.9 to 24.5% where AH Kha-007 had the highest TSS (24.5 %). The highest fruit yield (kg/plant) was found in AH Kha-006 (387.6 kg) and the lowest fruit yield was registered in AH Kha-010 (207.7 kg). The edible portion varied from 36.65 % to 52.67 % where AH Kha-005 showed the highest (52.67 %) edible portion followed by AH Kha-007 (52.3 %) and the lowest edible portion was observed in AH Kha-008 (36.6 %). Considering fruit characteristics i.e. taste, juiciness, sweetness, colour of pulp, fruit number and yield, the germplasm AH Kha-005, AH Kha-006 and AH Kha-007 were found to be suitable. The study will be continued for perfection of the result.

Survey on identification and collection of year round and off-season jackfruit germplasm

M. J. Rahman, S. M. M. Rahman and M. A. Islam

A base line survey on identification of year round and off-season jackfruit germplasm as well as production practices of jackfruit was carried out in Mymensingh. Fifty farmers of Bhaluka Upazila under Mymensingh district were selected randomly for interviewing to collect the information of year round and off-season jackfruit germplasm as well as production practices of jackfruit. Two year round (AH Joy-272 and AH Joy-273) jackfruit germplasm were identified. The age of AH Joy-272 and AH Joy-273 were 10 and 32 years, respectively. The number of fruits/year of AH Joy-272 and AH Joy-273 were 35 and 65, respectively. The shape of fruits was cylindrical. Scions were collected for grafting, grafting was done and grafted saplings of identified jackfruit germplasm would be planted in the Fruit Research Farm, Joydebpur to evaluate.

Evaluation of exotic jackfruit germplasm

M. J. Rahman, M. A. Islam and M. M. Islam

Eight exotic year round jackfruit germplasm and three red jackfruit germplasm were evaluated and characterized at the Fruit Research Farm, Joydebpur to study the growth and development of the germplasm. They were planted in the month of

July 2018 keeping spacing of 5 m x 5 m. Design was nil. Pest and diseases were monitored and controlled. Data on plant height, base girth, canopy spreading and number of male inflorescences were recorded. The average plant height was observed to be 3.83 m. Maximum plant height was recorded in AH Exo-05 (4.3 m) and minimum plant height was recorded in AH Exo-02 (3.2 m). All the germplasm were observed to produce male inflorescences and one of the germplasm was found to produce male inflorescences from the month of July 2020 which was the sign of off-season and year round behaviour. Male inflorescences were observed from the first year of planting, but female inflorescences were not found. Experiment will be conducted in the next year for further evaluation.

Evaluation of year-round and off-season jackfruit germplasm in Cumilla region

M. M. H. Bhuiyan and M. H. Rahman

Four identified year-round and off-season jackfruit germplasm; AH Cum-101, AH Cum-102, AH Cum-103 and AH Cum-104 were evaluated at three upazillas of two districts (Cumilla: Sadardhakhin, Barura and Lalmai; Brahmanbaria: Kashba, Akhaura and Bijoy Nagar) under Regional Agricultural Research Station, Cumilla. Fruits of identified germplasm were collected. The collected fruits were evaluated in the laboratory. Data on fruit yield and yield contributing characters of two germplasm were collected. The highest number of fruits per plant was observed in AH Cum-101 followed by AH Cum-102. However, maximum percent of edible portion was recorded in AH Cum-102 followed by AH Cum-101. The highest TSS (25.8 %) was noted in AH Cum-102 followed by AH Cum-101. Considering the fruit yield and yield contributing attributes, the germplasm AH Cum-102 exhibited superior results. Moreover, new germplasm will be identified in order to evaluate and develop off-season as well as year round jackfruit variety to extend the availability of jackfruit throughout the year.

Evaluation of existing superior jackfruit germplasm

S. M. K. H. Chowdhury, M. G. Azam and A. S. M. H. Rashid

An experiment was conducted at the Agricultural Research Station, Pahartali, Khulshi, Chattogram to evaluate the promising germplasm and to select desirable jackfruit germplasm with higher yield and qualities. Among the tested germplasm, the earliest flowering was observed in AH Pah-004 (Mid December) and the latest flowering was observed in AH Pah-001 and AH Pah-005 (Late January). Maximum number of fruits per plant was produced in AH Pah-004 (103) where minimum number of fruits was produced in AH Pah-007 (17). The heaviest fruit was observed in AH Pah-002 (7.81 kg) followed by that of AH Pah-007 (3.66 kg) and the lightest fruit was observed in AH Pah-004 (3.52 kg). Maximum fruit yield per plant was produced in AH Pah-004 (362.56 kg) where minimum fruit yield was produced in AH Pah-007 (62.22 kg). Maximum number of bulbs (124) was produced in AH Pah-002 compared to minimum (20) in AH Pah-007. Maximum weight of bulbs per fruit (3.65 kg) was produced in AH Pah-005 and minimum bulb weight was produced in AH Pah-007 (1.28 kg). Individual bulb weight was higher in AH Pah-007 (48.84 g) where, lower in AH Pah-003 (30.0). Maximum bulb size was produced in AH Pah-002 (7.31 cm x 3.67 cm). Edible portion was found the highest in AH Pah-004 (59.66 %) followed by AH Pah-001 (50.89 %) and the lowest in AH Pah-007 (35.52 %). TSS was the highest (21.1%) in AH Pah-002 followed by AH Pah-004 (20.4 %). The bulbs of AH Pah-004 were excellent in taste. Considering the number of fruits/plant, bulb size, bulb color, edible portion and TSS (%), the germplasm AH Pah-001, AH Pah-002 and AH Pah-004 were found promising. The experiment will be continued for further evaluation.

Evaluation of off season jackfruit germplasm

M. A. Habib, M. A. Hossain, M. A. H. Khan and Z. A. Firoz

The selected off-season jackfruit germplasm were evaluated at the Regional Agricultural Research Station, Akbarpur, Moulavibazar. Two germplasm were undertaken for the study which were planted in the RARS, Akbarpur in 2004. Jackfruits were collected from Mohazerabad under Sreemangal Upazilla of Moulvibazar district. Data on plant yield and fruit characters of off-season jackfruit germplasm were collected. Flower bud initiation

was occurred in mid August in the line AH Akb-001 and mid October in the line AH Akb-008. Maximum number of fruits was observed in AH Akb-001 (226) and minimum in AH Akb-008(62). The earliest harvest was done from the line AH Akb-001 in the month of January, followed by the line AH Akb-08 in the month of March. Percentage of edible portion was observed in the line AH Akb-001 (44.1%) followed by AH Akb-008 in (38.3%). Higher TSS was manifested in the line AH Akb-001(30.5%) as compared to lower TSS in the line AH Akb- 008 (25.0%).

Evaluation of colour fleshed jackfruit germplasm in the hilly region

S. M. Faisal and M. A. Salam

Three colour fleshed jackfruit germplasm were evaluated at the Hill Tracts Agricultural Research Station, Ramgarh to find out superior color fleshed jackfruit line for releasing as variety. Data on different physio-morphological characters of three colour fleshed jackfruit germplasm were collected. Variations were observed in respect of base girth, plant height, number of branch and spread of plant. The highest (165.2 cm) base girth and number of main branches/plant (4) were observed in AH Ram-001, but the highest plant height was recorded in AH Ram-002 (7.63 m). The highest plant spreads in E-W and N-S directions were recorded in AH Ram-003 (7.23 m) and AH Ram-001 (5.22 m), respectively. Further evaluation will be performed in the next following years.

Performance of BARI developed jackfruit varieties at RHRS, Narsingdi

M. J. Rahman, M. A. Islam, S. M. M. Rahman, and R. Aktar

An orchard with grafted saplings of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 was established at the Regional Horticulture Research Station, BARI, Shibpur, Narsingdi in 2020. Plant spacing was 5 m x 5 m. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 5 replications. Data on plant height, base girth and plant spreading were collected. Data were recorded and analyzed statistically with R software and mean separation was done by DMRT. Statistically, the highest plant height was obtained from BARI Kanthal-1 (2.58 m) followed by BARI

Kanthal-2 (2.32 m) but they were statistically at par. The lowest plant height was noticed in BARI Kanthal-3 (1.93 m). Base girth and plant spreading differed significantly among the varieties. The highest base girth was observed in BARI Kanthal-2 (18.4 m) followed by BARI Kanthal-1 (17.8 m). But they didn't produce significant difference among them. The highest plant spreading in north-south direction was recorded 1.33 m in BARI Kanthal-3 and the lowest in BARI Kanthal-1(1.04 m). Plant spreading in east-west aspect also differed significantly. The highest base girth was observed in BARI Kanthal-3 (1.23 m) followed by BARI Kanthal-2 (1.26 m) though they were statistically identical. The lowest plant spreading in east-west direction was exhibited in BARI Kanthal-1(1.08 m). The experiment will be continued for further evaluation.

Hybridization in mango

Maniruzzaman, M. S. Uddin and B. C. Sarker

The popular mango varieties; Langra, Harivanga, BARI Aam-3, BARI Aam-4 and BARI Aam-11 have huge demand to people for their unique taste and high nutrient content. To mitigate the growing demand of popular mango as well as to improve the export potentiality, a hybridization programme was conducted following half-diallel fashion at the Fruit Research Farm, Horticulture Research Centre, BARI, Gazipur to develop superior hybrids with desirable characters of mango. Harivanga x BARI Aam-4, BARI Aam-3 x BARI Aam-7, Langra x BARI Aam-3 and Langra x BARI Aam-4 were the crosses. A total of 1350 flowers from 450 panicles were emasculated and pollinated. Ten fruits were obtained from BARI Aam-3 x BARI Aam-4; BARI Aam-4 x BARI Aam-3 and BARI Aam-3 x BARI Aam-7. These mango hybrid fruits were harvested at matured stage and stones of the ripen fruits were sown in soil for germination in polybag in the net house. After germination, the performance of these hybrid seedlings will be evaluated in the following seasons for further variety improvement programme.

Hybridization in mango

M. H. Waliullah, K. H. Alam, G. M. M. Bari and M. A. Uddin

A hybridization programme was conducted in the flowering seasons at the Fruit Research Station (FRS), Binodpur, Rajshahi to develop new mango hybrids having desirable characters like colour, size, off season and regular bearing habit. From 155 panicles, a total number of flowers emasculated and pollinated were 892 and 880, respectively. Two hybrid fruits were obtained from the cross BARI Aam-14 x Langra and two fruits were obtained from the cross BARI Aam-4 x Cartimon. These mango hybrid fruits were harvested at the mature stage and stones of the fruits were sowed in soil for germination in the hybrid seedling plot. After germination, these one year hybrid seedlings will be transplanted in the main field and will be evaluated in the following seasons.

Hybridization in mango

S. Sultana, M. H. Rahman and M. O. Kaisar

A hybridization program was conducted in the flowering season at RARS, Cumilla to overcome the problems like irregular bearing, susceptibility to diseases and pests, poor eating and keeping quality. A total of 1087 flowers from 133 panicles were emasculated and pollinated. Fifteen fruits from the crosses were set initially, but all the fruits except one dropped before getting matured. The fruit was harvested at mature stage and stone of the fruit was sown in soil for germination. After germination, one-year old hybrid seedling will be planted in the main field and evaluated in the subsequent years.

Characterization and evaluation of late mango germplasm

M. H. Waliullah, K. H. Alam, G. M. M. Bari and M. A. Uddin

An experiment on characterization and evaluation of late mango germplasm was conducted at the Fruit Research Station, Rajshahi to identify the late mango germplasm with good qualitative characters. The experiment included only one late mango germplasm (MI Raj-002) which flowered two times in a year. First flowering occurred in the month of February in which fruits were harvested in the mid-season (June) and second flowering occurred in the month of May from which fruits were harvested in the late season (September). The germplasm MI Raj-002 produced 186 in number and 46 kg of

fruits in the mid-season (February- June) production. In case of late season production, the tree bore 155 in number and 27 kg of fruits. The individual fruit weight of MI Raj-002 was 270 g in the mid season and 182 g in the late season (May-September). TSS percentage of main season fruit was 17° Brix while it was 21° Brix in the late season fruit. Considering two times production and good flavor the germplasm can be considered as promising. The experiment should be carried out in the next year for further investigations.

Morphological characterization of mango germplasm using DUS testing

S. Sultana, M. H. Rahman and M. O. Kaisar

Studies were carried out on mango germplasm collected from different parts of Cumilla region to develop a descriptor. The experiment was laid out at the Regional Agricultural Research Station, BARI, Cumilla having 24 lines as treatments. Observations were recorded on various morphological parameters such as qualitative and quantitative characters. Only 19 germplasm gave flowers and fruits this year and data is being taken accordingly. Data were being recorded for four consecutive years, 2019-2020-2021-2022. From the observations made till to date, it was found that the mango varieties expressed the morphological variations from genotype to genotype. These morphological variations have the ability to distinguish between the mango lines with each other. Descriptors are being developed initially for 24 mango genotypes on different observations, which consist of 31 qualitative and 18 quantitative characters. The developed and documented descriptors will facilitate in plant variety registration, identification of genotypes and also in mango improvement programs.

Inter-varietal hybridization of mango

M. Z. Uddin, M. K. Islam, M. M. Hossain, A. S. M. Yousuf Ali, M. Y. Abida and H. C. Mohanta

A hybridization programme was conducted in the flowering season at RHRS, Chapai Nawabganj to develop new mango hybrids having desirable characters like colour, size and regular bearing habit. A total of 3357 flowers from 609 panicles were emasculated and pollinated. Five hybrid fruits were obtained from the cross Langra x BARI Aam-

3. These mango hybrid fruits were harvested at matured stage and stones of the fruits were sowed in soil for germination in the hybrid seedling plot. After germination, these one year old hybrid seedlings will be transplanted in the main field and will be evaluated in the following seasons.

Inter-varietal hybridization of mango

M. O. Hoque, M. Z. Uddin, M. M. Hossain and A. K. Saha

A hybridization program was conducted in the flowering season at Regional Agricultural Research Station, Burirhat, Rangpur to develop new mango hybrids having desirable characters like size, regular bearing and shelf life and also off season bearing. A total of 3477 flowers from 206 panicles were emasculated and pollinated. Five hybrid fruits were retained in plant after 100 days of pollination from the crosses between BARI Aam-3 x BARI Aam-4. On the other hand, three hybrid fruits remained in plant after 100 day of pollination from the crosses between Harivanga x BARI Aam-4. These mango hybrid fruits were harvested in the 1st week of July 2021. Harvested fruits were kept in the Laboratory. After ripening the stones were collected and were sown in the soil for germination on July 13, 2021. After germination, these hybrid seedlings will be evaluated in the following seasons.

Performance of some mango hybrids

M. Z. Uddin, M. K. Islam, M. M. Hossain, A.S.M. Yousuf Ali, M. Y. Abida and H. C. Mohanta

An experiment on performance of some mango hybrids was carried out with 2 mango hybrids namely MI Cha-Hy-058, and MI Cha-Hy-107 at RHRS, Chapainawabgonj during the fruiting season to know the detailed information on plant growth, fruit characteristics and fruit yield. Among the mango hybrids, the tree volume was recorded in MI Cha-Hy-107 to be 178.36 m³ and in MI Cha-Hy-058 to be 162.27 m³. Fruit weight was higher in Hybrid-107 (650.00 g) while the lower fruit weight in Hybrid-058 (242.00 g). The higher fruit yield was recorded in MI Cha-Hy-107 (162.50 kg) than that of MI Cha-Hy-058 (84.70 kg). MI Cha-Hy-107 had maximum edible portion (90.77%), whereas minimum (79.88 %) edible portion was noted in MI Cha-Hy-058. Higher TSS (23.50 %)

was recorded in MI Cha-Hy-058 while lower (20.70%) was in MI Cha-Hy-107. Maximum fruit fly infestation at the time of harvest was recorded in Hy-107 (11.10 %), while minimum infestation was found in MI Cha-Hy-058 (10.50 %). The mango hybrid Hy-058 showed the highest disease incidence (15.20%) while the lowest disease incidence was recorded in MI Cha-Hy-107 (14.20%) in natural condition. Stem end rot was absent in all the mango hybrids. Maximum shelf life was found in MI Cha-Hy-058 (8 days) and minimum shelf life was found in MI Cha-Hy-107 (7 days). So, considering the growth and fruit characteristics, both the MI Cha-Hy-058 and MI Cha-Hy-107 may be released as variety.

Characterization and evaluation of mango chance seedlings

A. S. M. Yousuf Ali, M. Z. Uddin, M. K. Islam, M. M. Hossain, M. Y. Abida and H. C. Mohanta

Three mango chance seedlings were characterized and evaluated at the Regional Horticulture Research Station, Chapainawabganj. In 2013, 10 stones of MI ChaL-001 were allowed to germinate in the seed bed. Among the 10 stones, only three were germinated and after germination they were planted in the main field for evaluation and characterization. Three accession numbers were given for each separate seedling viz. MI Cha-CS-01, MI Cha-CS-02 and MI Cha-CS-03. The data on different parameters were collected as per mango descriptor followed by IPGRI format. The three chance seedlings produced flowers and fruits in 2020-21. The highest individual fruit weight (543.5) was recorded in MI Cha-CS-01 compared to the lowest fruit weight (234 g) in MI Cha-CS-2. All the genotypes had the capability of late season fruit production. MI Cha-CS-01 and MI Cha-CS-02 produced greenish yellow coloured fruits but MI Cha-CS-01 produced attractive and good quality fruits. MI Cha-CS-02 had pleasant pulp flavour like Langra variety. Considering the harvesting season, fruit weight, percent TSS, fruit attractiveness, pulp texture and pulp flavour the germplasm MI Cha-CS-01 performed better and found promising. Since this is the 3rd year of the experiment, it should be continued for confirming the result.

Evaluation of off-season mango germplasm

A. S. M. Yousuf Ali, M. Z. Uddin, M. K. Islam, M. M. Hossain, M. Y. Abida and H. C. Mohanta

Twelve collected off-season mango germplasm were evaluated at the Regional Horticultural Research Station, Chapainawabganj. Collection of off-season mango germplasm was carried out from different districts during 2017-18. Twelve germplasm were included in this experiment. Each germplasm had three plants. Plant spacing was 5 m X 3.5 m. Flowering period of all the mango germplasm was June, 2021, No data regarding fruit yield and yield contributing attributes were taken. Maximum plant height (3.6 m) was recorded in MI Cha-Off-004 and minimum height (1.45 m) was recorded in MI Cha-Off-008. Tree volume varied from 1.13-16.68 m³. This is the 1st year observation. So this experiment will be continued.

Evaluation of exotic mango germplasm

M. O. Hoque, A. K. Saha and M. Z. Uddin

The experiment was conducted at the Regional Agricultural Research Station, Burirhut, Rangpur with a view to finding out a suitable mango germplasm for releasing as variety. Six germplasm were collected from local fruit fair and the saplings were planted in June 2018. The age of the tree was around 4 years and 2nd fruit bearing occurred in 2021. Among the six germplasm MI Exo-Bur-003 did not bear fruit this year. The plant height was attained maximum (2.90 m) in MI Exo-Bur-003, which was followed (2.60 m) by MI Exo-Bur-006, while minimum (2.22 m) plant height was recorded in MI Exo-Bur-002. The base girth was found more or less same in all the germplasm. Again, among the yield contributing characters, maximum number of fruits per plant (25) was recorded in MI Exo-Bur-001, which was followed by MI Exo-Bur-002 (10) and MI Exo-Bur-005, whereas minimum number of fruits (1) was found in MI Exo-Bur-004. The average fruit weight was found higher (622.50 g) from MI Exo-Bur-002, followed (597.00 g) by MI Exo-Bur-001, while the lowest (286.00 g) fruit weight was found in MI Exo-Bur-005. Maximum fruit yield was recorded (14.93 kg) in MI Exo-Bur-001, followed (6.22 kg) by MI Exo-Bur-002, while the lowest (0.34 kg) fruit yield was noticed in MI

Exo-Bur-004. This experiment will be continued for next year.

Performance of BARI developed mango varieties in Chattogram Hill Tracts

M. Islam, M. E. Hoque and M. A. Hossain

An experiment was conducted with five BARI developed mango varieties such as BARI Aam-1, BARI Aam-2, BARI Aam-3, BARI Aam-4 and BARI Aam-8 at hill valley of Hill Agricultural Research Station, Raikhali, Rangamati Hill District to observe the performance of some BARI developed mango varieties in Chattogram Hill Tracts. The experiment was conducted with the existing twelve years old mango orchard with an objective to verify their performances. Maximum plant height (815 cm), maximum number of fruits per plant (240) and fruit yield (21.9 t/ha) were observed in BARI Aam-8. Maximum fruit weight (370 g), maximum fruit breadth (9.2 cm) and fruit thickness (7.3 cm) and maximum TSS (23.0%) were recorded in BARI Aam-4. The minimum TSS (17.5%) and maximum edible portion (80.5%) were recorded in BARI Aam-2. The lowest number of fruits per plant (120), edible portion (65.2%) and fruit yield (5.5 t/ha) were found in BARI Aam-1. Based on number of fruits per plant, fruit yield and higher TSS (%), individual fruit weight, fruit volume, edible portion BARI Aam-8, BARI Aam-3 and BARI Aam-4 were superior among the varieties under study in Chattogram Hill Tracts. BARI Aam-2 was suggested as suitable early sweet variety and BARI Aam-4 for late variety.

Evaluation of mango germplasm for green consumption at hill valley in Chattogram Hill Tracts

M. Islam, M. E. Hoque and M. A. Hossain

An experiment was conducted at the hill valley of Hill Agricultural Research Station of Raikhali, Rangamati Hill District to find out the best green mango germplasm. Four existing seven years old mango germplasm namely; MI Rai -005, MI Rai-006, MI Rai-007, MI Rai-008 were evaluated keeping the variety BARI Aam-9 as check. The tallest plant (670 cm) was observed in MI Rai-006. The shortest plant (365 cm) was found in MI Rai-007. The highest base girth (99 cm) was recorded in MI Rai-008, whereas the lowest base girth (58

cm) was recorded in MI Rai-007. Maximum canopy spreading (620 cm × 530 cm) was noted in MI Rai-008. The flowering was earliest (middle of January) in MI Rai-005 and the last week of January in other varieties. The highest number of fruits per plant (129) was found in MI Rai-008 and the lowest number of fruits per plant (49) was recorded in MI Rai-006. The heaviest individual fruit weight (251 g) and highest edible portion (80.5 %) were recorded in MI Rai-008 on the other hand the lowest fruit weight (109 g) was found in MI Rai-007. Maximum TSS (11 %) was found in the germplasm MI Rai-008. Germplasm MI Rai-008 was found excellent in organoleptic test. Based on the number of fruits per plant and fruit yield with higher individual fruit weight, fruit volume, edible portion and organoleptic test MI Rai-008 was manifested superior among all the other germplasm under the study in Chattogram Hill Tracts. So, MI Rai-008 can be released as a green mango variety.

Performance of matured green sweet (Kanchamitha) mango germplasm at hilly region

M. A. A. Malek, M. G. Rahman and M. R. Ahmad

An experiment was conducted for the evaluation of one matured green sweet (Kanchamitha) mango germplasm (MI Kha-001) at the Hill Agricultural Research Station, Khagrachari to determine the performance of *kanchamitha* mango germplasm in respect of the yield and quality as green mango. After preliminary assessment, one germplasm of Kanchamitha mango (MI Kha-001) was considered for this study. The full blooming period was in January. The tree habit was spreading to intermediate type. Harvesting period was 02 to 09 May, 2021. The average individual fruit weight was recorded 252 g which was an acceptable size. Length and diameter of the fruit were recorded 13.6 and 6.3 cm, respectively. Total Soluble Solids (TSS) was recorded 9.90 %. Edible portion was found (80.16 %). Overall growth conditions of the germplasm were found satisfactory. Considering the fruit characters and edible quality MI Kha-001 was considered as a promising mango germplasm as unripe consumption. Considering the fruit characters and edible quality MI Kha-001 was considered as a promising mango for use as unripe

condition. The experiment will be continued for final recommendation.

Evaluation of mango germplasm at Jamalpur region

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

An experiment was conducted to identify the suitable mango germplasm at the Fruit Orchard of HRC, RARS, Jamalpur. The grafts of sixteen mango germplasm like MI Jam-001, MI Jam-002, MI Jam-003, MI Jam-004, MI Jam-005, MI Jam-006, MI Jam-007, MI Jam-008, MI Jam-009, MI Jam-010, MI Jam-011, MI Jam-012, MI Jam-013, MI Jam-014, MI Jam-015 and MI Jam-016 were collected from different areas of Jamalpur and planted in the Fruit Research Farm of RARS, Jamalpur. The grafts were planted in RCBD design. The planting distance was 5 m × 5 m. The highest plant height was recorded from MI Jam-003 (2.63 m) and the lowest (0.75 m) plant height was noted in MI Jam-008 and MI Jam-015. Maximum base girth was obtained from MI Jam-003 (33.0 cm) and minimum in MI Jam-010 (6.0 cm). The highest canopy spread was observed in MI Jam-003 (2.40 m × 2.40 m) and the lowest in MI Jam-015 (0.32 m × 0.30 m). Maximum tree volume was obtained from MI Jam-003 (7.96 m³) and minimum value in MI Jam-015 (0.04 m³). This was 2nd year experiment. Some trees were in vegetative stage and some were in bearing stage. The experiment would be continued.

Evaluation of newly collected mango germplasm

M. Islam, M. E. Hoque and M. A. Hossain

An experiment on the evaluation of mango germplasm in the hill valley was conducted at the fruits orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District. Twenty germplasm were collected from the farmer's orchard or household. Year of collection was 2018-21 and collected mango germplasm were planted at the hill valley of HARS, Raikhali, Rangamati Hill District. Maximum plant height was recorded in MI Rai-023 (211 cm), maximum base girth (20 cm) and canopy (195 × 190 cm²) were found in MI Rai-025 germplasm. Maximum number of fruits was recorded in MI Rai-025 germplasm (21). This is 2nd year experiment. Some trees are at vegetative stage

and some are at bearing stage. The experiment will be continued.

Evaluation of mango germplasm grown at coastal region of Satkhira

M. M. Hossain and O. A. Fakir

An experiment was conducted at the Agricultural Research Station, Benerpota, Satkhira to identify promising mango germplasm for higher fruit yield and qualities. Three mango germplasm namely MI Sat-001 (Brunai King), MI Sat-002 (Four-kg) and MI Sat-003 (Palmar) were included in this study. One year old grafts were planted in June 2019 in the field with a spacing of 8 m x 8 m. Among these, the earliest flowering was observed in MI Sat-002 but early fruit harvesting was noted in MI Sat-001. Maximum number of fruits (15) per plant was harvested from MI Sat-001 and minimum number of fruits (01) per plant was produced from MI Sat-002. The heaviest fruit (1300 g) was observed in MI Sat-002 and the lightest fruit (124 g) was observed in MI Sat-001. The highest edible portion (88.38 %) was achieved from MI Sat-002 and the lowest edible portion (72.52%) was achieved from MI Sat-003. Maximum total soluble solids (16 %) was observed in MI Sat-003 and minimum (10 %) TSS was observed in MI Sat-002. The highest yield per tree (1860 g) was produced by MI Sat-001 and the lowest yield per tree (1300 g) was produced by MI Sat-002. On the basis of fruit yield MI Sat-001 might be considered as a promising germplasm but in consideration of quality MI Sat-003 ranked first. However, this was the results of first year experiment it needs to continue successive three years for drawing final conclusion.

Clonal selection of banana germplasm cv. Sabri kola

J. C. Sarker, F. Ahmed, M. H. M. B. Bhuyan and S. M. L. Rahman

The experiment was conducted at the Citrus Research Station, Jaintapur, Sylhet with four sobri kola germplasm. Suckers were collected from the farmers' field and homesteads and planted at the experimental plot with a spacing of 2x1.5 m in the month of February 2018. A wide variation was observed regarding growth characteristics. Maximum bunch weight was obtained from MS Jai-024 (10.5 kg) while minimum in MS Jai-021

(6.4 kg). Variation was also found in other characters. The highest hands weight (1.6 kg) and finger weight (95.5 g) were also found in MS Jai-024. Maximum yield was found in MS Jai-024 (47.84 t/ha) followed by MS Jai-022 (38.37 t/ha) while minimum (25.54 t/ha) in MS Jai-021. The highest TSS (25.5 %) was recorded in MS Jai-024 while the lowest (18 %) in MS Jai-022. Number of hands per bunch was found maximum in MS Jai-024 (13) but number of fingers per hand was higher in MS Jai-022 (18) compared to that of MS Jai-024 (14). Maximum finger size (12.8x3.5 cm) was recorded in MS Jai-024 while minimum (11.4x2.7 cm) in MS Jai-022. Edible portion was found the highest (89 %) in MS Jai-024. This is the third year study. Considering all the parameters MS Jai-024 may be further investigated for advanced yield trail (AYT).

Evaluation of plantain germplasm

T. Tasmima and M. O. Kaisar

A field trial was conducted at the Regional Agricultural Research Station (RARS), Cumilla with a view to study the performance of plantain germplasm. Five plantain germplasm MP Cum-001, MP Cum-002, MP Cum-003, MP Cum-004, MP Cum-005 and BARI Kola-5 as check were used in the trial. Results revealed that maximum plant height was observed in MP Cum-002 (4.09 m) followed by MP Cum-003 (4.00 m) and minimum plant height was observed in BARI Kola-5 (3.85 m). The highest bunch length was recorded in lines MP Cum-003 (87.30 cm) and the lowest bunch length was recorded in BARI Kola-5 (64.10 cm). The highest bunch breadth (137.00 cm) was recorded in MP Cum-003 followed by MP Cum-005 (137 cm). Maximum bunch weight (17.50 kg) was recorded in lines MP Cum-003 followed by BARI Kola-5 (15.21 kg) while minimum bunch weight was recorded in MP Cum-002 (9.02 kg). Maximum peduncle weight (1.70 kg) was recorded in BARI Kola-5. Maximum hand number (8.43) was recorded in lines MP Cum-003 which was statistically similar to others. Maximum weight (2.17 kg) of individual hand was recorded in MP Cum-003 and it was minimum in MP Cum-002 (1.31 kg). The highest finger number (16.10) was recorded in BARI Kola-5 followed by MP Cum-005 (15.19) and it was lowest in MP Cum-004

(11.09). The highest finger length (20.54 cm) was recorded in MP Cum-003 which was statistically similar to others. The highest finger's diameter (5.29 cm), individual finger weight (255.01 g), skin weight of individual finger (91.10 g), skin thickness (0.55 cm), edible portion weight per finger (159.58 g), edible portion % (66.52) and fruit yield (46.49 t/ha) were recorded in MP Cum-003 which was statistically different to others. Considering all the parameter MP Cum-001, MP Cum-003, and MP Cum-005 were found promising and most promising germplasm was MP Cum-003 and may put under further trial.

Hybridization in litchi

M. J. Rahman, M. A. Islam, M. M. Khatun and M. Z. Rahman

Hybridization in litchi was carried out at the Fruit Research Farm of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during the flowering season to incorporate some important characters like earliness, lateness, colour, regular heavy bearing habit in the desired litchi variety or cultivar. Cross combinations for hybridization were: BARI Lichu-2 x BARI Lichu-3, BARI Lichu-2 x BARI Lichu-4, BARI Lichu-2 x Kadmi, Kanthali x BARI Lichu-3 and Kanthali x Kadmi. Initial fruit set was found 64, 25, 14, 25, 09 in BARI Lichu-2 x BARI Lichu-3, BARI Lichu-2 x BARI Lichu-4, BARI Lichu-2 x Kadmi, Kanthali x BARI Lichu-3 and Kanthali x Kadmi cross combinations and finally number of fruits was harvested 3, 1, 0, 0, 0 respectively. From the cross combinations BARI Lichu-2 x Kadmi, Kanthali x BARI Lichu-3 and Kanthali x Kadmi the initial fruit set was recorded to be 14, 25, 9 but unfortunately all the fruits dropped at the marble stage and finally no fruit was harvested. From the cross combinations of BARI Lichu-2 x BARI Lichu-3 and BARI Lichu-2 x BARI Lichu-4, 4 fruits were harvested and 4 seedlings have been raised, which will be planted in the main field.

Hybridization of local guava with improved/exotic guava varieties

M. R. Karim, M. T. Islam, M. A. Islam and J. Gomasta

A study was initiated at HRC, BARI, Gazipur on varietal improvement of guava through

hybridization with local improved and exotic guava varieties. Hybridization was done between BARI Payara-2, Thai Payara-5, Thai Payara-3, Thai special and Sowrupkathi (Atgharkuniana) guava lines. Only two fruits from BARI Payara-2 x Sowrupkathi cross combination were harvested successfully. Seedlings raised and planted for evaluation with closer spacing. After fruiting, the fruits of the F₁ line will be evaluated in respect of fruit size, mesocarp thickness, crispiness, flavor, taste and yield. The experiment will be continued to evaluate fruits found from hybridization program.

Development of population for gynodioecious papaya variety

M. R. Karim, Babul C. Sarker, M. T. Islam and M. A. Islam

Development of gynodioecious population for obtaining 100% productive plants with a view to increase farm income through papaya cultivation was performed at the Fruit Research Farm of Pomology Division under HRC, BARI, Gazipur. Four sets of plants namely S₇ progeny of CP Joy-005, CP Joy-009; BC₅ progeny and S₂ progeny of CP Joy-022 were included in the study. The seeds of S₂ progeny of CP Joy-022, S₇ and BC₅ progeny were collected from the selected fruits of previous year (from the fruits of S₁, S₆ and BC₄ progeny, respectively) and sown in 6 x 4 inch size poly bag, filled with 50% sandy loam soil and 50 % well rotten cow dung. Forty five to fifty five days old seedlings of S₂, S₇ and BC₅ progeny were then transplanted in the main field maintaining the spacing of 2.5 x 2 m on the 11 March 2021. Among the four sets; S₇ progeny of CP Joy-005 produced 52, 43 and 05 percent andromonoecious, female and male plants, respectively; S₇ progeny of CP Joy-009 produced 50, 45 and 5 percent andromonoecious, female and male plants; the BC₅ progeny produced 65, 35 and 0 percent andromonoecious, female and male plants, respectively and S₂ progeny of CP Joy-022 produced 25, 55 and 20 percent andromonoecious, female and male plants, respectively. Considering the number of fruits per plants, 27, 26, 26 and 28 fruits were recorded in S₇ progenies of CP Joy-005 and CP Joy-009; BC₅ and finally S₂ progeny of CP Joy-022, respectively. A gynodioecious papaya variety with 100 % productive plant from S₇

generation of the germplasm CP Joy-005 in next year to S₈ generation the germplasm CP Joy-005 might be proposed as a gynodioecious papaya variety.

Purification of Shahi papaya

M. R. Karim, Babul C. Sarker, M. T. Islam and M. A. Islam

An experiment was carried out at the Fruit Research Farm of Horticulture Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to purify the Shahi papaya variety. Seedlings of purified Sib-mated seeds were transplanted in the main field on the first week of March 2021 and the Sib-mating process (selfing of five flowers from each plant) for this year was started on 27 May 2021 and being continued. From May to June 2021, a total of 179 flowers were Sib-mated, among those flowers 156 fruits have been set. The experiment was started from 2010 and fruit characteristics of different years from 2011-2020 were observed to compare with original Shahi papaya. From last ten year's results, it can be concluded that the original Shahi papaya characters have almost been regained and we need to maintain it through sib-mating every year to retrieve the original characters and also to maintain the varietal purity.

Purification of Shahi papaya

M. H. Waliullah, Kh. H. Alam, G. M. M. Bari and M. A. Uddin

An experiment was carried out at the fruit research station, BARI, Binodpur, Rajshahi to purify the Shahi Papaya variety. Seedling of purified selfed seeds were transplanted in the main field on 08 March 2020 and 10 flowers in each plant were selfed (Sib mating) from June to August 2020. Plant and fruit characteristics of Shahi papaya under this experiment were almost similar to that of the original Shahi Papaya in the characters under consideration. The plant height, base girth, number of fruits/plant and individual fruit weight varied from 2.90-3.09 m, 39.3-45.4 cm, 24.3-31.6 and 1.03-1.08 kg, respectively. The fruit yield/plant ranged from 25.9-33.9 kg. Fruit characteristics of Shahi Papaya are stated in Table 2. The fruit length, fruit breadth, cavity length, cavity breadth, thickness ranged from 21.0-23.3 cm, 12.8-13.8 cm,

11.3-14.5 cm, 6.3-7.1 cm and 3.2-3.6 cm respectively. TSS of this variety ranged from 10.0-12.6 (%). The flesh colour varied from yellowish red to red. The existing cultivated Shahi Papaya showed number of seeds ranged 351-413. Plant and fruit characteristics of Shahi Papaya under this experiment were not similar to that of the original Shahi Papaya. Fruit characteristics of Shahi Papaya under this experiment were not similar to that of the original Shahi Papaya but it can be concluded that the original Shahi papaya characters have almost been regained and need to maintain it through sib-mating every year to retrieve the original characters also to maintain the varietal purity.

Evaluation of ber germplasm

A. Akter, M. A. Hossain, M. S. Rahman, R. Sultana and H. E. M. K. Mazed

An experiment was conducted to identify suitable ber germplasm at HRC Fruit Orchard, RARS, Jamalpur. Thirty nine germplasm were included in the study. Plant to plant distance was 6 m and row to row distance was 6 m. The experiment was conducted with nonreplicated design. The ages of trees were around eight years. Fifty fruits from each tree were randomly harvested and used for collection of data. Quantitative and qualitative data were recorded. Data were statistically analyzed with MS Excel. Wide range of variation was observed among the accessions in terms of morphological characters, flowering, harvesting time and fruit characters. Plant spread (N-S and E-W) ranged from 4.0 to 7.60 m and 4.2 to 7.3 m, respectively. Plant height ranged from 4.00 to 6.20 m. Base girth ranged from 36.25 to 66.35 cm. Flowering time of all ber germplasm was on August to November 2020 except ZM Jam-287(July – August). Harvesting time ranged from last week of December to first week of March-2021. ZM Jam-124 had the maximum individual fruit weight 20 g and ZM Jam-143 got the minimum fruit weight 5.60 g. Fruit yield per plant varied from 10 kg in ZM Jam-177 to 24 kg in ZM Jam-124. Edible portion varied from 84.93% in ZM Jam-225 to 95.29 % in ZM Jam- 207. Percent TSS varied from 13% (ZM Jam-141) to 22 % (ZM Jam-122). The experiment should be continued for further evaluation.

Evaluation of existing ber germplasm at RARS, Akbarpur

M. A. Sumi and M. A. Habib

An experiment was conducted to find out the suitable ber germplasm at the Regional Agricultural Research station, Akbarpur, Moulavibazar during the fruiting season. Seventeen germplasm were evaluated in this study. Twenty fruits from each tree were randomly taken for collection of data on fruit characters. Plant height varied from 2.50 m in ZM Akb-034 to 6.8 m in ZM Akb-64. Base girth varied from 14 cm in ZM Akb-020 to 96.3 cm in ZM Akb-053. Maximum individual fruit weight was found 44.04 g in case of ZM Akb-035 and minimum individual fruit weight was found 3.98 g in ZM Akb-055. Maximum TSS was recorded in ZM Akb-045 (24 %) and minimum TSS was in ZM Akb-053 (10.6%). Among seventeen germplasm they showed diversity in fruit shape which included oval, round, oblong and oval to oblong, similarly skin color varied including orange-yellow, green-orange, green-yellow, yellow, dark-yellow and green. Flesh color was cream and white. Taste varied from good to poor, fruit surface was smooth in case of all accession and crispiness varied from not crispy to crispy, sweetness varied from sour to sweet-sour and medium sweet. Among seventeen ber germplasm, they showed huge diversity, however none of them showed enough quantitative and qualitative traits for any kind of commercial use. Moreover, these germplasm can be utilized for diversified genetic collection and varietal development through crossing and other genetic conversion.

Evaluation of sour type ber germplasm

M. H. Waliullah, Kh. H. Alam, G. M. M. Bari and M. A. Uddin

A study was conducted at the Fruit Research Station, Binodpur, Rajshahi with sour ber lines with a view to selecting the promising germplasm for recommending them for release a new variety. The experimental materials were ten sour type ber lines namely ZM Raj-001, ZM Raj-002, ZM Raj-003, ZM Raj-004, ZM Raj-005, ZM Raj-006, ZM Raj-007, ZM Raj-008, ZM Raj-009 and ZM Raj-010. Fifty matured ripe fruits from each plant were collected randomly which were used for studding

physical characteristics. Data on fruit characteristics, stone characteristics, quality, harvesting period and yield were collected. Maximum fruit weight was recorded in ZM Raj-002 (11.07 g) followed by ZM Raj-005 (10.43 g) and ZM Raj-006 (10.43 g) whereas, minimum fruit weight was observed in ZM Raj-008 (6.17 g). Total soluble solids (TSS) of different ber germplasm varied from 14.33-19.67 %, where maximum TSS was in ZM Raj-002 (19.67 %) followed by ZM Raj-010 (16.66 %) and minimum TSS was recorded in ZM Raj-008 (14.33%). Maximum edible portion was found in ZM Raj-002 (91.59 %) followed by ZM Raj-005 (89.16 %) and ZM Raj-006 (88.59 %). Maximum fruit yield was recorded in ZM Raj-002 (13.53 t/ha) and minimum fruit yield was recorded in ZM Raj-010 (10.40 t/ha). Considering fruit quality and fruit yield, ZM Raj-002, ZM Raj-005 and ZM Raj-006 were found to be very promising for late season among the ten sour type ber germplasm.

Evaluation of local ber germplasm

M. H. Waliullah, K. H. Alam, G. M. M. Bari and M. A. Uddin

A study was conducted at the Fruit Research Station, Binodpur, Rajshahi with seven ber germplasm with a view to selecting the promising varieties for recommending them at farmer's level. The experimental materials were matured ripe fruits of seven ber germplasm namely Apple Kul, BARI Kul-1, BARI Kul-2, Chapai Kul, Local Kul Late, BARI Kul-3 and Umboli Kul. Fifty fruits from each plant were plucked randomly which were used for studding physical characteristics. Data on fruit characteristics, stone characteristics, quality, harvesting period and yield were undertaken. Fruit weight was recorded maximum in BARI Kul-3 (38.8 g) followed by BARI Kul-2 (34.5 g) whereas, minimum fruit weight was observed in Umboli Kul (15.7 g). Total soluble solid (TSS) was recorded maximum in Umboli Kul-1 (17.3 %) followed by Apple Kul (16.5%) and BARI Kul-1 (16.3%), while that was minimum in BARI Kul-2 (12.3%). BARI Kul-3 gave maximum fruit yield (25.47 t/ha) and it was minimum in Chapai Kul (10.92 t/ha). Among the germplasm, local Kul (Late) was found to be very promising for late season (up to Mid April). Among the

germplasm, ZM Raj-012 (Local Kul Late) was found to be very promising for late season. The experiment will be continued for further recommendation.

Evaluation of indigenous ber germplasm at Khagrachari

M. A. A. Malek, M. G. Rahman and M. R. Ahmad

A study was conducted at the Hill Agricultural Research Station in Khagrachari hill district with thirty one local ber germplasm to select superior land races for commercial cultivation in the hilly areas. Among the 31 accessions, 9 accessions were selected which had been evaluated. The evaluated materials were ZM Kha-005, ZM Kha-008, ZM Kha-013, ZM Kha-017, ZM Kha-021, ZM Kha-023, ZM Kha-024, ZM Kha-026, ZM Kha-030. The plants were about thirteen years old. Thirty fruits from each tree were collected randomly for studying physical characteristics. Average individual fruit weight ranged from 6 g to 18 g. The germplasm ZM Kha -013 produced the maximum individual fruit weight (18 g) and the minimum fruit weight was produced in ZM Kha-021 (6 g). The germplasm ZM Kha-023 produced the maximum fruit weight (178 g) and the minimum fruit weight was produced in ZM Kha-021 (6 g). Edible portion varied from 64.89 % in ZM Kha-005 to 79.85 % in ZM Kha-023. TSS of ber germplasm varied from 16.8 % (ZM Kha-008) to 26.0 % (ZM Kha-026). Considering fruit characteristics, appearance, edible quality, harvesting period, TSS and percent edible portion the germplasm ZM Kha-023, ZM Kha-024, and ZM Kha-030 were found promising which can be used for processing of pickles and ZM Kha-013 and ZM Kha-017 were almost sweet to taste. The study will be continued for the next following years.

Survey, collection and evaluation of jamun germplasm

M. H. Waliullah, Kh. H. Alam, G. M. M. Bari and M. A. Uddin

An experiment was conducted at the Fruit Research Station, BARI, Binodpur, Rajshahi to evaluate six jamun germplasm for superior traits. Survey was carried out in different areas of Rajshahi, Natore and Pabna. The plant age ranged from 10 years to 30 years. Twenty fruits of each tree were collected

randomly of which ten were used for studying their physical and qualitative characteristics. Wide variations were observed among the germplasm. The tallest tree was found in SC Raj-001, (15 m) against the dwarf in SC Raj-017 (4.5 m). Maximum base girth (85 cm) was recorded from SC Raj-001 and minimum base girth was recorded from SC Raj-002 and SC Raj-0016 (65 cm). The highest fruit weight (21.67 g) was obtained from SC Raj-015 followed by SC Raj-016 (20.67 g). Maximum edible portion (90.64 %) was obtained from SC Raj-016 and minimum edible portion (76.36 %) was found in SC Raj-017. The highest Total Soluble Solids (13 %) was obtained from SC Raj-002 and SC Raj-017. Maximum fruit yield per plant was recorded from SC Raj-001 (47 kg) followed by SC Raj-015 and SC Raj-016 (40 kg). Minimum fruit yield per plant was recorded in SC Raj-014 (20 kg). Considering fruit quality, percent TSS, flesh type, edible portion and fruit yield, SC Raj-014, SC Raj-015 and SC Raj-016 were noticed superior to those of other germplasm. Further evaluation of the jamun germplasm will be done.

Evaluation of dwarf coconut in hilly area of Rangamati

M. Islam, M.E. Hoque and M. A. Hossain

An experiment on the evaluation of dwarf coconut in the hill valley was conducted at the fruits orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District. Two varieties of dwarf coconut (Vietnam Xiem Blue and Kerala hybrid) were included in this experiment. The germplasm were planted during June 2017 maintaining 6 m x 6 m spacing. The average plant height was recorded 554.6 cm and 649.4 cm in Vietnam Xiem Blue and Kerala hybrid, respectively after four year of plantation. The vegetative growth rate was higher in Kerala hybrid coconut than Vietnam Xiem Blue coconut but only Xiem Blue coconut started to produce fruits after four year of plantation. The experiment will be continued for further evaluation.

Hybridization in citrus

S. M. L. Rahman, F. Ahmed, M. S. Zaman and M. H. M. B. Bhuyan

A hybridization program was conducted in the flowering season at the Citrus Research Station (CRS), Jaintapur, Sylhet and Regional Agricultural

Research Station (RARS), Akbarpur, Moulvibazar to develop new citrus hybrids having desirable characters like good quality fruits highly sweet in taste, quick growing tendency and having resistance to pest and diseases. The existing citrus germplasm of CRS, Jaintapur and RARS Akbarpur were used as parents. A total of 450 flowers were emasculated and pollinated. Seven hybrid fruits were obtained from different crosses. Two hybrid fruits from the cross of BARI Komala-1 x BARI Malta-1 and 5 hybrid fruits from the cross of BARI Satkara-1 x BARI Batabilebu-3 were borne. These citrus fruits will be harvested at matured stage and seeds of the fruits will be sowed in the soil for germination. After germination, seedlings of hybrid fruits will be transplanted in the main field and will be evaluated.

Evaluation of lemon germplasm

M. A. H. Khan, M. H. Rahman and M. O. Kaisar

An experiment with ten germplasm of lemon was conducted to evaluate the superior lemon germplasm at the Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Cumilla. The air layered 10 germplasm of local lemon were collected from Barura Upazilla under Cumilla district during August 2016. Collected saplings were nourished in the nursery for about 1 year. Lemon germplasm were transplanted in the experimental plot on June 2017 maintaining 3 m × 3 m spacing with three replications. Maximum number of fruits/plant (320) and weight of fruits/plant (50.5 kg) was observed in CL Cum-008. Maximum individual fruit weight (173.8 g) was found in CL Cum-015 followed by CL Cum-008 (165.0 g). The line CL Cum-008 performed better than those of other germplasm which could be proposed as a variety.

Evaluation of exotic lemon germplasm

M. H. Waliullah, K. H. Alam, G. M. M. Bari and M. A. Uddin

A lemon germplasm, planted at private nursery, Fatepur, Charghat, Rajshahi in 2008 which was collected from Greece. The germplasm was further collected and replanted at Fruit Research Station, Binodpur, Rajshahi in 2012 to compare its performance with BARI released and local existing lemon varieties. The plants were now eight years

old. The plant height and base girth were observed 3.7 m and 38 cm, respectively. Number of primary branches was recorded 3. The plant produced 45 fruits. The plant growth and fruit characteristics were satisfactory. Further study is needed for final conclusion.

Evaluation of lime germplasm

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

The experiment was conducted at HRC, RARS, Jamalpur to search out a suitable lime germplasm with excellent quality for both table and commercial purposes. Five lime (*Citrus aurantifolia*) germplasm were evaluated. Planting was done in August 2015. There were differences among the germplasm studied regarding plant height, base girth, canopy spreading, number of branches per plant, number of fruits per plant, fruit length, fruit breadth, individual fruit weight, fruit yield per plant and fruit yield per hectare. CA Jam-005 was found superior with the maximum plant height of 3.20 m, large canopy size (3.50 m x 3.10 m) and number of branches (4.0). Maximum number of fruits per plant was found in CA Jam-005 (220) and minimum number of fruit was found in CA Jam-004 (10). Maximum individual fruit weight was found in the line CA Jam-005 (78.5 g) and minimum individual fruit weight was found in the line CA Jam-002 (51.4 g). Maximum fruit yield per plant was observed in the line CA Jam-005 (17.27 kg) and minimum fruit yield was found in the line CA Jam-004 (0.50 kg). Considering growth, fruit yield and yield contributing characters the line CA Jam-005 performed better. The experiment will be continued for further evaluation.

Evaluation of lime germplasm

M. A. H. Khan, M. H. Rahman and M. O. Kaisar

An experiment with two lime germplasm was conducted to evaluate the superior lime germplasm at the Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Cumilla. The air layered three germplasm of local lime were collected from Baruraupazilla under Cumilla district during August 2017. Collected saplings were nourished in the nursery for about 1 year. The germplasm were transplanted in the experimental plot in June 2017

maintaining 3 m × 3 m spacing. Higher number of fruits/plant (300), weight of fruits/plant (14.90 kg) and individual fruit weight (49.67 g) was observed in CA Cum-001 than CA Cum-003. This experiment is going on and after completion of the experiment suitable lime variety will be developed.

Collection and evaluation of lime (kagzi)

M. R. Islam, S. D. Setu, S. Hasna, M. G. Kibria and M. R. Uddin

The experiment was conducted at the RARS, Rahmatpur with a view to selecting superior line (s) to release as a variety. Six germplasm of lime were collected from different areas of the southern part of country and planted in July 2013. Wide variations in growth characteristics among the germplasm were found. Among the germplasm, maximum plant height was attained in CA Rah-01 (6.2 m) and minimum plant height was attained in CA Rah-06 (2.78 m). Maximum base girth was found in the germplasm CA Rah-01 (31 cm) and minimum base girth was found in CA Rah-04 (14 cm). Maximum horizontal spread were found in CA Rah-01 (5.3 m & 4.9 m) and minimum plant spread was found in CA Rah-04 (2.5 m & 3.4 m). Maximum number of fruits was found in CA Rah 02 (860) and minimum number of fruits was found in CA Rah-04 (156). In case of average fruit weight, the heaviest fruit was harvested from CA Rah-02 (46.73 g) and the lightest average fruit weight was obtained from CA Rah 01 (33.45). Maximum fruit yield per plant was found in the germplasm CA Rah-02 (40.19 kg) and minimum fruit yield per plant was found in CA Rah-04 (6.31 kg). On the basis of fruit weight, number of fruits per plant, fruit yield, the germplasm CA Rah-02 was found better. To confirm the findings as well as to determine the yield performance the experiment should be continued.

Physio-morphological characterization of mandarin and sweet orange in the hilly area of Sylhet region

M. H. M. B. Bhuyan, F. Ahmed, J. C. Sarker and S. M. L. Rahman

An effort has been made for in situ characterization of BARI Komala-1 and BARI Malta-1. Wide variability was observed in different characters among the varieties/germplasm studied. Among the

varieties/germplasm, BARI Malta-1 produced flowers in early February and fruit setting completed in early March but BARI Komala-1 produced flower 2 weeks later. There were differences among the harvesting time also. BARI Malta-1 can be harvested from late August but BARI Komala-1 should not be harvested before mid-November. This is the first year of study. Next year more variety and germplasm will be included in the study.

***In-situ* evaluation of local mandarin lines under north-eastern hilly area of Bangladesh**

J. C. Sarker, F. Ahmed, M. H. M. B. Bhuyan and S. M. L. Rahman

The experiment was conducted to evaluate the mandarin germplasm in the farmer's orchard and homestead at Jaintapur area of Sylhet. BARI Komala-1 used as a check. All the germplasm were found satisfactory considering growth parameters and fruit yield as well as yield contributing characteristics. Among the germplasm maximum base girth (89.0 cm) was recorded in CR Jai 205 while minimum (46.6 cm) in BARI Komala-1. Plant height ranged from 3.25 m to 6.70 m in different germplasm with the tallest (6.70 m) in CR Jai-207 and the shortest (3.25 m) in BARI Komala-1. The highest canopy size (5.61 × 6.20 m) was found in CR Jai 207 while the lowest (2.12 × 2.42 m) in BARI Komala-1. The heaviest fruit (192.34 g) was found in CR Jai-203 while the lightest (156.38 g) in CR Jai-206. Maximum number of fruits per plant (622) was recorded in CR Jai-206 whereas minimum (310) in CR Jai-201. The highest yield per plant (98.43 kg) was found in CR Jai-203 whereas the lowest (54.54 kg) was in CR Jai-201. Maximum size of fruit (6.8×8.2 cm) was recorded in CR Jai-203 while minimum (6.1×6.5 cm) in CR Jai-206. Maximum edible portion was recorded in (72.69 %) in CR Jai-203 while, the lowest (64.48%) in CR Jai-205. In case of total soluble solids (TSS) it was recorded the highest (13.6 %) in CR Jai-203 and the lowest (10.3 %) in CR Jai-201. Titratable acidity (TA) was also varied among the tested germplasm and the lowest TA (0.72 %) was recorded in CR Jai-203 in contrast the highest (0.91 %) in CR Jai-205. The selected superior mandarin plants were found in good bearing stage and growth is satisfactory. Final

conclusion will be made after 2-3 years of continuous in-situ evaluation.

Evaluation of china mandarin germplasm in the hilly region

M. A. Salam and S. M. Faisal

Germplasm of China Mandarin were evaluated at the Hill Tracts Agricultural Research Station, Ramgarh. Seedlings raised from China mandarin collected from market were planted during 2014 maintaining 4 m plant spacing in a single row. Average of two years, plant height, base girth, number of main branch/plant, plant spread (N-S), plant spread (E-W) and number of fruit/plant range were 1.94-4.5 m, 13.0-19.0 cm, 1.0-5.0, 1.10-1.80 m, 0.92-2.0 m and 15-105 respectively. Maximum number of fruit/plant was calculated and it ranged from 15-105 in 2019 and 14-109 in 2021, respectively. Mean plant height, base girth, number of main branch/plant, plant spread and number of fruits per plant was higher during 2020-2021. This might be due to higher yield contributing characters. Therefore, the experiment exhibited that China mandarin may be suitable for hilly region of Bangladesh.

Evaluation of sweet orange germplasm in the hilly region

M. G. Rahman, M. A. A. Malek and M. R. Ahmad

The experiment was conducted to study the performance of sweet orange germplasm collected from different locations of CHT and planted at HARS, Khagrachari. Two germplasm viz. CS Kha-001, CS Kha-002 and a check variety BARI Malta-1 were evaluated to identify promising sweet orange germplasm in respect of fruit bearing, fruit quality and yield potentiality. Flowering time ranged from February to March. Harvesting time was late November-December in case of CS Kha-001. All the germplasm produced profuse fruits. Number of fruits per plants was the highest (220) in BARI Malta-1 while the lowest (135) number of fruit was found in CS Kha-002. Individual fruit weight was also varying from 135.33-165.67 g. The biggest (165.67 g) fruit was recorded in CS Kha-002 and the smallest (135.33) fruit was observed in BARI Malta-1. Weight of fruits per plant was the highest in CS Kha-001 (29.98 kg) while BARI Malta-1 produces 29.77 kg /plant yield and the

lowest (22.37 kg) yield was observed in CS Kha-002. Number of seed ranges from 10-22. TSS ranges from 7.5 to 8.5 %. Fruit aroma was strong in all the germplasm. Considering fruit characteristics i.e. taste, juiciness, sweetness, colour of pulp, fruit number and yield BARI Malta-1 was found excellent but in context of attractiveness, less incidence of insect-disease, considerable yield potentiality and edible qualities of CS Kha-001 was also found promising.

Evaluation of variegated sweet orange genotypes in Chattogram region

S. M. K. H. Chowdhury, M. G. Azam and A. S. M. H. Rashid

An experiment was conducted at Agricultural Research Station, Pahartali in Chattogram for the evaluation of seven sweet orange genotypes. The highest number of fruits (31) was attained from CS Pah-001 and CS Pah-007 and the lowest number of fruits was noted in CS Pah-008 which was noted as 06. The highest fruit weight (241 g) was obtained from CS Pah-005 followed by CS Pah-003 which is noted as 239.8 g. The lowest fruit weight (92 g) was observed in CS Pah-001. The large and small fruit was found from CS Pah-008 and CS Pah-001 respectively. The Lowest number of seed (12.33) and lightest seed (2.30 g) was obtained from CS Pah-008. In case of edible portion, highest edible portion (66.34%) was found from CS Pah-003 and CS Pah-008 produced the lowest edible portion (48.26 %). Highest TSS (12.95%) was attained from CS Pah-006 followed by CS Pah-007 (12.86 %). Though it was second year observation, evaluation will be needed in the next consecutive years.

Performance of exotic sweet orange germplasm

J. C. Sarker, M. H. M. B. Bhuyan, F. Ahmed and S. M. L. Rahman

A study was conducted with four exotic sweet orange germplasm to evaluate their performance in Bangladesh at the Citrus Research Station, Jaintapur, Sylhet. BARI Malta-1 was used as check. Significant differences were recorded among the studied germplasm in terms of growth, yield and yield contributing characteristics. Plant height, base girth and canopy spread (NS-EW) ranged from 129 cm to 184 cm, 7.5 cm to 15.7 cm

and E-W and N-S sprading ranged from 68 cm to 118 cm and 78 cm to 98 cm, respectively. Scion trunk surface was found smooth in all the germplasm. Tree shape was found ellipsoid in all the germplasm except CS Jai-051 which was found spheroid shape. All the germplasm exhibited upright growth habit except CS Jai 051 which was exhibited spreading growth habit. Among the germplasm BARI Malta-1, CS Jai-003 and CS Jai-012 were dense branching habit while CS Jai-051 and CS Jai-209 were sparse. Maximum fruit weight (455 g) was recorded in CS Jai-051 while minimum (145.8 g) in CS Jai-209. Fruit size also attained maximum (10.1×9.7 cm) in CS Jai-051. The highest TSS (15) was recorded in CS Jai-009. Edible portion was recorded maximum (79.12 %) in CS Jai-051 followed by CS Jai-209 (77.37 %), CS Jai-003 (75.87 %) and BARI Malta-1 (73.83 %). Fruit color at maturity stage of exotic sweet orange germplasm CS Jai-051, CS Jai-003, CS Jai-012, CS Jai-209 and BARI Malta-1 were found pale green, bright yellow and greenish yellow, respectively. Pulp colors of studied germplasm were found off white to orange, whereas BARI Malta-1 was light yellow. Among the germplasm, CS Jai-003 and CS Jai-051 are promising and can be released as new sweet orange (Malta) variety.

Evaluation of pummelo germplasm

M. A. Alam, M. R. Alam and K. U. Ahammad

The study was undertaken to identify suitable germplasm of pummelo with 21 accessions of 13-17 years old plants along with a locally collected germplasm at Regional Agricultural Research Station, Jashore. The heaviest fruit (1625 g) was collected from CG Jas-021 whereas the lightest fruit (635 g) was found in CG Jas-024. The highest edible portion (59.2 %) was observed in CG Jas-019 while the lowest edible portion (34.1 %) was observed in CG Jas-011. The highest TSS (11.0 %) was recorded in CG Jas-024 whereas the lowest TSS (6.5 %) was found in CG Jas-025. Maximum number of fruits per plant (145) was observed in CG Jas-026 followed by CG Jas-023 (142) whereas minimum number of fruits per plant (10) was found in CG Jas-011. Excellent eating quality was observed in CG Jas-013, CG Jas-018, CG Jas-019, CG Jas-021, CG Jas-022, CG Jas-023, CG Jas-025 and CG Jas-026 with bitterless pulp. However,

further investigation should be carried out for the next few years.

Evaluation of pummelo germplasm

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

The experiment was conducted at HRC, RARS, Jamalpur to find out the superior pummelo germplasm for releasing as variety. Seven germplasm were evaluated in this study. A wide variation was observed in case of different plant growth and fruit characteristics among the pummelo germplasm tested. Among the germplasm, CG Jam-001 was found superior with large canopy size (3.58 m x 3.80 m) and the highest tree volume. The highest base girth (39.6 cm) was observed in CG Jam-004 and the lowest in CG Jam-005. Number of branches was found the highest in the line CG Jam-002 (4.9). The highest number of fruits per plant was observed in CG Jam-001 (35) and the lowest was in CG Jam-004 (4). The highest yield per plant was recorded in CG Jam-001 (43.75 kg) and the lowest was in CG Jam-003 (4.40 kg). The highest TSS was observed in CG Jam-001 (9.2%) and the lowest was in CG Jam-004 (7.1%). Considering growth and yield contributing characters it could be concluded that the line CG Jam-001 performed better. The experiment would be continued.

***In-situ* evaluation of year round pummelo germplasm**

M. A. A. Malek, M. G. Rahman, and M. R. Ahmad

The study was conducted at the Hill Agricultural Research Station, BARI, Khagrachari during the last five years. One off-season pummelo germplasm (CG Kha-001) was selected for the evaluation along with a normal season control. Mainly year round bearing occurred in the germplasm. Maximum number of mature (43) and immature (66) fruits were found in the month of September and May respectively. Average fruit weight was 1.47 kg. Maximum edible portion was obtained (41.12 %) and the highest TSS (10.6 %). The average number of fruits per month (17.25) was collected from CG Kha-001. Consideration of fruit characteristics, edible quality, TSS, percent edible portion and yield potentialities, the germplasm CG Kha-001 was found promising for year round

cultivation of pummelo at the hilly region which can be released as variety.

Evaluation of late season pummelo germplasm in the hilly region

M. G. Rahman, M. A. A. Malek and M. R. Ahmad

The study was conducted at the Hill Agricultural Research Station, BARI, Khagrachari. One off-season/late season pummel germplasm (CG Kha-001) was selected for the evaluation along with a check variety (BARI Batabilebu-5). The germplasm CG Kha-001 resulted in 107 fruits/plant and 154.1 kg/plant compared to those of check variety (18.33 fruits/plant and 16.04 kg/plant). Fruits of the proposed line were pyriform in shape, large sized (fruit weight 1450 g) with excellent light yellow colour of rind where check variety produced less weight (875 g). Pulp is very sweet in taste, soft juicy, light pink in colour, having pleasant aroma and bitterness. Average edible portion was high (67.55%). Average TSS was comparatively high (9.30 %) than check variety (9.05 %). Fruit retention percentage was very high. Seeds were small in size (weight of 100 seed is 40.44 g). The germplasm (CG Kha-001) was less susceptible to insect- pests and diseases and plant can survive in drought condition. In general, the fruiting season of pummelo starts from August to October, but the fruit of the selected line were harvested till late January. Thus it will help in extending the availability of pummelo as well as may increase the export of sweet pulp citrus.

Evaluation of pummello germplasms in Chattogram region

S. M. K.H. Chowdhury, M. G. Azam and A. S. M. H. Rashid

An experiment was conducted at the Agricultural Research Station, Pahartali, Chattogram for the evaluation of twenty two pummelo genotypes. Among these twenty two germplasm, ten genotypes namely CG Pah-002, CG Pah-003, CG Pah-005, CG Pah-006, CG Pah-008, CG Pah-013, CG Pah-015, CG Pah-020, CG Pah-021 and CG Pah-022 produced fruits. The heaviest fruit (1826 g) was recorded from CG Pah-013 followed by CG Pah-005 that weighted 1790 g. The lightest fruit (730 g) was observed in CG Pah-020 followed by CG Pah-021 that weighted 740 g. The largest fruit size (15.2

cm x 17.9 cm) was obtained from CG Pah-013 and the smallest fruit size (10.67 cm x 12.57 cm) was found from CG Pah-021. Maximum edible portion (68 %) was calculated from CG Pah-015 and minimum edible portion (46.84 %) was calculated from CG Pah-003. The highest total soluble solid (10.73) was counted from CG Pah-020 and the lowest total soluble solid (7.04) was counted from CG Pah-002. CG Pah-015 produced maximum amount of fruit (24.15 kg) and CG Pah-002 produced minimum amount of fruit (1.13 kg). All the genotypes were bitter in taste except CG Pah-006. Considering the quantitative and qualitative characters especially the bitterness, CG Pah-003, CG Pah-005 and CG Pah-006 might be considered as a promising line. Though it was first year data collection, evaluation will be needed next consecutive years.

Evaluation of pummelo in thje hilly region of Rangamati

M. Islam, M. E. Hoque and M. A. Hossain

An experiment was conducted at the existing twelve years old orchard at the hill valley of Hill Agricultural Research Station of Raikhali, Rangamati to evaluate thirteen pummelo germplasm for release as a new variety. Maximum number of fruits per plant was observed in CG Rai-052 (67) followed by CG Rai-008 (63) and CG Rai-047 (63), whereas minimum in CG Rai-011(19). The earliest flowering was recorded in CG Rai-006 (mid-February) and the latest flowering was noted in CG Rai-047 (mid-March). Maximum weight of individual fruit was recorded in CG Rai-010 (1450g) followed by CG Rai-011 (1400g). Maximum edible portion was found in CG Rai-010 and CG Rai-014 (66%). Maximum TSS (12.1%) was recorded in CG Rai-014. Based on the edible portion (%), TSS (%), bitterness, organoleptic test and colour, the germplasm CG Rai-006, CG Rai-007, CG Rai-009, CG Rai-010, CG Rai-014, CG Rai-030, CG Rai-047 and CG Rai-052 were found superior which can be evaluated for next year to develop a variety.

Evaluation of bael genotypes

M. O. Hoque and A. K. Saha

An experiment was conducted at the Regional Agricultural Research Station, Burirhat, Rangpur

with a view to develop high yielding good quality variety of bael. Seventy two genotypes of bael were evaluated in this study. Out of 72 genotypes, 15 genotypes produced flowers and fruits during this season. Flowering time of different genotypes was observed in all the genotypes from 1st week of May to 1st week of June. Early flowering (1st week of May) was observed in the genotypes AM Bur-012, AM Bur-013 and AM Bur-052 and late flowering (1st week of June) was observed in the genotypes AM Bur-054 and AM Bur-061. Harvesting was done from 2nd week of March to 1st week of May. Maximum number of fruits per plant (29) was obtained from AM Bur-037, whereas minimum number of fruits (11) was found in AM Bur-027, AM Bur-032, AM Bur-044 and AM Bur-054, respectively. The genotype AM Bur-013 produced maximum fruit yield (16.00 kg/plant), while minimum fruit yield (1.81 kg/plant) was recorded in genotype AM Bur-026. Considering weight of pulp, color, flavor, stickiness texture, grittiness, bitterness and sweetness and TSS and quality it can be concluded that the genotypes AM Bur-012, AM Bur-013 and AM Bur-037 were found promising. The trial should be done in next year including these promising lines for finding out the best variety.

***In-situ* evaluation of bael germplasm**

A. S. M. Yousuf Ali, M. Z. Uddin, M. K. Islam, M. M. Hossain and H. C. Mohanta

An experiment was evaluated at Chapainawabganj Sadar and Shibganj Upazila to evaluate the performance of the selected bael germplasm for releasing as a variety. The study comprised one bael germplasm. BARI Bael-1 was used as check. Age of the germplasm AM Cha-001 was 33 years while BARI Bael-1 was 14 years. Maximum individual fruit weight (1050 g) was found in AM Cha-001, while the minimum (850 g) individual fruit weight in was found in BARI Bael-1. Maximum (107) number of fruits per plant was found in the germplasm AM Cha-001 while minimum (60) from BARI Bael-1. Considering TSS (38%), pulp percentage (74%) and yield/plant (112.35 kg), the germplasm AM Cha-001 was found better. This experiment will be continued.

Evaluation of existing bael germplasm

A. S. M. Yousuf Ali, M. Z. Uddin, M. K. Islam, M. M. Hossain and H. C. Mohanta

An experiment was conducted at the Regional Horticulture Research Station, Chapainawabganj including 22 bael genotypes to find out a good genotype of bael for commercial cultivation. Germplasm were collected from different places of Chapainawabganj and Rajshahi districts. A wide variation was observed among the genotypes regarding growth, fruit and tree characteristics. Only sixteen genotypes among 22 produced fruits this year. Among the fruit characteristics, fruit weight varied from 340 to 2250 g, fruit length from 9 to 16 cm, fruit breadth from 8.5 to 16.5 cm, pulp weight from 204 to 1732.5 g, fibre weight from 10 to 137 g, seed weight from 13 to 32.2 g and TSS from 26 to 38 %. No. of fruits per plant was recorded the highest from AM Cha-006 (60) and the lowest from AM Cha-011 (8). TSS was noted maximum (38%) in AM Cha-007 while it was minimum (26%) in AM Cha-011 and AM Cha-013. In respect of organoleptic test, grittiness, absence of bitterness and mucilage, the genotypes AM Cha-002, AM Cha-004, AM Cha-006, AM Cha-013, AM Cha-016 and AM Cha-014 were found promising. This experiment will be continued.

Evaluation of bael germplasm

J. C. Sarker, M. H. M. B. Bhuyan, F. Ahmed and S. M. L. Rahman

The experiment was conducted at Citrus Research Station, Bangladesh Agricultural Research Institute (BARI), Jaintapur, Sylhet, to observe the performance of bael germplasm for releasing as new variety. Four germplasm of bael viz., AM Jai-001, AM Jai-002, AM Jai-003 and AM Jai-004 were evaluated under this study. A wide variation was observed in the case of different characters of the germplasm tested. Among the germplasm the highest number of fruits was recorded in AM Jai-001 (141) with maximum TSS (39.4%). The heaviest fruit was found in AM Jai-002 (1250.6 g) with large sized (13.5×12.5cm²) fruit. The highest weight of pulp (959.2 g) was recorded in AM Jai-002 whereas the lowest (474.5 g) weight of pulp was recorded in AM Jai-001. Maximum weight of fiber (38.5 g) was recorded in AM Jai-004 whereas

minimum (34.7 g) fibre was recorded in AM Jai-003. Maximum edible portion was recorded in AM Jai-001(83.61%) while minimum edible portion was recorded in AM Jai-004(59.13%). The genotype AM Jai-001 was the best in terms of TSS (%), number of fruits/plant and edible portion with no bitterness. It may be released as a new variety.

In-situ evaluation of bael germplasm

R. Sultana, M. A. Hossain, M. S. Rahman, A. Akter and H. E. M K Mazed

An experiment was conducted at RARS, Jamalpur. Four bael germplasm were collected from Jamalpur Sadar to find out a good germplasm of bael for the commercial cultivation. Maximum individual fruit weight (1150 g) was found in AM Jam-004, while minimum (850 g) fruit weight was found in AM Jam-003. The pulp weight in different germplasm varied from 630 g in AM Jam-003 to 750 g in AM Jam-004. Maximum yield (220 kg/plant) was found in the germplasm AM Jam-004, while minimum (80.8 kg/plant) yield was recorded from AM Jam-003. Considering TSS (39.9%), pulp percentage (80.21), fiber percentage (1.21), and organolaptic test (excellent), the germplasm AM Jam-004 was found superior under this study. In the case of TSS (38.5%), pulp percentage (75.85), fiber percentage (1.28), grittiness (absent) and in organolaptic test, the germplasm AM Jam-001 was found superior. This experiment will be continued.

Evaluation of wood apple germplasm

S. C. Das, M. Rahman, M. M. Uddin, J. Gomasta and B. C. Sarker

An experiment was conducted at the Horticulture Research Farm, Breeder Seed Production Centre (BSPC), BARI, Debiganj, Panchagarh to evaluate six elephant foot apple germplasm. Among these germplasm only two germplasm namely FL Deb-001, FL Deb-002 produced fruits and the remaining germplasm namely FL Deb-003, FL Deb-004, FL Deb-005, FL Deb-006 did not produce any fruit. The highest number of fruits (75) was obtained from the germplasm FL Deb- 002. The highest fruit weight (223.83 g), fruit length (7.3 cm), fruit diameter (7.23 cm), pulp weight (155.67 g), TSS (15.83 %) and yield per plant (14.55 kg) were recorded in the germplasm FL Deb-001 than that of the germplasm FL Deb-002. The highest edible

portion 82.04% and the lowest rind weight (36.14 g), fiber weight (4.29 g), rind thickness (0.21 mm) and seed weight (14.71 g) were found in the germplasm FL Deb-002. As it was the second year data collection, further evaluation is needed.

Evaluation of golden apple germplasm in the hilly region

M. A. Salam and S. M. Faisal

Four Golden apple germplasm were evaluated at the Hill Tracts Agricultural Research Station, Ramgarh to develop a variety. These were SD Ram-001, SD Ram-002, SD Ram-003 and SD Ram-004. The germplasm was 15-20 years old. A lot of variability was found in respect to plant height, number of branch, spread of plant, fruit size, single fruit weight and edible portion (%). The germplasm SD Ram-001 produced the maximum number of fruits (4416/plant in 2019 and 4984/plant in 2020) followed by SD Ram-002. This might be due to higher yield contributing characters of that germplasm. Maximum fruit yield (446.1 kg/plant in 2019 and 550.8 kg/plant in 2020) was recorded from the germplasm SD Ram-001. Number of fruits and single fruit weight were recorded higher in SD Ram-001. The highest edible portion (%) was recorded from SD Ram-001 (64.5%) and the lowest edible portion was recorded in SD Ram-003 (45.8%) during two years. TSS (%) was almost similar in all the germplasm and the range was 5.98% in SD Ram-002 to 6.55% in SD Ram-001. The germplasm SD Ram-001 was found superior considering fruit yield and yield contributing characters and suitable for hilly region of Bangladesh. This experiment will be continued.

Evaluation of Burmese grape germplasm

M. H. M. B. Bhuyan, J. C. Sarker, F. Ahmed and S. M. L. Rahman

The experiment was conducted five Burmese grape germplasm at CRS, Jaintapur, Sylhet to fulfill the demand for good varieties of lotkon. Wide variation was observed in the case of growth, yield contributing characters, fruit yield, and fruit quality of the germplasm studied. The highest plant height, base girth, canopy spreading was found in BS Jai-005. BS Jai-002 takes 110 days to harvest is considered to be an early one. The number of fruit/cluster was higher in BS Jai-001 (30-35

fruits/cluster) with maximum cluster weight (365 g). The highest fruits/plant (6000), yield/plant (55.4 kg), and yield/ha (56.8 t/ha) were obtained in BS Jai-005. While BS Jai-001 was free from disease whereas the others suffer from powdery mildew and sooty mold. Chapper beetle was common in the case of all the germplasm but BS Jai-001 and BS Jai-003 were free from fruit borer. Fruit size recorded highest in BS Jai-003 (3.4 × 3.4 cm) followed by BS Jai-001 (3.3 × 3.1 cm). Flesh color and texture for all germplasm were off white and juicy respectively. Maximum edible portion (47.2%) and percent TSS (13.6%) were found in BS Jai-001. Therefore, BS Jai-001 may be released as a variety of lotkon.

Evaluation of sapota germplasm

S. Hasna, M. R. Islam, S. D. Setu, M. G. Kibria and M. R. Uddin

The experiment was conducted at the RARS, Rahmatpur to select the superior sapota germplasm suitable for commercial cultivation and release as a variety. Eleven germplasm of sapota were collected from different areas of the southern part of country and planted on July 2012. Wide variations were observed in growth characteristics among the germplasm. The tallest plant was observed in AS Rah-01 (9.45 m) followed by AS Rah-05, AS Rah-07, AS Rah-10 (9.35 m) and the smallest plant was observed in AS Rah-11 (8.23 m). The highest number of fruit per plant was found in AS Rah-01 (524) and the lowest number of fruit was in AS Rah-02 (356). The heaviest fruit was harvested from AS Rah-11 (92.80 g) and the lightest fruit was obtained from AS Rah-10 (69.20 g). The highest TSS (24°Brix) was obtained from the germplasm AS Rah-01 followed by AS Rah-06 (19°Brix). On the other hand, the lowest TSS (16°Brix) was recorded in AS Rah-04 and AS Rah-05. Among 11 germplasm, fruit yield per plant varied significantly and ranged from 28.51 kg to 46.03 kg. The germplasm AS Rah-11 produced the highest fruit yield of 46.03 kg followed by AS Rah-09 (44.12 kg) and AS Rah-01 (43.39 kg). On the other hand, the lowest (28.51 kg) fruit yield was recorded in AS Rah-04 and the mean value was 36.23 kg. This is the 1st year evaluation. To confirm the findings as well as to determine the yield performance, the experiment should be continued.

Evaluation of aonla genotypes in Chattogram region

S. M. K.H. Chowdhury, M. G. Azam and A. S. M. Harunor Rashid

An experiment was conducted at Agricultural Research Station, Pahartali, Chattogram for the evaluation of ten aonla genotypes to develop aonla variety with good size and shape. Aonla genotypes were collected and planted in 2016-2017. Among these ten genotypes only four produced fruits. Maximum numbers of fruits were acquired from EO Pah-010 which was documented as 674 followed by EO Pah-008 (180). The lowest number of fruits was observed in EO Pah-005. But TSS (18.75) of this germplasm was much higher than the other germplasm. The edible portion was also higher in EO Pah-005 (93.6%). Maximum fruit length (3.65 cm) and fruit breadth (4.11 cm) were attained from EO Pah-010 and minimum fruit length (2.65 cm) and fruit breadth (2.95 cm) were attained from EO Pah-005. EO Pah-010 ranked second in term of TSS (9.1 %) and edible portion (92.84%). It was second year data collection, evaluation will be needed next consecutive years.

Evaluation of bullock's heart genotypes at Jashore

M. A. Alam, M. R. Alam and K. U. Ahammad

A study was carried out at RARS, Jashore to find out the superior genotypes of bullock's heart (*Annona reticulata* L). Three to nine years old seven bullock's heart genotypes were identified from different locations of Jashore town and nearby areas and fruits were collected. Data were taken in respect of fruit length, fruit breadth, fruit weight, pulp content, edible portion, TSS; number of fruits per plant and fruit yield per plant. The heaviest fruit (526 g) was recorded in AR Jas-006, whereas the lightest fruit (305 g) was found in AR Jas-001. Maximum number of fruits per plant (42) as well as the highest fruit yield per plant (22.1 kg) was found in AR Jas-006 followed by AR Jas-005 (38 number and 13.4 kg respectively). The highest yield per plant (22.1 kg) was obtained from AR Jas-006 followed by AR Jas-005 (13.4 kg) while the lowest yield per plant (1.1 kg) was recorded in AR Jas-002. The highest edible portion (74.2%) was observed in AR Jas-007 while the lowest edible portion (57.0%) was found in AR

Jas-001. The highest TSS (24.5°Brix) was recorded in AR Jas-006 whereas the lowest TSS (16.5°Brix) was found in AR Jas-002. Flesh texture, organoleptic test as well as external look of fruits was excellent in AR Jas-005, AR Jas-006 and AR Jas-007. Further investigation should be done.

Evaluation of bullock's heart germplasm at Jamalpur

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

Six germplasm of bullock's heart viz. AR Jam-001, AR Jam-002, AR Jam-003, AR Jam-004, AR Jam-005 and AR Jam-006 were evaluated at the Regional Agricultural Research Station, Jamalpur to study the variability for selection of improved germplasm and release varieties for farmers. The bullock's heart germplasm were planted in July 2016. The highest plant height (6.20 m) was recorded in AR Jam-006 and the lowest (3.27 m) in AR-Jam-003. Base girth was maximum (42.50 cm) in AR Jam-006 and minimum (30.00 cm) in AR Jam-005. The highest canopy spreading was observed in AR Jam-006 and the lowest canopy spreading was in AR-Jam-005. The highest tree volume was observed in AR Jam-006 (59.30 m³) and the lowest tree volume was observed in AR Jam-005 (14.88 m³). The highest number of branches (5.4) was observed in AR Jam-006 and the lowest number of branches was observed in AR Jam-002 (3.3). The highest number of fruits per plant was recorded in AR-Jam-006 (120) and the lowest number of fruits per plant was recorded in AR Jam-005 (9.0). The highest yield per plant was recorded in AR-Jam-006 (28.68 kg) and the lowest was in AR Jam-005 (1.33 kg). The highest TSS was observed in AR Jam-006 (25.5°Brix) and the lowest TSS was observed in AR Jam-004 (21.0°Brix). The highest edible portion was recorded in AR Jam-006 (73.64%) and the lowest edible portion was recorded in AR Jam-003 (67.65%). Considering plant and fruit characters, germplasm AR Jam-006 performed better. The experiment will be continued.

Evaluation of bullock's heart germplasm at Debiganj

S. C. Das, M. Rahman, M. M. Uddin, J. Gomasta and B. C. Sarker

An experiment was conducted at the Horticulture Research Farm, Breeder Seed Production Centre (BSPC), BARI, Debiganj, Panchagarh to evaluate two bullock's heart germplasm for releasing as variety. The germplasm AR Deb-002 produced 200 fruits and AR Deb-001 produced 165 fruits this year. The individual fruit weight, fruit length, fruit diameter, pulp weight, edible portion (%) and Total soluble solids (TSS) was higher in the germplasm AR Deb-002 than that of AR Deb-001. The germplasm AR Deb-002 produced 48.8 kg of fruits and the germplasm AR Deb-001 produced 30.94 kg of fruits. Considering individual fruit weight, fruit length, fruit diameter, edible portion (72.53%), TSS (26) and fruit yield per plant, the germplasm AR Deb-002 was found promising. The experiment will be continued.

Evaluation of custard apple genotypes at Chapainawabganj

A. S. M. Yousuf Ali, M. Z. Uddin, M. K. Islam, M. M. Hossain, M. Y. Abida and H. C. Mohanta

An experiment was conducted at the Regional Horticulture Research Station, Chapainawabganj to identify superior genotypes as well as release as variety. Sixteen genotypes were collected from five Upazilas of Chapainawabganj district. Seeds were sown in seed bed and after germination all of the genotypes were transferred into main field between 2015 and 2016. All the genotypes produced flower in this year. So, data on plant growth characters and time of flowering were recorded only. The highest plant height (3.20 m) was recorded in the genotype AS Cha-03 and the lowest plant height (2.0 m) was recorded in AS Cha-05. Base girth varied from 12.47 cm to 19.65 cm. Maximum base girth (19.65 cm) was found from the genotype AS Cha-07 while minimum (12.47cm) from AS Cha-10. All the genotypes are at flowering stage. Time of flowering was in 3rd week of June for all the genotypes. So this experiment will be continued.

Evaluation of custard apple germplasm at Rajshahi

M. H. Waliullah, Kh. H. Alam, G. M. M. Bari and M. A. Uddin

Fruit characteristics of four custard apple germplasm were studied in the laboratory of Fruit Research Station, BARI, Binodpur, Rajshahi to

select superior germplasm for the improvement of custard apple as well as release as variety. Wide range of diversity existed in fruit weight, pulp weight, TSS content, pulp content and skin weight. The weight of fruit varied from 120.5 g to 129.4 g. The highest fruit weight (129.4 g) was observed in AS Raj-001 followed by AS Raj-002 (122.6 g) and the lowest fruit weight was noted in AS Raj-004 (120.5 g). The highest (81.6 g) skin weight was measured from AS Raj-001 and the lowest skin weight was recorded from AS Raj-002 (49.0 g), seed weight was measured highest in AS Raj-002 (20 g) and lowest seed weight was measured in AS Raj-003 (16 g). Maximum (43.72%) edible portion was observed in AS Raj-002. Total Soluble Solids varied from 23.3°Brix in AS Raj-001 and AS Raj-002 to 24.3° Brix in AS Raj-003 and AS Raj-004. This was second-year result, the germplasm AS Raj-002 showed better performance on the basis of fruit weight, skin weight, number of seeds/fruit, edible portion and TSS value. Further study is needed for developing variety.

Evaluation of indian dillenia germplasm in Jashore

M. R. Alam, M. A. Alam and K. U. Ahammad

A study was carried out at the Horticulture Research Center, Regional Agricultural Research Station, Jashore to evaluate the Indian dillenia (Chalta) germplasm with a view to developing a variety. One promising germplasm was collected from Jashore region and planted in 2009. The recorded plant height of the genotype was 8.7 m and date of flowering was 18 May 2020 and fruit ripening was started from November 15, 2020. It produced total 1273 fruits in the fourth year of reporting. Individual fruit weight and fruit yield/plant were 450.35 g and 573.18 kg, respectively. Number of segments/fruit and the average number of seeds/ fruit was 18 and 22, respectively. This is an excellent germplasm in respect of fruit yield and fruit quality. Therefore, the germplasm can be proposed as a variety.

Evaluation of Indian dillenia germplasm at Ramgarh

M. A. Salam and S. M. Faisal

An experiment was conducted at the Hill Tracts Agricultural Research Station, Ramgarh to evaluate

three Indian dillenia germplasm with a view to developing a variety. 15-30 years old three Indian dillenia germplasm were selected in different locations of Ramgarh. These were DI Ram-002, DI Ram-003 and DI Ram-005. There was a lot of variability in respect to plant height, number of branch, spread of plant, fruit size, single fruit weight and edible portion. The line DI Ram-003 produced maximum number of fruits (542 per plant in 2019-20 and 552 in 2020-21) while heavier fruit was of 742.3 g in 2019-20 and 680.5 g in 2020-21, respectively. Minimum number of fruits was recorded from the line DI Ram-0052 in both of the years. Maximum fruit yield was recorded from the line DI Ram-005 followed by DI Ram-003. Edible portion ranged from 69.2 to 71.2. Maximum fruit yield per plant (385.1 kg in 2019-20 and 310.6 kg during 2020-21) was obtained from the line DI Ram-005 and the lowest yield was recorded from DI Ram-002 in both the years. Minimum edible portion was calculated from DI Ram-003 during both the years. Among three germplasm DI Ram-005 was found superior considering fruit yield and yield contributing characters. So, the line DI Ram-005 may be suitable variety for hilly region of Bangladesh.

Evaluation of some pomegranate germplasm at Chapainawabganj

A. S. M. Yousuf Ali, M. Z. Uddin, M. K. Islam, M. M. Hossain, M. Y. Abida and H. C. Mohanta

Fifteen germplasm of pomegranate were evaluated for their performances at RHRS, Chapai nawabganj to observe the variability and to raise grafts or with the hope of getting chance seedlings. Flowering was occurred in mid-March in PG Cha-002, PG Cha-004 and PG Cha-008 though flowering of remaining germplasm were in mid-April. The highest number of fruits (55) was recorded in PG Cha-002 followed by PG Cha-004 (20). Four genotypes (PG Cha-006, PG Cha-009, PG Cha-014 and PG Cha-015) did not produce fruits. Only two fruits were borne in PG Cha-008 and PG Cha-011. The fruits were harvested from only three germplasm, but fruits were found rotten in other germplasm. PG Cha-004 showed better performances considering fruit weight (285 g), edible portion (51.9%) and TSS (14.5%) among the three germplasm. The germplasm PG Cha-002 gave

the highest (180 g) skin weight and the lowest (110 g) skin weight was recorded from PG Cha-004. Maximum number of arils per fruit (530) was observed from the germplasm PG Cha-002 while minimum (450) aril was recorded from PG Cha-004. Weight of single aril (0.33 g) was noted maximum in PG Cha-004 whereas minimum (0.33) aril weight was observed in PG Cha-002. PG Cha-004 gave maximum edible portion (51.2%) whereas the minimum (32.2%) edible portion was obtained from PG Cha-002. Among these germplasm, PG Cha-04 was found better. This experiment will be continued for drawing conclusion.

Evaluation of cowa germplasm at Rahmatpur

M. R. Islam, S. D. Setu, S. Hasna, M. G. Kibria and M. R. Uddin

An experiment was conducted at RARS, BARI, Rahmatpur, Barishal to conserve it and to popularise among the people as well as release as a variety. Ten germplasm of cowa (GC Rah-01, GC Rah-02, GC Rah-03, GC Rah-04, GC Rah-06, GC Rah-09, GC Rah-14, GC Rah-17, GC Rah-18 and GC Rah-19) were included in this study. One year old seedlings of cowa genotypes were planted in July 2008 at a spacing of 3.5 m×3.5 m. Wide variations in growth characteristics among the germplasm were found. Among the germplasm, the highest plant height was attained in GC Rah-04 (7.55m) and the lowest plant height in GC Rah-018 (1.0 m). The highest number of fruits per plant was found in GC Rah-09 (2864) and the lowest number of fruits per plant was obtained from GC Rah-18 (25). The highest individual fruit weight was found in GC Rah-03 (65.61 g) and the lowest fruit weight was recorded in GC Rah-02 (35.61 g). The highest fruit length was found in the germplasm GC Rah-03 (4.25 cm), while the lowest fruit length was recorded in GC Rah-02 (3.82 cm). The highest fruit breadth was found in GC Rah-10 (4.50 cm) and the lowest fruit breadth was noted in GC Rah-07 (3.40 cm). The highest number of bulb per fruit was found in GC Rah-02 (7.40) and the lowest number of bulb per fruit was manifested in GC Rah-05 (5.60). The highest edible portion was found in GC Rah-03 (70%) followed by GC Rah-02 and GC Rah-09 (69%). The highest fruit yield was manifested in the germplasm GC Rah-09 (166.86 kg/plant) followed by GC Rah-03 (147.29 kg/plant) and the lowest fruit yield was found in GC

Rah-18 (1.16 kg/plant). On the basis of fruit yield, the germplasm GC Rah-09 (166.86 kg/plant) and GC Rah-03 (147.29 kg/plant) were found superior. To confirm the findings, the experiment will be continued.

Evaluation of cowa germplasm

M. R. Karim, M. I. A Howlader, N. Akter and E. Mahmud

Three cowa germplasm viz. GC Leb-01, GC Leb-02 and GC Leb-03 were evaluated at the RHRS, Lebukhali, Dumki, Patuakhali with a view to conserve and popularize this fruit among the people as well as develop variety. One year old seedlings of cowa genotypes were planted in July 2017 at a spacing of 3.5 m x 3.5 m. Wide variations among the germplasm were found. Among the germplasm, the highest plant height was attained in GC Leb-01 (125 cm) and the lowest plant height was recorded in GC Leb-03 (110 cm). The highest base girth was found in the germplasm GC Leb-01 (39 cm) and the lowest base girth was noted in GC Leb-03 (24 cm). The highest canopy spreading was found in GC Leb-01 (280 cm and 260 cm) and the lowest canopy spreading was noted in GC Leb-02 (165 cm and 150 cm). The highest leaf length was found in GC Leb-02 (15.60 cm) and the lowest leaf length was recorded in GC Leb-01 (12.05 cm). The highest leaf breadth was found in GC Leb-01 (5.60 cm) and the lowest leaf breadth was noted in GC Leb-02 (3.50 cm). The highest number of fruits per plant was found in the germplasm GC Leb-02 (70) and the lowest fruits were noted in GC Leb-03 (40). The highest fruit weight was found in the germplasm GC Leb-02 (81.15 g) and the lowest fruit weight was recorded in GC Leb-03 (35 g). The largest fruit was found in GC Leb-02 (6 x 4.95 cm) and the smallest fruit was noted in GC Leb-03 (3.90 cm x 4.20 cm). Maximum number of bulb per fruit was found from the germplasm GC Leb-02 (6.90) and minimum number of bulb per fruit was found in GC Leb-03 (6). Maximum fruit yield per plant was recorded in CG Leb- 02 (5.68 kg). Considering all the characters, the germplasm GC Leb-02 may be released as a variety.

Evaluation of phalsa germplasm in the hilly area of Rangamati

M. Islam, M.E. Hoque and M. A. Hossain

An experiment on the evaluation of phalsa germplasm in the hill valley was conducted at the established minor fruits orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District to conserve and find out the superior phalsa genotypes in the hilly area. Four phalsa germplasm were planted during July 2009. Maximum plant height (830 cm) was recorded in GA Rai-004 germplasm, maximum base girth (84 cm) was observed in GA Rai-001 and maximum canopy spreading ($810 \times 730 \text{ cm}^2$) was found in GA Rai-002 germplasm. Flowering and harvesting time was same for all the genotypes and it was February and June, respectively. The highest 100 fruit weight (60.2 g) was measured in the genotype GA Rai-003. Maximum fruit length (9.25 mm) was found in GA Rai-002 but maximum fruit breadth (12.09 mm) was observed in GA Rai-003. Every fruit contained two seed of all the genotypes. The highest TSS% (25.5) was found in the genotype GA Rai-002. Maximum yield (4.1 t/ha) was recorded from the genotype GA Rai-002. Maximum fruit yield per plant (9.8 kg) was recorded from the genotype GA Rai-002. Considering number of fruits per plant, fruit length and fruit yield the genotype GA Rai-002 was found promising. The study will be continued.

Evaluation of star gooseberry genotypes in Chattogram region

S. M. K.H. Chowdhury, M.G. Azam and A. S. M. Harunor Rashid

An experiment was conducted at the Agricultural Research Station, Pahartali, Khulshi, Chattogram to identify the superior star gooseberry genotypes and release as variety. There were five star gooseberry genotypes viz. PD Pah-001, PD Pah-002, PD Pah-003, PD Pah-004 and PD Pah-005 were planted in 2008-2009. Maximum plant height (7.00 m) was found in PD Pah-001 whereas minimum (5.10 m) plant height was found in PD Pah-004. The flowering time was January for PD Pah-001, PD Pah-002 and PD Pah-003; February for PD Pah-004 and PD Pah-005. Harvesting time varies from 1st week of April to mid-May for the studied genotypes. Maximum number of fruits per plant (8136) was found in PD Pah-001 followed by PD Pah-004 (7776), while minimum number of fruits (1488) was harvested from PD Pah-002. The largest fruit (14.10

mm \times 18.30 mm) was observed in PD Pah-003 whereas the smallest fruit (13.4 mm \times 16.60 mm) was found from PD Pah-004. The highest 20 fruit weight (53.0 g) was attained from PD Pah-002 and the lowest 20 fruit weight (49.0 g) was obtained from PD Pah-004. Maximum edible portion (94.98 %) was recorded in PD Pah-004 followed by PD Pah-003 (94.56%) and minimum edible portion (94.12 %) was noted from PD Pah-001. The highest fruit yield was obtained from PD Pah-001 (20.75 kg) whereas PD Pah-002 gave the lowest yield (3.94 kg). Maximum TSS was found in PD Pah-003 (9.13%) which was very good in organoleptic test. Minimum TSS (7.28 %) was recorded from PD Pah-001. Based on the TSS, fruit size and organoleptic test; PD Pah-003 was found to be superior and might be considered as a promising line for variety.

Evaluation of rose apple germplasm in Chattogram region

M.G. Azam, S. M. K.H. Chowdhury¹ and A. S. M. Harunor Rashid

An experiment was conducted at the Agricultural Research Station, Pahartali, Khulshi, Chattogram to evaluate three rose apple germplasm for identifying the best genotype for releasing as variety. The highest number of fruits (86) was found from SJ Pah-003 and the lowest number of fruits (45) was recorded from SJ Pah-001. SJ Pah-003 also provided the highest fruit weight (25.0 g), fruit length (5.07 cm), fruit breadth (3.87 cm), seed weight (4 g), seed length (2.1 cm), TSS (9.6 %) and yield (2150 g). The lowest fruit weight (18 g), fruit length (4.23 cm), fruit breadth (3.40 cm), seed weight (3 g), seed length (1.7 cm), yield (810 g) were obtained from SJ Pah-001. In the case of seed breadth and edible portion, the highest seed breadth (2.00 cm) and edible portion (85.71 %) were attained from SJ Pah-002 and the lowest seed breadth (1.50 cm) and edible portion (83.33 %) was observed in SJ pah-001. Based on the yield and yield contributing characters, SJ Pah-003 was considered as a superior line and might be selected as a superior line. The experiment will be continued for further evaluation in the next consecutive years.

Evaluation of jaboticaba germplasm

S. C. Das, M. Rahman, M. M. Uddin, J. Gomasta and B. C. Sarker

An observation was done at the Horticulture Research Farm, Breeder Seed Production Centre (BSPC), BARI, Debiganj, Panchagarh to find out the promising line of variegated jaboticaba and release as variety. Only one germplasm (PC Deb-001) was included in the studied. The plant height (4.65 m) and base girth (63 cm) were recorded. The date of bud initiation and date of full bloom of the germplasm occurred during 2nd week of February 2021 and 3rd week of February, 2021, respectively. The fruits were harvested during April 2021. The germplasm PA Deb-001 in terms of fruit weight (9.98 g), fruit length (2.41 cm), fruit diameter (2.40 cm), pulp weight (6.63 g), TSS (17 %), edible portion (66.43%) and yield per plant (20 kg) was found promising. As it was the evaluation for the first time; it needs to be continued in the next three years for concrete recommendation.

Evaluation of jaboticaba germplasm at Ramgarh

M. A. Salam and S. M. Faisal

A field trial was conducted at the Hill Tracts Agricultural Research Station, Ramgarh to select better jaboticaba germplasm in the hilly region. Five germplasm of Jaboticaba viz. EC Ram -001, EC Ram-002, EC Ram-003, EC Ram-004 and EC Ram-005 were studied. There was a lot of variability in respect to plant height, number of branch, spread of plant, fruit size, single fruit weight and edible portion. Mature fruits were harvested from the plant during April 2020. Maximum number of fruits (770/plant in 2019-2020 and 782/plant in 2020-21) was found from EC Ram-002 and weight of fruits was calculated from the same germplasm during two consecutive years. The TSS was recorded the highest (11.92%) from EC Ram-004 in 2019-20 and 12.08% from EC Ram-001 in 2020-21). Maximum fruit yield recorded from the line EC Ram-002 followed by EC Ram -003. Edible portion (%) was almost similar in all the germplasm. maximum fruit yield (385.1 kg /plant in 2019-20 and 310.6 kg/plant during 2020-21) was obtained from the line EC Ram -002 and the lowest yield was recorded in EC Ram-005 in both the year. Therefore, it has been concluded that among the germplasm EC Ram-002 was noted superior considering yield and yield contributing characters than those of other lines.

So, the germplasm of jaboticaba EC Ram-002 may be suitable for hilly region of Bangladesh.

Performance of selected water chestnut germplasm in Satkhira

M. M. Hossain and O. A. Fakir

An experiment was conducted at the Agricultural Research Station, Benerpota, Satkhira to investigate in details of the water chestnut fruits using locally available two varieties (green and red). A Field survey for feasibility studies was conducted in order to select appropriate site and farmers for adaptive trial at Debhata, Kaligonj and Tala upazila of Satkhira. A field survey was conducted at Debhata, Kaligonj and Tala upazila of Satkhira to collect bench mark information about water chestnut. After conducting morphological studies and considering farmers field data, two types of water chestnut germplasm were collected from five different locations of Satkhira in 2020-21. Based on peel colour, two types of water chestnut fruit germplasm were collected from five locations of Satkhira during 2020-21. There was marked variation in fruit length. Fruit length was recorded 4.45 cm in red type and 3.75 cm in green type. Besides, fruit breadth was 2.70 cm and individual fruit weight was 18.60 g obtained from red type water chestnut. But, TSS was 5.50% recorded from green peeled chestnut. Between the germplasm, red type water chestnut gave the most satisfactory performance over green one. It was the first year experiment, so this will be continued for final conclusion.

Evaluation of water chestnut germplasm

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

Three lines of water chestnut such as TB Jam-001, TB Jam-002 and TB Jam-003 were evaluated at the Regional Agricultural Research Station, Jamalpur to test their potentiality and release as variety for commercial cultivation. The germplasm were planted in March 2020. Stem length ranged from 1.85 to 2.43 m in different germplasm. The highest (2.43 m) stem length was observed in TB Jam-001 and the lowest (1.85 m) stem length was found in TB Jam-003. The highest fruit weight was found in TB Jam-001 (18.8 g) and the lowest fruit weight was found in TB Jam-003 (9.2 g). Fruit length

ranged from 2.5 to 3.8 cm. The highest yield per hectare was observed in TB Jam-001(95.5 t) and the lowest yield per hectare was found in TB Jam-003 (78.8 t). TB Jam-001 performed the best in respect of growth and yield parameters such as stem length, leaf length, leaf breadth, petiole length, individual fruit weight, fruit length, fruit breadth and yield. The experiment would be continued.

Evaluation of minor fruit germplasm at Jaintapur

F. Ahmed, M.H.M.B. Bhuyan, J.C. Sarker and S.M.L. Rahman

The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet to know the performance and adaptability and to conserve minor fruit germplasm as well as find out suitable varieties for the northeastern region of Bangladesh. There are 10 types of minor fruit of different ages collected from different parts of Bangladesh and will be planted in June to August 2021. Plant height, canopy spreading, and base girth were 120 cm, 42 in E-W and 28 in N-S cm phase and 1.0 cm, respectively were observed in mangosteen germplasm. In case of monkey jack, plant height 112 cm, canopy spreading in E-W 55 cm and N-S 47 cm and base girth 1.0 cm were also observed. Plant height 120 cm, canopy spreading E-W:40 cm and in N-S:45 cm and base girth 1.0 cm were recorded in jamun germplasm. These three germplasm are relatively fast-growing than other minor fruits germplasm. On the other hand, wood apple is relatively slow-growing than all the germplasm. Wood apple attained the lowest plant height (48 cm), lowest base girth (0.3 cm) as well as lowest canopy spreading in E-W (15 cm) and N-S (18 cm) direction. The experiment will be continued.

Evaluation of dragon fruit germplasm in Rangamati hilly area

M. Islam, M.E. Hoque and M. A. Hossain

An experiment with two dragon fruit germplasm with BARI Dragon fruit-1 as check was conducted at the Hill Agricultural Research Station, Raikhali, Rangamati to observe the performance of some potential dragon fruits lines to develop high yielding and better quality dragon fruit variety for

Bangladesh. The cuttings were transplanted in November 2015 maintaining 2.5 m × 2.5 m spacing. Maximum individual fruit weight (470 g) was recorded from HU Rai-001 followed by HU Rai-002 (415 g) but minimum (272 g) fruit weight was recorded in the check variety BARI Dragon fruit-1. Maximum fruit length (12.7 cm) was found in HU Rai-002 followed by HU Rai-001 (12.5 cm). On the other hand, minimum fruit length (8.3 cm) was found in the check variety BARI Dragon fruit-1. Maximum fruit breadth (8.7 cm) was observed in HU Rai-001, whereas minimum (8.0 cm) fruit breadth was noted in HU Rai-002 and BARI Dragon fruit-1. Maximum number of fruits per pillar (64) was observed in the check variety BARI dragon fruit-1 followed by HU Rai-002 (60) and minimum number of fruits per pillar was found in HU Rai-001 (56). Maximum TSS (12.1%) was found in both HU Rai-001 and HU Rai-002 while the lowest (9.1%) TSS was found in the check variety BARI dragon fruit-1. Maximum fruit peel thickness (5 mm) was observed in HU Rai-002 followed by HU Rai-001 (4 mm), whereas minimum (3 mm) peel thickness was observed in the check variety BARI Dragon fruit-1. Similarly, maximum fruit peel weight (130 g) was recorded from HU Rai-002 followed by HU Rai-001 (117.5 g) but minimum (65 g) peel weight was found in BARI Dragon fruit-1. The highest edible portion (76.1%) was obtained from BARI Dragon fruit-1 followed by HU Rai-001 (75.1%) whereas the lowest (68.7%) edible portion was found in HU Rai-002. The germplasm HU Rai-002 was white fleshed fruit but others were red fleshed. The highest yield (42.1 t/ha) was obtained from HU Rai-001 followed by HU Rai-002 (39.8 t/ha) whereas the lowest (27.9 t/ha) yield was recorded in the check variety BARI Dragon fruit-1.

Evaluation of dragon fruit germplasm at Jaintapur

J.C. Sarker, M.H.M.B. Bhuyan, F. Ahmed and S.M.L. Rahman

The study was conducted at the Citrus Research Station (CRS), Jaintapur, Sylhet to evaluate the dragon fruit germplasm for release white fleshed as well as more improved varieties. Three dragon fruit germplasm were collected from different areas and abroad such as HC Joy-001 was collected from

BARI Headquarter, Gazipur, HU Jai-002 was collected locally as well as HM Jai-003 was collected from Thailand and planted at the research field of Citrus Research Station, Jaintapur, Sylhet with a distance of 3×3 m² spacing with concrete pole. Number of side branches was found maximum (23) in HU Jai-002 and minimum (16) number of side branches was found in HM Jai-003. Flowering duration was recorded from 24 May to 28 May among the germplasm. The heaviest fruit (398.3g) was recorded in HU Jai-002 while the lightest fruit was produced in HM Jai-003 (185.5 g). The largest fruit (7.8 × 7.8 cm²) was recorded in HU Jai-002 whereas the smallest (7.6 × 5.6 cm²) fruit in HM Jai-003. Maximum number of fruits was recorded in HU Jai-002 (24) with higher yield per plant (3.42 kg) while the minimum number of fruits and yield per plant was found in HM Jai-003 (12 and 2.2 kg, respectively). Maximum TSS (12.7%) was observed in HM Jai-003 while minimum (11.5%) in HC Joy-001. Maximum edible portion (84.56%) was recorded in HM Jai-003 whereas the lowest (80.43%) was noted in HC Joy-001. HU Jai-002 was found the best in respect to fruit weight, fruit size and yield but in consideration of edible portion, TSS as well as extraordinary yellow-skinned white flesh, HM Jai-003 was observed as the best one. Further evaluation may be needed for releasing as a variety.

Evaluation of cashew germplasm

M. Islam, M.E. Hoque and M. A. Hossain

An experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District to test the potentiality of cashew nut and release for commercial cultivation as well as strengthen the base of the fruit industry of our country. A total of six local and exotic germplasm were planted in June 2019. The exotic germplasm showed the superiority over local germplasm among all the growth parameters. Maximum plant height (437 cm) was recorded in AO Ex Rai-036 germplasm and the highest base girth (22 cm) was noted in AO Ex Rai-001, AO Ex Rai-034 and AO Ex Rai-036. Maximum canopy spreading (375 × 400 cm²) was also found in AO Ex Rai-036 germplasm. All the germplasm produced fruits this year. The highest number of fruit was found in AO Ex Rai-001. The number of fruits per plant ranged between 5 to 56.

All the germplasm produced fruits this year. The highest number of fruits was found in AO Ex Rai-001. The number of fruits per plant ranged between 5 to 56. This is 2nd year experiment. Some plants are at vegetative stage and some are at bearing stage. The experiment will be continued.

Evaluation of promising cashewnut germplasm at Ramgarh

M. A. Salam and S. M. Faisal

Ten promising cashewnut germplasm were evaluated at the Hill Tracts Agricultural Research Station, Ramgarh in order to develop a variety. The highest plant height (11.08 m) was recorded from AO Ram-010 but maximum base girth (151.6 cm) and maximum number of main branches (4.0) were found in AO Ram-008 and AO Ram-001, respectively. The line AO Ram-001 has the highest canopy spreading in E-W direction (11.62 m) and the highest canopy spreading in N-S direction (14.03 m) was observed in AO Ram-008, respectively. The line AO Ram-001 produced maximum number of fruits (1910/plant) followed by AO Ram-005 (1515/plant) while bigger nut (5.6 g) produced by the line AO Ram-009. Maximum nut yield (9.3 kg/plant) was obtained from the line AO Ram-001 and maximum edible portion of nut (36.8%) was recorded in AO Ram-010. Considering nut yield and yield contributing characteristics AO Ram-001 was found the best. The experiment will be continued.

Evaluation of coffee germplasm in Chattogram region

M.G. Azam, S. M. K.H. Chowdhury and A. S. M. Harunor Rashid

An experiment was conducted at the Agricultural Research Station, Pahartali, Khulshi, Chattogram to evaluate ten coffee genotypes with a view to identify the best genotype for releasing as variety. Ten coffee genotypes were collected from the hilly areas of Bangladesh and planted in 2017-2018. The germplasm were CA Pah-001, CA Pah-002, CA Pah-003, CA Pah-004, CA Pah-005, CA Pah-006, CA Pah-007, CA Pah-008, CA Pah-009 and CA Pah-010. The highest number of coffee bean (2649) per plant was obtained from CA Pah-002. On contrary, the lowest number of coffee bean (784) per tree was recorded from CA Pah-006. The

genotype CA Pah-008 yielded maximum 50 fresh bean weight (69 g) and the genotype CA Pah-001 and CA Pah-004 provided minimum 50 fresh bean weight (48 g). In case of dry bean, the highest weight (21 g) was obtained from CA Pah-008 and the lowest weight (17 g) was attained from CA Pah-001 and CA Pah-004. In case of fresh bean, the highest length was found from CA Pah-006 which was noted as 1.58 cm and the lowest fresh bean length (1.32 cm) was observed in four genotype namely CA Pah-002, CA Pah-003, CA Pah-004 and CA Pah-005. The lowest bean breadth (1.08 cm) was obtained from CA Pah-005. In the case of dry fruit, CA Pah-006 provided the highest length (1.50 cm) and CA Pah-004 gave the lowest bean length (1.27 cm). The highest dry bean yield per plant (953.64 g) was obtained from CA Pah-002. The lowest dry bean yield per tree was found from CA Pah-006 which was recorded as 297.82 g. Based on yield and yield contributing characters, CA Pah-001, CA Pah-002, CA Pah-003, CA Pah-005 and CA Pah-008 can be selected as superior lines. It was first year evaluation, further evaluation will be needed in next consecutive years.

Evaluation of coffee germplasm

M. Islam, M.E. Hoque and M. A. Hossain

An experiment on the evaluation of coffee in hill valley was conducted at the Hill Agricultural Research Station, Raikhali, Rangamati to evaluate coffee genotypes with a view to identify the best genotype for releasing as variety. Two genotypes were included in this experiment namely *Coffea arabica* and *Coffea robusta* were planted in June 2019. Maximum plant height (133.3 cm) was recorded in *Coffea robusta* germplasm. Maximum base girth (11.5 cm), canopy (115.8×113.7 cm²), leaf length (15.5 cm) and leaf breadth (7.9 cm) were found in *Coffea robusta* germplasm. On the other hand, *Coffea arabica* showed inferior performance regarding all the growth parameters. This is 2nd year experiment. Some plants are at vegetative stage and some are at bearing stage. The experiment will be continued.

Evaluation of promising coffee germplasm in the hilly region of Bangladesh

M. G. Rahman, M. A. A. Malek and M. R. Ahmad

The experiment was carried out at the existing plantation of Hill Agricultural Research Station at Khagrachari during 2019 to identify high yield potentiality and better quality coffee beans. Twenty genotypes of *Coffea canephora* (syn. *Coffea robusta*) commonly known as robusta coffee from the existing coffee orchard of HARS, Khagrachari were selected for the study. The average height of evaluated line (CC Kha-001) was medium (4.31 m) and regular bearing evergreen shrub or small tree. The average length and width of leaf was 21.50 cm and 10.08 cm, respectively with 1.82 cm of leaf petiole length. The average length and width of individual fruit was 1.31 cm and 1.19 cm, respectively. Harvesting duration of fruit was mid January to mid February. The seed colour of evaluated coffee plant (CC Kha-001) was greenish brown with roundish shape. The average length and width of individual seed were 1.08 cm and 0.96 cm, respectively. Average weight of 100 bean was 100.33 g. Average fruit weight (kg) per plant was 7.94. The present finding shows the great genetic potentiality of the studied germplasm. So, this line could be proposed for releasing as a coffee variety.

Study on floral biology and pollen preservation of avocado (*Persea americana*)

A. Anwari and B. C. Sarker

An experiment to gather knowledge about particular floral biology (behaviour: protogynous dichogamy) of avocado to optimize yield, perform appropriate crosses and also preserve pollen of avocado for future breeding programs, performed at the Fruit Research Farm of Horticulture Research Centre, BARI, Gazipur. There were 8 germplasm in the fruit research farm, among them, the germplasm PA Joy-006 (*Persea americana*) was used in this experiment. This is 1st year experiment. 0-15 unopened flower buds of different inflorescences were tagged for observation and only 4 days data have been presented in the report. Data on the following parameters such as flower type, 1st flower initiation, time of female flower opening-closing, time of male flower opening-closing etc. were collected on daily basis. Avocado has structurally perfect or complete or bisexual flowers but functionally unisexual. Female open first only for 2-3 hours then closes. The flower opens again next day and sheds pollen as male organ and

remain open for several hours, then closes permanently. The female and male organs of avocado within one flower do not function at the same time. Flowers grow in terminal panicles or clusters composed of 200-300 small, yellowish A-type flowers. Stigma of female flower was white and sticky when receptive and shriveled and brown at male stage. PA Joy-006 had A-type flower which played role as functional female and male at different time of a day followed by next day. ♀ flower starts to open from 10.30 a.m. and within 11.30 a.m., stigma becomes receptive, receptivity remains up to 12.30 p.m. and then it's started to close. Finally, the female flower closes within 4.00 p.m. and never opened as female again. Day-1 afternoon's closed female flowers remain closed overnight and up to 12.30 p.m. of the next day i.e. Day-2. Within 4.00 p.m. ♂ flowers opened, dehisced and closed for ever. Synchronization of male and female flowers of avocado is far most difficult. This is first year experimental observation. Further study is needed to gather exact knowledge about the floral biology of avocado and the experiment will be continued.

Evaluation of avocado germplasm

M. Islam, M.E. Hoque and M. A. Hossain

An experiment on the evaluation of avocado in the hill valley was conducted at the Hill Agricultural Research Station, Raikhali, Rangamati Hill District to test the potentiality of avocado and release for commercial cultivation as well as strengthen the base of the fruit industry of our country. The germplasms were planted during July, 2019. Ten germplasm were included in this study. Maximum plant height (240 cm) was recorded in PA Rai-004 germplasm, base girth (22 cm) in PA Rai-003 and canopy (246×250 cm²) was found in the germplasm PARai-004. Time of flowering was same for all the genotypes and it was in the month of February but no fruit set was occurred. This is 2nd year experiment. All the plants are at vegetative stage. The growth of all the germplasm was noted satisfactory. The experiment will be continued for further investigation.

Evaluation of avocado germplasm

S. C. Das, M. Rahman, M. M. Uddin, J. Gomasta and B. C. Sarker

An experiment was conducted at the Horticulture Research Farm, Breeder Seed Production Centre (BSPC), BARI, Debiganj, Panchagarh to evaluate two avocado germplasm. Between the two germplasm only one germplasm viz. PA Deb-001 provided fruits and the remaining germplasm namely PA Deb-002 did not produce fruit this year. The fruit weight 780.67 g, fruit length 11.80 cm, fruit diameter 10.93 cm, pulp weight 472.67 g, TSS 10.33 %, edible portion 60.52 % and yield per plant 400.00 kg were recorded in the germplasm PA Deb-001. As it was the first year observation, for further evaluation is needed to be continued in the next year.

Collection and evaluation of peach (*Prunus persica* L.) germplasm

S. C. Das, M. Rahman, M. M. Uddin, J. Gomasta and B. C. Sarker

A study was conducted at the Horticulture Research Farm, Breeder Seed Production Centre (BSPC), BARI, Debiganj, Panchagarh to evaluate the growth, flowering and fruiting behavior of five peach fruit germplasm. Three peach germplasm viz. PP Deb-001, PP Deb-002 and PP Deb-003 were included in the study. Three germplasm were of 5-7 years age and the germplasm PP Deb-005 was 3 years old. Data on the plant growth and fruit characteristics plant height, base girth, canopy spread, date of flowering, date of full bloom (at 80% flowers open), date of fruit set and harvest of fruit (tree-ripe stage), fruit length and diameter, fruit weight, pulp weight, peel weight, total soluble solids (TSS%), edible portion (%), yield per plant, seed characteristics of peach fruit germplasm were recorded. The highest individual fruit weight (98 g), fruit length (6.36 cm), fruit diameter (5.58 cm), pulp weight (84.8 g), edible portion (86.53 %) were found in PP Deb-004. The highest total soluble solids (TSS) which (11.6%) was recorded in the germplasm PP Deb-005 and maximum yield per plant (180 kg) was observed in the germplasm PP Deb-001. The lowest peel weight (6.4 g) and seed weight (2.8 g) were reported in the germplasm PP Deb-002. Considering yield and yield contributing characters all the germplasm were found promising. As it was the second year observation, for confirmation the evaluation is needed to be continued in the next year.

Project ii: Propagation Technique

Effect of time of grafting on BARI developed jackfruit varieties

M. J. Rahman, M. A. Islam and S. M. M. Rahman

An experiment was conducted at the Fruit Research Farm, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to study the effects of time and variety on the grafting success of jackfruit. There were two factors in the experiment viz. time of grafting (February, March, April, May, June, July, August, September, October, November, December and January) and variety of jackfruit (BARI Kanthal-1 and BARI Kanthal-2). Time of grafting and variety alone and in combination influenced the success of grafting and days required to sprouting. The highest grafting success (83.6%) was recorded in January grafting with BARI Kanthal-1 followed by that of February grafting with BARI Kanthal-1 (82.3%). The highest days required to sprouting were noticed in grafting done in October with BARI Kanthal-1 (28.6 days) and the lowest days required in November grafting with BARI Kanthal-1 (17.4 days). Considering grafting success, January and February were the most suitable time for cleft grafting of jackfruit.

Manipulation through grafting and pruning for dwarf shape of BARI developed mango variety

A. S. M. Yousuf Ali, M. Z. Uddin, M. K. Islam, M. M. Hossain and H. C. Mohanta

A study on manipulation through grafting and pruning for developing dwarf shape of BARI released mango variety was conducted at RHRS, Chapainawabganj. The first grafting in all the treatments was done in 29 May 2018. Second grafting was performed in the four treatments and cutting main stem 5 inch above grafting was done in the treatment T₅ in 29 May 2019. Triple grafting was done in the two treatments (T₄ and T₇) and cutting main stem 5 inch above grafting was also done in the treatment T₆ in 20 May 2020. This year, cutting main stem 5 inch above grafting was also done in the treatment T₇ in 30 May 2021. According to the treatments, cutting main stem 5 inch above grafting was done only in the treatment T₇. This is the 4th year experimental result. So, this experiment should be continued.

In-vitro propagation of guava

M. K. Jamil

The study was undertaken with a view to develop a suitable and reproducible protocol for *in-vitro* propagation of guava (*Psidium guajava* L.). Shoot tips from healthy and disease free plants of BARI Peyara-2 were used as explant and cultured on MS media supplemented with different concentrations of BAP and one concentration of GA₃ along with a control. The response of the explant varied with different concentrations of plant growth regulators. However, the highest survival percentage (88%) of explant were found in T₄ treatment i.e. MS media supplemented with BAP at 1.5 mgL⁻¹ + GA₃ at 0.5 mgL⁻¹ and the maximum number (4) of explant turned into greenish color in T₄ followed by T₅ (3) and T₃ (2) treatments of BAP along with GA₃. It was found that BAP at 1.5 mgL⁻¹ combined with GA₃ at 0.5 mgL⁻¹ on MS media performed better than all other treatments for preliminary responses of the explant. The experiment is now on going. So, it needs to be continued for the next year to obtain the final result of the experiment.

Micro propagation of papaya

M. K. Jamil

For the development of a suitable and reproducible protocol for micro propagation of papaya, shoot tips of Shahi Papaya were cultured on MS medium supplemented with different concentrations of BAP with 4% sugar. The types of responses were varied at different concentrations of BAP. Among the treatments, BAP at 4.0 mg/l (T₅) and 3.0 mg/l (T₄) were found better for shoot induction of the explants. It was found that different concentrations of BAP with 4% sugar on MS media affected micro propagation of papaya by shoot tips. Among the treatments, BAP at 3.0 mg/l and 1.0 mg/l with 4% sugar found better for shoot induction of papaya. The experiment is now on going. So, it needs to be continued for the next year to obtain the final result of the experiment.

Influence of rootstock on the growth, yield and quality of satkara

M. H. M. B. Bhuyan, S. M. L. Rahman, J. C. Sarker and F. Ahmed

The rootstock identification is a vital step towards developing a suitable propagation technique for any fruit. Three different rootstocks viz. Pummelo, Rangpur lime and Rough Lemon were selected for rootstock trial of satkara cv. BARI Satkara-1. The highest plant height (307.67 cm, base girth (26.93cm) and canopy spreading (319.00×312.33 cm) was found from Rough lemon rootstock. But maximum leaf and canopy size was found Rangpur lime rootstock (10.50×3.67 cm). Pummelo rootstock produced the highest number of branches/plant. Among the yield contributing characters Rangpur lime was found superior regarding maximum number of fruits/plant (50.21), but fruit size (10.01×90.25 mm) and individual fruit weight (250.36 g) was the highest in Pummelo root stock. But fruit yield was maximum in Rangpur lime rootstock (13.54 t/ha). This is the second year of fruiting. Final conclusion will be made after another years of evaluation.

Project iii : Cultural Management

Split application of fertilizer for young grafted jackfruit plant

M. A. Islam and M. J. Rahman

An experiment was conducted at the Fruit Research Farm of Horticulture Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to study the effects of split application of fertilizer on young grafted plants of BARI Kanthal-3. There were five fertilizer practices; total amount of N and K fertilizers applied 2 times at May and September; 4 times at May, August, November and February ; 6 times at May, July, September, November, January and March; NPK fertilizers 6 times at May, July, September, November, January and March and control (only cowdung). Data on growth characters like plant height, base girth and plant spreading of the grafted jackfruit plant were recorded. Grafted jackfruit plants are in growing condition. Higher growth and development were observed in plants treated with N and K for more times. Split application of NPK 30 g and NK 30 g applied 6 times each at May, July, September, November, January and March along with gypsum-200 g, boric acid- 20 g and cow dung @ 20 kg/plant as blanket dose exhibited the best

performances for grafted jackfruit plant of BARI Kanthal-3

Growth, yield and quality of mango as influenced by fertilizer and irrigation

Babul C. Sarker and J. Gomasta

Influence of fertilizer and irrigation on the yield and quality of mango was studied at the Fruit Research Farm of Horticulture Research Centre, BARI, Joydebpur, Gazipur. Three different levels of fertilizer like a) 100 % of the fertilizer dose (Cowdung: 25 kg; N: 230.41 g, P: 50.00 g, K: 100.00 g, S: 35.97 g, Zn: 3.60 g, B: 3.40 g), b) 175 % of the fertilizer dose, c) 250 % of the fertilizer dose and control along with two levels of irrigation (irrigations one at flowering stage and another one at pea stage of fruit and irrigations at an interval of 10 days up to maturity of fruit) were included in the study as treatments. Number of fruit set per panicle and number of fruits at harvest were noticed the highest in the treatments 250 % (27.2) and 175 % (0.83) of the fertilizer dose, respectively. Control plants exhibited minimum number of fruits retention per panicle. On 30.06.2021 maximum number of fruits (170.0) per plant were recorded from the plants treated with 250 % of the fertilizer dose combined with two irrigations one at flowering stage and another one at pea stage of fruit as compared to minimum fruits (129.96/plant) in the treatment combination of no fertilizer and two irrigations one at flowering stage and another one at pea stage of fruit.

Organic production of mango

Babul C. Sarker, J. Gomasta and M. J. Hussain

A study with three organic fertilizers i.e. vermicompost, tricompost and cowdung along with the control (no fertilizer) was performed in order to produce safe and quality fruit at the Fruit Research Farm of Horticulture Research Centre, BARI, Gazipur. In the vegetative characters, no significant variations were noticed with respect to canopy spread (N-S), length of panicle, number of secondary branch per panicle but plant height, canopy spread (E-W), length of terminal shoot and number of leaves per terminal shoot differed significantly due to organic treatments. Vegetative growth was more in the treatment vermicompost compared to other treatments. The number of

panicles per plant and number of fruit set per panicle on 11.03.2021 were recorded maximum (313.7 and 31.1, respectively) in plants treated with tricocompost. Vermicompost treated plants produced higher number of fruits (165.0) compared to those of other organic fertilizer treated plants and control. Irrespective of kinds, all the organic fertilizers performed well in terms of number of fruits, fruit weight and yield over control. Superiority was observed with respect to edible portion (79.6 %) and TSS (18.3 %) in tricocompost. The experiment will be continued owing to confirm the result.

Effect of integrated fertilizer management on growth and yield of mango (cv. Harivanga)

M. O. Hoque, A. K. Saha, M. Bodruzaman and M. Z. Uddin

An experiment was conducted at Khoragach, Mithapukur, Rangpur under Regional Agricultural Research Station, Burirhat, Rangpur with a view to find out optimum doses of organic and inorganic fertilizer enhancing the growth and yield of mango cv. *Harivanga*. Six levels of fertilizer were used in the experiment. Fertilizer levels were T₁ (Control), T₂ (Cowdung 15 kg + Urea 300 g + TSP 150 g + MoP 50 g + Zypsum 50 g + ZnSo₄ 5 g + Boron 15 g), T₃ (Cowdung 20 kg + Urea 350 g + TSP 200 g + MoP 100 g + Zypsum 100 g + ZnSo₄ 10 g + Boron 20 g), T₄ (Cowdung 25 kg + Urea 400 g + TSP 250 g + MoP 150 g + Zypsum 150 g + ZnSo₄ 15 g + Boron 25 g), T₅ (Cowdung 30 kg + Urea 450 g + TSP 300 g + MoP 200 g + Zypsum 200 g + ZnSo₄ 20 g + Boron 30 g) and T₆ (Cowdung 35 kg + Urea 500 g + TSP 350 g + MoP 250 g + Zypsum 250 g + ZnSo₄ 25 g + Boron 35 g). Maximum number of fruits per plant (225) was obtained from T₄ (Cowdung 25 kg + Urea 400 g + TSP 250 g + MoP 150 g + Zypsum 150 g + ZnSo₄ 15 g + Boron 25 g), which was at par (197.00) with T₅ (Cowdung 30 kg + Urea 450 g + TSP 300 g + MoP 200 g + Zypsum 200 g + ZnSo₄ 20 g + Boron 30 g), T₃ (Cowdung 20 kg + Urea 350 g + TSP 200 g + MoP 100 g + Zypsum 100 g + ZnSo₄ 10 g + Boron 20 g) (193.00) and T₆ (Cowdung 35 kg + Urea 500 g + TSP 350 g + MoP 250 g + Zypsum 250 g + ZnSo₄ 25 g + Boron 35 g) (160.00), while the lowest number of fruits (72.00) was found in T₁ (Control) treatment. The highest fruit yield (81.28 kg) per plant was

recorded in T₄ (Cowdung 25 kg + Urea 400 g + TSP 250 g + MoP 150 g + Zypsum 150 g + ZnSo₄ 15 g + Boron 25 g), which was at par (67.22 kg) with T₅ (Cowdung 30 kg + Urea 450 g + TSP 300 g + MoP 200 g + Zypsum 200 g + ZnSo₄ 20 g + Boron 30 g) and T₃ (Cowdung 20 kg + Urea 350 g + TSP 200 g + MoP 100 g + Zypsum 100 g + ZnSo₄ 10 g + Boron 20 g) (63.80 kg), while the lowest (22.88 kg) yield of fruits was found in T₁ (Control) treatment. However, the trial should be continued for next year.

Effect of irrigation on mango fruit cracking in Chattogram region

M.P. Haque, M.K.R. Bhuiyan, M.A. Hossain and S.K. Biswas

The study was conducted at the existing HRC Mango Orchard of Regional Agricultural Research Station, Hathazari, Chattogram to explore the optimal period of irrigation to mitigate mango fruit cracking. Five treatments were applied: T₁ (rain-fed i.e. local practice), T₂ (irrigation at flowering stage), T₃ (irrigation at fruiting stage), T₄ (irrigation at flowering and fruiting stages and T₅ (irrigation at 2 weeks interval). The highest yield (76.5 kg plant⁻¹) was found at higher frequency irrigation (T₅). Maximum irrigation (2000 litres plant⁻¹) was applied at two weeks interval irrigation (T₅). In rain-fed condition (T₁), yield was the lowest (56.8 kg plant⁻¹). The lowest number of fruit dropping (21 no. fruits) was occurred in irrigation at flowering and fruiting stages (T₄). The lowest number of cracking (15 no. of fruits) as well as the highest sweetness (TSS 24%) occurred where irrigation was applied at fruiting stage (T₃) and the benefit-cost ratio was also higher in this treatment. Irrigation at fruiting stage of mango (T₃) was more profitable, resulted in higher sweetness and lower fruits cracking although its yield was lower than the highest frequency of irrigation (T₅) at two weeks intervals. This experiment is required to be continued for the conformation of findings.

Effect of bagging and fruit thinning on the yield and quality of mango

A. Akter, M. A. Hossain, M. S. Rahman, R. Sultana and H.E.M.K. Mazed

The study was carried out at the HRC Fruit Orchard, RARS, Jamalpur to study the effect of

bagging and fruit thinning on the yield and quality of BARI Aam-3. The treatments were: Factor-A: Fruit thinning (04) viz; 15%, 30%, 45% and Control, Factor-B: Bagging (03) viz; Single layer white bag, Double Layer brown bag and Control. In consideration of effect of fruit thinning and fruit bagging, in terms of yield contributing characters of BARI Aam-3, 45% fruit thinning and fruit bagged with double layer brown bag produced the heaviest fruit (181.67 g), maximum edible portion (73.73%), more shelf life, low incidence of diseases and no insect infestation. Fruit size increased by all types of thinning compared to no thinning. Attractive fruit colour grew with both types of bagging. It could be concluded that thinning and bagging are beneficial to BARI Aam-3.

Study on the pollen viability of litchi during preservation

M. A. Islam, M. Z. Rahman, M. M. Khatun and M. J. Rahman

An experiment was carried out at the Pomology Division, Horticulture Research Center, BARI, Gazipur owing to study the pollen viability of litchi during storage. Male flowers of BARI Lichu-2 were collected at anther dehiscence stage, between 8 and 10 a.m. Collected pollens were stored at 5 different storage conditions such as; at room temperature (25-30°C) in petridish, at room temperature in desiccator, refrigerator (5-7°C), deep freezer (-20±2°C) and -80°C Deep freezer. Fresh pollen showed 47.72% viability, which had 29.33% viability after 7 days of storage in petridish. After 7 days of storage, 32.11% viable pollen was noticed when pollen was stored in desiccator at ambient temperature. Pollen viability under refrigerated condition lasted up to 60 days and it was observed 27.80%. At deep freezer (-20±2°C) condition, pollen remained viable up to 60 days, which was 35.00%. Pollen viability was tested through in-vitro germination for all the storage conditions. Pollen stored in deep freezer remained viable up to 60 days, which exhibited 27.00% germination at the same condition.

Effect of organic and inorganic fertilizers with different spacings on yield and quality attributes of guava

M. T. Islam, M. A. Quddus, B. C. Sarker, J. Gomasta and M. S. Arfin

An experiment was carried out at the Fruit Research Farm of Horticulture Research Centre, BARI, Gazipur in order to evaluate the effect of organic and inorganic fertilizer with different spacings on growth, yield and quality of guava through maximum use of land. BARI Peyara-2 was used in the study as variety. There were six levels of organic and inorganic fertilizer doses as T₁: control or farmer's practice, T₂: 100% Recommended dose/plant, T₃: 10 kg vermicompost + 10 kg cowdung + 50% Recommended dose/plant, T₄: 10 kg vermicompost + 10 kg cowdung + 25% Recommended dose/plant, T₅: 10 kg vermicompost + 75% Recommended dose/plant, T₆: 10 kg cowdung + 75% Recommended dose/plant and three types of spacing as S₁: (1.5 x 3.0) m, S₂: (2.0 x 3.0) m and S₃: (2.5 x 3.0) m. Results revealed that the highest fruit yield (16.83 kg plant⁻¹) due to highest individual fruit weight (282.02 g) and maximum number of fruits per plant (59.67) was recorded from the treatment T₅ (10 kg vermicompost + 75% Recommended dose/plant) and the lowest fruit yield (12.14 kg plant⁻¹) was noted in T₁ (control or farmer's practice). The highest fruit yield (15.41 kg plant⁻¹) was noted in S₂ (2.0 m x 3.0 m) compared to that of S₃ (2.5 m x 3.0 m) (13.87 kg plant⁻¹). The highest fruit yield (18.53 kg plant⁻¹) of guava was recorded with the combination of 2.0 m x 3.0 m spacing and 10 kg vermicompost + 75% Recommended dose/plant (S₂T₅) treatment, which was statistically at par to that of S₂T₃ (2.0 m x 3.0 m spacing and 10 kg vermicompost + 10 kg cowdung + 50% Recommended dose/plant) (17.50 kg plant⁻¹) and the least yield (11.31 kg plant⁻¹) was recorded from S₁T₁ (1.5 m x 3.0 m spacing and control or farmer's practice) treatment combination. Maximum vitamin C (mg/100g) content (366.00) was obtained in S₂T₅ (2.0 m x 3.0 m spacing and 10 kg vermicompost + 75% Recommended dose/plant) and minimum (206.00) vitamin C (mg/100g) content was noted in S₁T₁ (1.5 m x 3.0 m spacing and control or farmer's practice) treatment combination. Maximum TSS (10.30 %) was recorded from S₂T₅ (2.0 m x 3.0 m spacing and 10 kg vermicompost + 75% Recommended dose/plant) treatment combination compared to minimum (8.00%) TSS in S₁T₁ (1.5 m

x 3.0 m spacing and control or farmer's practice). This is the second year trial. The experiment will be continued owing to confirming the outcome of the study.

Application of fertilizer in coconut

M. J. Rahman, M. A. Quddus, M. T. Islam, M. A. Islam and B. C. Sarker

The experiment was carried out at the Fruit Research Farm of Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur to develop a recommendation of fertilizer for coconut. There were 5 fertilizer treatments viz. T₁ (RD): N₄₅₀P₁₀₀K₁₀₀₀S₆₃Zn₂₁B₅ per plant, T₂ (RD + 25% more): N₅₆₂P₁₂₅K₁₂₅₀S₇₉Zn₂₆B_{6.25} per plant, T₃ (RD+ 50% more): N₆₇₅P₁₅₀K₁₅₀₀S₉₃Zn₃₂B_{7.5} per plant, T₄ (FP): 20 kg cowdung per plant and T₅: Control (Native soil). The experiment was laid out in Randomized Complete Block Design (RCBD) with four replications. BARI Narikel-2 was taken for the experiment. Age of palm tree was 10-12 years at Gazipur. The highest number of initial female flowers was observed in T₃ (18.4) and the lowest number of female flowers was obtained from T₅ (10.3). Fruit set differed significantly among different treatments. The highest number of fruit per bunch was noticed in T₃ (12.4) followed by T₂ (11.8) and T₁ (10.2). The lowest number of fruit set per bunch was recorded in T₁ i.e., control (7.3). Number of fruits per plant differed significantly among the treatments. The highest number of fruits per year was observed in T₃ (156.2) and the lowest in T₅ (56.9). The highest water content was found in T₃ (1004 ml) followed by T₂ (950 ml) and T₁ (880 ml). The lowest water content in green coconut was observed in T₅ (580 ml). From five fertilizer treatments, the treatment T₃: N₆₇₅P₁₅₀K₁₅₀₀S₉₃Zn₃₂B_{7.5} was found suitable for BARI Narikel-2; 50% NPK applied at September/October and the rest 50% NPK applied at April/May is recommended. Gypsum, boron, zinc and cowdung would be applied as blanket doses at Sept/Oct.

Effect of split application of fertilizer on the harvesting time, yield and quality of ber

A. Akter, M. A. Hossain, M. S. Rahman, R Sultana, H. E. M. K. Mazed, F Sultana and B. C. Sarker

The study was carried out at the HRC Fruit Orchard, RARS, Jamalpur. The treatments were; Factor-A: fertilizer dose like F₁: Recommended dose (1222 g Urea, 1000 g TSP, 1000 g MOP, 281 g gypsum, 15 g boron and 30 Kg cowdung), F₂: 150% of the recommended dose and F₃: 200% of the recommended dose; Factor-B: split application of fertilizer like S₁: Total amount of fertilizer in one installment (at vegetative stage), S₂: Total amount of fertilizer in two installments (at vegetative stage + just after fruit set) and S₃: Total amount of fertilizer in three installments (at vegetative stage + just after fruit set+1 month after fruit set) and Variety: BARI Kul-2. A wide range of variations was observed in the treatments in terms of parameters studied). Fruit set (%) was varied from 3.21 to 4.62. Individual fruit weight ranged from 29.83 to 30.67 g, where F₂ had the maximum and F₁ got the minimum fruit weight. Fruit length varied from 4.18 to 4.37 cm. Fruit breadth varied from 3.64 to 3.89 cm. Stone weight ranged from 1.49-1.66 g. Stone length ranged from 2.26-2.36 cm. Stone breadth ranged from 1.09-1.10 cm. Edible portion varied from 94.55 to 95.03 %. TSS varied from 9.17 to 11.17 %, where F₂ recorded the maximum TSS and F₃ exhibited minimum TSS. Yield per plant varied from 34.83 to 44.33 kg, where F₂ got the maximum and F₃ had the minimum. Considering the effect of fertilizer dose and split application of fertilizer in terms of the plant characters, yield contributing characters and yield of BARI Kul-2, 150% of the recommended dose and total amount of fertilizer in two installments (at vegetative stage + just after fruit set) produced the highest yield (48.50 kg/plant).

Effect of fertilizer application on yield and quality of sweet orange

J. Gomasta, B. C. Sarker, M. Z. Rahman and M. A. Quddus

An experiment was conducted at the Fruit Research Farm, Pomology Division, Horticulture Research centre, BARI, Gazipur to find out a suitable fertilizer dose with respect to growth, yield and fruit quality of sweet orange. BARI Malta-1 was used as variety for applying treatments. The experiment was laid out in a randomized Complete Block Design with 4 replications. Four different

levels of fertilizer i.e., T₁: 100 % of the dose (N: 179 g, P: 79 g, K: 88 g, S: 18 g, Zn: 32 g, B: 1.0 g and Cowdung: 15 kg); T₂: 125 % of the dose; T₃: 150 % of the dose and T₄: 175 % of the dose per plant mentioned in the FRG, 2018 were used as treatments of the experiment. Fertilizers like cowdung, P, S, Zn and B were applied as basal dose on October 2020 just after fruit harvest and urea and MoP were applied in three splits, October 2020, March 2021 and May 2021. Plant height, base girth, north-south canopy and east-west canopy dimension of the treated plants ranged from 282.21 cm to 323.33 cm, 27.20 cm to 30.67 cm, 212.23 cm to 372.16 cm and 214.62 cm to 324.35 cm, respectively. The highest number of fruit set per plant and fruits retained per plant (30.06.2021) were recorded in plants treated with 175 % of the recommended dose per plant mentioned in the FRG' 2018 (174.33 and 87.00, respectively) which was statistically followed by plants treated with 150 % of the recommended dose. Control plants exhibited minimum number of fruits set per plant and number of fruits retained per plant (105.67 and 48.00, respectively). Nutrient must be provided for enhancing growth and yield of sweet orange. From this experiment, it was observed that applying 175 % of the recommended dose exhibited the best results.

Effect of vermicompost on growth, yield and quality of sweet orange

S. D. Setu, M. R. Islam, S. Hasna, M. G. Kibria, and M. R. Uddin

A field experiment on sweet orange (*Citrus sinensis* L.) plant was conducted at the Regional Agricultural Research Station (RARS), Rahmatpur to investigate the effect of vermicompost on growth and fruit yield of sweet orange. There were four treatments comprising T₁: 100 % of the recommended fertilizer dose per plant (FRG, 2018); T₂: 100 % of the recommended fertilizer dose plus 10 kg vermicompost; T₃: 100 % of the recommended fertilizer dose plus 20 kg vermicompost; T₄: 100 % of the recommended fertilizer dose plus 30 kg vermicompost. All the treatments were significantly different from the control on all the growth and yield parameters.

Data revealed that, plant height was recorded maximum in the plants treated with 100 % of the recommended dose and maximum base girth was noticed in plants treated with 100 % of the recommended dose and 100% of the recommended dose plus 10 kg vermicompost simultaneously. The highest number of fruits per plant was counted in plants treated with 100 % of the recommended dose plus 30 kg vermicompost (104.00) which was statistically followed by 100 % of the recommended dose plus 20 kg vermicompost (103.33). Individual fruit weight was maximum in plants treated with 100 % of the recommended dose plus 30 kg vermicompost (147.67 g). The highest fruit yield and TSS in plants treated with 100 % of the recommended dose plus 30 kg vermicompost were observed to be 15.35 kg/plant and 10.70 %, respectively. Minimum number of fruits per plant and fruit yield (97.33 and 13.32 kg/plant, respectively) was recorded in plants treated with only 100 % of the recommended dose per plant where no vermicompost was added. From the experimental results, it revealed that vermicomposting is a good source of nutrient in enhancing growth and fruit yield of sweet orange. and hence applying 100 % of the recommended dose plus 30 kg vermicompost exhibited the best results.

Effect of rootstock and spacing on sweet orange

M. M. H Bhuiyan and M. H. Rahman

The field experiment was conducted at the fruit orchard of Regional Agriculture Research Station, Cumilla to observe the performance of different root stocks and spacing on the growth and yield of sweet orange (BARI Malta-1). The experiment was initiated in 2016. Five rootstocks like Rough lemon, Rangpur lime, Pummelo, Cleopetra mandarin and Calamansi were evaluated under the experiment. It was observed that plant height and plant volume of BARI Malta-1 was influenced by different root stocks and spacing. The tallest plant was noted in 3 m × 3 m spacing with Rangpur lime root stock. Rangpur lime rootstock also showed better performance concerning yield and yield attributes of BARI Malta-1. First fruit harvesting was done in 2019-20. The plant height and plant volume indicated that Rangpur lime, Calamansi and Rough Lemon root stocks performed better over other treatments. But

Rangpur lime rootstock not only showed better performance regarding vegetative parameters but also yield and yield attributes of BARI Malta-1. This experiment is on-going and after completion of the experiment suitable rootstock and spacing will be identified.

Effect of different doses of glufosinate-ammonium 88 % (Expert 88 WDG) for controlling weed in citrus field

M. Z. Rahman, S. M. M Rahman and B. C. Sarker

A field trial was conducted at the Fruit Research Farm of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to find out the optimum dose of herbicide to control weed in the citrus field. Five treatments i.e. T₁: spraying of expert 88 WDG @ 2.5 g/litre of water, T₂: spraying of expert 88 WDG @ 3.0 g/litre of water, T₃: spraying of expert 88 WDG @ 3.5 g/litre of water, T₄: Two hand weeding at 25 and 50 DAE (Days After Establishment) and T₅: no spray (control) were included in this study. Number of weed/m² and weed control efficiency (WCE) were influenced by different treatments. Maximum (144 and 210) weeds/m² was recorded in control plot at 25 and 50 DAE, respectively and minimum 29 weeds/m² were recorded in T₄ followed by T₃ treatment (33 weeds/m²), respectively. The highest weed control efficiency 60.00 % and 60.26 % were found in T₃ treatment at 25 DAE followed by T₄ treatment (59.65 % and 56.62 %) in the field-1 and field-2. The results revealed that spraying of herbicide (Expert 88 WDG @ 3.5 g/litre of water) was most effective in controlling weeds up to 25-35 days of herbicide spraying. The herbicide action was shown quickly after spraying of a day.

Effect of split application of fertilizer on growth and yield of golden apple (var. BARI Amra-1)

J. Gomasta, B. C. Sarker and M. T. Islam

Influence of fertilizer dose and its application method on the growth and yield quality of BARI Golden Apple-1 was studied at the Fruit Research Farm of Horticulture Research Centre, BARI, Joydebpur, Gazipur. Three different levels of fertilizer i.e. F₁: 100 % of the dose (N: 100 g, P: 50 g, K: 90 g, S: 15 g, B: 1.5 g and Cowdung: 15 kg); F₂: 150 % of the dose and F₃: 200 % of the dose per plant mentioned in the FRG, 2018 in combination

with four application methods were used as treatments in the experiment. All the fertilizers except urea and MoP were applied during final land preparation as basal dose and the rest of urea and MoP are being applied in splits as per treatments. Urea and MoP were splitted I₁: twice (September and April), I₂: thrice (September, March-April and May-June) and I₃: four times (September, November, March-April and May-June) and the other application method was I₀: the application of whole urea and MoP at a time (September-October). Harvesting is not completed yet. Among the collected data superiority in number of fruits retained per panicle (3.44) was recorded from plants treated with 150 % of the dose per plant mentioned in the FRG, 2018. Control plants always exhibited minimum number of fruits per panicle. The highest number of panicles per plant (10.00) and fruits retained per panicle (11.53) were counted in plants received 200 % of the fertilizer dose per plant mentioned in the FRG, 2018 in combination with urea and MoP were applied twice and the lowest number of panicles per plant (4.00) and fruits retained per panicle was recorded (4.04) in plants where 100 % of the dose per plant mentioned in the FRG, 2018 was applied at a time. Yield attributes responded significantly with the increase of fertilizer doses and splitting of urea and MoP.

Growth, yield and quality as influenced by split application of fertilizer on BARI Amra-2

B. C. Sarker, J. Gomasta and M. Torikul Islam

Influence of fertilizer dose and its application method on the growth and yield quality of BARI Golden Apple-2 was studied at the Fruit Research Farm of Horticulture Research Centre, BARI, Joydebpur, Gazipur. Three different levels of fertilizer i.e., F₁: 100 % of the dose (N: 100 g, P: 50 g, K: 90 g, S: 15 g, B: 1.5 g and Cowdung: 15 kg); F₂: 150 % of the dose and F₃: 200 % of the dose per plant mentioned in the FRG, 2018 in combination with four application methods were used as treatments in the experiment. All the fertilizers except urea and MoP were applied during final land preparation as basal dose and the rest of urea and MoP are being applied in splits as per treatments. Urea and MoP were splitted I₁: twice (September and April), I₂: thrice (September, March-April and May-June) and I₃: four times (September,

November, March-April and May-June) and the other application method was I_0 : the application of whole urea and MoP at a time (September-October). Harvesting as well as data collection on yield and post-harvest attributes are not completed yet. Superiority in number of fruit retention was recorded from plants treated with 200 % of the dose per plant mentioned in the FRG, 2018. Control plants always exhibited minimum number of fruits per panicle. The highest number of panicles per plant (39.69) and fruits retained per panicle (5.45) were counted in plants received 200 % of the fertilizer dose per plant mentioned in the FRG, 2018 in combination with urea and MoP which were applied thrice (F_3I_2) and 200 % of the fertilizer dose per plant mentioned in the FRG, 2018 in combination with urea and MoP applied twice, respectively.

Effect of fertilizer dose on growth, yield and quality attributes of wax apple

M. T. Islam, M. A. Quddus, B. C. Sarker, M. S. Arfin and M. A. Islam

An experiment to find out the optimum fertilizer dose for better growth, yield and fruit quality of wax apple and to increase fertilizer uptake was performed at the fruit research field of Horticulture Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. BARI Jamrul-3 was used as variety in the experiment. The experiment was laid out in a randomized complete block design with 3 replications. Four treatments were considered in the study with different levels of fertilizer as T_1 : control or farmer's practice, T_2 : 100 % Recommended dose per plant (cowdung₁₀ kg, Urea 304 g, TSP 300 g, MoP₄₀₀ g, gypsum 100 g, zinc sulphate₁₉ g and boric acid 18 g), T_3 : 125 % Recommended dose per plant (cowdung_{12.5} kg, Urea 380 g, TSP 375 g, MoP₅₀₀ g, gypsum 125 g, zinc sulphate₂₄ g and boric acid 23 g) and T_4 : 150 % Recommended dose per plant (cowdung₁₅ kg, Urea 456 g, TSP 450 g, MoP₆₀₀ g, gypsum 150 g, zinc sulphate₂₉ g and boric acid 27 g). Results revealed that plant growth in terms of plant height, base girth, tree volume, horizontal canopy spread in N-S and E-W direction (4.30 m, 53.50 cm, 67.78 m³, 5.35 m and 5.63 m, respectively) was recorded maximum in plant, which were treated with 150 % Recommended fertilizer dose and minimum

number was noted from control or farmer's practice. The highest fruit yield (52.11 kg plant⁻¹) due to the highest individual fruit weight (50.50 g) and maximum number of fruits per plant (1034) was found in the treatment T_4 (150 % Recommended fertilizer dose per plant) and it was followed by T_3 and T_4 treatments. The least fruit yield was observed in T_1 (control or farmer's practice) (28.48 kg plant⁻¹). Maximum TSS (%) was noted from the treatment T_4 (6.88) and the minimum TSS (%) was recorded in T_1 (5.50). The highest increase in terms of all the growth parameters of BARI Jamrul-3 over control was noted from the treatment T_4 (150 % of the recommended fertilizer dose per plant).

Effect of fertilizer on flowering and fruit drop in coconut

M. J. Rahman, M. A. Quddus, M. T. Islam, M. A. Islam and B. C. Sarker

The experiment was carried out at the Fruit Research Farm of Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. There were 5 fertilizer treatments viz., T_1 (RD): $N_{450}P_{100}K_{1000}S_{63}Zn_{21}B_5$ per plant, T_2 (RD + 25% more): $N_{562}P_{125}K_{1250}S_{79}Zn_{26}B_{6.25}$ per plant, T_3 (RD+ 50% more): $N_{675}P_{150}K_{1500}S_{93}Zn_{32}B_{7.5}$ per plant, T_4 (FP): 20 kg cowdung per plant and T_5 : Control (Native soil). The experiment was laid out in Randomized Complete Block Design (RCBD) with four replications. BARI Narikel-2 was taken for the experiment. Age of palm tree was 10-12 years at Gazipur. The highest number of initial female flowers was observed in T_3 (18.4) and the lowest number of female flowers was obtained from T_5 (10.3). Fruit set differed significantly among different treatments. The highest number of fruit per bunch was noticed in T_3 (12.4) followed by T_2 (11.8) and T_1 (10.2). The lowest number of fruit set per bunch was recorded in T_1 i.e., control (7.3). Number of fruits per plant differed significantly among the treatments. The highest number of fruits per year was observed in T_3 (136.2) and the lowest in T_5 (56.9). The highest water content was found in T_3 (1004 ml) followed by T_2 (950 ml) and T_1 (880 ml). The lowest water content in green coconut was observed in T_5 (580 ml). From five fertilizer treatments, the treatment T_3 : $N_{675}P_{150}K_{1500}S_{93}Zn_{32}B_{7.5}$ was found suitable for

BARI Narikel-2; 50 % NPK applied at September/October and rest of the 50 % NPK applied at April/May is recommended. Gypsum, boron, zinc and cowdung would be applied as blanket doses at Sept/Oct. Before use of fertilizer, sanitation i.e. cleaning 2 times at September/October and April/May must be done.

Effect of fertilizer on flower and fruit drop in coconut

M. R. Islam, M. J. Rahman, S. D. Setu, S. Hasna and M. R. Uddin

The study was conducted at Regional Horticultural Research Station, RARS, Rahmatpur, Barishal to evaluate the effect of fertilizer on flower and fruit drop in coconut. The experiment was carried out in the coconut orchard (cv. BARI Narikel-2) which was established 25-30 years ago at a distance of 8 m \times 8 m in a square system and following RCBD with three replications. There were five treatments, i.e., T₁ (RD): N₄₅₀P₁₀₀K₁₀₀₀S₆₃Zn₂₁B₅ g/tree/year, T₂ (RD + 25% more): N₅₆₂ P₁₂₅K₁₂₅₀S₇₉Zn₂₆B_{6.25} g/tree/year, T₃ (RD + 50% more): N₆₇₅P₁₅₀K₁₅₀₀S₉₃Zn₃₂B_{7.5} g/tree/year, T₄: PF (20 kg cowdung) and T₅: Control. The highest plant height was observed in the treatment T₄ (19.15 m) whereas the lowest one was noted in the treatment T₅ (17.44 m). The highest base girth was found in the treatment T₂ (1.31 m) and the lowest base girth was noted in T₄ (1.12 m). The highest number of leaves per plant was 30.33 in the treatment T₂ and the lowest one was in the treatment T₂ (23.67). The highest number of bunch per plant was counted in the treatment T₂ and T₃ (10) where the lowest in T₁ and T₅ (7.67). The highest length was observed in the treatment T₂ (95.91cm) and the lowest one was noticed in the treatment T₁ (70.95 cm). The highest number of fruit per bunch was observed in the treatment T₂ (10.54) followed by T₃ (9.87). The lowest number of fruit per bunch was observed in the treatment T₅ (5.35). There was a significant difference in the number of nut per plant. The higher nut number was found in the treatment T₂ (105.73) and the lowest one was observed in the treatment T₅ (41.20).

Response of strawberry to organic and inorganic fertilizer

M. A. Quddus, M. A. Siddiky, M. Rahman and M. O. Kaisar

Strawberry is responsive to organic and inorganic fertilizers. Hence, an experiment on strawberry was conducted in research field of RARS, BARI, Cumilla to evaluate the combined effect of organic and inorganic fertilizers on yield and quality of strawberry. Eight treatments were tested in this trial. The treatments were T₁= Control, T₂= 100 % RDF (FRG, 2018), T₃= 125 % RDF + 5 ton vermicompost ha⁻¹, T₄= 125 % RDF + 3-ton poultry manure ha⁻¹, T₅=125 % RDF+5 ton cowdung ha⁻¹, T₆= 75 % RDF+5 ton vermicompost ha⁻¹, T₇= 75 % RDF + 3-ton poultry manure ha⁻¹, T₈= 75 % RDF + 5 ton cowdung ha⁻¹ including blanket dose 8 kg Mg ha⁻¹. The experiment was set up in a randomized complete block design with three replications. Results showed that the treatment T₄ produced the highest strawberry fruit yield (4.33 t ha⁻¹) followed by T₅ treatment. The lowest fruit yield (3.06 t ha⁻¹) was found in control treatment. Most of the cases, yield attributes were more pronounced in the T₄ treatment. The highest TSS (⁰Brix 6.84) was estimated in T₄ treatment. So, the result suggests that application of 125 % RDF with 3 t ha⁻¹ of poultry manure along with blanket fertilizer of Mg 8 kg ha⁻¹ can support to get higher yield and improve the quality of strawberry. Combination of organic and inorganic fertilizer at 125 % of recommended dose with 3 t poultry manure ha⁻¹ has led to achieve the highest yield of strawberry. Most of the yield and yield attributes of strawberry were performed better in the treatment receiving the combination of 125 % of recommended dose with 3 t poultry manure. Hence, the result suggests that combined application of at 125 % recommended of inorganic fertilizer dose with 3 ton poultry manure ha⁻¹ can support to get maximum yield and quality improvement of strawberry. This is the first year experiment. It will be continued in next year.

Effect of stem pruning on the growth and yield of dragon fruit

A. Akter, M. A. Hossain, M. S. Rahman, R. Sultana and H. E. M. K. Mazed

The study was carried out at the HRC Fruit Orchard, RARS, Jamalpur to study the effect of stem pruning on the growth and yield of dragon fruit. The treatments were: T₁: Only mother stem allowed up to trellis; T₂: Two stems allowed up to trellis (with mother stem); T₃: Three stems allowed

up to trellis (with mother stem); T₄: Four stems allowed up to trellis (with mother stem); T₅: Five stems allowed up to trellis (with mother stem) and T₆= Control. In consideration of effect of stem pruning yield contributing characters of dragon fruit, only mother stem allowed up to trellis; two stems allowed up to trellis (with mother stem) and three stems allowed up to trellis (with mother stem) produced the heaviest fruits (243 g, 223 g and 222 g, respectively). Maximum edible portion (67.40 %) was found from three stems allowed up to trellis (with mother stem). The results revealed that stem pruning had an effect on yield contributing characters of dragon fruit, only mother stem allowed up to trellis; two stems allowed up to trellis (with mother stem) and three stems allowed up to trellis (with mother stem) produced the highest fruit yield. This is the 1st year result. So, the experiment will be continued in the next year for confirmation of the result.

Effect of light arrangement for off season dragon fruit production

M. G. Azam, S. M. K. H. Chowdhury and A. S. M. Harun Or Rashid

An experiment with light arrangement was conducted at the dragon fruit orchard of Agricultural Research Station, Pahartali, Khulshi, Chattogram to find out the best light arrangement in order to minimize the number of bulb for off season dragon fruit production. The light was 6 hrs (6 pm-12 pm) for each treatment. The experiment was conducted in Randomized Completely Block Design (RCBD) with 3 replications. There were four treatments viz. T₁: One bulb top of each pillar, T₂: One bulb middle of four pillar, T₃: Two bulb between the two pillars of two row and T₄: Four bulb between the two pillars of two row. T₄ required less time for flowering recorded as about 46 days followed by T₃ (47 days). Treatment T₁ required more time (65 days) for flowering. Treatment T₃ and T₄ required less time than other treatment. The maximum number of bud/ pillar (65.67) was obtained from T₄ which is statistically similar with T₃ treatment (62.55). The highest number of fruit (29.55) was obtained from T₄ which is statistically similar with T₃ treatment (29.22). The highest fruit weight (459.33 g) was obtained from T₃ treatment which is statistically similar with

T₄ (434.67 g) and T₂ (442.67 g) treatment. The highest yield/ pillar and yield/ ha were obtained from T₃ treatment which is recorded as 13.40 kg and 21.44 tons, respectively. Treatment T₃ can be considered as the best light arrangement for off season dragon fruit product suggested by its high BCR (2.39).

Development of a fertilizer management package for dragon fruit cultivation

M. R. Alam, M. Islam, M. A. Alam and K. U. Ahammad

A study was carried out at the Horticulture Research Center, Regional Agricultural Research Station, Jashore to develop fertilizer management package for commercial cultivation of dragon fruit. Five packages with different combinations viz. P₁ (Urea 217 g, TSP 500 g MoP 200 g and 2 kg Manure @ once in a month), P₂ (Urea 110 g, TSP 250 g, MoP 100 g and 2 kg manure @ every 4 months), P₃ (Urea 435g, TSP 1 kg and MoP 400 g/2 months), P₄ (Urea 435 g, TSP 1 kg, MoP 400 g/2 months and 5 kg manure @ every 4 months) and P₅ (Urea 72 g, TSP 88 g, MoP 40 g /4 months and 20 kg manure/year) were used as treatment in the experiment. All the parameters under study were varied significantly among the treatments except TSS. However, the treatment P₄ produced the tallest plant (2.72 m) and the shortest plant was found in the treatment P₂ (2.22 m). The number of fruits/plant was harvested maximum (15.25) in the treatment P₄ followed by the treatment P₁ (15.08) and minimum from P₅ (10.91). The longest fruit (8.83 cm) was obtained from the treatment P₄ closely followed by the treatment P₃ (8.59 cm) and smallest fruit was produced by the treatment P₅ (7.26 cm). The fruit diameter was highest in P₃ (7.59 cm) closely followed by the treatment P₄ (7.28 cm) and lowest in P₅ (6.71 cm). Individual fruit weight was observed maximum in the treatment P₄ (246.63 g) followed by P₃ (244.77 g) and the lowest was found in the treatment P₅ (183.58 g). However, the highest average yield (11.98 t/ha) was also obtained from the treatment P₄ which was closely followed by the treatment P₁ (11.54 t/ha) and on the other hand, the lowest yield was recorded in the treatment P₅ (6.43 t/ha). All the parameters varied significantly under the study among the treatments. By considering growth,

yield, yield contributing characters and qualitative characters the package P₃ and P₄ performed better compared to other treatments. However, in the first year P₁ performed better than P₃ in respect of yield but in 2nd and 3rd year P₃ and P₄ performed better. Therefore, the experiment can be repeated for one more year for confirmation of the result.

Intercropping of winter vegetables in mango orchard

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

An experiment was conducted at the Regional Agricultural Research Station, Jamalpur to evaluate the performance of winter vegetables such as radish, sweet gourd and red amaranth under mango orchard to increase vegetable production through this fallow land. The highest yield (30.50 t ha⁻¹) was found from radish, followed by red amaranth (23.82 t ha⁻¹) and lowest yield (18.25 t ha⁻¹) was found from sweet gourd under mango orchard. Radish equivalent yield was the highest (30.50 t ha⁻¹) from radish and the lowest (20.07 t ha⁻¹) yield was obtained from sweet gourd. Gross return, net return and BCR also followed the same trend of radish equivalent yield. It may be concluded that radish is the best among the three tested vegetables in respect to the fresh yield in mango orchard. It was 2nd year experiment. So, it may be repeated next year for more concrete result.

Effect of intercropping sweetgourd with dragon fruit in semi hilly sylhet region

M. A. Sumi and M. A. Habib

A field experiment was conducted at the Regional Agricultural Research Station, Akbarpur, Moulvibazar to find out the effect of intercropping sweet gourd with dragon fruit at Moulvibazar region. Three treatments were implied in this experiment named D₁, S₁ and D₁S₁, where in D₁ only dragon fruit was cultivated, in S₁ only sweet-gourd was cultivated and in D₁S₁ sweet-gourd was intercropped among dragon fruit lines. In comparison with solo cultivation of dragon fruit and intercropped cultivation of sweet-gourd and dragon fruit there showed no major variation about yield and fruit size. They had almost similar pattern of fruit yield of dragon fruit. Moreover, sweet-gourd added production of the orchard. In case of

fruit number, solo dragon fruit cultivation 6.67 and in intercropped cultivation it was 7.67, fruit yield per plant was 818.0 g and in intercrop it was 935.17 g. In case of solo sweet-gourd and intercropped sweet-gourd cultivation, fruit number was 6.33 and 6.0 respectively, yield variation was also found. The highest yield was obtained from D₁S₁ treatment which was sweet gourd intercropped with dragon fruit where dragon fruit yield was 1039.07 kg/ha and sweet-gourd yield was 10145.54 kg/ha.

Project IV: Disease Management

Survey of floral malformation of mango in major mango growing regions of Bangladesh

M. M. Hossain, M. Z. Uddin, M. K. Islam, A. S. M. Yousuf Ali, M.Y. Abida and H. C. Mohanta

A study was conducted to assess the prevalence and severity of mango floral malformation. Fifty locations were visited in five upazilas of Chapainawabganj districts with the objectives to confirm the status and update the existing statistics for the future planning and management. The disorder was found widely distributed in all over the survey area. The maximum severity (6.71 %) was observed in Gomostapurupazilla followed by Nachol (6.41 %). All the traditional cultivars were more or less affected by the disease. Among the varieties the highest severity (19.23 %) was recorded from Ashwina followed by BARI Mango-3 (15.88 %). Ashwina and BARI Mango-3 is moderately susceptible (MS) while BARI Mango-1 is moderately resistant and others are tolerant variety to the malady.

Evaluation of new fungicides against anthracnose of mango

M. M. Hossain, M. Z. Uddin, M. K. Islam, A. S. M. Yousuf Ali, M.Y. Abida and H. C. Mohanta

A field trial was conducted at the Regional Horticulture Research Station, Bangladesh Agricultural Research Institute, Chapainawabganj to test the efficacy of 10 new fungicides against post-harvest anthracnose of mango fruits. None of the fungicides under investigation was able to control the disease completely. Out of 10 fungicides code no 92 and code no 558 were the best fungicides to control postharvest anthracnose

as these two fungicides were able to control 84.55 % of the disease. Although some other fungicides were able to control more than 80 % of the disease. None of the fungicides under investigation was able to control the disease completely. Out of 10 fungicides code no. 280 and code no. 558 were the best fungicides to control postharvest anthracnose as these two fungicides were able to control 84.55 % of the disease. Although some other fungicides were able to control more than 80 % of the disease. So, the fungicides that were able to control more than 80 % of the disease may be considered for recommendation for the control of mango anthracnose as the fungicides showed similar results with standard check Pencozeb 80 WP.

Characterization of novel species for degradation of propiconazole fungicide in mango

M. T. Hossain and M. K. R. Bhuiyan

Triazole fungicide like propiconazole group especially Tilt-250 EC is very effective to control the stem end rot of mango. But, Tiazole fungicide inhibits the demethylation that is serious harmful in human body. Therefore, the basic experiment has been conducted at Regional Agricultural Research Station, Hathazari, Chattogram to find out the eco-friendly antagonistic endophytic novel *Bacillus* species that might degrade the propiconazole properties. Out of ten (10) isolates, only one isolate BARI/HAT/GL6 could change the color of Tilt within 6 hr. It also showed 0.13 absorbance by 600 nm web length by deleting the absorbance of Tilt-250 EC. It seems strain BARI/HAT/GL6 has positive effect to degrade the propiconazole. The newly isolated endophytic bacterium GL6 has strong antagonism against to devastating plant fungus *Lasioidiplodiatheobromae* that actually causes the stem end rot of mango. A very clear and distinct inhibition zones were observed at *in vitro* cell bioassay. They are now subjected for sequencing preparation for novel species. Only one isolate GL6 was selected as a strong endophytic *Bacillus* species named *Bacillus velezensis* BARI/HAT/GL6 that degrade the propiconazole. Further it needs more study to finalize the actual findings.

Survey and collection of pathogen isolates of panama disease of banana

M. Afroz and L. Yasmin

In Bangladesh, the most common and widely damaging disease of banana is panama caused by *Fusariumoxysporum* f. sp. *cubense* (FOC). The survey area was covered at Bogura, Rangpur, Narsinghdi, Gazipur, Faridpur, Jashore and Cumilla only with the objectives to collect the isolates, purify and preservation of the panama causing fungus for characterization in banana production. Panama disease was found in all area surveyed. Incidence of panama disease ranged from (5-90%). The highest disease incidence (90%) was found in Chapa at Chupinagar, Shahjahanpur, Bogura (24°77'04"N, 89°50'45"E) and the lowest disease incidence (5%) was recorded in Sabri/Anupom and Plantain varieties at Gabtoli, Bogura (24°51' 54.061"N, 89°24' 57.306"E). Based on the morphological characteristics 320 symptomatic samples were collected. Among the locations, the highest disease incidence (90%) of panama was found in Chapa at Chupinagar, Shahjahanpur, Bogura (24°77'04"N, 89°50'45"E) and the lowest disease incidence (5%) of *Fusarium* wilt was recorded in Sabri/Anupom and Plantain varieties at Gabtoli, Bogura (24°51'54.061"N, 89°24'57.306"E). In case of Chapa, the disease incidence ranged 20 to 90% and in Sabri 5 to 60%. The infected roots investigated and the pathogen was identified. Isolates of *Fusariumoxysporum* f. sp. *cubense* were isolated, purified, store in slants and refrigerated. This information will be needed for further study by using molecular tools.

Fungi causal of post-harvest fruit rot of fruit and vegetable crops

L. Yasmin, M Afroz and M. M. Rahman

A survey was conducted to identify post-harvest fruit rot diseases of widely cultivated fruit and vegetable crops with their causal fungi. Diseased samples of capsicum, brinjal, tomato, cucumber, country bean, banana, straw berry, beal, grape and orange were collected from vegetable and fruit research fields of Horticulture Research Centre, BARI, Gazipur. Fungi associated with the roted fruit samples were isolated and identified following standard methodology. Species of *Fusarium* and *Alternaria*

were identified from capsicum; *Fusarium* *Alternaria* and *Diplodia* from brinjal; *Fusarium* from cucumber; *Colletotrichum* from country bean; *Fusarium*, *Chladosporium* and *Colletotrichum* from banana; *Fusarium*, *Chladosporium*, *Pestalotia*, *Aspergillus* *Penicillium*, and *Rhizopus* from straw berry; and *Fusarium*, *Chladosporium* and *Diplodia* from beal; and *Aspergillus* and *Penecilium* from grape and orange. Basd on findings of the present experiment it may be concluded that at least speciesof *Alternaria*, *Aspergillus*, *Candida*, *Chladosporium*, *Colletotrichum*, *Diplodia*, *Fusarium*, *Odiodendron*, *Penecilium* and *Rhizopus* are common causal fungi of fruit rot of fruit and vegetable crops in Bangladesh.

Survey of floral malformation of mango in major mango growing regions of Bangladesh

M.M. Hossain

A study was conducted to assess the prevalence and severity of mango floral malformation. Fifty locations were visited in five upazilas of Chapainawabganj districts with the objectives to confirm the status and update the existing statistics for the future planning and management. The disorder was found widely distributed in all over the survey area. The maximum severity (6.71%) was observed in Gomostapurupazilla followed by Nachol (6.41%). All the traditional cultivars were more or less affected by the disease. Among the varieties the highest severity (19.23 %) was recorded from Ashwina followed by BARI Aam-3 (15.88%). Ashwina and BARI Aam-3 are moderately susceptible (MS) while BARI Aam -1 is moderately resistant and others are tolerant variety to the malady. It may be concluded from the study that no orchard is free from floral malformation disease. Among the surveyed area the maximum severity (6.71 %) was observed in Gomostapurupazilla followed by Nachol (6.41 %). On the other hand, Ashwina and BARI Aam-3 are moderately susceptible (MS) while BARI mango-1 is moderately resistant and others are tolerant variety to the malady. Susceptibility of promising cultivars suggests the need to devise suitable control strategies to tackle the crux.

Evaluation of new fungicides against anthracnose of mango

M.M. Hossain

A field trial was conducted at the Regional Horticulture Research Station, Bangladesh Agricultural Research Institute, Chapainawabganj in Bangladesh to test the efficacy of 10 new fungicides against post-harvest anthracnose of mango fruits. None of the fungicides under investigation was able to control the disease completely. Out of 10 fungicides code no 92 and code no 558 were the best fungicides to control postharvest anthracnose as these two fungicides were able to control 84.55 % of the disease. Although some other fungicides were able to control more than 80 % of the disease.

Project V: Insect-Pest Management

Efficacy of different control measures against litchi mite (*Aceria litchi keifer*)

M. A. Uddin and G. M. M. Bari

The experiment was conducted at Fruit research station, Binodpur, Rajshahi to know litchi mite, its extent of damage to litchi leaves and inflorescence and the effectiveness of different management practice for controlling litchi mite. To its control, there were five treatments such as T₁ = Two pruning of infested foliage 1st on June just after harvesting of fruits and 2nd on August + Spraying of Abamectin 1.8 EC (Vertimec 1.8 EC @ 1.5 ml /l of water in February before opening flower). T₂ = Two pruning of infested foliage 1st on June after harvesting fruits and 2nd on August + Spraying of wettable Sulphur (Thiovit 80 WP @ 2 g/l of water in February before opening flower). T₃ = Two pruning of infested foliage 1st on June after harvesting of fruits and 2nd on August + Spraying of Dimethoate 40 EC (Tafgor 40 EC @ 2 ml/l of water in February before opening flower). T₄ = Two pruning of infested foliage 1st on june after harvesting fruits and 2nd on August, T₅ = Untreated control, among all the treatments, T₁ = pruning of infested foliage + one spray of Abamectin 1.8 EC (Vertimec 1.8 EC @ 1.5 ml /liter of water) resulted the lowest leaf infestation (4.01%) and showed 86.38% infestation reduction over control. Whereas, the highest leaf infestation (29.46%) was

observed in T₅ (Untreated control). Leaf infestation found ranged 6.98–10.98% in other treatments. In case of per cent infested inflorescence the lowest infested inflorescence (2.88%) was also observed in T₁ treated plant with 68.42% infestation reduction over control followed by T₂ (3.02%) and T₃ (3.65%). The highest value in per cent infestation of inflorescence was found in T₅ (9.12%). The MBCR was highest in T₁ (5.75) followed by T₄ (3.40) and T₂ (3.25) over control. All varieties are susceptible to litchi mite. Pruning of mite infested leaf and inflorescence as well as spraying of Abamectin might be promising in controlling litchi mite. The highest MBCR 5.75 was found in T₁ (Pruning + Vertimec spray). However further investigation is needed.

Efficacy of different types of baggs for management of mango fruit fly *Bactrocera dorsalis* attacking mango

M.A. Uddin and G.M.M. Bari

A research work on the fruit fly (*Bactrocera dorsalis*) of mango was conducted at Fruit Research Station, BARI, Binodpur, Rajshahi to know incidence, nature and extent of damage and effect of different control measures. There were 8 Treatments viz T₁= Bagging by polythen bag (perforated), T₂ = Bagging by butter paper bag (Perforated), T₃ = Bagging by brown paper bag (Perforated), T₄ = Bagging by mosquito net, T₅ = Bagging by mosquito net (Bag banded by Bokrom), T₆ = Bagging by China brown paper bag, T₇ = Bagging by China white paper bag and T₈ = Untreated control to evaluate their effectiveness. All types of bagging showed 0 % infestation except bagging by mosquito net which caused 24.82% infestation, on the other hand the highest 61.12% infestation was found in untreated control. Except bagging by mosquito net (59.39%), all other bagging performed the best result with 100% reduction of fruit infestation. Bagging by polythene bag showed the highest MBCR (1.9).

Survey and documentation of different insect pollinators/ visitors in different fruit crops during flowering period

M.A. Uddin and G.M.M. Bari

The present study deals with the pollinators on selected fruit crops like, wax jambu, wood apple, longan, pummelo, phalsa, ber, olive, hog plum/ golden apple and guava. In Wax Jambu, the average population was the highest (2.98) of Honey bee in decreasing order of Syrphid fly (0.79) and Flower fly (0.62). In Wood apples, the average population was the highest (3.21) of Honey bee in decreasing order of Flower fly (2.24) and Syrphid fly (1.06). In Longan, the average population was the highest (4.87) of Honey bee in decreasing order of Flower fly (2.89), Syrphid fly (0.92), Blow fly (0.85) and House fly (0.41). In Pummelo, the average population was the highest (2.11) of Honey bee in decreasing order of Carpenter bee (1.02) and Syrphid fly (0.98). In Phalsa, the average population was the highest (1.43) of Honey bee in decreasing order of Sawfly (0.92), Flower fly (0.60) and Carpenter bee (0.47). In Ber, the average population was the highest (3.10) of wasp in decreasing order of Honey bee (2.04), Flower fly (0.92), Blow fly (0.81) and House fly (0.62). In Olive, the average population was the highest (9.92) of Flower fly in decreasing order of Blow fly (5.64), House fly (1.24), Honey bee (1.02) and Wasp (0.52). In Hog plum, the average population was the highest (1.05) of Flower fly in decreasing order of Syrphid fly (0.87). In Guava, the average population was the highest (1.12) of Flower fly, in decreasing order of Honey bee (1.02), Blow fly (0.81), House fly (0.67) and Carpenter bee (0.23). Nine fruit crops were observed and two to five types of pollinators/visitors were found for each crops.

Development of management approach against litchi fruit borer (*Conopomorpha sinensis*)

M.A. Uddin and G.M.M. Bari

Two separate experiments were conducted at Fruit Research Station, BARI, Rajshahi to select fruit borer (*Conopomorpha sinensis*) tolerant litchi variety and to develop cost effective guidelines for managing this pest. For litchi varietal susceptibility test, trees of three common cultivated varieties viz. BARI Litchi-1, Bombai and China-3 with five replications were opened for fruit borer infestation up to harvest and were kept without any chemical treatment. Besides, for litchi fruit borer management, six treatment packages including

untreated control were undertaken in RCBD design with three replications. Treatment packages were such as T₁= Netting of whole tree with mosquito net (60 mesh) starting from pea stage; T₂= Netting of whole tree with mosquito net (60 mesh) starting from marble stage; T₃= Sanitation + Three sprays: 1st with Imidacloprid @1ml/L at pea stage, 2nd and 3rd with Spinosad (Success 2.5 EC) @1.2 ml/L at marble and early ripening stage; T₄= Sanitation + Three sprays: 1st with Emamectin benzoate (Heclaim 5% SG) @1g/L at pea stage, 2nd and 3rd with Lufenuron (Heron 5 EC) @1ml/L at marble and early ripening stage; T₅= Sanitation + Three spray of Emamectin benzoate (Heclaim 5% SG) @1g/L at pea, marble and early ripening stage and T₆= Untreated control. Among the tested three litchi varieties, least borer infestation 23% was observed in China 2 variety. Among the mentioned 6 treatment packages, highest fruit infestation (25% and 43% at developing and ripening stage respectively) was observed in untreated control plant. Whereas, netting the whole plant with mosquito net (60 mesh) starting from pea stage performed better results which reduced borer infestation by 89% and 95% respectively over control followed by three sprays: 1st with Imidacloprid @1ml/L at pea stage, 2nd and 3rd with Spinosad (Success 2.5 EC) @1.2 ml/L at marble and early ripening stage including sanitation reduced 65% and 83% respectively. Farmers may follow any of the tow effective and eco-friendly guidelines for managing litchi fruit borer

Development of integrated management approach against wax apple fruit flies, *Bactrocera dorsalis*

M.A. Uddin and G.M.M. Bari

Present studies were conducted at experimental farm of Fruit Research Station, BARI, Rajshahi. An experiment was conducted to select fruit fly tolerant wax apple variety. The results showed that fruit fly infestation was highest (50.6 %) in BARI Jamrul-1 followed by BARI Jamrul-3 (44.20%) whereas; least infestation (24.60%) was observed in Rajshahi local variety. Another separate experiment was laid out in RCB design with three replications to develop cost effective guidelines for managing fruit fly infestation. Five treatment packages including untreated control against fruit fly

infestation were undertaken, such as T₁= Sanitation + Attract and kill lure method + Application of Soil recharge; T₂= Sanitation + Mass trapping with Methyl-eugenol Pheromone trap + Application of Soil recharge; T₃=Sanitation + Four Spray of chemical pesticide (Cypermethrin) at 10 days' interval when mature stage of fruits; T₄= Covering of fruit brunches with polythene bag and T₅= Untreated control. Treatment, T₄ (covering of fruit bunches with polythene bag) performed better results which reduced 90% over control. Highest yield (61.42 kg) was obtained from T₁ package (Sanitation + Attract and kill lure method + Application of Soil recharge) treated plant followed by T₃ (Sanitation + Four Spray of chemical pesticide (Cypermethrin) at 10 days' interval when mature stage of fruits) treated plant. Treatment, T₁ increased 72.33% healthy fruit yield followed by treatment, T₃ (70.20%) over control. Though Treatment, T₄ reduced fruit fly infestation remarkably, it might decline fruit yield drastically due to excessive dropping. Another separate experiment was conducted from March to June 2020 to estimate fruit dropping (%) of wax apple covered with polythene bag, treated with five concentrations of Gibberellic Acid (GA₃) viz. 10 ppm, 25 ppm, 50 ppm, 75 ppm and 100 ppm; four concentrations of Hydrogen peroxide (H₂O₂) viz. 5 mM, 10 mM, 20 mM and 40 mM including untreated control. Bagging caused fruit dropping 11.61% Extra compared to open condition. Among all the Treatments, GA₃ with 25 ppm concentration resulted lowest fruit dropping (23.04%) which was decreased by 68.73% over untreated control. Again, H₂O₂ with 5 mM concentration performed best that dropped only 21.58% fruits which were decreased by 69.99% over control.

Dissemination of mango bagging with double layer brown paper bag technology for controlling fruitfly, *Bactrocera dorsalis* in high rainfall and hilly areas of Bangladesh

M. S. Hossain, M.R. Ahmad, M.A. Hossain, M.A. Hossain and M. Y. Mian

The experiment was conducted in farmers' fields of three locations such as Khagrachari and Rangamati Hill districts to disseminate and popularize the fruit bagging technology for controlling mango fruitfly in high rainfall and hilly areas. Dispersed

Randomized Complete Block design (dispersed) was followed with four treatments and four replications. The treatments were, Treatment₁= Bagging by double layer brown paper bagat six weeks before mango harvest, Treatment₂= Installation of methyl eugenol pheromone trap, Treatment₃= Foliar spray of Shobicron 425EC @ 1.5ml/L of water and Treatment₄= Control. Results revealed that bagging of mango with double layer brown paper bags showed the best performance in reducing fruitfly infestation (100%) and increasing of marketable yield over control (127.92%) and maximum marginal benefit cost ratio (5.24). From the results, it may be concluded that mango fruit bagging with double layer brown paper bags showed the best performance in reducing fruitfly infestation (100%) and increasing of marketable yield over control (127.92%) and maximum marginal benefit cost ratio (5.24). The similar results were found also found in previous three successive years. So, considering two year's result, the fruit bagging by double layer brown paper bag may be suggested as a suitable, effective and eco-friendly approach against mango fruit fly management.

Project VI: Soil and Water Management

Response of strawberry to organic and inorganic fertilizer

M. A. Quddus, M. A. Siddiky, Aatur Rahman, M. J. Hussain and M. S. Arfin

Strawberry (*Fragaria X annanassa* Duch.) is responsive to organic and inorganic fertilizers. Hence, an experiment on strawberry was conducted in fruits research field of Horticulture Research Centre, BARI, Gazipur to evaluate the combined effect of organic and inorganic fertilizers on yield and quality of strawberry. Eight treatments were tested in this trial. The treatments were T₁= Control, T₂= 100% RDF (FRG, 2018), T₃= 125% RDF+5 t vermicompost ha⁻¹, T₄= 125% RDF+3 t poultry manure ha⁻¹, T₅=125% RDF+5 t cowdung ha⁻¹, T₆= 75% RDF+5 t vermicompost ha⁻¹, T₇= 75% RDF+3 t poultry manure ha⁻¹, T₈= 75% RDF+5 t cowdung ha⁻¹ including blanket dose 8 kg Mg ha⁻¹. The experiment was set up in a randomized complete block design with three replications. Results showed that treatment T₄

produced highest strawberry fruit yield (4.98 t ha⁻¹) followed by T₃ and T₅ treatment. The highest percent fruit yield increment (45.0%) over control was achieved in the same (T₄) treatment. Most of the cases, yield attributes were more pronounced in the T₄ treatment. The highest vitamin C content (70.5 mg/100 g) also found in T₄ treatment. So, the result suggests that application of 125% RDF with 3 t ha⁻¹ of poultry manure along with blanket fertilizer of Mg 8 kg ha⁻¹ can support to get higher yield and improved the quality of strawberry. Combination of organic and inorganic fertilizer at 125% of recommended dose with 3 t poultry manure ha⁻¹ has led to achieve the highest yield of strawberry. Most of the yield and quality attributes of strawberry were performed better in the treatment receiving the combination of 125% of recommended dose with 3 t poultry manure. Hence, the result suggest that combined application of at 125% recommended of inorganic fertilizer dose with 3 t poultry manure ha⁻¹ can support to get maximum yield and quality improvement of strawberry.

Project VII: Post-Harvest Management

Postharvest storage and value addition of mango through semi solid mesocarp

M. S. Arfin and T.A.A. Nasrin

An experiment was carried out to find out the effectiveness of different preservatives (citric acid, potassium meta bi sulphate, calcium chloride, salt and ascorbic acid) on semi solid mesocarp of mango at three drying percentages (50, 60 and 70). Findings of the present study revealed that preservatives had positive effect on drying of semi solid mango mesocarp and changes occurred on colour of mango slices, nutritional and shelf life related data will be taken after COVID 19 lockdown period. Therefore, the research is needed to be done on the next year for confirmation of the results.

Standardization of ethylene dose for uniform and safe ripening of fruits using developed low-cost ethylene generator

M. S. Arfin and T.A.A. Nasrin

An experiment was carried out to find out the effective concentration of ethephon with developed

simple 'Ethylene Generator' on safe ripening and quality of banana. Bananas were harvested and exposed to ethylene gas that generated from ethephon (48 SL) by low-cost simple 'Ethylene Generator'. Five concentrations of ethephon i.e. 10, 20, 30, 40 and 50 ppm were used as source of ethylene gas. Bananas were exposed to ethylene gas for 24h at ambient storage ($27\pm1^{\circ}\text{C}$ and $70\pm5\%$ RH) condition for uniform ripening. Treatment with ethylene gas resulted in 99% fruit ripe with uniform yellow colour, desirable firmness and acceptable quality after end of three days' storage. Untreated control fruits, on the other hand, also ripened with acceptable colour and quality, but took longer time (8 days) for complete ripening. Banana peel colour changed from green to yellow after 24 hours of treatment at all treated fruits and 10 ppm found enough to triggering the ripening process of banana fruit. Tissue softening of treated banana fruits was higher in 50 ppm and lower in 10 ppm of ethephon concentration with the storage time. For distant marketing and later consumption, 10 ppm and for nearer marketing and early consumption, 20 and 30 ppm of ethephon concentration was suitable for safe ripening of banana. Findings of the present study revealed that ethephon concentration used in developed simple ethylene generator to produce ethylene gas has a positive effect on safe ripe of banana fruits. The changes occurred during ripening process of banana such as development of distinct uniform yellow skin colour were markedly enhanced by the ethylene gas, illustrating potential for commercial application for uniform ripening of bananas. In this process ethephon at very low concentration ie 10 ppm found enough to triggering the ripening process of banana fruit. The firmness of 50 ppm of ethephon concentration was lower from the first day of storage (2.525 kg) to third day of storage (0.257 kg) compared to 10 ppm of ethephon concentration of 2.775kg at 1 DAS and 0.665 kg at 3 DAS. In this point of view, it can be concluded that 10 ppm of ethephon concentration is suitable for distant marketing and later consumption (after 3 days to eat) and 20 to 30 ppm of ethephon concentration is suitable for nearer marketing and early consumption (after 2 days to eat). This is the first year's trial. Therefore, more research is needed with bulk volume and lower concentration of

ethephon to generate additional information and further confirmation of the results.

Effect of edible coating on postharvest quality of fresh cut guava

T.A.A. Nasrin and M. S. Arfin

Fresh cut guava (*Psidiumguajava*) slices were coated either with chitosan (1.5, and 2% solution, w/v) or aloe vera (AV) gel and the coatings were air dried. Coated guava slices were put in a polypropylene box and stored in refrigerator ($5\pm1^{\circ}\text{C}$ and $50\pm5\%$ relative humidity). The success of coating in retaining the postharvest quality of the fresh cut guava was evaluated by determining respiration rate, firmness, weight loss, external colour change, ascorbic acid content, total soluble solids, pH, total sugar, reducing sugar and sensory quality. Aloe vera gel or chitosan coating reduced respiration rate, weight loss and preserved firmness, ascorbic acid content, and other quality parameters, thus delaying ripening and the progress of fruit decay due to senescence or microbial attack. Furthermore, AV gel delayed the changes in external colour and retained all other postharvest quality of fresh cut guava compared to chitosan coated or uncoated ones throughout the storage. Based on all sensory, physical and chemical parameters uncoated fresh cut guava was acceptable up to 4 days, fresh cut guava coated with chitosan (1.5% and 2%) was acceptable up to 6 days and AV gel coated fresh cut guava was acceptable for up to 8 days.

Novel coconut oil and beeswax edible coating for postharvest quality maintenance of malta at ambient condition

T.A.A. Nasrin and M. S. Arfin

An experiment was conducted to assess the influence of coconut oil and beeswax edible coating on postharvest storage quality of Malta (*Citrus sinensis*) at ambient condition ($27\pm4^{\circ}\text{C}$ and $65\pm5\%$ RH). Sorted fruits were washed with drinking water; fruit surface water was removed and then coated with coconut oil and beeswax mixture (90:10 or 80:20 or 70:30) or only coconut oil. After coating, fruits were kept in crates and stored at $27\pm4^{\circ}\text{C}$ and $65\pm5\%$ RH. Weight loss, firmness, external colour (hue angle and lightness), TSS, pH, ascorbic acid, total sugar and reducing sugar were

analyzed periodically during storage. The results revealed that coconut oil-beeswax coating had a good effect on retaining ascorbic acid, reducing weight loss, and preserving firmness of Malta throughout the storage. The physical and chemical parameters of BARI Malta-1 were positively influenced by coconut oil beeswax or only coconut oil coating during storage at ambient temperature (27 ± 4) °C. Coating helps to preserve firmness, weight loss and ascorbic acid throughout the storage period.

Project VIII: Urban Horticulture

Standardization of soil media for roof gardening of guava

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana H. E. M. K. Mazed and M. Yasmin

An experiment was conducted at the RARS, Jamalpur to standardize the soil media in terms of plant growth, fruit retention as well as yield and quality of guava for roof top gardening. There were seven treatments i. e. T_1 : 50 % soil + 50 % cowdung, T_2 : 75 % soil + 25 % cowdung, T_3 : 50 % soil + 25 % sand+ 25 % cowdung, T_4 = 50 % soil + 50 % vermicompost, T_5 : 75 % soil + 25 % vermicompost, T_6 := 50 % soil + 25 % sand + 25 % vermicompost and T_7 := 100% soil. The highest tree volume (4.20 m^3) was found in 50 % soil + 50 % vermicompost followed by 50 % soil + 50 % cowdung (3.87 m^3) and the lowest tree volume (1.54 m^3) was obtained from 100% soil (control). Maximum number of fruits per plant (87.5) was observed in T_4 treatment whereas the Minimum number of fruits per plant (54.5) was observed in T_7 (control) treatment. The highest yield per plant (32.09 kg) was found in T_4 treatment followed by T_1 (27.93 kg) and the lowest yield (17.40 kg) was noticed in T_7 (control) treatment.

Standardization of soil media for roof top gardening of dragon fruit

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana, H. E. M. K. Mazed and M. Yasmin

An experiment was conducted at the RARS, Jamalpur to standardize the soil media in terms of plant growth, fruit retention as well as yield and quality of dragon fruit for roof top gardening. There

were seven treatments i. e. T_1 : 50 % soil + 50 % cowdung, T_2 : 75 % soil + 25 % cowdung, T_3 : 50 % soil + 25 % sand+ 25 % cowdung T_4 : 50 % soil + 50 % vermicompost, T_5 : 75 % soil + 25 % vermicompost, T_6 : 50 % soil + 25 % sand + 25 % vermicompost and T_7 = 100% soil. The highest tree volume (4.28 m^3) was found in 50 % soil + 50 % vermicompost and the lowest tree volume (1.91 m^3) was obtained from 100% soil (control). Maximum number of fruits per plant (9.67) was observed in T_4 followed by T_1 treatment (8.33) whereas the minimum number of fruits per plant (3.0) was observed in T_7 (control) treatment. The highest yield per plant (2.67 kg) was found in T_4 treatment followed by T_1 (2.26 kg) and the lowest yield (0.62 kg) was manifested in T_7 (control) treatment.

Project IX: Adaptive Trial

Adaptive trial of BARI developed jackfruit varieties in different regions of Bangladesh

M. J. Rahman, M. A. Islam and S. M. M. Rahman

Adaptive trial of BARI developed jackfruit varieties viz. BARI Kanthal-1 (harvested during mid-May to June); BARI Kanthal-2 (harvested during January to March) and BARI Kanthal-3 (harvested during September to June) was carried out in four locations of four districts-Gazipur, Khagrachari, Narsingdi and Mymensingh to evaluate the performances of grafted jackfruit plants in the farmer's field. Twenty-five orchards were established in the farmer's field in each location where 5 saplings of every variety were planted. In the year 2018, SreepurUpazila of Gazipur; in the year 2019, RamgarhUpazila of Khagrachari and ShibpurUpazila of Narsingdi; and in the year 2020, BhalukaUpazila of Mymensingh were taken for orchard establishment. From twenty farmers of Sreepur and Ramgarh, average data on 10 orchards of 10 farmers (F) were presented for the evaluation of adaptive trial. At Sreepur, Gazipur, maximum plant height of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were observed in F2 farmer which were 4.60 m, 4.75 m and 4.50 m, respectively. Minimum plant height of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were recorded in F10 (2.50 m), F3 (2.10 m) and F3 (2.10 m), respectively. Base girth differed greatly among the orchards. Maximum

base girth of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were observed in F1 (25 cm), F2 (34 cm) and F1 (37 cm). Minimum base girth of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were recorded in F3 (14 cm), F5 (10 d) and F3 (8 cm), respectively. Plant spreading also showed difference among the treatments.

At Ramgarh, Khagrachhari, plant height of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 also differed. Maximum plant height of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were observed in F7 (4.40 m), F4 (3.70 m) and F6 (3.70 m), respectively. Minimum plant height of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were recorded in F9 (2.70 m), F7 (2.50 m) and F2 (2.50 m), respectively. Base girth differed significantly among the treatment. Maximum base girth of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were observed in F7 (25 cm), F6 (20 cm) and F6 (22 cm). Minimum base girth of BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 were recorded in F4 and F5 (14 cm), F7 (13 cm) and F9 (12 cm), respectively. Plant spreading also showed difference among the treatments.

Project X: Horticultural Economics

Baseline study on dissemination of BARI released fruit varieties at farmer's level for increasing farm productivity

S. M. A. Shiblee, R. Islam and S.M. M. Rahman

This study has been undertaken to know the existing status of the farmers on fruit cultivation in Shariatpur district aimed at determining the benefit of the farmers from the project run by Pomology Division of HRC, BARI. Data were collected from 42 farmers from Shariatpur district using pre-designed structured questionnaires. The average total land owned by the respondent farmers was 228.41 decimal in which cultivated land was 96.46 decimal (42.23% of total land), homestead (29.29%), garden (14.55%), pond (10.18%) and fallow (3.74%). A total of 26 fruit trees were identified namely mango, jackfruit, litchi, banana, lemon, hog plum, guava, malta, wax apple, wood apple, coconut, pomegranate, papaya, ber, sapota, carambola, olive, elephant apple, pummelo, velvet

apple, cawfol, date plum, blackberry, orange, tamarind, palm tree. Except one, every respondent farmer had mango tree (98%) followed by jackfruit (69%), litchi (55%). There were 46% fruit trees in homestead and 54% fruit trees in garden and pond of the total fruit trees of the farmers. Total cash return on average was found 145,545/- Tk/ha and total variable cost on average was calculated 32,001/- Tk/ha. Therefore, gross margin on cash cost basis on average was found 113,544 Tk/ha with 4.55 benefit cost ratio (BCR). Among the fruit trees, farmers earned highest cash income from coconut tree Tk39,386/- (27.06% of total cash income) followed by mango Tk 25,280/- (17.37%). Farmers expressed their willingness to grow mango, litchi, guava, malta, sapota, jackfruit, wax apple, aonla, aashfol, hog plum, coconut, banana, papaya, carambola, pummelo, lemon, dragon, strawberry, orange, bullock's heart, custard apple, dwarf coconut, year round mango, year round guava. Farmers applied ripcord to control hopper and sumithion to control anthracnose in mango tree. Most of the farmers informed the problems of insect infestation in mango and litchi tree, tannin in jackfruit, raid of bat etc. They expressed the need of training on control of insect infestation, fertilizer management, and learning of grafting technique and wanted to get information where from they can get good quality of saplings of fruit tree.

Project XI: Maintenance and Conservation of Fruit Germplasm

Maintenance of different fruitgermplasm at HRC, RARS, Jamalpur

M. S. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

Horticulture Research Centre, RARS, Jamalpur is maintaining 2820 germplasm of 48 different crops both indigenous and exotic in the field gene bank. The fruit germplasm are mango, litchi, banana, guava, jackfruit, jujube, aonla, bael, bilimbi, bullock's heart etc. The vegetable germplasm is drumstick. The exotic germplasm are avocado, pear, tamarind, dragon fruit and tisa etc. The intercultural practices were done as and when necessary. A total of 2850 germplasm of 48 crops

both indigenous and exotic are conserved in the field gene bank up to June 2021. The field gene bank acts as a reliable source of indigenous and exotic germplasm for researcher, plant breeders, NGO, and farmers for crop improvement.

Mother orchard establishment of BARI released/popular citrus fruit varieties

M. H. M. B. Bhuyan, S. M. L. Rahman, F. Ahmed and J. C. Sarker

An experiment was conducted at citrus research station, Jaintapur, Sylhet to maintained BARI released and popular citrus fruit varieties in Bangladesh. Different citrus fruit such as mandarin, pummelo, sweet orange, Citron/ Jara lemon, lemon, Seedless lemon, lime included. The plants are in good condition. The growth is satisfactory. Regular intercultural operations are going on. The orchard will serve as the source of true type citrus sapling in near future.

Project XII: Technology Transfer

A. FT/TOT/Field Day/Workshop etc conducted during 2020-2021

Title	No. of batch	No. of participant
Trainers' Training	04	120
Farmers' Training	45	1680
Field day	14	1120
Workshop	02	140
Motivational and Study Tour	07	500
Total	72	3,560

B. Grafts and seedlings of fruits produced and distributed during 2020-2021

Sl. No.	Name of fruit crops	Production of saplings (Nos.)	Distribution of saplings (Nos.)
1.	BARI Released Jackfruit Varieties	6,352	1,989
2.	Jackfruit (local improved)	2,282	2,262
3.	BARI Released Mango Varieties	57,697	33,656

Sl. No.	Name of fruit crops	Production of saplings (Nos.)	Distribution of saplings (Nos.)
4.	Commercial Mango Varieties	1,324	760
5.	BARI Released Litchi Varieties	500	410
6.	BARI Released Litchi Varieties	13,269	9,098
7.	Litchi (local)	2,618	2,555
8.	BARI Shahi Papaya-1	5,300	2,599
9.	Papaya (local)	899	899
10.	BARI Released Guava Varieties	16,478	12,197
11.	Local Guava Varieties	1,567	1,141
12.	BARI Malta-1	17,597	15,082
13.	BARI Malta-2	750	539
14.	BARI Released Lemon Varieties	10,545	3,379
15.	Others Lemon Varieties	9,084	7,500
16.	Seedless lemon	4,700	5,174
17.	BARI Jaralebu -1	1,937	9,96
18.	BARI Kazgilebu -1	690	320
19.	BARI Released Pummelo Varieties	10,454	4,779
20.	BARI Released Mandarin Varieties	1,798	1,742
21.	BARI Released Ber Varieties	224	224
22.	BARI Released Carambola Varieties	91	36
23.	BARI Coconut-1	1,500	400
24.	BARI Coconut-2	3,012	1,360
25.	Coconut (Local)	105	57
26.	BARI Released Sapota Varieties	1,340	784
27.	BARI Released Wax jambu Varieties	2,503	1,148
28.	BARI Released Wood apple	573	173

Sl. No.	Name of fruit crops	Production of saplings (Nos.)	Distribution of saplings (Nos.)
	Varieties		
29.	BARI Released Golden apple Varieties	350	156
30.	BARI Jamun-1	50	50
31.	BARI Falsa-1	145	32
32.	BARI Longan-1	100	65
33.	BARI Longan-2	125	97
34.	BARI Lotkan-1	848	800
35.	BARI Dragonfruit-1	27,466	21,848
36.	BARI Bullock's heart-1	358	278
37.	BARI Indian olive-1	411	318
38.	BARI Velvet Apple-1	310	200
39.	Velvet Apple (Local)	519	284
40.	BARI Bael-1	250	100
41.	BARI Satkara-1	240	225
42.	BARI Sweet lime-1	58	32
43.	BARI Aonla-1	651	241
44.	BARI Pear-1	380	225
45.	BARI Passion fruit-1	258	241
46.	Cashew nut	109	109
47.	Coffee	11,918	11,431
48.	Tisha	80	50
49.	Custard apple	800	340
50.	Indian dillenia	80	50
51.	Cow fall	400	300
52.	Jaboticaba	405	242
53.	Betelnut	3,278	2,277
54.	Agar	868	698
55.	Medicinal plants	40	40
56.	Minor fruits	1,853	1,051
57.	Rootstock	49,730	5,145
Total		2,77,269	1,58,184

C. Other Activities

- Participated in Sapling Distribution Programmes, Fruit Tree Plantation Programmes, World Food Day and Exhibitions
- Provided advisory services to the fruit growers
- Supplied propagules of improved BARI developed fruit varieties for establishing BARI Technology Villages
- Supplied propagules and provided technical assistance to the selected farmers and BARI fruit tree plantation programme.

Survey of panama disease of banana and collection of its causal pathogen

M. Afroz And L. Yasmin

Abstract

In Bangladesh, the most common and widely damaging disease of banana is panama caused by *Fusarium oxysporum* f. sp. *cubense* (FOC). A survey was conducted to survey incidence of panama disease of banana and to isolate, purify, characterize and preserve isolates of causal fungus. The survey was conducted during 2017-18, 2018-19 2019-2020 and 2020-2021 in the districts of Bogura, Rangpur, Narsinghdi, Gazipur, Faridpur, Jashore and Cumilla. Incidence of panama disease was found in every surveyed area within the range of 5-90%. The highest disease incidence (90%) was found in cultivar Chapa at Chupinagar, Shahjahanpur, Bogura (and the lowest disease incidence (5%) was recorded in Sabri/Anupom and Plantain varieties at Gabtoli, Bogura.

Monitoring of post harvest diseases in common horticultural fruits and vegetables

L. Yasmin, M Afroz And M. M. Rahman

A survey was conducted to identify post harvest fruit rot diseases of widely cultivated fruit and vegetable crops with their causal fungi during October 2020 to May 2021. Diseased samples of capsicum, brinjal, tomato, cucumber, country bean, banana, straw berry, beet, grape and orange were collected from vegetable and fruit research fields of Horticulture Research Centre, BARI, Gazipur. Fungi associated with the rotted fruit samples were isolated and

identified following standard methodology. Species of *Fusarium* and *Alternaria* were identified from capsicum; *Fusarium*, *Alternaria* and *Diplodia* from brinjal; *Fusarium* from cucumber; *Colletotrichum* from country bean; *Fusarium*, *Chladosporium* and *Colletotrichum* from banana; *Fusarium*, *Chladosporium*, *Pestalotia*, *Aspergillus*, *Penicillium*, and *Rhizopus* from straw berry; and *Fusarium*, *Chladosporium* and *Diplodia* from beal; and *Aspergillus* and *Penicillium* from grape and orange.

Survey of floral malformation of mango in major mango growing regions of Bangladesh

M.M. Hossain

A study was conducted to assess the prevalence and severity of mango floral malformation during March to April 2021. Fifty locations were visited in five upazillas of Chapainawabganj districts with the objectives to confirm the status and update the existing statistics for the future planning and management. The disorder was found widely distributed in all over the survey area. The maximum severity (6.71%) was observed in Gomostapur upazilla followed by Nachol (6.41%). All the traditional cultivars were more or less

affected by the disease. Among the varieties the highest severity (19.23 %) was recorded from Ashwina followed by BARI Aam-3 (15.88%). Ashwina and BARI Aam-3 are moderately susceptible (MS) while BARI Aam -1 is moderately resistant and others are tolerant variety to the malady.

Evaluation of new fungicides against anthracnose of mango

M. M. Hossain

A field trial was conducted at the Regional Horticulture Research Station, Bangladesh Agricultural Research Institute, Chapainawabganj in Bangladesh during February to July 2021, to test the efficacy of 10 new fungicides against post-harvest anthracnose of mango fruits. None of the fungicides under investigation was able to control the disease completely. Out of 10 fungicides code no 92 and code no 558 were the best fungicides to control postharvest anthracnose as these two fungicides were able to control 84.55 % of the disease. Although some other fungicides were able to control more than 80 % of the disease.



Collection, evaluation, characterization and maintenance of liliu

K. Ambia, F. N. Khan, A. Naznin, M. M. R. Bhuiyin, M. T. Rashid and K. A. Ara

Thirty genotypes of liliu were evaluated under liliu shed at Floriculture Division, Horticulture Research Centre, BARI during 2020-21. Liliu genotypes showed wide variation in all qualitative and quantitative parameters studied. Among the collected liliu germplasm, 30 attractive colored and two types of flowers viz., Asiatic liliu and Oriental liliu have been found. Among them 24 germplasm were suitable for cut flower and 6 were suitable for pot culture. Regarding fragrance, Oriental type liliu produced strong scented flowers whereas Asiatic types have no fragrance. The longest stalk and the rachis were produced by the genotype Lil-018 and Lil-026, respectively. The maximum number of florets per stick were produced by the genotype Lil-001. The maximum vase life was observed in Lil-007 and Lil-010 whereas the minimum in Lil-022 and Lil-026. The heaviest bulb was produced by the genotypes Lil-007 and Lil-012 and the largest bulb were produced by the genotypes Lil-007.

Collection and Evaluation Of Tuberose (*POLIANTHES TUBEROSA* L.) Genotypes

M. M. R. Bhuyin, F. N. Khan, K. Ambia, A. Naznin, M. T. Rashid and K.A.Ara

Six tuberose genotypes with BARI Tuberose-1 as check variety were evaluated at the Floriculture Research Field of HRC, BARI, Gazipur during 2020- 2021. A wide variation was exhibited in the qualitative parameters like flower type, bud and petal color, floret arrangement on spike and fragrance. The genotype TR-001, TR-004 and TR-

005 produced heavy scented flowers. The quantitative data revealed that, BARI Tuberose-1 required minimum days (17.23) to reach 50% germination of bulbs and also to reach 50% spike initiation (88.78days). TR-001 produced the longest spike (88.02 cm). The longest rachis (43.47cm) was recorded by TR-004. The maximum number of flower sticks/ha (2,65,000 sticks) were recorded in TR-003. The heaviest (32.23 g) and the largest bulbs (3.49 cm) were recorded by TR-001. BARI Tuberose-1 remained fresh for the longest time (14.75days) in the field and also in the vase (7.12 days). The highest percentage of florets (68.83%) was opened in the vase by the genotype TR-004.

Collection and maintenance of cactus

M. T. Rashid, K. A. Ara, A. Naznin, F. N. Khan, M. O. Hoque, A. K. Saha and R. Sultana

Thirty cactus genotypes were collected and maintained at Floriculture Field of HRC, BARI, Gazipur. Wide variation in respect of vegetative and floral traits was observed. Among the genotypes, Cac-011 exhibited distinctly large flower than the others. Flower durability varied from 2.0 to 7.0 days. The genotypes Cac-015 and Cac-016 produced higher number (15.0 and 13.0 respectively) of flower whereas Cac-008 produced lowest number of flower (2.0). A large variation was found in shape, size and colour of the observed genotypes.

Collection and maintenance of succulents

M. T. Rashid, A. Naznin, K. A. Ara F. N. Khan, M.M.R. Bhuyin, K. Ambia, M. O. Hoque, A. K. Saha and R. Sultana

Succulents are the xerophytic plants and members of the family Agavaceae, Euphorbiaceae Crassulaceae and Liliaceae etc. with swollen fleshy

parts, curious forms, diversity of shape and colour. They can store water to survive in the drought condition. Succulent cultivation has become a fascinating hobby among amateur gardeners and these desert plants which are mostly unknown have become the subject of greatest care and delicate handling (Hewitt, 1993; Tony and Mace, 2001). Their soft nature and easy cultivation in shallow soils are additional features for their popularity (Randhwa and Mukhopadhyay, 1999; Peter, 1996). Therefore, the present study was under taken to collect and maintain succulents for decorative and commercial purposes.

Collection and maintenance of rose genotypes

A. Naznin, K. Ambia, M. M. R. Bhuiyin, F. N. Khan, K.A. Ara and M. T. Rashid

Ten genotypes of rose were evaluated that showed wide range of variation for all vegetative and floral traits under study. Rose belongs to family *Rosaceae*, is one of the nature's beautiful creations and is universally known as the Queen of Flowers (Hessayon, 1996). Rose is a symbol of love, adoration and innocence (Yadav *et al.*, 1989). It may be used for planting in beds, borders, as ground covers, growing in pots and for cut flower production. Roses are also grown for their multiple uses like production of petals, extraction of perfumes, for medicinal uses and for sale as cut flowers. At present, it has become the most important commercial flower. It can be grown in Bangladesh for easy cultivation and wider adaptability. However, research works on different morphological and floral traits of rose are not characterized properly in Bangladesh. Therefore, this investigation was carried out.

Evaluation of gerbera genotypes

A. Naznin, K. Ambia, M. M. R. Bhuiyin, F. N. Khan, K. A. Ara and M. T. Rashid

Twenty nine genotypes of gerbera with BARI Gerbera-1 were evaluated that showed wide range of variation for all quantitative and qualitative characters under study. Based on colour, flower number, flower size and vase life, the genotypes GJ-013, GJ-023, GJ-024 and GJ-028 were identified as promising.

Collection and maintenance of carnation genotypes

M. T. Rashid, K. A. Ara, F. N. Khan, K. Ambia, A. Naznin and M. M. R. Bhuiyin

An experiment was conducted at Floriculture Division of Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur during October 2020 to June 2021. Experiment consisted of six carnation genotypes viz. white (V₁), red (V₂), pink (V₃), light pink (V₄), light yellow (V₅) and cream (V₆). Maximum plant height (61.2 cm), leaf number (21.8), internode number (7.8), first appearance of flower bud (68.0 days), flower stalk length (51.2 cm), number of petal (29.0), number of flower (8.0) was found from V₂ (red) genotype. Significant variation was also found in vase life and flowering duration. Among the genotypes, V₂ exhibited the longest vase life and flowering duration of 10.0 and 18.3 days followed by V₃ (9.8 and 18.0 days).

Performance on growth and flowering behaviour of dendrobium genotypes

K. A. Ara, F. N. Khan, M. T. Rashid, K. Ambia, A. Naznin and M. M. R. Bhuiyin

The present investigation was carried out to study the performance of twelve genotypes of Dendrobium orchid coded from V₁ to V₁₂ (Dendrobium Alba, Dendrobium Red, Dendrobium Candy Stripe, Dendrobium Sharifa Fatema, Dendrobium Sonia, Dendrobium Thong Chai Gold, Dendrobium Malay, Dendrobium Jenny Denny, Dendrobium Bicolour, Dendrobium Yellow, Dendrobium Paradise and Dendrobium Asian Beauty respectively) under shade net house conditions. Vegetative and flowering characters varied significantly among the genotypes. Longest plant (40.0 cm) and maximum girth of pseudobulb (15.2 mm) was found with Dendrobium Sonia genotype. For the same genotype, maximum other growth and flowering characteristics were observed and recorded as number of pseudobulb/plant (5.0), number of leaves/pseudobulb (12.0), leaf area (35.9 cm²), number of spikes/plant (3.5), spike length (35.0 cm), number of florets/spike (14.5), rachis length (15.5 cm), fresh weight of spike (30.0 cm) and longest vase life (24 days).

Performance of exotic ornamental gourds lines

M. O. Haque, K. A. Ara, F. N. Khan, M. M. R. Bhuiyin, M. T. Rashid, K. Ambia and A. K. Saha

Eighteen ornamental cucurbit lines were collected and evaluated at the research field of RARS, Burirhat, Rangpur and Floriculture Division, Horticulture Research Centre, BARI during the Rabi season of 2020-2021 to observe the adaptability as well as yield and storage duration. Wide variability was observed among the lines. The number of fruit per plant was range from 3.5-6.8; fruit weight range from 105.0 - 320.0 g. The range of fruit size was 4.2-12.4 cm. Fruit yield varied from 0.5-2.2 kg per plant. Storage duration was good ranging from 158.0-310.0 days.

Performance of bari developed gladiolus varieties at Jamalpur region

R. Sultana, M. S. Rahman, M. Quader, F. N. Khan and K. A. Ara

A study was conducted at Regional Agricultural Research Station, Jamalpur during the year 2020-2021 to find out the performances of five gladiolus varieties in Regional Agricultural Research Station, Jamalpur. BARI Gladiolus-4, BARI Gladiolus-5 and BARI Gladiolus-3 found more suitable on the basis of its flower and corm characters such as attractive colour, early flowering, maximum number of florets, longest spikes and rachis, highest weight of spike, longest flower durability and corm and cormel production.

Collection, evaluation and maintenance of water lily

F.N. Khan, Mt. Rashid, K. Ambia, A. Naznin, Mmr. Bhuiyin and K.A. Ara

A study on the performance of twenty water lily germplasm was conducted at Floriculture Field of HRC, BARI, Gazipur during 2020-21. Wide range of variations for all qualitative and quantitative characters was observed.

Hybridization in gladiolus flower

F.N. Khan, A. Naznin, K. Ambia, Mmr. Bhuiyin and Mt. Rashid

A hybridization program on gladiolus was conducted in the flowering season November, 2016 to June, 2021 at Floriculture Farm, Horticulture

Research Centre, Bangladesh Agricultural Research Institute, Gazipur. Four crossing were done among five attractive gladiolus genotypes and pods were successfully produced. A large number of cormels were produced from a single cross from first generation. After a successive year of maintenance 3 new gladiolus hybrids have been found.

Effect of growth regulators on growth and flowering of chrysanthemum

K. A. Ara, Mt. Rashid, F.N. Khan, A. Naznin, K. Ambia, and Mmr. Bhuiyin

The experiment was conducted to evaluate the two different concentrations of gibberellic acid (GA_3), benzyladenine (BAP) and naphthalene acetic acid (NAA) on growth and flowering of chrysanthemum. Four weeks old seedlings of chrysanthemum (CM-019) were transplanted in pot where aqueous solution containing 2 concentrations of GA_3 (100 and 200 ppm), BAP (100 and 200 ppm) and NAA (100 and 200 ppm) were applied along with a carrier (control). More number of leaves and maximum leaf area were recorded in BAP 100 ppm, whereas minimum number of leaves and leaf area were recorded in control. Irrespective of concentration, GA_3 produced the higher number of flowers and BAP produced less. GA_3 also caused faster initiation of flowering and NAA and BAP delayed it. Length of flower stalk significantly increased with GA_3 . Use of growth regulators showed an increasing vase life of flowers. In this study, foliar application of 100 ppm GA_3 was the best for obtaining better growth of plants, maximum number of cut blooms with longer stalk as well as bigger flower size with prolonged vase life in chrysanthemum.

Effect of potting media on growth and quality in aglaonema

K. A. Ara, Mmr. Bhuiyin, Mt. Rashid, F.N. Khan, A. Naznin, and K. Ambia

Effect of potting media on growth and quality of ornamental foliage plant, Aglaonema was evaluated during 2020-2021 at Floriculture Shade Net House of Horticulture Research Centre. Maximum plant height (70.0 cm), number of leaves (11.6), leaf length (35.0 cm), leaf width (9.5 cm), basal stem diameter (2.5 cm), visual plant grade (4.50) and colour grade (4.58) were recorded with the medium

containing cocodust + perlite + vermicompost in 1:1:1, (v/v) combination.

Effect of substrates on yield and quality of anthurium in soilless culture

K. A. Ara, Mmr. Bhuiyin, Mt. Rashid, F.N. Khan, A. Naznin, and K. Ambia

An experiment was conducted at the Floriculture Shade Net House of Bangladesh Agricultural Research Institute, Gazipur during 2020-21 to study the effect of different substrate on growth, flowering, yield and quality of anthurium. Four different potting substrates like soil, cocodust, perlite and sawdust were used in six combinations. The treatment combinations were T₁: Soil (control), T₂: Cocodust, T₃: Perlite, T₄: Sawdust, T₅: Cocodust + perlite (1:1), and T₆: Cocodust + sawdust (1:1). Among the various substrates, cocodust and perlite (T₃) (1:1) as well as cocodust (T₂) singly performed best in respect of growth, floral and quality characteristics of anthurium. Contrasting to this, anthurium grown on soil (T₁) alone performed poor result.

Effect of different growing media on growth and yield of pot grown rose

Mt. Rashid, K. A. Ara, Mmr. Bhuiyin, F.N. Khan, A. Naznin, and K. Ambia

An experiment was conducted to observe the effect of potting media {T₁ - Soil + Farmyard Manure (1:1, v/v), T₂ - Soil + Vermicompost (1:1, v/v), T₃ - Soil + Vermicompost+ Cocodust (1:1:1, v/v), T₄ - Soil + Farmyard Manure + Cocodust (1:1:1, v/v), T₅ - Soil + Vermicompost + Perlite (1:1:1, v/v), T₆ - Soil + Perlite (1:1:1, v/v) and T₇ Soil (Control)} on growth and yield of Rose at Landscape, Ornamental and Floriculture Division, HRC, BARI at Joydebpur, Gazipur during the period from 2020-2021. During the year 2020-202. Data on morphological and flower character like survivability %, plant height, number of leaves, number of branches, days to flowering, number of flowering, stalk length, vase life and duration flowering 2020-2021 were recorded. Among the various potting media, Soil + Vermicompost+ Cocodust (1:1:1, v/v) (T₃) performed the best in respect of growth and floral characteristics of Rose. Contrasting to this, the medium soil (T₇) alone performed poor result.

Bulb production of liliun from bulblets influenced by growing media

A. Naznin, K. Ambia, M. M. R. Bhuyin, F. N. Khan, K.A. Ara and M. T. Rashid

An experiment was conducted at Floriculture Division of HRC, BARI to find out suitable growing media for production of liliun bulb through bulblets. Eight combinations of different growing media i.e. T₁: 50% cocodust+25% soil+25% cowdung, T₂: 50% sawdust+25% soil+25% cowdung, T₃: 50% perlite+25% soil+25% cowdung, T₄: 50% cocodust+50% sawdust, T₅: 50% cocodust+50% perlite, T₆: 50% sawdust+50% perlite, T₇: 50% soil+50% cowdung, and T₈: 20% cocodust + 20% sawdust + 20% perlite + 20% soil + 20% cowdung were used as treatments and bulblets of BARI liliun-2 was used as planting materials. Among the various treatments, cocodust+ sawdust+ perlite+soil+cowdung and cocodust +soil+cowdung performed better for quality bulb production. Contrasting to this bulblets grown with soil+cowdung gave poor output.

Effect of corm treatment in controlling seed borne fungal disease of gladiolus

M. M. R. Bhuyin, L. Yesmin, K. Ambia, F. N. Khan, A. Naznin, M. Afroz, K. A. Ara and M.T. Rashid

An experiment was conducted at Floriculture division of Horticulture Research Centre, BARI during 2020-2021 to study the effect of different biological and chemical measures on corm to control seed-borne disease and yield in gladiolus. Six treatment combination was used along with control. i.e., T₁: 55°C for 8 minutes, T₂: Trichoderma Talc, T₃: Rovral fungicide, T₄: Corm soaked with Autostin, T₅: Control (Untreated). All treatments performed better than control. Results indicated that the most influenced variables were Germination percentage, Plant survived, spike length (cm), rachis length (cm), Days to spike initiation, Days to 50% spike initiation, floret no./spike, Corm diameter, cormel no./hill, cormel diameter, weight of single corm, Weight of cormel/hill.

Effect of soil amendments in controlling soil borne fungal disease of gladiolus

M. M. R. Bhuyin, L. Yesmin, K. Ambia, F. N. Khan, A. Naznin, M. Afroz, K. A. Ara and M. Alam

An experiment was conducted at Floriculture division of Horticulture Research Centre, BARI during 2020-2021 to study the effect of different biological and chemical measures on seed-borne disease, seed quality and yield in gladiolus. Five treatment combination was used along with control. i.e., T₁: Mustard Oil cake (MOC), T₂: Trichocompost, T₃: Talc based Trichoderma, T₄: Autostin Drenching, T₀: Control (Untreated). All treatments performed better than control. Results indicated that the most influenced variables were spike length (cm), rachis length (cm), Days to spike initiation, Days to 50% spike initiation, floret no./spike, Corm diameter, cormel no./hill, cormel diameter, weight of single corm, Weight of cormel/hill.

Production of quality liliu bulb influenced by different layer of scales

M. M. R. Bhuyin, F. N. Khan, A. Naznin and M.T. Rashid

An experiment was conducted at Floriculture Division of HRC, BARI to find out suitable layer of liliu scale to produce quality bulb for specific genotypes of Liliu during 2020-21. The Experiment was laid under factorial design. Factor A is for Varieties, two liliu variety were used V₁ = BARI Liliu-001 and V₂ = BARI Liliu-010, and Factor B is for Scale position, three scale position of liliu was used i.e., L₁ = Outer layer, L₂: Middle layer, L₃: Inner layer. In case of variety, V₂ performed better than V₁ in case of leaf length and germination capacity, in case of scale layer, L₂ showed better performance than other layers. Maximum leaf length (15.56) and better plant germination (4.11) was found in V₂ and L₂ showed better performance than other layers in case of scale diameter and germination capacity.

Standardization of substrates for liliu bulb production through scaling

K. Ambia, F. N. Khan, M. M. R. Bhuyin and K. A. Ara

An experiment was conducted to find out suitable substrate for propagation of liliu bulb through scaling. Seven combinations of substrates i.e. T₁: sand, T₂: sawdust, T₃: cocodust, T₄: Sand + sawdust (1:1), T₅: Sand + cocodust (1:1), T₆: Sawdust + cocodust (1:1) and T₇: Sand + sawdust + cocodust (1:1:1) were used as treatments and Outer scales of bulb from Lil-001 were used. Sprouting percentage after 7days of storage, T₁ is best substrate among the others. In case of bulblet production T₄ (Sand + sawdust) performed better. Maximum number of leaves were produced by T₅ (1.5). Maximum number of bulblet were produced by T₄ (3.5cm) and minimum were produced by T₂, T₆ and T₇ (1.5cm). In case of weight of bulblets/scale, highest bulblets weight was found in T₄ (4.20g). Maximum sized bulblets were observed in T₄ (11.90mm). Longest root was produced in T₆ (4.01cm) followed by T₁ (4.3cm), T₄ (4.01cm), T₇ (3.91cm) and T₂ (2.46cm).

Effect of management practice and bulb sizes for quality liliu bulb production

F.N. Khan, K. Ambia, A. Naznin, Mmr. Bhuiyin K.A. Ara and Mt. Rashid

An experiment was conducted at Floriculture division of Horticulture Research Centre, BARI, Gazipur during November, 2019 to June 2021 to study the effect of management practice and bulb sizes on production of quality bulb and bulblets of liliu. Removal of spikes produced the maximum number of bulbs and bulblets/plant (1.41 & 1.81, respectively), the heaviest and the largest bulb (26.02g & 4.47cm) and also the heaviest bulblets/plant (6.88g). Large sized bulbs produced the maximum number of bulbs and bulblets/plant (1.51 & 1.98, respectively), the heaviest and the largest bulb (27.80g & 4.67cm) and also the heaviest bulblets/plant (7.92g). Large sized liliu bulbs combined with removal of spikes showed very good performances in respect of quality liliu bulb production as well as flower production.

Effect of pinching and boron on quality flower production of carnation

M. T. Rashid, K. A. Ara and F. N. Khan

An experiment was conducted to study the effect of pinching and application of boron on carnation under polyhouse condition during 2020-2021.

Tissue cultured plantlets of Carnation (C-002) were transplanted in 1.5×1.0 m plots under poly house conditions. There were seven treatments i.e. T₀-Control(No pinching+No boron), T₁- single pinching (SP), T₂- double pinching (DP), T₃- SP+ 0.05% boron, T₄- SP+ 0.1% boron, T₅- DP+ 0.05% boron and T₆- DP + 0.1% boron. Experiment was laid out in a randomized complete block design with three replications. Double pinching + 0.1% boron (T₆) significantly increased secondary branches and leaves per plant, plant spread, flower number and flower weight. Single pinching treatment (T₁) significantly increased number of primary branches/plant, whereas early flowering and maximum vase life was recorded with treatment T₄- single pinching + 0.1% boron. All the treatments failed to exert any striking effect on stem girth and flower diameter.

Effect of different potting media on plant growth and yield of ground orchid

M. T. Rashid, K. A. Ara, F. N. Khan, K. Ambia, A. Naznin and M. M. R. Bhuiyin

The present investigation entitled effect of different potting media on plant growth and yield of ground orchid under shade net conditions was carried out at Floriculture field of Horticulture Research Centre, Bangladesh Agricultural Research Institute during 2020-21. The experiment was laid out in a completely randomized design with 6 treatments and each treatment replicated thrice. The data recorded on various parameters viz., plant height, leave number, leaf area, shoot girth, spike length, rachis length, spike weight, floret number, spike yield, vase life, flowering duration and were statistically analyzed. Significant differences were observed among different potting media on various parameters in ground orchids CV. Spathogottis Orchids. Among all the treatments, T₅- Coconut husk chips + sphagnum moss + vermicompost + farmyard manure (1:1:1:1) showed significantly the best results with respect to plant height (60.5 cm), number of leaves (9.5), leaf area (40.0 cm), number of shoots (5.0), spike length (45.0 cm), rachis length (30.0 cm) number of florets (14.0), spike yield (5.0), flowering duration (20.0 days) and vase life (15.8 days).

Adaptive trial of gladiolus varieties at farmers field

K. A. ARA, F. N. KHAN, M. O. Hoque, A. K. Saha, M. A. Uddin, M. R. Ahmad, R. Sultana, A. Naznin, M. T. Rashid, Mm.Rbhuyian and M.S Alam

A trial was conducted at Gazipur, Rajshahi, Bogura, Rangpur, Khagrachori and Jamalpur during 2020-2021 to evaluate the performance of gladiolus varieties and to popularize among the farmers. All varieties like BARI Gladiolus-3, BARI Gladiolus-4 and BARI Gladiolus-5 showed better performance and produced higher yield at all locations than BARI Gladiolus-1. The demand of BARI Gladiolus-3 and BARI Gladiolus-5 was more in Gazipur, Rajshahi and Bogra depending on the consumer's choice, early flowering and economic value. But the demand of BARI Gladiolus-3 and BARI Gladiolus-4 were more in Rangpur and Jamalpur.

Adaptive trial of tuberose varieties at farmers field

K. A. Ara, F. N. Khan, M. O. Hoque, A. K. Saha, M. A. Uddin, M. R. Ahmad, R. Sultana, A. Naznin, M.M.R.Bhuiyan and M.S. Alam

Trials were conducted at Gazipur, Bogura, Rangpur, Rajshahi, Khagrachori and Jamalpur during summer season of 2020-2021 to observe the performance of BARI released Tuberose variety under farmer's field condition. BARI Tuberose-1 variety showed better performance and produced higher yield over local variety at all locations.

Adaptive trial of marigold variety at farmers field

K. A. Ara, F. N. Khan, M. O. Hoque, A. K. Saha, M. A. Uddin, M. R. Ahmad, R. Sultana, A. Naznin, M. M. Rbhuyian and M.S. Alam

Trials were conducted at Gazipur, Jamalpur, Rajshahi, Khagrachori, Bogura and Rangpur during summer season of 2020-2021 to observe the performance of BARI released Marigold variety under farmer's field condition. BARI Marigold-1 produced higher yield over local variety at all locations.

Adaptive trial of liliun variety at farmers field

K. A. Ara, F. N. Khan, M. O. Hoque, A. K. Saha, M. A. Uddin, M. R. Ahmad, R. Sultana, A. Naznin, M. M. Rbhuyian and M.S. Alam

Trials were conducted at Gazipur, Jamalpur, Rajshahi, Khagrachori, Bogura and Rangpur during rabi season of 2020-2021 to observe the performance of BARI released liliun variety under farmer's field condition. BARI liliun-1 and BARI liliun-2 getting higher yield and better market price at all locations.

Adaptive trial of gypsophila variety at farmers field

K. A. Ara, F. N. Khan, M. O. Hoque, A. K. Saha, M. A. Uddin, M. R. Ahmad, R. Sultana, A. Naznin, M. M. Rbhuyian and M.S. Alam

Trials were conducted at Gazipur, Jamalpur, Rajshahi, Khagrachori, Bogura and Rangpur during Rabi season of 2020-2021 to observe the performance of BARI released Gypsophila variety under farmer's field condition. BARI Gypsophila-1 getting higher yield and better market price at all locations.

Incidence and severity to botrytis blight disease of liliun

L. Yasmin, M Afroz, M. M Rahman and F. N. Khan

Survey was conducted in Floriculture research field of Horticulture Research Centre, BARI, Gazipur

during December 2020 to March 2021 to record the incidence and severity of botrytis gray mold disease of liliun. The surveyed germplasm were Lil-001, Lil - 002, Lil-003, Lil-007, Lil-008, Lil - 010, Lil-011, Lil- 014, Lil-016, Lil- 019, Lil-021, Lil-022, Lil-023, Lil-024, Lil-026, Lil-027, Lil-028, Lil-030, Lil-033, Lil-034, Lil-061, Lil-067, Lil-077, Arbatax, Oriental and Table damee. Disease incidence of botrytis blight of liliun was 50-80% in Lil-007, Lil-008, Lil-010, Lil-011, Lil-014, Lil-022, Lil-023, Lil-024 and Lil-027; Disease incidence was 30-35% in Lil-016 and Lil-026. Disease incidence was 0-20% in Lil-001, Lil- 002, Lil-003, Lil-019, Lil-021, Lil-028, Lil-030, Lil-033, Lil-034, Lil-061, Lil-067, Lil-077, Lil-028, Lil-030, Lil-033, Lil-034, Lil-061, Lil-067, Lil-077, Arbatax, Oriental, Table damee. The highest PDI was 80% in Lil-011 and lowest was 0% in Lil-002, Lil-003, Arbatax and Table damee. The PDI was 10-60% in Lil-001, Lil-007, Lil-008, Lil-010, Lil-014, Lil-016, Lil-019, Lil-021, Lil-022, Lil-023, Lil-024, Lil-026, Lil-027, Lil-028, Lil-030, Lil-033, Lil-034, Lil-061, Lil-067, Lil-077 and Oriental.

Research progress:

Plant breeding division of BARI works on varietal improvement of barley, millets, sorghum, oat, quinoa and buckwheat. Crop improvement includes for collection and characterization of germplasm, hybridization and conformation of barley, evaluation of barley, millets, sorghum, oat, quinoa and buckwheat, population development with variation, breeder seed production and technology transfer to farmers. The endmost objective is to develop and improve varieties and fitting technologies for the development of these field crops to the benefit of the farmers in all around Bangladesh particularly in saline, char, barind and marginal areas. Therefore, development of stress tolerant (drought, salt and waterlogging) varieties have been strengthened. Emphasis is also given for location specific variety development. The urgency is given to popularize and disseminate released varieties and developed technologies among farmers and private agencies through demonstration, training, workshop, field days, publications, electronic media etc.

A. Barley variety development

Hybridization of barley (Set-I)

M. M. Rohman, H. Raihan and M. M. Ali

The experiment was conducted at the research field of Bangladesh Agricultural Research Institute, Gazipur during rabi 2020-21 to develop early, drought and saline tolerant high yielding hull-less barley variety. In set-I, eight parental genotypes of barley including six advance lines, BHL-25 (P_1), BHL-27 (P_2), INBYT-18-E4 (P_3), INBYT-19-E5 (P_4), INBYT-18-E9 (P_5) and INBYT-20-E85 (P_6), and two released varieties (BARI Barley-7 (BB-7, P_7) and BARI Barley-9 (BB-9, P_8) were crossed following a 8×8 half diallel fashion. Additionally,

a new line-112/21, early, short, waxy and medium yielder, was also included and crossed with P_7 and P_8 . Among 30 cross combinations, 29 successfully produced 1352 seeds.

Hybridization of barley (Set-II)

H. Z. Raihan and M. M. Rohman

In this experiment, ten parents, IBON-HI-19 E3 (P_1), IBON-HI-19 E24 (P_2), IBON-HI-19 E43 (P_3), IBON-HI-19 E75 (P_4), IBON-HI-19 E100 (P_5), IBON-HI-19 E47 (P_6), IBON-HI-19 E20 (P_7), IBON-HI-19 E34 (P_8), BB-7 (P_9) and BB-9 (P_{10}) were crossed in 10×10 half diallel method to develop early, dwarf and high yielding hull-less barley variety. Among 45 cross combinations, 37 cross has successfully produced 1230 seeds. The seeds will be evaluated in next year confirmation trials.

Confirmation of F_1 generation

M. M. Rohman and S. H. Omy

Ten parents and their F_1 progenies were grown in single row in family block during rabi 2020-2021 to confirm F_1 population and identify the better cross combinations. Variation was observed among the genotypes for most of the traits studied. Analysis of better parent heterosis 12 crosses showed positive and significant heterosis over better parents for yield/plant. The extent of better parent heterosis for maturity -8.14 ($P_5 \times P_7$) - 6.71 ($P_5 \times P_{10}$) yield ranged from -46.7 ($P_4 \times P_6$) to 68.0 ($P_5 \times P_{10}$), -48.6% ($P_2 \times P_6$) to 40.0% ($P_3 \times P_7$) for tiller/plant. Twelve crosses with earliness and positive heterosis for yield were selected for next year experiment.

Advancing of F_2 generation of barley

M. M. Rohman, M. Amiruzzaman and M. M. Ali

Thirty-two F_1 s from two sets were advanced to F_2 generation for selecting desirable segregates. The

crosses were grown in 5m long one row plot. Seeds were sown on 08 December, 2020. Selection was done based on earliness, plant vigor, number of tillers per plant, panicle length and other desirable yield contributing characters. Based on earliness, tillering and yield, 258 individual plants were selected. The seeds of the plants were harvested, and threshing was done manually. The seeds were preserved for next year advancing.

Advancing of F₃ – F₆ generation of barley

M. M. Billah, A.N.M.S. Karim and M. M. Rohman

The experiments were conducted at Gazipur, during rabi 2020-21. In F₃ generation, 15 crosses in 5m long 3 rows plot, F₄ families in 2 rows 5m long plot, F₅ families in 5 rows 5m long plot and 9 crosses of F₆ families in 5 m long 5 rows plot were also grown. Evaluation of all the plants and families were done in the field based on desirable traits. In F₃ generation, 140 plants, in F₄ generation 16 families, in F₅ generation 3 families and in F₆ generation, 9 families were selected for future breeding program.

Evaluation of barley germplasm for high yield

A.N.M.S. Karim, M. M. Billah, A. H. Akhi and M. M. Rohman

Twelve hull-less barley lines along with three standard checks BARI Barley-7 (BB-7), BARI Barley-8 (BB-8) and BARI Barley-9 (BB-9) were evaluated to select early and high yielding hull-less barley lines. Significant variation was observed for the traits days to heading, no. of tiller/plant, spike length, grains/spike, 1000 grain wt. and yield (t/ha). Days to heading ranged 55 to 63 while plant height ranged 71 to 81 cm. Yield showed significant variations among the entries ranging from 1.51 to 3.12 t/ha. Considering earliness and yield, E111 (2.67 t/ha), E32 (2.39 t/ha) and E119 (2.39 t/ha) were selected for next year trial.

Evaluation of selected international hull-less barley germplasm for high-yield

A.N.M.S. Karim, A. H. Akhi, M. M. Billah and M. M. Rohman

Ten selected barley lines along with those three check varieties were evaluated Gazipur during the

rabi season of 2020-21 for high yield. Plot size was 2 rows; 5m long with row spacing of 25 cm and seeds were sown continuously. The studied genotypes in the trial significantly differed for days to heading, spike length, grains/spike, 1000-grain wt. yield/plot and yield. Considering yield and yield contributing characters, four barley lines, E17 (3.06 t/ha), E7 (2.98 t/ha), E10 (2.96 t/ha) and E21 (2.93 t/ha), were selected for next year trial.

Evaluation of barley varieties and promising lines for dual purpose (Grain and Fodder)

S. S. Alam and M. M. Rohman

Barley is mostly grown in the northern part of the country during rabi season. In dry areas, there is a shortage of forage in rabi season. To meet up the forage demand locally, this program has been taken to evaluate the performance grain and fodder of BARI released barley varieties and promising lines. Fourteen barley lines including nine BARI barley varieties and five promising barley lines were evaluated. Considering yield and fodder production, four BARI barley varieties, BB-9, BB-1, BB-7 and BB-5, and one promising line INBYT E9/18 were selected.

Screening of barley lines against salinity in laboratory condition

S. H. Omy, A.H. Akhi and M. M. Rohman

Twenty nine barley lines were screened under 8 dS/m salinity under laboratory and green house condition to select saline tolerant lines. Germination % and germination speed was observed in petri dish in Plant Breeding laboratory. Screening experiment was set in CRD with 3 replications in Hoagland solution at Green house, Plant Breeding Division, BARI, Gazipur. Four genotypes, BHL-25, BHL-27, BB-7 and BHL-32 performed better under salinity in germination stage.

Screening of barley lines under irrigated and non-irrigated condition

S. H. Omy, A. H. Akhi and M. M. Rohman

A field experiment was conducted during rabiseason of 2020 plot at BARI, Gazipur for screening barley germplasm under irrigated and

non-irrigated conditions with seventeen barley genotypes i.e., BHL-25, BHL-26, BHL-27, BHL-28, BHL-29, BHL-30, BHL-31, BHL-32, BHL-33, BHL-34, BHL-35, IBON-HI-19-E-3, IBON-HI-19-E-24, IBON-HI-19-E-43, IBON-HI-19-E-47, IBON-HI-19-E-75, and IBON-HI-19-E-100 along with two check varieties BB-5 and BB-7. Each entry was sown in 2 rows 5 m long plot. Pre-sowing irrigation was applied for uniform germination because no rainfall was received at the time of sowing. After germination, only one irrigation was given for seedling establishment in non-irrigated condition while in irrigated condition, irrigation was continued up to flowering stage. Considering yield potentiality, three genotypes BHL-24 (0.96 t/ha), BHL-29 (0.654 t/ha) and BHL-28 (0.59 t/ha) performed better in non-irrigated condition.

Preliminary yield trial of hull-less barley

H. Z. Raihan, M. I. Riad, B. Sarker, M. M. Rohman and M. M. Ali

Six genotypes of barley (IBON-HI-19 E3, IBON-HI-19 E24, IBON-HI-19 E43, IBON-HI-19 E75, IBON-HI-19 E100, IBON-HI-19 E47) along with two check varieties (BB-7 and BB-9) were evaluated in a preliminary yield trial at Gazipur, Jamalpur and Rangpur. The analysis of variance revealed that environment was greatly responsible for the variations of the traits under study while both genotypes and genotypes-environments interaction was non-significant for most of the characters. Considering days to maturity, plant height and mean yield potentiality. Based on early maturity and yield, two genotypes IBON-HI-19 E100 (2.69 t/ha) and IBON-HI-19 E24 (2.68 t/ha) were selected.

Advance yield trial of hull-less barley

M. M. Billah, M. I. Riad, B. Sarker and M. M. Ali

Eight lines and two checks viz. BB-8 and BB-9 were evaluated at Gazipur, Jamalpur and Burirhut to find out the suitable genotypes. Combined analysis was carried out for grain yield, days to heading, days to maturity, plant height, tiller per plant, spike length, grains per spike and thousand grain weight. Analysis of variance for different

characters showed the presence of genetic variabilities among lines. Two lines BHL-30 and E-53 were selected. At Gazipur and Jamalpur, BHL-30 gave highest yield (2.38 and 2.28 t/ha, respectively) and E-53 (2.44 t/ha) at Burirhut.

Regional yield trial of hull-less barley

H. Z. Raihan, M. I. Riad, B. Sarker, M. M. Rohman and M. M. Ali

Eight genotypes of barley along with two check varieties (BB-7 and BB-8) were assessed for high and stable yield at Gazipur, Jamalpur and Rangpur during rabi 2020-21. The analysis of variance revealed that environment was greatly responsible for the variations of the traits under study while both genotypes and genotypes-environments interaction was non significant for most of the characters. Considering days to maturity, plant height and yield potentiality, three lines, BHL 26 (1.92 t/ha) and BHL 34 (2.16 t/ha) were selected.

International barley yield trial high input conditions (IBYT-HI)

S.S. Alam, M. M. Rohman and M. M. Ali

Twenty four barley lines received from ICARDA along with one standard check BB-9 were evaluated at BARI, Gazipur, during rabi 2020-21 to select early, dwarf and high yielding barley lines. Significant variation was observed for all the traits except number of tiller per plant among the tested entries except number of tiller per plant. Days to heading and maturity ranged from 55 to 78 days and 92 to 106 days, respectively. Plant height ranged from 73 to 95 cm while yield ranged 0.81 to 3.33 t/ha. Considering short stature and yield, two lines ISB-21018 (3.33 t/ha) and ISB-21011 (3.14 t/ha) were selected.

Global spring barley observation nursery for low input conditions (GSBON)

S.S. Alam, M. M. Rohman and M. M. Ali

One hundred and seventy one barley lines with one check BB-9 were evaluated at BARI, Gazipur. Each line was grown in 1 row of 5m long with row distance of 25 cm and seeds were sown continuously. Standard agronomic practices were followed as and when necessary. Data were

recorded and analyzed from 152 lines on days to 50% heading and maturity, plant height (cm), number of fertile tillers/plant, spike length (cm), number of grains/spike, 1000-grain wt. (g), and yield (t/ha). Considering yield, yield contributing traits and earliness five lines, (ISB-20294 (3.12 t/ha), ISB-20283 (3.10 t/ha), ISB-20229 (3.06 t/ha), ISB-20292 (3.04 t/ha) and ISB-20282 (2.76 t/ha) were selected. Range, mean, standard deviation and co-efficient of variation of the genotypes are presented in Table 1.

Table2. Range, mean, standard deviation and co-efficient of variation of different characters of 152 barley lines evaluated at Gazipur during rabi 2010-21

Characteristics	Range		Mean	Standard Deviation	CV (%)
	Min	Max			
Days to 50% heading	44	76	60	4.63	7.65
Days to Maturity	86	111	100	5.30	5.30
Plant height (cm)	65	110	80	8.52	10.6
No. of tiller/ plant	3	8	5	0.73	14.9
Length of spike (cm)	5	9	7	0.84	11.9
No. of grains/spike	10	59	37	17.6	48.2
1000- grain weight (g)	15.6	55.0	37.7	9.12	24.2
Yield (t/ha)	0.40	3.12	1.17	0.626	53.5

International barley observation nurseries-high input (IBON-HI)

A.N.M.S. Karim, A. H. Akhi, M.M. Billah, M. M. Rohman and M. M. Ali

One hundred and forty barley lines from IBON-HI including one check BB-9 were evaluated at Gazipur. Range, mean, standard deviation and co-efficient of variation of different traits are presented in Table 2. Considering yield, 12 lines, ISB-21140 E96, ISB-21113 E69, ISB-21072 E28, ISB-21096 E53, ISB-21048 E4, ISB-21092 E48, ISB-21075 E31, ISB-21066 E22, ISB-21052 E8, ISB-21128 E84, ISB-21110 E66 and ISB-21059 E15 (yield ranging 2.04-2.92 t/ha) were selected for further breeding program.

Table. 2. Range, mean, standard deviation and co-efficient of variation of different characters of 140 barley lines evaluated at Gazipur during rabi 2020-21

Characteristics	Range		Mean	Standard Deviation	CV (%)
	Min	Max			
Days to 50% heading	47	82	63	6.90	10.95
Days to Maturity	90	106	95	3.94	4.16
Plant height (cm)	56	93	76	8.17	10.75
Length of spike (cm)	6	12	8	2.16	17.80
No. of tiller/ plant	5	20	12	1.28	15.73
1000- grain weight (g)	26	64	46	6.83	14.80
Yield (t/ha)	0.48	2.92	1.29	0.52	39.94

B: Millets and sorghum variety development

Evaluation of proso millet (*Panicum miliaceum* L.) germplasm collections

H. Z. Raihan and M. M. Rohman

Evaluation of twenty five proso millet germplasm were evaluated at BARI, Gazipur. Days to 50% flowering ranged 59 to. Plant height ranged from 95.33 to 112cm with a mean height of 103.75 cm. Numbers of tillers ranged from 5 to 7 with a mean of 5. Thousand grain weight ranged from 7.67g to 10.92g with a mean of 9.13 g. Grain yield ranged from 0.99 t/ha to 1.85 t/ha with a mean of 1.52 t/ha. Four lines, BD 1419 (1.85 t/ha), BD 1426 (1.77 t/ha), BD 1417 (1.76 t/ha) and BD 1406 (1.73 t/ha) were selected considering yield, and will be used in future breeding program.

Observation trial of foxtail millet germplasm under irrigated and non-irrigated condition

S. H. Omy, A. H. Akhi and M. M. Rohman

Nineteen (19) foxtail millet genotypes (BD-859, BD-862, BD-922, BD-962, BD-1023, BD-1041, BD-1063, BD-1105, BD-1114, BD-1116, BD-1256, BD-1259, BD-1261, BD-1264, BD-1272, BD-1284, BD-1289, BD-1300 and BD-1330)along

with 4 check varieties BARI Kaon-1 (BK-1), BARI Kaon-2 (BK-2), BARI Kaon-3 (BK-3) and BARI Kaon-4 (BK-4) were evaluated in irrigated and non-irrigated conditions in observation trial at BARI, Gazipur. Each entry was sown in 2 rows 5 m long plot. Pre-sowing irrigation was applied for uniform germination because no rainfall was received at the time of sowing. After germination, only one irrigation was applied for seedling establishment for non-irrigated condition. In irrigated condition, irrigated up to flowering stage. Considering yield potentiality and yield contributing characters, genotype BD-1284 (2.70, 0.117 t/ha in irrigated and non-irrigated condition, respectively) and BD-1114 (1.68, 0.261 t/ha, respectively) were found promising and selected for irrigated and non-irrigated condition respectively.

Preliminary yield trial of foxtail millet germplasm

S. S. Alam and M. M. Ali

Twelve foxtail millet lines (12) with two check varieties Bk-2 and BK-4 were evaluated at Gazipur and Burirhat in a preliminary yield trial to select early, dwarf and high yielding foxtail millet lines. Each genotype was grown in 4 rows and 5 m long plot with row to row distance of 25 cm and seeds were sown continuously with two replications. Six lines (6), BD-1105 (3.33 t/ha), BD-922 (3.18 t/ha), BD-862 (3.15 t/ha), BD-1116 (3.15 t/ha), BD-1041 (3.10 t/ha) and BD-1063 (3.03 t/ha) were selected for next year regional trial.

Screening of pearl millet germplasm under irrigated and non-irrigated condition

A.N.M.S. Karim, A. H. Akhi and M. M. Rohman

Twelve (12) pearl millet genotypes were evaluated and screened under irrigated and non-irrigated conditions in BARI, Gazipur. The experiment was laid out in randomized block design with two replications. Significant difference was found all the characters. Yield attributing characters and yield were higher under irrigated condition by maintaining higher tiller no., panicle length, wt. individual panicle, 1000 grain wt., and yield/plot. Considering yield potentiality three genotypes ICMH-1201 (2.51 t/ha), ICMV-05555 (2.29 t/ha) and ICMH-1301 (2.28 t/ha) were selected for

irrigated condition and the genotype ICMV-05222 (0.56 t/ha) was selected for non-irrigated condition for future trials.

Regional yield trial of pearl millet germplasm

A. H. Akhi, M. M. Billah, M. I. Riad and B. Sarkar

Four (4) pearl millet genotypes were evaluated at three locations viz. Gazipur, Jamalpur and Rangpur in a regional yield trial. The experiment was laid out in a RCB design with three replications. Stability analysis was carried out for grain yield, days to heading and maturity, plant height, tiller/plant, spike length, weight of individual panicle and thousand grain weight of four pearl millet germplasm. Analysis of variance for different characters showed the presence of genetic variability among the genotypes. Considering yield and other yield contributing characters, two genotypes IP5711 (2.11 t/ha) and IP3706 (2.10 t/ha) were selected.

Development of base population in sorghum

A. H. Akhi and S. S. Alam

Seventy germplasm were planted for random mating for developing of source populations in sorghum at BARI, Gazipur. Three hundred healthy, disease free panicles were collected based on short, medium and tall plants. Seeds of 7.15 kg (for short statured), 4.95 kg (medium height) and 4.43 kg (tall) were harvested separately from selected panicles, and they will be grown in isolation for random mating in coming rabi season for next breeding cycle.

Screening of sorghum lines against salinity in laboratory condition

S. S. Alam and M. M. Rohman

Four sorghum genotypes were screened for salinity tolerance in pots containing three treatments (control, 8.0 and 12 dS/m) of NaCl solution following completely randomized design at green house of Plant Breeding Division in BARI, Gazipur. The treatment solution was changed every three days. Salinity levels were measured by an EC meter (HI 993300). The seedlings were observed for two months, and data were taken on different parameter from plant. Considering fresh and dry weight, leaf area, shoot and root length, sorghum

line IS-2867 and variety BS-1 were found tolerant to salinity (12dS/m) which can be used for further breeding program.

Screening of sorghum lines under waterlogging condition

M. S. Parvin, M. M. Billah and A. H. Akhi

Twenty four genotypes were screened against waterlogging stress at field lab of Plant Breeding Division, BARI, Gazipur. Genotypes were imposed waterlogging at their five leafs expanding stage and observed for twenty days. Four genotypes; IS-29464, IS-23514, IS-9745, and BARI-Sorghum-1 were germinated. All four genotypes were turned yellow and gradually reached a senescence state. However, all genotypes were recovered when waterlog stress was turned off. The revive ability of four genotypes after waterlogging state suggests that the waterlogging at vegetative stages maybe not a big concern for sorghum.

Large plot yield trial of selected sorghum lines

M. M. Billah, M. I. Riad and B. Sarker

Three (3) sorghum lines with one check BARI Sorghum-1 (BS-1) were evaluated at Gazipur, Jamalpur and Burirhat in a large plot yield trial to find out the suitable genotype(s). The unit plot size was 5m×5m maintaining spacing of 60 cm row to row and seeds were sown continuously. Combined analysis was done for days to heading, days to maturity, plant height, panicle length, 1000-grain weight and yield. Considering the yield and yield contributing traits, IS-29464 (2.67 t/ha) line was selected for further breeding program.

C: Buckwheat and oat variety development

Advance yield trial of buckwheat

A. H. Akhi, S. S. Alam and M. M. Rohman

Four genotypes along with one local check variety Bog-1 of buckwheat were assessed at three different locations, Gazipur, Debiganj and Jamalpur for genotype environment interaction (GEI) and stability to select the best buckwheat lines. The analysis of variance revealed that environment was greatly responsible for the variations of the traits under study while both genotypes and genotypes-

environments interaction explained very little variation. Considering the mean, bi and S²di for grain yield, it was evident that all the genotypes showed differential response of adaptability under different environmental conditions. The genotype E3 (1092 kg/ha) and E2 (1211 kg/ha) are high yielding and more stable to environments.

Characterization of oat lines

A. H. Akhi and M. Ali

Four (4) oat genotypes were characterized to estimate the extent of variation for morphological traits. Observations were recorded for the different agro-morphological characters viz., growth habit, hairiness of leaf sheath, hairiness of leaf margin, angle of flag leaf to culm, angle of leaves to culm (other than flag leaf), rigidity of flag leaf, rigidity of leaves, shape of panicle, erectness of panicle, angle of panicle branches to the main axis, erectness of spikelet, waxiness of panicle, number of tillers, number of fertile tillers/plant, days to 50% flowering, plant height, days to maturity, number of tiller, number of fertile tiller/plant, seed yield/plot and yield. Among the four lines both qualitative and quantitative morphological variation were found. In crop improvement program this variability could be used. The highest yield was found in BOL-2 (1.2 t/ha).

Induced mutagenesis in oat (*Avena sativa* L.) to develop variable population

A. H. Akhi, S. H. Omy and M. M. Rohman

Two oat genotypes (BOL-1 and BOL-2) were irradiated (Gamma radiation) and chemically treated with Ethyl methane sulphonate (EMS) and combinely (Gamma radiation+ EMS) to induce variability. The irradiation treatments were carried out at the laboratory of Institute of Food and Radiation Biology, Ganakbari, Savar. The lower doses of gamma radiation, combination treatments and EMS treatments alone have been proved to be more efficient for most of the characters in M₀ generation. There are some mutagenic effects showed in some of the treatment i.e. short plant height, early to late flowering, and highest number of seed per plant. M₁ seeds of different treatments were harvested and kept separately for future breeding program.

Priliminary yield trial of oat

A. H. Akhi and M. M. Ali

Four (4) oat genotypes namely BOL-1, BOL-2, BOL-3 and BOL-4 were evaluated in randomized complete block design with three replications at research field of PBD, Bangladesh Agricultural Research Institute, Gazipur during the rabi season of 2020-21 for grain yield and other agronomic traits. . Each entry was sown in a unit plot of 2 rows 5m long with row spacing of 25 cm and seeds were sown continuously. Data were recorded on days to heading and maturity, plant height (cm), number of total tillers per plant, number of fertile tillers per plant, number of panicle per plant, number of seed per panicle, panicle length(cm),1000 seed weight(gm), yield/plot (gm) and yield(t/ha). Considering plant height, yield and other yield contributing characters BOL-1 (1.2 t/ha), BOL-2 (1.4 t/ha) and BOL-4 (1.5 t/ha) were selected for next year advance yield trial.

D: Seed production

Seed increase of buckwheat germplasm

A.N.M.S. Karim and A.H. Akhi

Seed is essential for maintaining purity of the variety. Genetic purity seed significantly affects the yield and quality of a variety. A total of 760 g breeder seed of five buckwheat (Bog-1, 4275, 4274, 4273 and 4272) germplasm were produced at BARI, Gazipur and stored for further use.

Breeder seed production of barley

M. M. Billah, M. I. Riad, B. Sarker and N. Amin

Seed is the fundamental input for crop production. Quality seed is important to maintain the purity of a variety. To maintain the purity of the released barley varieties, total 1,168 kg breeder seeds of 9 barley varieties (BARI Barley-1, BARI Barley-2, BARI Barley-3, BARI Barley-4, BARI Barley-5, BARI Barley-6, BARI Barley-7, BARI Barley-8, and BARI Barley-9) were produced at Gazipur, Burirhat, Debigonj and Ishwardi.

Breeder seed production of foxtail and proso millet varieties

M. M. Billah, M. I. Riad, B. Sarker and M. N. Amin

Breeder seeds of BARI Kaon-1, BARI Kaon-2, BARI Kaon-3, BARI Kaon-4, BARI Cheena-1 and BARI Sorghum-1 were produced at Gazipur, Jamalpur, Burirhat and Ishwardi. A total 848 kg seeds which were collected and stored for distribution and demonstration of the varieties.

Seed increase of advance lines of finger millets

M. M. Billah and M. I. Riad

Four finger millet advanced lines (IE-501, IE-2034, IE-2619 and IE-3392) were grown during rabi 2020-2021 at Gazipur and Jamalpur to increase seeds of selected finger millets lines. A total of 89.5 kg seeds were produced for next year trial.

Seed increase of advance lines of proso millets

A.H. AKHI, S.H. S. S. H. Omy and M. M. Billah

The experiment was conducted at BARI, Gazipur during rabi season 2020-21 to increase seeds of selected proso millets lines. Total 63.7kg seeds were produced from seven selected proso millets lines for next year trial.

E: Minor cereals biotechnology: molecular biology

Genetic diversity of newly develop barley lines and varieties

S. H. Omy, H. Z. Raihan and M. M. Rohman

Eleven simple sequence repeats (SSRs) markers were used to characterize BARI developed 9 barley varieties and 13 advanced lines. Optimum PCR profile for Amplification of SSRs loci are being standardizing now to find out highly polymorphic one(s). Two markers have been completed; remaining will be done in next year. Diverged advance lines would be selected for hybridization.

Comparative response of antioxidants in C₃ (barley) and C₄ (sorghum) under drought

M. M. Rohman and S. S. Alam

Comparative study of C₃ (barley) and C₄ (sorghum) under drought in the context of antioxidants response was conducted at green house and lab of PBD, BARI, Gazipur. Last year, we showed an intrinsic relation of NADPH-oxidase with reactive oxygen species (ROS). This year, water relation

and enzymes of ascorbate-glutathione (ASA-GSH) cycle were studied. Higher loss of water was found in drought in C₃ barley than C₄ sorghum, which was resulted from higher Gs. Ci was very low in barley. In ASA-GSH cycle, comparatively higher GR and MDHAR activities were the advantages in C₄, sorghum. However, higher DHAR activity can be important for prolong drought in C₃, barley. Loss of GSH and ASA was also slower in C₄ crop, and played important role to confer tolerance to sorghum in prolong drought.

Advancing of F₁ to F₂ generations for saline tolerant barley line

M. M. Rohman and H. Raihan

These experiments were executed with the fund of Ministry of Science and Technology. Forty five F₁s from a 10×10 diallel cross of barley were screened hydroponically against 8 dS/m equivalent salinity in Hoagland media to select saline tolerance F₂ generation for further advancing. Among which, 12 were eliminated due to poor germination or poor growth. Remaining 33 crosses were evaluated based on grain setting, K⁺/Na⁺, root volume, ROS and their scavenging enzymes and stay grain. Based on the criteria, 14 genotypes selected as tolerant, 7 as medium tolerant and 12 as susceptible. The seeds will be used for F₂ advancing. On the other hand, 31 genotypes of F₂ generation were grown on 8 dS/m saline soil in green house and advanced for F₃ generation. Thirty-nine plants were selected for next generation advancing.

F: Technology transfer activities

One variety, BARI Oat-1 has been proposed for release.

Salient feature:

- Yield: 1.0 - 1.2 t/ha
 - 10-14 erect panicle per plant
 - Grains are long and brown in color
 - Plant height: 110-115 cm
 - Maturity: 125-130 days
- Training: Five (05) training program on minor cereals were conducted for farmers (750 participants) at Khulna, Tangail, Jamalpur, Manikgonj and Gaibandha to trained up for modern cultivation process.
 - Field days: Four (04) field days of minor cereals were conducted at Khulna, Tangail, Jamalpur, Manikgonj and Gaibandha to popularize BARI released varieties.
 - Demonstration/adaptive trial: Thirty six (36) demonstration and adaptive trial were conducted in collaboration of OFRD at Shatkhira, Khulna, Noakhali, Tangail, Jamalpur, Manikgonj, Gaibandha, Rajshahi, Rangpur, Faridpur, Bogura and Munshigonj to disseminate and popularize BARI released varieties.
 - One (01) seminar workshop was executed.
 - One (01) annual report and 1 leaflet on BARI Sorghum-1 were published.

09

AGRONOMY



Crop management

Nitrogen use efficiency in maize through different application method

M.A.K. Mian, A.A. Begum and D.A. Choudhury

The field experiment was conducted at Agronomy Research Field, Gazipur of Bangladesh Agricultural Research Institute during *rabi* season of 2019- 2020 and 2020-2021 to determine the optimum dose of nitrogen. Treatments included in the experiment were as F_1 = Recommended fertilizer dose (RF) with prilled urea, F_2 = USG through hand applicator (80% N), F_3 = Band application (80% N) with prilled urea, F_4 = USG through hand applicator (100% N), F_5 = Band application (100% N) with prilled urea and F_6 = RF except N (RF-N). The experiment was laid out in a randomized complete block design with three replications and the unit plot size was 6m × 5m. Hybrid maize (BARI Hybrid maize-16) was used in the experiment. Seeds were sown on 6 December 2019 and 8 December 2020. The seeds were treated with provax @ 3 g/kg seed before sown. Fertilizers except urea were applied at the rate of 60-120-45-4-1.6 kg/ha of PKSZnB (FRG, 2018) as triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid. Whole amount of TSP, MoP, gypsum, zinc sulphate and boric acid were applied as basal. Nitrogen was applied as per treatment. In the experiment, 100% or recommended N (225 kg/ha) was used. In treatment F_1 , 1/3rd prilled N was applied as basal. Remaining 2/3rd N was top dressed at 30 and 50 days after sowing (DAS) of maize. In treatment F_2 and F_4 whole USG at the rate of 80% N and USG 100% N, respectively, were applied through applicator at 20 DAS. In treatment F_3 and F_5 , 1/3rd prilled N (80% N) and (100% N) respectively, were

applied as basal through band method. Remaining 2/3rd N was applied in two splits at 30 and 50 DAS as band application in both treatments. Data on growth parameters like leaf area and dry matter accumulation were measured at different dates with 15 days interval. Different nitrogen form through different application method distinctly differed in leaf area index (LAI), total dry matter production (TDM), photosynthetically active radiation (PAR) interception, crop growth rate (CGR), yield components and yield, and nitrogen use efficiency (N_{UE}) in hybrid maize. USG (100% N) application through hand applicator produced the maximum TDM and LAI followed by USG with 80% N. Maize was harvested on 24 April 2020 and 26 April 2021. Leaf area measured by an automatic leaf Area Meter (LI3200 C, LICOR, USA). Collected data were pooled analyzed and the means were adjudged by using LSD at 5% level of significance. Cost and return analysis was also done considering local market price of harvested crop. Light availability or Photosynthetically active radiation (PAR) was measured only by PAR Ceptometer (Model – LP-80, Accu PAR, Decagon, USA). LP-80 has an 80 cm long sensor, which is usually used for below canopy measurement. Another optional quantum sensor can be used for above canopy measurement through a cable connection. So, simultaneous measurement of PAR at above and below canopy is possible with this instrument. The respective sensors were simultaneously installed above and below of the canopy (10 cm above the soil surface) for incident PAR (PAR_{inc}) and transmitted PAR (PAR_t), respectively. The PAR was measured at 5-day intervals from 25 to 40 DAS at around 11:30 am to 13:00 pm. Four readings each of PAR_{inc} and PAR_t were recorded at different spots of each plot. The proportion of intercepted PAR (PAR_{int}) was calculated using the

following equation and expressed in percentage (Ahmed *et al.*, 2010):

$$\text{Light availability \{PARint (\%)\} = } \frac{\text{PARinc} - \text{PARt}}{\text{PARinc}} \times 100$$

Nitrogen use efficiency was calculated by using the formula given below (Ahmmmed *et al.*, 2018):

$$\text{Nitrogen use efficiency, } N_{UE} = (\text{GY}_{NA} - \text{GY}_{NO})/N_R$$

Where, GY_{AN} = Grain yield (kg/ha) with addition of nitrogen, GY_{NO} = Grain yield (kg/ha) without addition of nitrogen, N_R = Rate of added nitrogen (kg/ha). The highest grain yield (9.90 t/ha) was found when USG (100% N) applied through hand applicator followed by USG (80% N). The highest nitrogen use efficiency (N_{UE} : 19.72 kg/kg) was recorded in USG (80% N) treatment followed by USG (100% N). Cost and return analysis revealed that the highest gross return (Tk.178110/ha), gross margin (Tk.85816/ha) and cost of cultivation (Tk.92294/ha) were found in USG (100% N). The highest benefit cost ratio (BCR) of 1.93 was obtained from F_2 and F_4 . The results revealed that among the different nitrogen form through different application method, USG (80% N application through hand applicator) was found better in respect of yield, N_{UE} and economic returns saving 20% N for maize cultivation.

Light interception, chlorophyll content and productivity of baby corn as influenced by planting geometry and fertilizer management

S.S.Kakon, J.A.Chowdhury, M.Z.Ali and D.A.Choudhury

A field experiment was conducted during *rabi* seasons of 2019-20 and 2020-2021 to find out optimum plant spacing and fertilizer levels on yield of baby corn. Three plant spacing viz, $S_1=40 \text{ cm} \times 20 \text{ cm}$ (1,25,000 plants/ha), $S_2=50 \text{ cm} \times 20 \text{ cm}$ (1,00,000 plants/ha) and $S_3=60 \text{ cm} \times 20 \text{ cm}$ (83,333 plants/ha) and three fertilizer doses viz, $F_1=150-30-50-25-3.5-1.5 \text{ kg/ha}$ of NPKSZnB (Recommended fertilizer dose for baby corn), $F_2=F_1+25\% \text{ NPK}$ and $F_3=F_1+50\% \text{ NPK}$, were used as treatments. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4 m x 3.6 m. Seeds of BARI Baby corn-1 were sown on 12 December 2019 and on 3 December 2020. Fertilizers were applied as per treatments. One-

third of nitrogen (Urea) and full amount of Triple super phosphate (TSP), Muriate of potash (MoP), Zinc sulphate and Boric acid were applied at the time of final land preparation. The remaining N (Urea) was top dressed in two equal splits at 25 DAS and 45 DAS, respectively and mixed thoroughly with the soil as soon as possible for better utilization. A light irrigation was given after sowing of seeds for uniform germination. Two irrigations were done at 30 and 45 DAS. Thinning's were done at 10 DAS and weeding at 15 and 25 DAS. Leaf area was measured by an automatic leaf Area Meter (L13200 C, LICOR, USA). For dry matter estimation, 5 plants were sampled started from 20 DAE at 15 days interval up to maturity. Dry weight of the samples was taken after drying at 80°C in an oven for 72 hours. $\text{CGR} (\text{g m}^{-2}\text{day}^{-1})$, was calculated using equation as suggested by Yellam as follows. Soil-Plant-Analysis Development (SPAD) Value. Leaf chlorophyll content may be used as an indirect indicator of crop N status. Chlorophyll meter values (SPAD) were taken using a portable SPAD meter (Model SPAD-502, Minolta corp, Ramsey, NJ) starting from 35 DAS with 15-day interval.

BARI Babycorn-1 was harvested on 04 March 2020 (85 days after sowing) and on 08 March 2021. The yield component data was taken from 5 randomly selected plants from each plot. At harvest, the yield data was recorded plot wise. The collected data were analyzed statistically and means were adjudged by LSD test at 5% level of significance using MSTAT-C package. Results revealed that, planting geometry and fertilizer levels showed great influence on leaf area index (LAI), light interception, dry matter production and yield of baby corn. LAI was found the highest with the population of 125,000 plants/ha receiving $N_{225}P_{45}K_{75} \text{ kg/ha}$. Light absorption was maximum at densely plant population with $N_{225}P_{45}K_{75} \text{ kg/ha}$. Response of soil-plant-analysis development (SPAD) value to planting geometry and fertilizer level was found significant. Plants grown with 40 cm x 20 cm spacing (125,000 plants/ha) with recommended fertilizer dose + 50% N-P-K of RF gave the highest dehusked cob yield over the years (3.42 and 3.73 t/ha) which was followed by 40 cm x 20 cm (1,25,000 plants/ha) with recommended fertilizer dose + 25% N-P-K of RF. Though S_1F_3

combination gave the highest gross return (Tk.333140/ha in 2019-20 and Tk. 378900/ha in 2020-21) but the highest benefit cost ratio over the years (3.64 and 3.83) was recorded in S_1F_2 treatment. The overall results indicated that 40 cm × 20 cm (1,25000 plants/ha) with fertilizer dose of RFD + 25% NPK ($N_{187.5} P_{37.5} K_{62.5} S_{25} Zn_{3.5} B_{1.5}$ kg /ha) might be economically profitable for baby corn production.

Estimation of optimum plant population of maize through functional model

M. A. K. Mian, S.T. Zannat and D. A. Chowdhury
A field experiment on hybrid maize with different plant population density was conducted at the Agronomy field of BARI, Joydebpur, Gazipur during the *rabi* season of 2020-2021. Five plant population density, viz. T_1 = 66666 plants/ha (75 cm × 20 cm spacing), T_2 = 83333 plants/ha (60 cm × 20 cm spacing), T_3 =100000 plants/ha (50 cm × 20 cm spacing), T_4 =125000 plants/ha (40 cm × 20 cm spacing) and T_5 =166666 plants/ha (30 cm × 20 cm spacing) were used in the experiment. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4.5 m × 5 m. Seeds were sown on 4 November 2020. Nutrients were applied at the rate of 275-76-121-72-5-1 kg/ha of N-P-K-S-Zn-B (FRG, 2018) as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid. One third of urea, whole amount of TSP, MoP, gypsum, zinc sulphate and boric acid will be applied as basal dose. Remaining 2/3 Urea was top dressed at 35 days after sowing (DAS) and 55 DAS followed by irrigation. Three irrigations were given when it was necessary to maintain adequate soil moisture. Plants were sampled at different DAS (days after sowing) for leaf area and dry matter accumulation. Leaf area was measured by an automatic area meter (LI 3100 C, LI-COR, USA). For dry matter, plant samples were dried in an oven at 80 °C for 72 hours. Optimum plant population of maize was estimated through the following functional model like $Y = a + bx - cx^2$,

When optimum plant population for maximum grain yield = $-b/2c$

The crop was harvested on 8 April 2021. The yield components data were collected from 5 randomly

selected plants prior to harvest from each plot. At harvest, the yield data was recorded plot wise and analyzed statistically. Model analysis was done using the data of 2017-2018 and 2020-2021. LAI and TDM increased with the increase of plant population, those influenced the grain yield. Plant population showed significant influence on grain yield. LAI with the value of 4.33 at 85 DAS and TDM with the value of 5343 g/m² at harvest were found suitable for the maximum grain yield of maize in T_3 (50 cm × 20 cm spacing: 100000 plants/ha). The highest grain yield (10.12 t/ha) was recorded in 100000 plants/ha (T_3 : 50 cm × 20 cm spacing) and the lowest (7.72t/ha) in 166666 plants/ha (T_5 : 30 cm × 20 cm spacing). The maximum grains/cob, 1000-grain weight were recorded in T_1 but the highest grain yield was obtained in T_3 (50 cm × 20 cm spacing: 100000 plants/ha). The weight of 1000-grain reduced in dense population. Functional relationship between plant population and grain yield of maize was established as $Y = 1.9893x - 0.0919x^2$; ($R^2 = 0.83$). The result indicated the effect of plant population on the grain yield of maize could be explained 83% by the functional model. The coefficient indicated that increase of one plant/m² would increase the grain yield at the rate of 1.9893 t/ha. The estimated optimum plant population was 10.73 plants/m² through the developed functional model. Then the maximum predicted grain yield would be 10.78 t/ha according to developed model.

Effect of sampling technique on yield assessment of lentil

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The field experiment was conducted in Agronomy research field, Bangladesh Agricultural Research Institute, Gazipur during *rabi* 2020-21 to find out whether there is any variation of assessed yield from different sampling technique. Six treatments; T_1 = Linear meter from border line, T_2 = Five random plant yield from border line, T_3 = Linear meter from inner line, T_4 = Five random plant yield from inner line, T_5 = Random unit square yield and T_6 = Whole plot yield to find out whether there is any variation of assessed yield from different sampling technique. The experiment was laid out in randomized complete block design with three

replication. Unit plot size was 3m × 3m. Seeds of BARI masur-6 were treated with Provax-200WP and sown in line with 25 cm row to row distance. Thirty six garm seed were uniformly sown in twelve line in each plot to maintain uniform plant population. The crop was fertilized with 21-39-24-10-1.8 kg/ha of N-P-K-S-B respectively (FRG, 2018). All fertilizers were applied during final land preparation. Irrigation was done as and when necessary in all the treatments. Provax with irrigation water was also applied to control seedling foot rot disease. Data was collected as per treatment. Yield was calculated from yield contributing parameters except T₆. All the treatments showed increased yield than whole plot yield. Maximum yield increase (34.80%) was found in T₂ and the lowest increase was found in T₃ (6.86%). Whole plot yield sampling is more preferable technique to assess the real yield of crop. For larger plot size, sample collection from inner lines either in the form of linear meter or square meter is better than five plant sampling.

Performance of BARI released mustard varieties at Moulvibazar

M. A. M. Miah, M.A. Hossain, M.Samsuzzaman, M.A.Habib and Z.A.Firoz

A field experiment was conducted at Regional Agricultural Research Station, BARI, Moulvibazar during *rabi* season of 2020-2021 to evaluate the yield performance of BARI developed mustard varieties against local variety at Moulvibazar area. Four mustard varieties, viz. BARI Sarisha 14, BARI Sarisha 15, BARI Sarisha-17 and BARI Sarisha -18 were compared with Tori -7. Seeds were sown on 16 November, 2020. Seeds were sown in line with 30 cm line spacing. Unit plot size was 3.90 m × 3.00 m. The experiment was laid out RCB design with 3 replications. Fertilizers were applied as basal at 105-32-40-24-2-1-10kg/ha, of NPKSZnB (FRG, 2018) in the form of Urea, TSP, MOP, Zypsum, Zinc sulphate, Boric Acid and 10t/ha well decomposed cowdung, respectively. The field was affected by cutworm. Acimix (cloropyrifos+cypermethrin mixture) was sprayed to control cutworm at every 7 days interval at two times. Rovral was sprayed to control Alternaria blight at every 10 days interval. Three irrigations were given at 12 days after sowing (DAS), after top

dressing and at 50 DAS. The crop was kept weed free up to 20 DAS by two hand weeding at 10 and 20 DAS. Data on different parameters were statistically analyzed following MSTAT-C software package and the treatment means were compared by Least Significance Difference (LSD) test at 0.05 level of probability. Among the varieties, BARI Sharisha-18 produced the highest yield (1.52 t/ha) and it produced 39% higher yield than that of Tori -7. The second highest yield (1.32 t/ha) was recorded in BARI Sarisha 17. The results revealed that BARI Sarisha 18 is suitable for cultivation at Moulvibazar area. Alternately, BARI Sarisha 14 may be grown as short duration (75-80 days) variety.

Effect of sowing date on sunflower at Moulvibazar

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A field experiment was conducted at Regional Agricultural Research Station, BARI, Moulvibazar during *rabi* season of 2020-2021 to find out optimum sowing date for BARI Surjomukhi-3 at Moulvibazar. There were four sowing dates viz., 1 November, 15 November, 30 November and 15 December in the study. Seeds were sown in line with 50 cm × 25 cm spacing. Unit plot size was 3.00 m × 3.5 m. The experiment was laid out in RCB design with 3 replications. Cow dung @ 5t/ha was applied and other fertilizers were applied at the rate of 105-36-84-24-2-1.6 kg/ha of NPKSZnB (FRG, 2018), in the form of Urea, TSP, MOP, Zypsum, Zinc sulphate, boric acid, respectively. Half of N and all of triple super phosphate (TSP), muriate of potash (MOP), gypsum, zinc sulphate and boric acid were applied as basal during final land preparation. Remaining half of N was applied as top dress in two equal splits at 25 and 45 DAS. Data on different parameters were subjected to analysis of variance and the treatment means were compared by Least Significance Difference (LSD) test. The highest yield was obtained from 30 November sowing (1197.5 kg/ha) followed by 15 December sowing (938.5 kg/ha). The results revealed that 30 November sowing was found optimum for higher seed yield of BARI Surjomukhi-3 at Moulvibazar area.

Effect of different sowing time and spacing of advanced linseed line (Lin-W-17)

M. S. Huda and M. M. Khanum

The trial was carried out at ARS, BARI, Dinajpur during *rabi* season of 2020-21 to find out suitable sowing time and spacing for higher yield of linseed for Dinajpur region. There were four sowing time viz., 15 November, 30 November, 15 December and 30 December and four line spacing viz. 15, 20, 25 and 30 cm in the study. Early planting took longer time for flowering (72 days) and fruiting while late planting gave early flowering, decreased inflorescences number and increased sterile inflorescences. The experiment was laid out in RCBD with 3 replications and plot size was 6.0 m × 3.0 m. The crop was fertilized with @ 45: 15: 25: 10 kg/ha NPKS (FRG, 2018). Chemical fertilizers were used in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid. Half of urea and all the fertilizers were applied during the final land preparation. Remaining urea was applied at flowering initiation (20 days after germination) as top dress. Intercultural operations like watering, weeding and pest control were done as and when required. Yield components of linseed were taken from randomly selected 5 plants from each plot. Seed yield were taken from whole plot. Collected data were analyzed statistically by using R software packages and mean differences for each character were compared by Least Significant Difference (LSD) test. The highest yield (1289 kg/ha) was recorded from 15 November with 30 cm row spacing which was similar to that of 15 November with 25 cm spacing (1208 kg/ha). The lowest seed yield (237 kg/ha) was recorded from 15 December with 15 cm spacing. The result revealed that 15th November sowing with 30 cm line spacing was found the most suitable as sowing time at Dinajpur region of advanced linseed line of Lin-W-17.

Effect of different concentration and application time of gibberellic acid on growth and yield of potato

M. S. Huda and M. M. Khanum

An experiment was conducted at the research field of Agricultural Research Station, Rajbari, Dinajpur, during 2020-21 to find out the appropriate

application time and GA₃ concentration for maximizing potato yield. The treatments combinations were as follows; the different application time of GA₃ were used as Factor A: ie. A₁=Just after sprouting of seed, A₂=At 30 DAP (seedling stage), A₃=At 45 DAP (vegetative growth stage) and A₄=At 60 DAP (maturity stage). The Different concentration of GA₃ were used as factor B; ie. G₀₀ = 00 ppm, G₂₀ = 20 ppm, G₄₀ = 40 ppm and G₆₀ = 60 ppm. The 28 to 40 mm size foundation seed tubers of variety “BARI Alu 36” were used in the study with 60 cm × 30 cm spacing planted in RCBD design with three replications. Planting was done on 16 November 2020. The plot size was 3 m × 3 m. The cowdung was used during land preparation at rate of 10 t/ha. Chemical fertilizers were applied with 120-39-75-20 N-P-K- S kg/ha, respectively (FRG, 2018). Half of N, K and full dose of P, S were applied at time of final land preparation and remaining N and K were applied as top dress at 25 and 50 days after planting (DAP) followed by irrigation. One gram GA₃ was dissolved in 70% ethyl alcohol (1 to 3 ml) and then make it volume 100 ml by adding distilled water, thus 10000 ppm GA₃ was prepared as stock solution. Then 20, 40 and 60 ppm GA₃ solutions were prepared by adding distilled water and the following formula was used $V_1S_1 = V_2S_2$, Where V_1 =Volume of Stock solution, S_1 =Strength of Stock solution, V_2 =Volume of expected solution and S_2 =Strength of expected solution. The seed tubers were taken out from the cold storage 8 days before planting. Non sprouted tuber of potato was wetted one time by spraying with different concentrated GA₃ solution and spread over the floor under diffused light for sprouting. The good looking, healthy and well sprouted seed tubers were used for planting. The crop was haulm pulled at 16 February 2020 of 92 DAP. Collected data were analyzed statistically by using R software packages and mean differences for each character were compared by Least Significant Difference (LSD) test. The application of GA₃ affected the germination% at 12 DAP, the number of tuber per plant and tuber weight per plant and tuber yield. Application of GA₃ (20 to 40 ppm) in seed tuber or in seedling of potato can increase the number of tuber per plant and also yield. Application of GA₃ (20 to 40 ppm) in vegetative stage of potato can

increase the yield of potato. Significantly the highest yield (44.70 t/ha) was recorded in A₃G₄₀. From the above results it may be concluded that application of GA₃ in seed tuber or in seedling of potato can increase the number of tuber per plant and application of GA₃ in vegetative stage of potato can increase the yield of potato.

Effect of variety and transplanting date on year round chilli production

J. Rahman, M.R. Ali, A.A. Begum, S.S. Kakon, D.A. Choudhury and M.M. Kadir

This research was carried out at the RARS, Jamalpur during 2020-2021 to find out the suitable variety and transplanting date for chilli production. Chilli seedlings of third transplanting (June transplanting) were damaged due to heavy rainfall. Treatments included in the experiment were: Variety: V₁ = BARI Morich -2, V₂ = Bindu (local); transplanting date: T₁ = November, T₂ = March and T₃ = June. These three transplanting dates cover the year round chilli production. Design of the experiment was split plot with 3 replications. Each treatment was transplanted in unit plot having 3m × 3.2m with the spacing of 50cm × 60cm. Fertilizers were applied at the rate of 60-25-30-7-1-0.5 kg/ha NPKSZnB (FRG, 2018) as urea, triple super phosphate (TSP), muriate of potash (MOP), gypsum, Boron. All of P, K, S, Zn, B and ½ N were applied as basal. Rest N was applied at 25, 50 and 70 DAP. Seedlings were transplanted on 14 November 2020. Weeding was done when necessary. Fruit yield was calculated from the whole plot. Yield contributing characters were taken from 10 randomly selected plants from the middle rows of each plot. Data were analyzed with the help of a computer package program Statistix 8.0 and means were separated following LSD test at 5% level of significance. BARI Morich-2 showed better performance than Bindu (local cultivar) in November planting while Bindu (local cultivar) performed better than BARI Morich-2 in March transplanting. BARI variety and local cultivar were found to be suitable for year-round chilli production, with the best growth condition occurring in high terrain, homestead regions, or with specific cultivation management.

Effect of planting date and variety on taro

J. Rahman, M.R. Ali, A.A. Begum, S.S. Kakon, D.A. Choudhury and M.M. Kadir

This study was conducted at RARS, Jamalpur during 2020 and 2021 to determine the suitable of variety taro and planting date for vegetable production in the lag period shortly after monsoon. Two varieties like BARI PK-1 and BARI PK-2, and five planting dates viz., August, December, January, February and March were used in the experiment. Design of the experiment was split plot design with 3 replications. Each treatment was sown in unit plot having 4.5m × 3m with the spacing of 60 cm × 45cm. Fertilizers were applied at the rate of 90-30-90-15 kg/ha NPKS (FRG, 2018) as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, Boron. All of P, K and S were applied as basal during land preparation. N was side dressed in two equal splits at 30 and 60 DAP. Seedlings were transplanted as per treatment. Weeding was done when necessary. Yield of rhizomes and stolons were calculated from the whole plot area. Yield contributing characters were taken from 5 randomly selected plants from the middle rows of each plot. Data were analyzed with the help of a computer package program, Statistix 8.0 and means were separated following LSD test at 5% level of significance. Both varieties showed better performance in February and March planting than other months. But both the varieties showed good performance and gave better economic return in all the planting dates supplying nutritious vegetables (stolon and rhizome) during the lag period also after monsoon.

Performance of garlic varieties at Dinajpur region

M.M. Khanum and M. S. Huda

The experiment was carried out at the research field of Agricultural Research Station, Rajbari, Dinajpur (Latitude: 25°38'7.22" N, Longitude: 88°39'6.22" E) during *rabi* season of 2020-21. The objective of this study was to evaluate the performance of garlic varieties at Dinajpur region. There were four garlic varieties, namely BARI Roshun-1, BARI Roshun-2, BARI Roshun-3, BARI Roshun-4 against local cultivar in the experiment. The experiment was laid out in randomized completely

block design (RCBD) with three replications. The unit plot size was 3.0 m × 3.6 m. Five varieties of garlic, viz. BARI Roshun-1, BARI Roshun-2, BARI Roshun-3, BARI Roshun-4 and local (Kacinia) were tested. The seeds (clove) were planted in 09 November, 2020 with spacing of 15 cm × 10 cm. The soil was fertilized with N₁₀₀P₅₄K₁₆₇S₂₀B_{1.7} kg ha⁻¹ and cow dung 5 t ha⁻¹ (Mondal *et al.*, 2011). The entire amount of cowdung, P, S, B and ½ of N and ½ of K were applied at the time of final land preparation. The remaining N and K were top dressed in equal two splits, at 25 and 50 days, after planting (DAP). The crops were weeded two times, while five times sprayed with Rovral, Ridomil gold, Amistertop for controlling purple blotch (*Alternaria porri*) as well as Tido plus, confidor and Vertimec were done to control thrips and mite. Irrigation was applied in four times at 15, 30, 45, and 60 days after planting (DAP). The crop was harvested on 31 March, 2021. Yield components of garlic were taken from randomly selected 10 plants from each plot. Bulb yields were taken from whole plot. Collected data were analyzed statistically by using R software packages and mean differences for each character were compared by Least Significant Difference (LSD) test. Results revealed that the highest yield (10.76 t/ha) was obtained from BARI Roshun-3, followed by BARI Roshun-4 (9.52 t/ha) and BARI Roshun-2. BARI Roshun-3 produced 40, 27, 13 and 55% higher bulb yield than BARI Roshun-1, BARI Roshun-2, BARI Roshun-4 and local cultivar. The highest gross return (Tk. 430400/ha) and gross margin (Tk. 288233/ha) and BCR (3.03) were obtained from BARI Roshun-3. Therefore, the result of this study could be helpful for improving bulb production of garlic under Old Himalayan Piedmont plain soil (non-calcareous soils) in Bangladesh.

Growth and yield of sorghum as influenced by spacing and nutrient management

A. A. Begum, J.A. Chowdhury, M.R. Karim and D.A. Choudhury

A field experiment was conducted at Agronomy Research Field of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during *rabi* season of 2020-2021 to find out optimum fertilizer dose and suitable plant spacing for better growth

and higher grain yield of sorghum. Three plant spacing viz., S₁=60 cm × 10 cm (1,66,666 plants/ha), S₂=50 cm × 15 cm (1,33,333 plants/ha) and S₃=40 cm × 20 cm (1,25,000 plants/ha), and four fertilizer doses viz., F₁=N₁₂₀P₆₀K₅₀S₂₇Zn_{2.8}B_{1.4} kg/ha, F₂=F₁ + 25% NPK (N₁₅₀P₇₅K₆₃S₂₇Zn_{2.8}B_{1.4} kg/ha), F₃=F₁ + 50% NPK (N₁₈₀P₉₀K₇₅S₂₇Zn_{2.8}B_{1.4} kg/ha) and F₄=Control (Native fertility) were used as treatments in the experiment. There were 12 treatment combinations as follows: S₁ × F₁, S₁ × F₂, S₁ × F₃, S₁ × F₄, S₂ × F₁, S₂ × F₂, S₂ × F₃, S₂ × F₄, S₃ × F₁, S₃ × F₂, S₃ × F₃ and S₃ × F₄. The experiment was laid out in a two factor randomized complete block design with three replications. The unit plot size was 8 m × 6 m. Seeds of sorghum (BARI Sorghum-1) were sown on 10 December 2020. Fertilizers were applied as per treatments. One-third of urea and full amount of triple super phosphate (TSP), muriate of potash (MoP), zinc sulphate and boric acid were applied at the time of final land preparation. The remaining urea was side dressed in two equal splits at 30 DAS and 50 DAS and mixed thoroughly with the soil as soon as possible for better utilization. A light irrigation was given after sowing of seeds for uniform germination. Three irrigations were done at 30 and 50 DAS and grain development stage. Thinning was done at 20 DAS and weeding at 25 and 45 DAS. Data on growth parameters like leaf area and dry matter accumulation were measured at different dates with 25 days interval. For recording dry matter weight and leaf area, three plants from each replication were sampled at 25, 50, 75, 100 DAS and at harvest. Different plant parts of the collected samples were separated and then oven dried at 80°C for 72 hours. Leaf area was measured by an automatic leaf area meter (LI3100 c, LICOR, USA). Light interception (LI) by the crop was recorded at five times (25, 50, 75 DAS and at harvest) at around 11:30 am to 13:00 pm by Sunfleck Ceptometer (Model Decagon, Pulman, Washington, USA). Four readings each of PAR_{inc} and PAR_t were recorded at different spots of each plot. The proportion of intercepted PAR (PAR_{int}) was calculated using the following equation and expressed in percentage (Ahmed *et al.*, 2010):

$$\text{Light interception } \{ \text{PAR}_{\text{int}} (\%) \} = \frac{\text{PAR}_{\text{inc}} - \text{PAR}_{\text{t}}}{\text{PAR}_{\text{inc}}} \times 100$$

whrer, PAR_{inc} = Incident PAR, PAR_t = Transmitted PAR, PAR_{int} = Intercepted PAR

Soil-Plant-Analysis Development (SPAD) Value of leaf chlorophyll content might be used as an indirect indicator of crop N status. Chlorophyll content measured using a portable SPAD meter (Model SPAD-502, Minolta corp, Ramsey, NJ) at 30, 45, 60, 75 and 90 DAS. The crop was harvested on 21 April 2021 (133 days after sowing). The yield component data was taken from 5 randomly selected hills from each plot. At harvest, the yield data was recorded plot wise from central 10 m² area. The collected data were analyzed statistically and means were adjudged by LSD test at 5% level of significance using MSTAT-C package. Cost and return analysis was also done considering local market price of harvested crops. Results revealed that, plant spacing and fertilizer levels has great influence on leaf area index (LAI), light interception, chlorophyll content (SPAD value), dry matter production and yield of sorghum. LAI was the highest with the lowest population of 125000 /ha with the highest fertilizer N₁₈₀ P₉₀ K₇₅ S₂₇ Zn_{2.8} B_{1.4} kg /ha (F₃). Light interception, chlorophyll content (SPAD value) was the maximum in the same treatment. Plants grown in 40 cm × 20 cm spacing (125000 plants/ha) with N₁₈₀ P₉₀ K₇₅ S₂₇ Zn_{2.8} B_{1.4} kg /ha (F₃) gave the highest grain yield (5.55 t/ha) followed by same spacing 40cm × 20 cm (S₃) with N₁₅₀ P₇₅ K₆₃ S₂₇ Zn_{2.8} B_{1.4} kg /ha (F₂). Though S₃F₃ combination gave the maximum gross return (Tk. 110930/ha) but maximum benefit cost ratio (2.16) was recorded in S₃F₂ treatment. The results indicated that plant spacing of 40 cm × 20 cm with fertilizer dose N₁₈₀ P₉₀ K₇₅ S₂₇ Zn_{2.8} B_{1.4} kg/ha and N₁₅₀ P₇₅ K₆₃ S₂₇ Zn_{2.8} B_{1.4} kg/ha might be suitable for sorghum cultivation.

Grain and fodder yield of sorghum as affected by cutting time

S.S. Kakon, A.A.begum, J.A.Chowdhury, M.R.Karim and D.A.Chowdhury

The experiment was conducted at the research field of Agronomy Division, BARI, Gazipur, Joydebpur during *rabi* season of 2020-21 to find out proper cutting time for maximum yield of fodder and grain yield in sorghum and the effect of cutting time on sorghum yield components. There were

nine treatments in this study viz., T₁ = no cutting, T₂ = cutting whole plant at 60 DAS for fodder purpose, T₃ = Cutting plant 8" up from ground level at 70 DAS for fodder purpose, T₄ = Keeping main tiller then cutting all tillers at 70 DAS for fodder purpose, T₅ = Keeping all tillers then cutting main tiller at 70 DAS for fodder purpose, T₆ = Cutting plant 8" up from ground level at 80 DAS for fodder purpose, T₇ = Keeping main tiller then cutting all tillers at 80 DAS for fodder purpose and T₈ = Keeping all tillers then cutting main tiller at 80 DAS for fodder purpose. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 3 m x 3 m. Seeds of Sorghum were sown on 07 November 2020. Sorghum seeds were sown at a spacing of 60 cm between rows and 10 cm between the plants. Fertilizers were applied at the rate of 120-48-75-30-3-1 kg/ha of N, P, K, S, Zn, B (FRG, 2018) as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid for sorghum. One third of N, whole amount of TSP, MoP, gypsum, zinc sulphate and boric acid were applied as basal. Remaining 2/3 N was top dressed at 25 and 45 days after sowing (DAS) of sorghum. A light irrigation was given after sowing of seeds for uniform germination. Two irrigations were done at 30 and 45 DAS. Thinning was done at 10 DAS and weeding at 15 and 25 DAS. For dry matter estimation, 5 plants were measured at harvest. Dry weight of the samples was taken after drying at 80°C in an oven for 72 hours. Cutting was done for green fodder leaving the plants 8" above the ground level to facilitate regeneration. The fodder was harvested as per cutting treatment. Green biomass weight of fodder was taken immediately after cutting in the field. T₁ treatment was harvested at 155 DAS and the rest were harvested on 05 May, 2020. At harvest 10 plants were randomly selected for collecting data on yield components. Grain yields were calculated on whole plot basis and adjusted at 12% moisture content. Local market price of the products at harvest was considered for calculation of gross return and economic performances. The collected data were analyzed statistically and the means were compared using LSD test at 5% level of significance. The results indicated that cutting time significantly affected sorghum fodder yield. Fodder yield increased with

increasing cutting time. Cutting sorghum at 60, 70 and 80 DAS resulted in re-growth that eventually produced both fodder and grain. Significantly the highest fodder yield (42.59t/ha) was recorded in cutting whole plant at 80 DAS for fodder purpose. Significantly the highest seed (4.40 t/ha) yield was recorded in no cutting treatment which was followed by keeping main tiller then cutting all tillers at 80 DAS for fodder purpose but seed yield reduction was 5.02% over control. From the results it could be concluded that keeping main tiller then cutting all tillers at 80 DAS may be chosen for fodder purpose with slight reduction in seed yield for getting dual purpose of fodder yield and seed yield of sorghum in Gazipur region.

Effect of nutrient management and harvesting time on ratooning of sorghum as fodder crop

A.A. Begum, S. S. Kakon, S. T. Jannat and D. A. Choudhury

The experiment was conducted at the Research Field of Agronomy Division BARI, Gazipur during *rabi* season of 2020-2021 and *kharif* season of 2021 to find out the optimum fertilizer dose for ratooning of sorghum. Five fertilizer doses viz., $F_1 = N_{120}P_{60}K_{50}$ kg/ha, $F_2 = N_{96}P_{48}K_{40}$ kg/ha (80% NPK of F_1), $F_3 = N_{72}P_{36}K_{30}$ kg/ha (50% NPK of F_1), $F_4 = N_{120}$ kg/ha and $F_5 = \text{Control}$ (Native fertility), and three harvesting times viz., $H_1 = 35$ days after harvest of grain crop (DAH), $H_2 = 40$ DAH and $H_3 = 45$ DAH were used as treatments in the experiment. The 1st or grain crop experiment was laid out in a piece of land with the area of 32 m × 28 m. Seeds of sorghum (BARI Sorghum-1) were sown on 5 December 2020. Seeds were sown with spacing at 60 cm × 10 cm. Fertilizers were applied at the rate of 120-48-75 kg/ha of NPK (FRG, 2018) as urea, triple super phosphate (TSP), muriate of potash (MoP) for grain sorghum. One third of N, whole amount of TSP and MoP were applied as basal. Remaining 2/3 N was top dressed at 25 and 45 days after sowing (DAS) of sorghum. A light irrigation was given after sowing of seeds for uniform germination. Two irrigations were done at 30 DAS and 45 DAS. Thinning was done at 10 DAS and weeding at 25 DAS. Main crop was harvested at 144 DAS on 27 April, 2021. At harvest, plant was cut 15 cm above the ground level to facilitate regeneration for ratooning of sorghum as fodder

purpose. After harvesting of the main or grain crop, ratooning experiment was laid out in a randomized complete block design with three replications. One-third of urea and full amount of TSP and MoP were applied just after harvesting of 1st or grain crop. The remaining urea was side dressed in two equal splits at 15 DAH and 25 DAH. The fodder was harvested as per time of cutting treatment. For recording dry matter weight and leaf area, three plants from each replication were sampled at harvest for analysis to determine the quality of ratoon sorghum as a fodder crop. Dry weight of the samples was taken after drying at 80°C in an oven for 72 hours. Soil-Plant-Analysis Development (SPAD) value of leaf chlorophyll content might be used as an indirect indicator of crop N status. Green biomass weight of fodder was recorded plot wise immediately after harvest. The collected data of the experiment were analyzed statistically and the means were compared using LSD test at 5% level of significance. Results revealed that, fertilizer dose and harvesting time had influence on dry matter production (TDM) and green fodder yield of ratoon sorghum. Higher TDM and green fodder yield of ratoon sorghum were recorded when the crop receiving the higher fertilizer like $N_{120}P_{60}K_{50}$ kg/ha, $N_{96}P_{48}K_{40}$ kg/ha, $N_{72}P_{36}K_{30}$ kg/ha and N_{120} kg/ha and harvested at 45 days after harvesting of grain crop. The results indicated that fertilizer dose of $N_{120}P_{60}K_{50}$ kg/ha, $N_{96}P_{48}K_{40}$ kg/ha, $N_{72}P_{36}K_{30}$ kg/ha, N_{120} kg/ha with harvested at 45 days after harvest of first grain crop might be optimum combination for ratoon sorghum production as fodder crop.

Effect of sowing time and plant population on growth and yield of chia (*salvia hispanica*)

S.S. Kakon, M.A.K. Mian, M.R. Karim, A.A. Begum and D. A. Choudhury

The experiment was conducted at Agronomy research field of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, during *rabi* (winter) season of 2020-21 to determine optimum sowing date and spacing of chia seeds. The experiment consisted of three sowing date viz. 15 November, 30 November and 15 December and three spacing viz. 30 cm × 05 cm, 40 cm × 05 cm and 50 cm × 05 cm as treatments. The average maximum (32.8 °C) temperature was found in the

month of November at early stage of crop establishment and minimum (7.5 °C) in the month of February during the crop growing season. The experiment was laid out in a RCBD design with three replications. The unit plot size was 3.6 m x 3.0 m. The crop was fertilized with 60-15-30 -5 N-P-K-S kg /ha, respectively (Karim *et al.*, 2015). Half of N and full doses of other fertilizers were applied at the time of final land preparation and the rest urea was top dressed 35 days after sowing (DAS). Seeds were treated with vitavax. Hand weeding was done at 25 and 40 days after sowing (DAS). The crops were harvested on 4 March 2021, 16 March 2021 and 24 March 2021. Data of plant height, yield components and others were recorded from 10 randomly selected plants. Yield was calculated from whole plot. Data on different parameters were subjected to analysis of variance and the treatment means were compared by Least Significant Difference (LSD) test. Sowing date showed great influence on total dry matter (TDM) production, leaf area index (LAI), yield components and yield of chia. The 30 November sowing produced the maximum TDM and LAI followed by 15 November sowing. These parameters finally contributed to higher seed yield than earlier and later sowing date. Early planting took longer time for flowering (66 days) and fruiting while late planting gave early flowering, decreased inflorescences number and increased sterile inflorescences. It was also found that 15 November sowing with 40 cm x 05 cm row spacing produced the higher seed yield (1024kg/ha). The results revealed that 15-30 November sowing with 40 cm x 05 cm produced higher seed yield might be due to favourable air temperature for growth and development of chia crop. Late sowing after November 30 produced lower seed yield due to high temperature (22°C) prevailed at the later growth stage (February) of chia. Wider spacing gave higher number inflorescences but closer spacing gave higher seed yield. Significantly the lowest seed yield (510 kg/ ha) was recorded in 15 December sowing with 50 cm x 05 cm. Plant height was higher in early planting and was minimum in late planting. Results revealed that 15-30 November sowing with 40 cm x 05cm performed better. With the advancement of sowing dates the

temperature increased, reduced the grain growth duration and decreased the seed yield.

Effect of sowing date and planting method on growth and yield of squash

M. M. Khanum and M. S. Huda

The experiment was conducted at the research field of Agricultural Research Station, Rajbari, Dinajpur during *rabi* season of 2019-20 and 20-21 to evaluate the optimum sowing time and planting method of Squash and to increase the productivity and yield. Three sowing dates of viz. S₁= 1 November, S₂= 10 November, S₃= 20 November and two planting method viz., P₁= direct seed sowing method, P₂= transplanting of seedling method were as treatment. The experiment was laid out in randomized complete block (RCB) design with three replications. The unit plot size was 4.0 m x 4.0 m and the crop sown in line with 100 cm row to row distance and plant to plant distance 80 cm. 15-16 days old seedlings were transplanted as per treatment. The crop was fertilized at the rate of 80-35-75-20-4-2 kg/ha NPKSZnB + CD: 20 t/ha (Krishiprosukti hatboi, 9thed.). All organic manure were applied at the time of final land preparation. All of phosphorus, sulphur, zinc and boron were applied in pit before one week of direct sowing and transplanting of seedlings. Nitrogen and potassium were applied in three equal splits at 15, 30, and 45 DAT as ring method around the plants and mixed thoroughly with the soil followed by light irrigation. Fungicide (Dithane M-45) @ 1ml/liter water was sprayed at every 10 days interval beginning from 25 days after planting to 70 days after planting for preventing fungal disease. Pheromone traps (Cue lure) were used to control cucurbit fruit fly in the squash field @ 82 traps/ha from 30 days after planting up to harvesting of squash (Cork *et al.*, 2003). Intercultural operations like watering, weeding and pest control were done as and when required. Yield components of squash were taken from randomly selected 8 plants from each plot. Fruit yields were taken from whole plot. Collected data were analyzed statistically by using R software packages and mean differences for each character were compared by Least Significant Difference (LSD) test. Early flowering (54 days) as well as early fruit harvesting (70 days) was occurred in 1 November sowing, whereas sowing

on 20 November resulted in delayed flowering (63 days) and fruit harvesting (90 days), respectively. Seed sowing of 1 November was found better in respect of yield (35.77 t/ha) compared to 10 November (32.85 t/ha) and 20 November (22.12 t/ha) sowing. Between, the planting method, transplanting of seedling method produced the highest (33.59 t/ha) marketable yield while direct sowing seed method gave the lowest (26.90 t/ha) marketable yield.

Effect of plant population and integrated nutrient management on yield of yard long bean (*vigna unguiculata*)

S.S.Kakon, S. Paul, A.A.Begum, S.T.Zannat and D.A.Choudhury

The experiment was conducted at Agronomy research field of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, and RARS, Jashore, during *kharif* season of 2020-21 to find out the optimum plant population and suitable fertilizer dose for higher yield of yard long bean. Two plant spacing viz, $S_1=45\text{ cm} \times 30\text{ cm}$, $S_2=40\text{ cm} \times 20\text{ cm}$ and three fertilizer doses viz, F_1 =Recommended fertilizer dose (RFD)(21-27-33-9-1.2-1.2 kg/ha NPKSZnB), F_2 = IPNS with Poultry manure (3 t/ha), F_3 =IPNS with Vermicompost (3 t/ha) were used in Joydebpur and Jashore but additional F_4 = IPNS with trichocompost (3 t/ha) was used in Jashore. Seeds of yard long bean were sown on 18 March, 2021 at Joydebpur and 4th March, 2021 at Jashore. Fertilizers were applied as per treatments in the form of Urea, TSP, MoP, Gypsum, Zinc sulphate and Boric acid. One-third of urea and full amount of all other fertilizers were applied at the time of final land preparation. The remaining Urea was top dressed in two equal splits at 35 DAS and 50 DAS. A light irrigation was given after sowing of seeds uniform for germination. Three irrigations were done at 25 and 50 DAS. Intercultural operations like thinning were done at 15 DAS and weeding were done two times at 15 and 25 DAS. For dry matter estimation, 5 plants were sampled at maturity. The collected samples were dried component wise in an oven at 80°C for 72 hours. Yard long bean was harvested several times and started on 17 May 2021 at Joydebpur and on 27th April, 2021 at Jashore. The yield component data was taken from 5 randomly

selected plants prior to harvest from each plot. At harvest, the yield data was recorded plot wise. The collected data were analyzed statistically and means were adjudged by LSD test at 5% level of probability using MSTAT-C package at Joydebpur and Jashore. The best results in terms of vegetable fresh yield were obtained in the following order: PM > VC > NPK. Application of VC is not beneficial due to 15 times higher price than PM. The result indicated that plant spacing of 40 cm × 20 cm with IPNS (16-25-30-9-1.2-1.2 kg/ha NPKSZn) with poultry manure (3 t/ha) gave the highest pod yield (4.90 t/ha) at Joydebpur. Again plant spacing of 40 cm × 25 cm with IPNS with poultry manure (3 t/ha) and trichocompost (3 t/ha) produced the highest pod yield (7.04- 7.67 t/ha) at Jashore. The highest benefit cost ratio (2.22 at Joydebpur and 2.99 at Jashore) of yard long bean was recorded in S_2F_2 treatment. From the result it could be concluded that plant spacing of 40 cm × 20 cm (1,25,000 plants/ha) with fertilizer dose IPNS (16-25-30-9-1.2-1.2 kg/ha NPKSZn) with Poultry manure (3 t/ha) might be suitable for yard long bean cultivation at Joydebpur and Jashore.

Determination of harvesting efficiency of mung bean

M. A. K. Mian, M.R. Islam and S.T. Zannat

A field experiment was conducted at the Agronomy field of BARI, Joydebpur, Gazipur and RARS Ishurdi, Pabna during the *kharif* season of 2020-2021. Four harvesting time viz. T_1 = Harvesting at 60 DAS (days after sowing), T_2 = Harvesting at 65 DAS, T_3 = Harvesting at 70 DAS and T_4 = Harvesting at 75 DAS were as treatments in the experiment. Later harvesting increased the pods/plant which contributed to higher seed yield. The trial was set up in a randomized complete block design. Sowing was done with spacing of 30 cm × 10 cm with three replications at 3 March 2021 on both the locations. The unit plot size was 3 m × 3.6 m. The test crop was BARI mug-8. The crop was fertilized with cow dung (5 t/ha) and 24-24-32-16-3-2 kg/ha of N-P-K-S-Zn-B, respectively in the form of urea-TSP-MoP-gypsum-zinc sulphate and boric acid (FRG' 2018). The whole amount of CD and N-P-K-S-Zn-B fertilizers was applied during final land preparation. A light irrigation was given after sowing for uniform emergence of seeds.

Harvesting was done as per treatment. At the time of harvest, yield contributing characters were recorded from one linear meter. Yield data was recorded by harvesting the whole plot. The highest seed yield (814-997 kg/ha) was noticed in T₄ (harvesting at 75 DAS) at both the locations. The average harvesting efficiency was computed the highest in T₄ (100%) treatment followed T₃ (97.57%). Harvesting at 70 DAS-75 DAS would be suitable for higher seed yield and harvesting efficiency of mung bean.

Effect of management practice on the yield and quality of murta plant (shitalpati)

M.A. Rahman and M.M. Rahman

The field experiment was conducted at farmers' field of Kamdebpur village, Nalchity, Jhalakati on year round of 2020-21 to develop suitable management package for increasing the yield of murta plant and to improve the quality of shitalpati (cooling mat). The experimental site is located under the agro-ecological zone Ganges Tidal Floodplain (AEZ-13). The soil type is medium low land and soil texture is siltly-clay. The treatments of the experiment were five management practices on existing murta plants viz., T₁ = Plant nutrients (chemical + organic, @ urea 150 kg, triple super phosphate (TSP) 160 kg, muriate of potash (MoP) 80 kg and compost 3 t/ha) + Pesticides application (on rhizome and plant parts) + Pruning (extra tillers and cleaning of dead plant parts), T₂ = Plant nutrients (chemical + organic) + Pruning, T₃ = Pesticides (Insecticide + Fungicide) + Pruning, T₄ = Pruning and T₅ = Farmers' practice (control, without management). The experiment was set up on 8 years old of existing murta plant on 19 March 2020. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 4.5 m × 3 m. The experimental plots were fertilized as per the treatment specifications. The murta crop (main internode/doga) was harvested on 26 January, 2021. Data were collected on different parameters such as plant hill population/m², plant height, number of main internode (doga)/m², Main internode/doga height, doge diameter, single doge weight, doge weight/plot and rating of doge quality. The plot wise doge weights were then converted into tonne/hectare. The quality of treatment-wise

harvested doge was rated based on 1-7 scale, where 1 = Excellent quality, 2 = Very good, 3 = Good, 4 = Moderate, 5 = Poor, 6 = Very poor, and 7 = Not useable/worst quality. Data were analyzed through Statistix10 computer software and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT) following Gomez and Gomez (1984). The main internode/doga yield was the highest (32.37 t/ha) in T₁ and T₂ (26.66 t/ha). The Treatments T₃ and T₄ gave statistically similar yields (25.26 and 22.10 t/ha, respectively). In terms of rating of doge quality, treatment T₁ exhibited the highest quality (2.33) and it was partially at par to that of T₂ and T₃ treatments (3.33). The farmers' practice showed the lowest quality doge (4.67), which was partially similar to that of T₄ treatment (4.00). The results further revealed that treatment T₁ increased the doge yield of 68.35%. However, the increased yield of doge for treatments T₂, T₃ and T₄ treatments were 38.64%, 31.38% and 14.97%, respectively. It can be noted that quality doge is able to produce quality cane for shitalpati making. Treatment T₁ (Chemical & organic fertilizers + pesticide application + pruning) could be suitable for cultivating murta crop in achieving higher yield and quality of murta doge.

Effect of different chemical treatments of murta cane on the quality of shital pati in Bangladesh

M.A. Rahman, M.M. Rahman and M.R. Uddin

The experiment was conducted during 2019-20 and 2020-21 seasons at Farmers' home of Kamdebpur village under Nalchity upazila of Jhalakati district (2019-20) and Regional Agricultural Research Station, BARI, Rahmatpur, Barishal (2020-21) to develop suitable protocol of chemical treatment/process on murta cane for improving the quality of shitalpati in Bangladesh. The treatment of the experiment was nine type of chemical treatment/process of murta cane viz., T₁ = Boiled with Tamarind leaf + Cowa leaf, T₂ = Soaking and boiled with fermented rice starch, T₃ = Boiled with white vinegar (vinegar: water = 1:4), T₄ = Boiled with cowa leaf + Vinegar, T₅ = Boiled with Detergent powder, T₆ = Boiled with Fermented rice starch + Arrowroot, T₇ = Boiled with Tamarind leaf + Cowa leaf + Rice starch, T₈ = Boiled with Rice starch + Fermented milk, and T₉ = Control (no treatment). The qualitative data were evaluated just

after weaving the shitalpati based on 1 to 7 rating scale, where 1 = Excellent quality, 2 = Very good, 3 = Good, 4 = Moderate, 5 = Poor, 6 = Very poor, and 7 = Not useable/worst quality. The design of the experiment was Completely Randomized Design (CRD) with three replications. In this connection, the stem (*doga*) of murta plant was harvested and then the green top layer was separated from the stem for making cane (locally known as *Ati beti*). The cane was processed following the chemical treatment specifications. The processed cane then was dried in the sun for 2-3 days until getting ready for making shitalpati. The workers those who have been making shitalpati since from the ancient time generally known as “*Patikor*” (Surname) in the locality. The unit size of shitalpati was 2.3 meter long and 1.38 meter wide. Data were recorded on different quantitative traits viz. p^H (before and after boiling), temperature (before adding murta cane), temperature (after adding murta cane), surface temperature) and qualitative traits viz. shitalpati brightness, surface glossiness, surface smoothness and relax) during cane processing and shitalpati preparation. Data were analyzed through Statistix10 computer software and the mean differences were adjudged with Duncan’s Multiple Range Test (DMRT) following Gomez and Gomez (1984). In 2019-20, the chemical treatment of murta cane created variation in quantitative and qualitative traits of shitalpati. Considering the qualitative traits (brightness, surface glossiness, surface smoothness and relax), the average rating of treatment T₈ (Boiled with Rice starch + Fermented milk) existed between very good and good qualities of shitalpati. Ratings of treatment T₄ (Boiled with Cowa leaf + Vinegar) and T₇ (Boiled with Tamarind leaf + Cowa leaf + Rice starch) treatments were Good. In 2020-21, all the quantitative and qualitative traits varied significantly due to imposing chemical treatment on murta cane. In terms of qualitative traits, the average lowest value (2.58) was recorded in treatment T₇ that denotes from very good to good quality of shitalpati. Statistically similar result was also observed in T₄ treatment (rating 2.67). The rating from good to moderate qualities of shitalpati were found in T₆ (3.33), T₂ (3.42) and T₁ (3.42). However, the experiment should be continued in the next years for making final recommendation.

Weed management

Effect of integrated weed management on sorghum cultivation

N. Akther, S.S. Kakon, M.A.K. Mian and D.A. Choudhury

The field experiment was conducted at Agronomy Research Field, Joydebpur, Gazipur, Bangladesh Agricultural Research Institute (BARI) during *Rabi* season of 2020-2021 to find out suitable weed management practice in sorghum field. There were six treatment viz. T₁ = One hand weeding at 25 DAS, T₂ = Two hand weeding at 25 and 40 DAS, T₃ = Herbicide Atrazine @ 2 L/ha spraying as pre-emergence, T₄ = Herbicide Atrazine @ 2 L/ha spraying as post-emergence at 25 DAS, T₅ = Weeding by BARI weeder at 25 DAS, T₆ = No weeding included in the experiment. The experiment was consisted of six treatments viz. The experiment was laid out in RCBD design with three replications. The unit plot size was 3m × 3m. The crop was fertilized with 255-75-120-50-4-2 kg/ha NPKSZnB (FRG, 2018). One third N and all other fertilizers were applied as basal. Rest N was applied at 20 and 40 DAS. The test variety was BARI sorghum-1. The date of sowing was 1 December 2020. There times of irrigation were applied in field. The crop was harvested on 8 March 2021. Weed sample were collected (1 m² per each plot) at 40 DAE and 80 DAE and dry matter was taken after oven dry. Weed control efficiency (WCE) was calculated according to following formula:

WCE (%) = {(A-B)/A} * 100; where, A = Dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. Data on weed species weeds/m² and weed dry matter at were taken at 40 DAE and 80 DAE. Data were also recorded on plant height, number of panicle per hill, number of grain per panicle, 1000-grain weight and grain yield. Collected data were analyzed statistically with MSTAT-C statistical package. The means were separated by least significant difference test (LSD 0.05%). Results showed that the highest weed population 137 and 151 /m² were recorded in control plot at 25 and 40 DAS, respectively. The lowest weed population 15 and 22/m² was recorded in T₂ treatment at 25 and 40 DAS, respectively. Among all the treatments, the

highest weed control efficiency herbicide Atrazine @ 2 L/ha spraying as post-emergence at 25 DAS (63.79% at 40 DAE and 95.95% at 80 DAE) was found in T₄ (Herbicide Atrazine @ 2 L/ha spraying as post-emergence at 25 DAS) treatment. Significantly the yield (3.87 t/ha) was obtained from T₄ treatment. The highest gross return of (Tk. 109300/ha) and BCR (2.33) were obtained from T₄ (Herbicide Atrazine @ 2 L/ha spraying as post-emergence at 25 DAS) treatment. The result revealed that four herbicides (Herbicide Atrazine @ 2 L/ha spraying as post-emergence at 25 DAS) would be effective for weed control and economically profitable for sorghum cultivation at Gazipur (AEZ 28).

Effect of weeding and nutrient management practice on yield of sweet gourd

N. Akther, M.A.K. Mian and D.A. Choudhury

The field experiment was conducted at the Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during 2020-2021 to find out the optimum fertilizer dose and appropriate weed management method for getting higher yield and economic return in sweet gourd (var. BARI sweetgourd-2). The experiment was consisted of eight treatments viz. T₁ = Recommended fertilizer dose (RFD) (75-36-60-21-2.0-1.4 kg/ha NPKSZnB) + no weeding, T₂ = 125% RFD + two hand weeding at 25 and 50 DAP, T₃ = RFD + Spading at 25 and 50 DAP, T₄ = 125% RFD + Spading at 25 and 50 DAP, T₅ = RFD + BARI weeder weeding at 25 and 50 DAP, T₆ = 125% RFD + BARI weeder weeding at 25 and 50 DAP, T₇ = RFD + herbicide (Pendimethalin 45.5%) spray at 4 DAP + one hand weeding at 50 DAP, T₈ = 125% RFD + Herbicide spray at 4 DAP + one hand weeding at 50 DAP. The experiment was laid out in RCBD design with three replications. The unit plot size was 4m × 4 m. All of organic manure P, K, S, Zn and B were applied in pit 5-7 days before planting and mixed thoroughly with the soil N was applied around the plant as side dressing at 15, 35, 55 and 75 days after planting under moist soil condition and mixed thoroughly with the soil as soon as possible for better utilization. The test variety was BARI sweetgourd-2. Sweetgourd plants were transplanted at 2m × 2m spacing on 1 December 2020. The crop was harvested on 06 to

20 March 2021 at three times. Weed sample were collected (1 m² per each plot) at 25 DAP and 50 DAP and dry matter was taken after oven dry. Weed control efficiency (WCE) was calculated according to following formula:

WCE (%) = {(A-B)/A}*100; where, A = Dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. Data on weed species weeds/m² and weed dry matter at were taken from 40 DAE and 80 DAE. Plant data on fruit yield, breadth of fruit, length of fruit, number of fruit per plant, single fruit weight per plant were recorded. Collected data were analyzed statistically with MSTAT-C statistical package. The means were separated by least significant difference (LSD) test. Among the treatments the highest weed control efficiency (53.84% at 40 DAE and 93.65% at 80 DAE) was found in T₈ (125% RFD + herbicide spray at 4 DAP + One hand weeding at 50 DAP) treatment. Significantly the highest fruit yield (32.03 t/ha) was recorded in T₈ (125% RFD + herbicide spray at 4 DAP + One hand weeding at 50 DAP) treatment. Highest BCR (2.08) was recorded in T₈ (125% RFD + herbicide spray at 4 DAP + One hand weeding at 50 DAP) treatment. The result revealed that 125% RFD (94-45-75-26-2.5-1.75 kg/ha of NPKSZnB + pre emergence herbicide spray at 4 DAP + One hand weeding at 50 DAP treatment would be most effective to control weeds for obtaining higher yield of sweet gourd.

Optimization of dose and time of application of pendimethalin on weed control of onion

M.R. Islam, J. Hossain, M.S. Alam and D. Sarker

A field experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during 2020-2021 to find out the appropriate dose, and time of spray of Panida for weed control of onion. Four doses of Panida herbicide viz; i) D₁ = 3 ml /L of water, ii) D₂ = 5 ml /L of water, iii) D₃ = 7 ml /L of water, iv) D₄ = Control, and four spraying time namely, i) T₁ = Spraying just after planting and irrigation, ii) T₂ = Spraying 1 days after planting and irrigation, iii) T₃ = Spraying at 2 days after planting and irrigation, iv) T₄ = Spraying at 7 days after planting and irrigation were included in the experiment. Herbicides were applied at post-sowing condition. Unit plot size was 3m × 2 m. The

crop was fertilized with 240-260-150-110 kg ha⁻¹ of Urea-TSP-MOP-Gypsum, and cowdung 5 t ha⁻¹ (KrishiProjukti Hatboi-2019). Half of all fertilizers were applied as basal. Rest half of fertilizers were top dressed at 30 DAP. Onion was sown on 05 January 2021 and harvested on 30 March 2021. Weed sample was collected at 60 DAP and 80 DAP from every plot. Collected data were analyzed statistically with the help of 'R' program and mean separation was done by LSD at 5% level of significance. Herbicides were applied at post-showing condition. Dose and spraying time of Panida had significant effect of bulb yield. D₃T₁ produced the highest bulb yield (13.99 t/ha) and also giving better economic returns.

Effect of integrated weed management on tomato cultivation

S.T. Zannat, M.A.K. Mian, S.S. Kakon and D. A. Chowdhury

The field experiment was conducted at the Agronomy Research Field of Bangladesh Agricultural Research Institute (BARI) during *rabi* season of 2020-21 to find out suitable weed management practices in tomato field. Treatments consist of T₁= Two hand weeding at 25 and 45 DAT, T₂= Magzin 70 WG (Metribuzin) @ 300-400 g/ha + One hand weeding at 45 DAT, T₃= G-Penda 33 EC (Pendimethylene) @ 1 L/ha + One hand weeding 45 DAT, T₄= Shagun 54 WG (Metribuzin 42% + Clodinafop Propargyl 12% WG) @ 400-500 g/ha + One hand weeding 45 DAT and T₅= Control (No weeding). The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 3 m × 4 m. The crop was fertilized with cow dung @ 10 t/ha and 160-60-80-28-3-1.5 kg/ha of N P K S Zn B (FRG,2018) in the form of urea, triple super phosphate, muriate of potash and gypsum, respectively. Cow dung with other chemical fertilizers along with one third N and one third K were applied as basal dose. Rest of N and K all fertilizers were applied at 25 and 45 DAT in two equal splits. Weeding operation was applied as per treatments. BARI Tomato- 14 was used as test crop. Seedlings 29days old and were transplanted in main field on 03December 2020. Transplanting was done maintaining 60 cm line to line spacing and 40 cm plant to plant spacing. Weed samples

were collected from each plot at 25 and 45 DAT using a quadrat and dry weight was recorded to evaluate the efficacy of different weed control treatments. Tomato was harvested for six times and final harvest was done on 28 March 2021. Total Soluble Solids (TSS) or Degrees of Brix (°B) of tomato fruits was measured by a digital refractometer (Model NR151). Weed control efficiency (WCE) was calculated according to following formula:

WCE (%) = {(A-B)/A}*100; where, A = Dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. Yield and yield contributing characters were recorded and analyzed statistically using "STAR" software package and means were separated by LSD at 5% level of significance. Economic analysis was performed considering the prevailing market price of applied inputs and output of tomato. Results showed that *Helencha (Enhydra fluviatilis)* was observed as a major weed in tomato field. Number of weed/m² and weed control efficiency (WCE) was affected by different treatments. The highest weed populations (84/m² and 93/m²) were recorded in control plot at 25 and 45 DAT, respectively. The highest WCE (weed control efficiency) was 87.39 and 84.42% at 25DAT and 45 DAT respectively in T₄ treatment. Total Soluble Solids (5.50, 6.10, 5.70) and yield (74.60 t/ha) of tomato were obtained from T₄ treatment. The highest gross return (Tk. 895200/ha), gross margin (Tk. 733250/ha) and BCR (5.53) was observed in T₄{spraying of herbicide i.e. Shagun 54 WG (Metribuzin 42% + Clodinafop Propargyl 12% WG) @ 400-500 g/ha + One hand weeding at 45 DAT} treatment. The result revealed that application of herbicide Shagun 54 WG (Metribuzin 42% + Clodinafop Propargyl 12% WG) @ 400-500 g/ha + one hand weeding at 45 DAT would be effective to control weeds for obtaining higher yield of tomato.

Response of fertilizer and weed management on okra

J.A. Chowdhury, A.A. Begum, S.S. Kakon, M.R. Karim, M.A.K. Mian and D.A. Choudhury

The field experiment was conducted at the Agronomy research field of Bangladesh Agricultural Research Institute (BARI) during March to May 2020 and 2021 to find out the

suitable weed management practice for obtaining higher yield and economic return of okra. Treatments consist of T₁= Two hand weeding at 25 & 50 DAE, T₂= Pre emergence Herbicide at 4 DAS, T₃= Post emergence Herbicide at 25 DAE, T₄= Pre emergence Herbicide at 4 DAS + one hand weeding at 25 DAE, T₅=Pre emergence Herbicide at 4 DAS + two hand weeding at 25 and 50 DAE, T₆= Pre emergence Herbicide at 4 DAS + one hand weeding at 50 DAE, T₇= Post emergence Herbicide at 25 DAE +one hand weeding at 50 DAE, T₈= BARI weeder weeding at 25 DAE and 50 DAE, T₉= Control. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 3.6 m × 3.6 m. 5 t/ha cowdung and other fertilizers at the rate of 90 kg N, 30 kg P, 50 kg K, 15 kg Sand 1.3 kg B /ha (FRG, 2018) was applied in the form of urea, triple super phosphate, murate of potash, gypsum, zinc sulphate and boric acid, respectively. One fourth N and all other fertilizer including cowdung was applied as basal during final land preparation and rest N will be applied at 20, 40 and 60 days after sowing in equal split. Weeding operation was done as per treatments. BARI Dharos-2 was used as test crop. Seeds were sown on 19 March, 2020 and 28 March, 2021 with a spacing of 50 cm × 40 cm. Weed samples were collected from each plot at 25 DAE and 50 DAE using a 50 cm × 50 cm quadrat placed randomly at three spots within each plot. Weeds sampled from the quadrat were counted and oven-dried at 70 °C for 72 hours, after which they were weighed and expressed in g/ m². Weed control efficiency (WCE) was calculated according to following formula:

WCE (%) = {(A-B)/A}*100; where, A = Dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. Harvesting started on 16 May, 2020 and 25 May, 2021. Green immature pods could be broken with a hand snap (not yet fibrous), were harvested every three days, from each plot. Data on yield and yield parameters was recorded and analyzed statistically with the help of MSTAT-C programme. Means were adjusted by LSD test at 5% level of significance. Cost and return analysis was performed considering the prevailing market price of okra and other inputs. Results showed that Shyama (*Echinochola crusgali*) was observed as a major weed in okra

field. Numbers of weed/m² and weed control efficiency (WCE) were affected by different treatments. The highest weed population (183/m² at 25 DAE and 206/m² at 50 DAE) was recorded in control plot (T₉) and the lowest (46/m² at 25 DAE and 17/m² at 50 DAE) from T₅ treatment. The highest WCE (82.65% at 25 DAE and 91.51% at 50 DAE) was found in T₅ treatment. The maximum fruit yield of okra (9.85 t/ha) was obtained from T₅ (Pre emergence Herbicide at 4 DAS + two hand weeding at 25 and 50 DAE) treatment. The highest gross return (Tk.197000/ha), gross margin (Tk.115500/ha) and BCR (2.42) were also obtained from T₅ (Pre emergence herbicide at 4 DAS + two hand weeding at 25 and 50 DAE) treatment. The result revealed that application of pre emergence herbicide at 4 DAS + two hand weeding at 25 and 50 DAE treatment would be most effective weed control method for obtaining higher yield of okra.

Effect of different herbicide for controlling weeds in maize field

M. R. Karim, J. A. Chowdhury, A. A. Begum, S. S. Kakon, M.Z. Ali and D. A. Chowdhury

A field experiment was conducted at Agronomy Research Field of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur in 2020-21 to find out the suitable herbicide for controlling weeds in maize field. The treatments were: T₁= AP-Saf 55 SC (Atrazine 50% + Mesotrione 5%) @ 2.5 L/ha at 2-3 leaf stage of weed, T₂=East killer 55 SC (Atrazine 50% + Mesotrione 5%) @ 2.5 L/ha at 2-3 leaf stage of weed; T₃= Mukti 55 SC (Atrazine 50% + Mesotrione 5%) @ 2.5 L/ha at 2-3 leaf stage of weed, T₄ = Alphanash 6 OD (Cyhalofop-butyl 5% + Penoxulam 1%) @ 1.5 L/ha at 2-3 leaf stage of weed, T₅ = Klinz 50 EC (Acetochlor 50%) @ 2.0 L/ha before maize seed sowing, T₆= Two hand weeding at 25 and 40 days after sowing and T₇= Control (no Weeding). The trial was set up in randomized complete block design with three replications at December 10, 2019. The unit plot size was 3 m × 3 m. Test crop was BARI hybrid maize-9. The crop was fertilized with cow dung (5 t/ha), 250-55-110-40-5-1.5 kg/ha of N-P-K-S-Zn-B, respectively (FRG, 2018) in the form of urea-TSP-MoP-gypsum-zinc sulphate and – boric acid. One third of urea and all other fertilizers were applied during final land preparation. Remaining 2/3 urea

were top-dressed in two equal splits at 30 and 60 DAE followed by irrigation. A light irrigation was given after sowing for uniform emergence of seeds. Weed samples were collected from randomly selected four places from each plot at 40 and 60 days after emergence. Number and dry weight of weeds were recorded carefully. Harvesting was done at May 2, 2020 and yield data were collected. Weed control efficiency (WCE) was calculated according to following formula:

$WCE (\%) = \{(A-B)/A\} * 100$; where, A = Dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. Yield and economic performance were calculated for the treatments. Results showed that number of weed/m², weed control efficiency (WCE) and yield of maize were significantly influenced by different herbicides. The highest weed population (89 and 103 /m²) was recorded in T₇ at 40 and 60 DAE. The highest WCE of 97.75 & 97.79 % was found in T₃ treatment at 40 DAE and 60 DAE, respectively. The result showed that, spraying of atrazine + Mesotrione would be more effective for controlling weed in maize field at AEZ 28.

Effect of different herbicide for controlling weeds in maize field (set-2)

S.T. Zannat, A. A. Begum and D. A. Choudhury

A field experiment was conducted at Agronomy Research Field of Bangladesh Agricultural Research Institute, Joydebpur, and Gazipur in 2020-21 to find out the suitable herbicide for controlling weeds in maize field. The treatments were: T₁ = Rush 55 EC @ 2.0 L/ha before weed emergence, T₂ = Rimquat 20 SL @ 3 L/ha at 2-3 leaf stage of weed; T₃ = Mia Bhai 550 EC @ 2.0 L/ha at 2-3 leaf stage of weed, T₄ = E- Maize @ 2 L/ha at 2-3 leaf stage of weed, T₅ = Control (No Weeding). The trial was set up in randomized complete block design with three replications at December 09, 2020. The unit plot size was 3 m × 3 m. Test crop was BARI hybrid maize-9. The crop was fertilized with cow dung (5 t/ha), 250-55-110-40-5-1.5 kg/ha (FRG' 2018) of N-P-K-S-Zn-B, respectively in the form of urea-TSP-MoP-gypsum-zinc sulphate and boric acid. One third of urea and all other fertilizers were applied during final land preparation. Remaining 2/3 urea were top-dressed in two equal splits at 25 and 50 DAS followed by

irrigation. Weed samples were collected from randomly selected four places from each plot at 45 and 65 days after emergence. Harvesting was done at April 19, 2021 and yield data were collected. Weed control efficiency (WCE) was calculated according to following formula:

$WCE (\%) = \{(A-B)/A\} * 100$; where, A = Dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. Yield and economic performance were calculated for the treatments. Results showed that number of weed/m², weed control efficiency (WCE) and yield of maize were significantly influenced by different herbicides. Results showed that number of weed/m², weed control efficiency (WCE) and yield of maize were significantly influenced by different herbicides. The highest weed population (78 and 97/m²) was recorded in T₅ at 45 and 65 DAE. The lowest weed number (21 and 38/m²) was found in T₄ at 45 and 65 DAE, respectively. At 45 DAE the highest WCE 90.76% and 90.82% was found in T₁ and T₄ treatments and at 65 DAE the highest WCE (86.64% and 86.56%) was also found in same treatment. The result showed that, spraying of T₁ (Rush 55 EC @ 2.0 L/ha before weed emergence), T₂ (Rimquat 20 SL @ 3 L/ha at 2-3 leaf stage of weed), T₃ (Mia Bhai 550 EC @ 2.0 L/ha at 2-3 leaf stage of weed), T₄ (E- Maize @ 2 L/ha at 2-3 leaf stage of weed) would be effective for controlling weed in maize field at AEZ 28.

Multiple cropping

Carbon sequestration through residue management and crop productivity in Potato-Maize-T.aman cropping pattern in long term basis

M.A.K.mian, A.A. Begum and D.A. Choudhury

The experiment was conducted at Agronomy Research Field in 2019-2020. The objectives were: i) to find out carbon sequestration rate, ii) to maintain soil health in long term basis and iii) to assess productivity trend in long term basis. Treatment were viz., T₁=Full residue of potato, maize and 1/3 of rice + 100% recommended fertilizer dose (RFD) of T.aman, T₂=Full residue of potato, maize and 1/3 of rice + 80% RFD of T.aman, T₃=Full residue of potato, maize and 1/3

of rice + 60% RFD of *T.aman*, T_4 =Residue removed + 100% RFD of *T.aman*, T_5 =Control (Farmers' practice). The experiment was laid out in a RCB design with three replications. Spacing of potato, maize and transplanting *aman* rice were as 60cm × 25cm, 60cm × 25cm and 25cm × 20cm, respectively. Potato (var. BARI Alu-8) was sown on 20 November 2019 and harvested on 17 February 2020. Maize (var. BARI Hybrid maize-9) was sown on 5 March 2020 and harvested on 7 June 2020. *T. aman* (var. BRRI dhan62) was transplanted on 16 July 2020 and harvested on 5 October 2020. Nutrients were applied as per treatments of recommended doses as given below.

Treat.	Potato (NPKSZnB kg/ha)	Maize (NPKSZnB kg/ha)	<i>T.aman</i> (NPKSZnB kg/ha)
T_1	180-40-135-15-4-1	200-53-107-40-4-1.6	80-16-60-9-1.2-1.0
T_2	180-40-135-15-4-1	200-53-107-40-4-1.6	64-12.8-48-7.2-0.96-0.80
T_3	180-40-135-15-4-1	200-53-107-40-4-1.6	48-9.6-36-5.4-0.72-0.60
T_4	180-40-135-15-4-1	200-53-107-40-4-1.6	80-16-60-9-1.2-1.0
T_5	190-24-95-20-5-1.5	207-36-90-25-3-1.0	60-11-50-8-1-0

Nutrient application methods were followed as per recommendation of crops. Key data and crop residue were collected properly. Dry matter weight was recorded and organic carbon in residue and grain was analyzed in the laboratory following the standard procedure. Chemical properties of initial and after three year cropping soil were estimated. Key data was analyzed statistically and mean values were compared by $LSD_{(0.05)}$. Carbon input from individual crop and total carbon input from pattern were calculated. Carbon input was computed with multiplication of dry matter by organic C% concentration (like 54.60%). [e.g. 4.02 t/ha × 0.546=2.20 t/ha C input]. One hectare ≈ considered 2250 ton soil (0-15 cm depth and bulk density=1.5g/cc). The soil weight is multiplied by soil organic C percent (like 1.33%). [e.g. 2250 t/ha × 0.0133=29.92 t/ha organic C]. Carbon added from plant residue was also calculated. Organic carbon balance in the soil was estimated. Changes of other soil properties after three year cropping cycle was estimated. Potato tuber yield was higher in all

treatments (24.39-24.72 t/ha) except T_5 (14.58 t/ha). Grain yield of maize was similar (4.48-4.66 t/ha) in T_1 - T_4 treatments. The maximum grain yield (3.86-4.44 t/ha) of rice was recorded from T_1 - T_4 but the lowest (3.61 t/ha) in T_5 . Higher rice equivalent yield (28.82-28.83 t/ha) was recorded in T_1 and T_2 followed by T_3 . Total organic C input from Potato-Maize-*T. aman* rice cropping pattern was noticed higher values (10.26-10.87 t/ha) in T_1 , T_2 and T_3 but the lowest in T_5 (7.30 t/ha). The total organic C adding from the pattern was estimated higher (3.33-3.70 t/ha) from T_1 , T_2 and T_3 but the lowest in control, T_5 (0.38 t/ha). Treatments, T_1 , T_2 and T_3 showed positive balance of organic C in soil while T_4 and T_5 showed the negative values (-0.02% and -0.04 %, respectively). Hence, the C sequestration was estimated higher in T_1 , T_2 and T_3 (6.30-6.75 t/ha) while T_4 and T_5 showed negative values (-0.45 t/ha and -0.90 t/ha respectively). The results expressed that addition of crop residues as well as organic C in soil enhanced C balance or C sequestration in soil. Treatments, T_1 , T_2 and T_3 showed positive balance of total N in soil but negative balance in T_4 and T_5 . Addition of crop residues also slightly enhanced positive balance of other nutrients in soil.

Maize- legume strip cropping for resource conservation

J.A. Chowdhury, M.A.K. Mian, A.A. Begum and D.A. Choudhury

A field experiment was conducted under irrigated condition during *rabi* season, 2020-2021 at the Agronomy Research Field of Bangladesh Agricultural Research Institute to maintain sustainable productivity and to conserve soil health and soil moisture. The experiment consisted of four treatments viz., T_1 = Maize (4 row) alternate with lentil (8 row), T_2 = Maize (4 row) alternate with pea (8 row), T_3 = Maize (4 row) alternate with grass pea (6 row) and T_4 = Sole Maize (8 row). Experiment was laid out in a RCB design with three replications and each gross plot of 9.6m × 7.0m. Maize (var. BARI Hybrid maize-9), lentil (var. BARI Masur-6, pea (var. BARI Motorsuti-3) and grasspea (var. BARI Khasari-1) were used as test crops. All crops were sown on 29 November 2020. Five t/ha of cowdung was applied to the crop before sowing. Recommended dose of fertilizer

was applied to all crops (for maize: 225-60-120-45-4-1.6 kg/ha N- P- K- S- Zn- B; for lentil: 21-18-21-9-2-1.2 kg/ha N- P- K- S- Zn- B; for pea 45-24-30-12-1.4 kg/ha N- P- K- S- Zn and for grass pea 15-15-18-9 kg/ha N- P- K- S) (FRG, 2018). For maize one third of N and all of other fertilizer would be applied during final land preparation and rest N was applied in two equal splits at 30 days after sowing and 50 days after sowing. For other three crops all fertilizer were applied during final land preparation. Cultural and plant protection measures were taken up as and when required. Observations were taken on the five randomly selected plants in each plot in respect to plant height, yield component and yield. For economic analysis, gross return, total operational cost, gross margin and BCR were used. Strip cropping significantly increased the accumulation of all investigated macronutrient in maize grain. The inclusion pea as strip cropping (T_2 treatment) resulted in higher content of all investigated nutrients in maize grain. The maximum maize equivalent yield (13.46t/ha) was observed in T_2 treatment (maize + pea strip cropping). The grain yield of maize (7.49t/ha) was higher in sole maize plot than all strip cropping plot. But maize equivalent yield (MEY), gross return, gross margin and benefit cost ratio (BCR) were higher in all strip plots than sole maize plot. The highest gross return (Tk.201900/ha), gross margin (Tk.121900/ha) and BCR (2.52) were also observed in T_2 treatment. The result revealed that the farmers can be benefited by cultivating any one maize legume strip cropping with higher productivity. But among the three strip croppings, maize + pea strip cropping was economically profitable.

Performance of intercropping dwarf yard long bean with maize under different planting system

A.A. Begum, J.A. Chowdhury, M.Z. Ali and D.A. Choudhury

The field experiment was conducted at Agronomy Research Field, BARI, Gazipur during *khari* season of 2020 and 2021 to find out suitable combination of maize and dwarf yard long bean in intercropping system for higher productivity and monetary advantage. Treatments included in the experiment were as T_1 = Maize normal row (MNR) +1 row dwarf yard long bean (DYLb), T_2 = Maize

paired row (MPR) + 2 row DYLb, T_3 = MPR +3 row DYLb, T_4 = MPR +4 row DYLb, T_5 = Sole maize (60 cm × 20 cm) and T_6 =Sole DYLb (40 cm × 25 cm). The experiment was laid out in a randomized complete block design with three replications and the unit plot size was 4.8 m × 5 m. Hybrid maize (var. BARI Hybrid maize-9) and DYLb (BARI Barboti-2) were used in both years. Seeds of both crops were sown on 10 March, 2020 and 15 March, 2021. The seeds of both crops were treated with provex@ 3 g/kg seed. Fertilizers were applied at the rate of 225-60-120-45-4-1.6 kg/ha of NPKSZnB (FRG, 2018) as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid for sole maize and intercrop. One third of N, whole amount of TSP, MoP, gypsum, zinc sulphate and boric acid were applied as basal. Remaining 2/3 N was top dressed at 20 and 40 days after sowing (DAS) of maize. In intercrop, extra N (20 kg/ ha) was applied at 20 DAS as side dress to DYLb. Sole DYLb was fertilized at the rate of 21- 27-33-9-1.2-1.2 kg/ ha of NPKSZnB. Two third of N and all other fertilizers were applied as basal. Rest N was applied at 20 and 40 DAS. Light availability or Photosynthetically active radiation (PAR) was measured by PAR Ceptometer (Model – LP-80, Accu PAR, Decagon, USA). The PAR was measured at 10-day intervals from 30 to 100 DAS at around 11:30 am to 13:00 pm in both years. Data on yield contributing characters of maize were taken from randomly selected 5 plants from each plot. Yields of both crops were taken from whole plot area. Maize was harvested on 25 June 2020 and 30 June 2021. DYLb was harvested five times on 20 April, 30 April, 10 May, 18 May and 24 May 2020 and on 25 April, 05 May, 14 May, 22 May and 01 June 2021. Maize equivalent yield was computed by converting yield of intercrops on the basis of prevailing market price of individual crop. Collected data of both the years were pooled analyzed statistically and the means were adjudged by using LSD at 5% level of significance. Cost benefit analysis was also done considering local market price of harvested crops. It was observed that Light availability on DYLb decreased with the increased of shade produced by maize canopy over the time up to 100 days after sowing (DAS) in all treatments. The lowest light availability on DYLb

was observed in T₁ treatment and the highest light availability was observed in sole DYLB (T₆). The highest grain yield of maize was observed in sole maize and it was decreased by 1-4 % among the intercrop treatments. The highest maize equivalent yield (MEY: 13.75 t/ha), gross return (Tk.247500/ha), gross margin (Tk.139000/ha) and benefit cost ratio (BCR: 2.28) were observed when maize grown in paired row with 3 rows of DYLB (T₃). The highest land equivalent ratio (LER: 1.56) was also found in the same treatment. The results revealed that maize paired row + 3 row dwarf yard long bean might be agronomically feasible and economically profitable for maize + dwarf yard long bean intercropping system at Gazipur.

Intercropping onion and garlic with brinjal under different planting system

M.Z. Ali, A.A. Begum, S.S. Kakon, J.A. Chowdhury and D.A. Choudhury

The experiment was conducted at the Agronomy Research Field of Bangladesh Agricultural Research Institute, Gazipur during *rabi* season of 2019-2020 and 2020-2021 to find out the suitable crop combination of onion and garlic with brinjal for increasing total productivity, economic return and maximize land utilization through intercropping. Seven treatments viz., T₁= Brinjal (80 cm × 60 cm) 100% + 4 row onion (15 cm × 10 cm) 57%, T₂= Brinjal (80 cm × 60 cm) 100% + 3 row onion (15 cm × 10 cm) 43%, T₃= Brinjal (80 cm × 60 cm) 100% + 4 row garlic (15 cm × 10 cm) 57%, T₄= Brinjal (80 cm × 60 cm) 100% + 3 row garlic (15 cm × 10 cm) 43%, T₅= Sole brinjal (80 cm × 60 cm) 100%, T₆= Sole onion (15 cm × 10 cm) 100%, T₇= Sole garlic (15 cm × 10 cm) 100% were used in the experiment. The trial was set up in randomized complete block design with three replications. The unit plot size was 3.2 m × 4.2m. The sole crop of brinjal and intercrop treatments were fertilized with cowdung 5 t/ha and 140- 41-120-18-3-1.5 kg/ha N-P-K-S-Zn-B. For sole brinjal and intercrop, except N and K, full amount of all other fertilizers were applied in pit before 1 week of transplanting brinjal seedlings. N and K were applied in three equal splits at 21, 40 and 60 days after transplanting (DAT) brinjal seedling as ring method followed by irrigation. Sole onion and garlic were fertilized with 105-60-144-32-3.5-2.1

kg/ha N-P-K-S-Zn-B and 135-57-105-50-4.0-4 kg/ha N-P-K-S-Zn-B. For onion and garlic half N, K and all other fertilizers were applied at the time of final land preparation. Rest N and K were applied in two equal splits at 25 DAT and 50 DAT (FRG, 2018). Brinjal (var. BARI Begun-8) as base crop and onion (var. BARI Piaz-4) and garlic (var. BARI Roshun-4) were used as intercrops in this experiment. After establishment of brinjal seedling (12 days after transplanting) onion seedling and garlic cloves were transplanted/planted as per treatments. Brinjal (thirty days old seedling) was transplanted on 29 November, 2019 and 10 December, 2020. Onion seedling and cloves of garlic was transplanted/planted on 11 December, 2019 and 23 December, 2020 respectively. Brinjal was harvested four times and it was harvested in 2020 (12 March, 23 March, 18 April, 7 May) and in 2021 (25 March, 7 April, 21 April, and 12 May). Both Onion and garlic were harvested on 16 April, 2020 and 21 April, 2021. Five irrigations were done in the experimental field. First was applied at just after brinjal transplanting. Second, third, fourth and fifth irrigation were applied at 10, 45, 60 and 90 days after transplanting (DAT) of brinjal seedling. Weeding was done as per requirement. Sex pheromone trap were used for controlling of brinjal shoot and fruit borer at active vegetative, fruit setting and fruit developing stage. Light availability or Photo synthetically active radiation (PAR) was measured by PAR Ceptometer (Model – LP-80, Accu PAR, Decagon, USA). The PAR was measured at 5-day intervals from 25 to 90 DAT of onion seedling/DAS of garlic cloves at around 11:30 am to 13:00 pm. The yield component data of brinjal was taken from 10 randomly selected plants prior to harvest from each plot. Yield data of brinjal, onion and garlic were recorded plot wise. Yield and yield contributing characters were recorded and pooled data analyzed statistically and mean separations were done by LSD test at 5% level of significance. Brinjal equivalent yield (BEY) was converted by converting yield of intercrops on the basis of present market price of individual crop. Results showed that Light availability on onion and garlic decreased with the increased of shade produced by brinjal canopy over the time up to 95 days after transplanting of onion seedling and planting of

garlic cloves. In both the years, throughout the growing period of onion and garlic the maximum light availability was observed in T₆ (sole onion) and T₇ (sole garlic) treatments followed by T₄ treatment (3 row garlic 43% in between two row of brinjal 100%) and T₃ treatments (4 row garlic 57% in between two row of brinjal 100%) and the minimum light availability was observed in T₁ treatment (4 row onion 57% in between two row of brinjal 100%) followed by T₂ treatment (3 row onion 43% in between two row of brinjal 100%). Light availability was more in brinjal + garlic intercropping system than brinjal + onion intercropping system throughout the growing period. All the intercropping combinations showed better performance in terms of brinjal equivalent yield, gross return, gross margin and benefit cost ratio (BCR) over sole crops. Among the intercropping combination, 4 row garlic (15 cm × 10 cm) 57% in between two row of brinjal (80 cm × 60 cm) 100% was the agronomically most feasible and profitable intercropping system in respect of brinjal equivalent yield (36.42 t/ha), land equivalent ratio (1.29), gross return (Tk.7,28,333/ha), gross margin (Tk.4,76,596/ha) and BCR (2.89).

Performance of legume vegetables intercropping with chilli

J.A. Chowdhury, S.S. Kakon, M.Z. Ali And D.A. Choudhury

The field experiment was carried out on chilli legume vegetables intercropping system using five treatments at the Agronomy Research Field of Bangladesh Agricultural Research Institute at Gazipur during *rabi* season, 2019-2020 and 2020-2021. The study was conducted to find out the suitable intercrop combination for higher productivity and economic return. The treatments were viz., T₁= Sole chilli (60 cm × 50 cm), T₂= Chilli (100%) + one row bush bean (50%), T₃= Chilli (100%) + two row bush bean (100%), T₄= Chilli (100%) + one row pea (50%), T₅= Chilli (100%) + two row pea (100%). Experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications and each gross plot of 3.6 × 3.0 m². Chilli cv. BARI Morich-3 was transplanted with 2 seedlings per hill and later maintained one seedling per hill. The inter row

spacing was 60 cm and intra row spacing was 50 cm. Intercrops were sown between the rows. Bushbean (var. BARI Jharsheem-2), pea (var. BARI Motorsuti-3) were used. Five tons of Cowdung per ha was applied to the crop before transplanting. Basal dose of fertilizer was applied to chilli @ 96-45-75-15-1.5-1.4 kg/ha N P K S Zn B (FRG, 2018). Half of N and all other fertilizers will be applied as basal during final land preparation. Remaining N was applied in three equal splits at 25, 50 and 70 DAT. Cultural and plant protection measures were taken up as and when required. Observations were taken on the five randomly selected plants in each plot in respect to plant height, number of pods, pod length, single plant pod weight and yield. For economic analysis, gross income, total operational cost, gross margins and BCR were calculated. Data on yield and yield contributing characters were taken and statistically analyzed following MSTAT-C software package. Means were adjusted by LSD test at 5% level of significance. Significantly the highest yield (8.67 t/ha) was obtained in sole chilli. But chilli +one inter row pea intercropping system gave the highest chilli equivalent yield (21.47 t/ha). The highest gross margin (Tk. 151896/ha) and BCR (3.42) were obtained from the same treatment. The results revealed that one row pea (50%) intercropped with chilli (100%) might be suitable intercrop combination for higher productivity and economic return.

Yield process and crop competition of leafy vegetables intercropping system with chilli

J.A. Chowdhury, S.S. Kakon, M.R. Karim, M.A.K. Mian and D.A. Choudhury

The field experiment was carried out on chilli + leafy vegetables intercropping at the Agronomy Research Field of Bangladesh Agricultural Research Institute (BARI), Gazipur during *rabiseason* of 2020-2021. The study was conducted to find out the suitable intercrop combination of these crops for higher productivity and economic return. The treatments were viz., T₁= Two row spinach (66%) in between two row of chilli (100%), T₂= Two row red amaranth (66%) in between two row of chilli (100%), T₃= Two row radish (66%) in between two row of chilli (100%), T₄= Sole chilli (60 cm × 50 cm). Experiment was

laid out in a randomized complete block design with three replications and each plot size was 3.6m × 3.0m. BARI Morich-3, BARI Palongshak-1, BARI Lalshak-1 and BARI Mula-1 were used as test crops. Chilli was transplanted with 2 seedlings per hill and later maintained one seedling per hill. The inter row spacing was 60 cm and intra row spacing was 50 cm. Intercrops were sown between the rows. Five tons of cowdung per ha was applied to the crop before transplanting. Basal dose of fertilizer was applied to chilli @ 96-45-75-15-1.5-1.4 kg/ha N-P-K-S-Zn-B (FRG, 2018). Half of N and full of all other fertilizers were applied as basal during final land preparation. Remaining N was applied in three equal splits at 25, 50 and 70 DAT. Inter cultural operation and plant protection measures were taken up as and when required. In case of chilli observations were taken on the five randomly selected plants in each plot in respect to plant height, number of pods, pod length, single plant pod weight and yield. Yield of leafy vegetable were taken from whole plot. For economic analysis, gross income, total operational cost, gross margin and BCR were used. Data on yield and yield contributing characters were taken and statistically analyzed following MSTAT-C software package. Means were adjusted by LSD test at 5% level of significance. Significantly the highest chilli yield (8.46 t/ha) was obtained in sole chilli. Chilli equivalent yield were higher in all the intercrops (29.15 - 33.97 t/ha) than the sole crop of chilli. The highest chilli equivalent yield (33.97 t/ha) was recorded when two row raddish (66%) intercropped in between two row of chilli (100%) (T₃). The highest gross margin (Tk. 276396/ha) and BCR (5.37) were also obtained from the same treatment. The result expressed that the intercrop combination of two row raddish (66%) in between two row of chilli (100%) might be agronomically feasible and economically profitable.

Performance of intercropping bushbean with sorghum

M.Z. Ali, A.A. Begum, S.S. Kakon, J.A. Chowdhury and D.A. Choudhury

The experiment was conducted at the Agronomy Research Field of Bangladesh Agricultural Research Institute, Gazipur during *rabiseason* of 2020 -2021 to find out the suitable crop

combination of bush bean with sorghum for increasing total productivity, economic return, maximize land utilization through intercropping. Six treatments viz., T₁= Sorghum normal row (100%) + 1 row bush bean in between two rows of sorghum (43.75%), T₂= Sorghum normal row (100%) + 2 row bush bean in between two rows of sorghum (87.50%), T₃= Sorghum paired row (100%) + 2 row bush bean in between two paired rows of sorghum (37.50%), T₄= Sorghum paired row (100%) + 3 row bush bean in between two paired rows of sorghum (56.25%), T₅= Sole sorghum (60 cm × 20 cm) and T₆= Sole bush bean (30 cm × 5 cm) were used in the experiment. The experiment was laid out in a randomized complete block design with three replications and the unit plot size was 4.8m × 5m. Sorghum (var. BARI Sorghum-1) and Bush bean (var. BARI Jharsheem-3) were used in the experiment. Sorghum and bush bean seeds were sown on 06 December 2020. The seeds of both crops were treated with provex @ 3g/kg of seed. Fertilizers were applied at the rate of 120-48-75-30-3-1 kg/ha of N, P, K, S, Zn, B as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid for sole sorghum and intercrop. One third of N, whole amount of TSP, MoP, gypsum, zinc sulphate and boric acid were applied as basal. Remaining 2/3 N was top dressed at 25 and 45 days after sowing (DAS) of sorghum. In intercrop, extra N (40 kg/ha) was applied in 2 splits at 25 and 45 DAS to bush bean. Sole bush bean was fertilized at the rate of 88- 35-53-11-2.2-1.5 kg/ha of N, P, K, S and Zn (FRG, 2018). 1/3 N and all other fertilizer were applied as basal at the time of final land preparation. Remaining N was applied as side dress at 20 and 35 DAS under moist soil condition and mixed thoroughly with the soil as soon as possible for better utilization. Light availability or Photo synthetically active radiation (PAR) was measured by PAR Ceptometer (Model – LP-80, Accu PAR, Decagon, USA). The PAR was measured at 5-day intervals from 25 to 65 DAS at around 11:30 am to 13:00 pm. Data on yield contributing characters of sorghum were taken from randomly selected 5 plants from each plot. Yields of both the crops were taken from whole plot area. Sorghum was harvested on 18 April, 2021 and bush bean was harvested 2 times on 10 and 17 February,

2021. Sorghum equivalent yield (SEY) was calculated by converting yield of intercrops on the basis of prevailing market price of individual crop. Collected data of both the crops were analyzed statistically and the means were adjudged using LSD_(0.05) test. Economic analysis was also done considering local market price of harvested crops. Light availability on bush bean decreased with the increase of shade produced by sorghum canopy over the time up to 65 DAS. The lowest light availability on bush bean was observed in T₂ treatment (SNR 100% + 2 rows bush bean 87.50%) and the highest light availability was observed in sole bushbean (T₆) followed by T₃ treatment (SPR 100% + 2 row bush bean 37.50%). The maximum grain yield of sorghum was observed in sole crop (4.56 t/ha) and it was decreased by 10.09-19.52 % among the intercrop combination. The highest Sorghum equivalent yield (SEY) of 6.55 t/ha, gross return (Tk. 98,200/ha), gross margin (Tk. 52,200/ha) and benefit cost ratio (BCR) of 2.13 were obtained from T₂ treatment (SNR 100% + 2 rows bush bean in between two normal rows of sorghum 87.50%). The highest land equivalent ratio (LER) of 1.68 was also found in the same treatment. The results revealed that sorghum normal row 100% + 2 rows bush bean (87.50%) in between two normal rows of sorghum might be agronomically feasible and economically profitable.

Compatibility of minor cereals - groundnut intercropping

M.R. Karim, J.A. Chowdhury, A.A. Begum, S.S. Kakon, M.Z. Ali, D.A. Choudhury and M.H. Sarker

The experiment was conducted in Agronomy Research Field, Bangladesh Agricultural Research Institute, Gazipur, during *rabi* season of 2020-2021 to find out suitable combination of minor cereals for intercropping with groundnut. Nine treatments were viz., T₁ = Groundnut: Sorghum = 6:1, T₂ = Groundnut: Cheena = 6:1, T₃ = Groundnut: Cheena = 6:2, T₄ = Groundnut: Kaon = 6:1, T₅ = Groundnut: Kaon = 6:2 and T₆ = Sole groundnut, T₇ = Sole sorghum, T₈ = Sole cheena, T₉ = Sole kaon. The highest groundnut equivalent yield as well as gross margin was found in Groundnut: Kaon = 6:1. The experiment was laid out in RCBD design with three replications. BARI Cheenabadam-8, BARI

Sorghum-1, Tushar and BARI kaon-3 were taken as groundnut, sorghum, cheena and kaon varieties, respectively. Twelve rows of groundnut were sown in line with adjusted row to row distance for each treatment along with 15 cm plant to plant distance in 3.6 m × 3.6 m plot. Sorghum, cheena and kaon were used as additive series and were sown in between two rows of groundnut and as per treatment combination. The plants were fertilized with 15-80-60-60-1.8 kg/ha of N-P-K-S-B, respectively. Half N and all of other fertilizers were applied during final land preparation. Rest half N was applied at 40-45 DAS (FRG, 2018). Irrigation was done as and when necessary. Data on grain yield (kg/ha), tillers per plant, panicles per plant and 1000-grain weight were collected for cereals while seeds per pod, pods per plant, number of primary branches per plant, 100-seed weight and shelling percentage were collected for groundnut. Crops were harvested as whole plot basis. Mean comparison among the treatments was made by LSD test at 5% level of significance. Groundnut equivalent yield, gross margin (Tk/ha), benefit cost ratio (BCR), land equivalent ratio (LER), competitive ratio (CR) and the relative crowding coefficient (RCC) were calculated to find out the best intercrop combination. Considering equivalent yield, land equivalent ratio (LER), competitive ratio (CR), relative crowding coefficient (RCC) and economic return, Groundnut : Cheena = 6:2 combination was found suitable.

Performance of relay bitter gourd in chilli + red amaranth intercropping at medium high land under AEZ-9 without trellis

M.R. Ali and J. Rahman

An experiment was conducted at Regional Agricultural Research Station (RARS), Jamalpur during November 2020 to July 2021 to find out suitable relay bitter gourd with chilli + red amaranth intercropping for higher productivity and economic return. The experiment consisted of five treatments viz., T₁ = Sole chilli (60cm × 60cm), T₂ = Chilli (100%) + 3 row red amaranth + relay bitter gourd (60cm × 150cm), T₃ = Chilli (100%) + 3 row red amaranth + relay bitter gourd (120cm × 150cm), T₄ = Chilli (100%) + 3 row red amaranth + relay bitter gourd (180cm × 150cm), T₅ = Chilli paired row + 6 row red amaranth + relay bitter

gourd (105cm × 150cm). The treatments were tested in randomized complete block design with 3 dispersed replications. The unit plot size was 3 m × 3.6 m and spacing for chilli was 60 cm × 60 cm. BARI Morich-2 for chilli, BARI Lalshak- 1 for red amaranth and BARI korolla 1 for bitter gourd were used. Chilli was transplanted on 26 November 2020, red amaranth was sown on 3 December 2020 and bitter gourd was transplanted on 20 April 2021. Red amaranth was harvested 6 January 2021, chilli harvest started on 1 April 2021 and continued upto 29 June 2021 and bitter gourd harvest started on 10 June and continued upto 30 July. Red amaranth and bitter gourd were sown in lines between the chilli rows maintaining the spacing of the respective treatments. Fertilizer 128-76-128-20-2-1.5 kg/ha of NPKSZnB with cowdung 5 t/ha for chilli (FRG, 2018) and 100-40-60-20-1.5 kg/ha NPKSB and cowdung 5 t/ha for bitter gourd (FRG, 2018). For chilli all amount of cowdung, chemical fertilizer and half of nitrogen was applied during final land preparation. Remaining nitrogen fertilizer was applied in three equal splits at 25, 50 and 70 days after transplanting and for bitter gourd all amount of cowdung, phosphorus, potassium, sulphur and boron was applied in pit 5-7 days before planting and mixed thoroughly with the soil. Weeding, irrigation and other intercultural operations were done as and when necessary. Yield of chilli and red amaranth was calculated in ton per hectare considering the whole plot as harvest area. Ten plants of chilli from each plot were selected randomly to collect data on yield components. Collected data were analyzed statistically with the help of STAR programme. The result indicated that chilli yield was reduced due to relay cropping systems. The highest chilli yield (12.09 t/ha) was found from sole chilli and lowest chilli yield (7.98 t/ha) was found from chilli (100%) + 3 row red amaranth + relay bitter gourd (60cm × 150cm). The highest chilli equivalent yield (43.21 t/ha) was achieved from chilli paired row + 6 row red amaranth + relay bitter gourd (105m × 150cm) and lowest chilli equivalent yield (12.09 t/ha) was obtained from sole chilli (60cm × 60cm) treatment. The highest gross return (Tk. 1080250/ha), gross margin (Tk. 887250/ha) and benefit cost ratio (5.60) was found from the same treatment. The results expressed that relay bitter gourd (105cm ×

150cm) with chilli paired row + 6 row red amaranth intercropping without trellis might be agronomically feasible and economically profitable at medium high land under AEZ-9.

Performance of relay bitter gourd in chilli +onion intercropping at medium high land under AEZ-9 without trellis

M.R. Ali and J. Rahman

An experiment was carried out at Regional Agricultural Research Station, Jamalpur during November, 2020 to May, 2021 to find out suitable relay snake gourd with brinjal + onion intercropping for higher yield and economic return. The experiment consisted of five treatments, viz., T₁= Sole brinjal (100cm × 60cm), T₂= Brinjal (100%) + 8 row onion + relay snake gourd (1m×1.5m), T₃= Brinjal (100%) + 8 row onion + relay snake gourd (2m × 1.5m), T₄= Brinjal (100%) + 8 row onion + relay snake gourd (3m × 1.5m), T₅= Brinjal paired row + 16 row onion + relay snake (1.75m × 1.5m). The treatments were tested in randomized complete block design with 3 dispersed replications. The unit plot size was 6.0 m × 3.0 m. BARI Begun-8 for brinjal, BARI Piaj- 4 for onion and BARI Chichinga-1 for snake gourd were used. Brinjal was transplanted on 15 October 2020, onion was transplanted on 8 December 2021 and snake gourd was transplanted on 4 April. Onion was harvested on 23 March 2021, brinjal was harvested on 14 February 2021 to 18 May 2021. Snake gourd was harvested on 20 May 2021 to 20 July 2021. Onion and snake gourd were sown in lines between the brinjal rows maintaining the spacing of the respective treatments. Fertilizer 173-30-125-18-2 kg/ha NPKSB with cowdung 10 t/ha for brinjal (FRG, 2018) and 100-40-60-20-2 kg/ha NPKSB and cowdung 10 t/ha for chichinga (FRG, 2018). For brinjal, all amount of cowdung, TSP, gypsum, borax and one-third of nitrogen, half of muriate of potash were applied during final land preparation. Remaining nitrogen fertilizer was applied in three equal splits at 15, 50 and 70 days after transplanting and remaining muriate of potash was applied in two equal splits at 15 and 50 days after transplanting. Weeding, irrigation and other intercultural operations were done as and when necessary. The yield of brinjal, onion and snake gourd was calculated in ton per hectare considering

the whole plot as harvest area. Ten plants of chilli and onion from each plot were selected randomly to collect data on yield components. Collected data were analyzed statistically with the help of a computer package program STAR and the means were adjusted by Least Significance Difference (LSD) test at 5% level of significance. The result indicated that brinjal yield was reduced due to relay cropping system. The highest brinjal yield (29.08 t/ha) was found from sole brinjal (100cm × 60cm) treatment and the lowest yield (16.58 t/ha) was found from brinjal (100%) + 8 row onion + relay snake gourd (1.0m × 1.5m) treatment. The highest brinjal equivalent yield (74.96 t/ha) was obtained from brinjal paired row + 16 row onion + relay snake gourd (1.75m × 1.50m) treatment. The highest gross return (Tk. 1874000/ha), gross margin (Tk. 1671000) and benefit cost ratio (9.23) was found from the same treatment. The results expressed that brinjal paired row + 16 row onion + relay snake gourd (1.75m × 1.50m) without trellis might be agronomically feasible and economically profitable at medium high land under AEZ-9.

Nutrient management for mustard as relay crop with *T.aman* rice under Ganges Tidal Floodplain

M.A. Rahman, M.M. Rahman and R.R. Saha

The field experiment was carried out at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during two consecutive *rabi* seasons of 2019-20 and 2020-21 to develop nutrient management package for mustard as relay crop with *T.aman* rice under Ganges Tidal Floodplain and to increase the productivity and economic return of the system. The treatments of the experiment were: T₁ = 100% Recommended dose (RD: 90-27-16-15-1.5-1-1 kg/ha N-P-K-S-Mg-Zn-B) [FRG, 2018], T₂ = 75% of RD, T₃ = 50% of RD, T₄ = 25% of RD, and T₅ = Nutrient dose on soil test based (STB) result. The experimental site is situated in the latitudes and longitudes of 22°47'6.50629"/N and 90°17'30.977"/E. The experimental site is located under the agro-ecological zone Ganges Tidal Floodplain (AEZ-13). The soil type is medium high land and soil texture is loamy. The variety of mustard was BARI Sarisha-14. Mustard seeds were sown through broadcasting method on 26 November, 2019 and 1 November, 2020 as relay crop with previous

T.aman rice (var. BRR1 dhan52). Seed rate for mustard was 6 kg/ha. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 4 m × 3 m. The initial soil moisture was 32% on oven dry basis. Before seeding soil samples of the experimental plots were taken for plant nutrient determination in the laboratory. The soil sample was tested in the laboratory of Soil Resource Development Institute (SRDI), Barishal. The analyzed result of the soil sample was given below:

Soil pH	Salinity (dS/m)	Organic matter (%)	Nitrogen (%)	Potassium (meq/100g soil)	Phosphorus (µg/g soil)	Sulphur (µg/g soil)	Boron (ppm)	Zinc (ppm)
7.60	0.72	0.11	0.006	0.13	17.20	1.30	0.45	1.12

The experimental plots were fertilized as per the treatment specifications for relay mustard crop. Fertilizer dose for previous *T.aman* rice was: 75-10-18-4-1 kg/ha N-P-K-S-Zn, respectively. The soil test base fertilizer dose for mustard was 72-22-13-12-0.8kg/ha N-P-K-S-Zn, respectively. Half amount of N fertilizer (urea) and full amount of other nutrients were applied as basal, five days before seed sowing. The rest amount of urea was top dressed at 23 days after emergence of seedling (i.e. before flowering). Irrigation was applied for two times and other intercultural operations were done as when necessary following the recommended production technologies of mustard (BARI, 2019). Data were collected on different parameters such as plant population/m², days to 50% flowering, days to maturity, plant height, yield components and seed yield/plot. The plot yields were then converted into tonne/hectare. Data were analyzed statistically and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT) following Gomez and Gomez (1984). In 2019-2020, nutrient management package had significant effect on plant height, number of siliqua/plant, 1000-seed weight and seed yield. The highest yield was recorded in T₁ treatment (1235 kg/ha). In 2020-21, significant differences were observed in the case of days to 50% flowering, number of siliqua/plant, number of seed/siliqua, seed yield and straw yield. The seed yield was the highest in T₂ (1228 kg/ha) and T₁ (1225 kg/ha). In average of two years results, the highest gross

return was found in treatment T_1 (100% RD) but the highest gross margin (Tk. 21830/ha) was obtained from treatment T_2 (75% RD). The average BCR value was the highest (1.42) in treatment T_2 (75% RD). From economic point of view treatment T_2 (75% RD) could be suitable for nutrient management for cultivation of mustard as relayed with *T. aman* rice system.

Intercropping of cauliflower with sweet gourd at different plant population

M.M. Khanum and M.S. Huda

The experiment was carried out at the research field of Agricultural Research Station, Rajbari, Dinajpur during *rabi* season of 2019-20 and 20-21 to find out the suitable cauliflower population for intercropping with sweet gourd for higher productivity and economic return. Seven treatments viz., T_1 =Sole Sweet gourd (2m × 2m), T_2 =100% Sweet gourd + 3 rows cauliflower (60cm × 50cm), T_3 =100% Sweet gourd + 3 rows cauliflower (60cm × 80cm), T_4 =100% Sweet gourd + 4 rows cauliflower (50cm × 50cm), T_5 =100% Sweet gourd + 4 rows cauliflower (50cm × 80cm), T_6 =100% Sweet gourd + 5 rows cauliflower (40cm × 100cm) and T_7 =Sole Cauliflower (50cm × 50cm). The experiment was laid out in a RCB design with 3 replications. The unit plot size was 4m × 4m. BARI Mistikumra-2, BARI Fulcopy-1 was used in this experiment. In sole sweet gourd and intercrop fertilizers were applied at the rate of 80-36-100-24-2-2 kg/ha of N-P-K-S-Zn-B through urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid, respectively (FRG, 2018). Cowdung @ 10 t/ha were applied as a blanket dose during final land preparation. All of organic manure and chemical fertilizers were applied at final land preparation, while urea and MoP were top dressed in two equal splits at 15 and 35 DAT of cauliflower. All chemical fertilizer along with organic manure was applied in pit 7 days before transplanting of cauliflower and sweet gourd seedlings. Twentyfive days old seedlings of cauliflower was transplanted on 12 November, 2019 and 20 November, 2020. Fifteen days old seedlings of sweet gourd were transplanted on 27 November, 2019 and 05 December, 2020. Full amount of nitrogenous fertilizer was applied in two equal installments to sweet gourd plant only as ring

method at 30 and 50 days after planting. Intercultural operations like watering, weeding and pest control were done as and when required. Sweet gourd harvesting was started from 105 DAT and harvesting was done four times in both years. Cauliflower was harvested three times (74, 80 and 84 DAT). Yield components of sweet gourd were taken from selected 4 plants from each plot. Yield of both the crops were taken from whole plot. Sweet gourd equivalent yield was computed using the formula of Bandyopadhyaya (1984). Collected data of all crops were analyzed statistically by using R software packages and mean differences for each character were compared by Least Significant Difference (LSD) test (Gomez and Gomez, 1984). The maximum sweet gourd equivalent yield (SGEY) was obtained from T_4 followed by T_2 . The maximum gross return, gross margin and BCR were also obtained from T_4 which was followed by T_2 and the lowest was in sole cauliflower (T_7). The results indicated that among the intercrop combinations Sweet gourd (100%) + 4 rows cauliflower (50cm × 50cm) and Sweet gourd (100%) + 3 rows cauliflower (60cm × 50cm) combinations might be economically profitable for cauliflower with sweet gourd intercropping system.

Productivity and profitability of intercropping potato with hybrid maize at different planting system

M.M. Khanum and M.S. Huda

The experiment was carried out at the research field of Agricultural Research Station, Rajbari, Dinajpur during *rabi* season of 2020-2021 to assess the economic performance of intercropping potato with long duration maize. Five treatments viz., T_1 = Sole maize (60cm × 20cm), T_2 = Maize normal row (60cm × 20cm) + 1 row potato in between two maize rows, T_3 = Maize paired row (30cm/120cm/30cm × 20cm) + 2 rows potato, T_4 =Maize paired row (30cm/120cm/30cm × 20cm) + 3 rows potato and T_5 = Sole potato (60cm × 25cm). The experiment was laid out in randomized complete block (RCB) design with three replications. The unit plot size was 4m × 3.6m. The land of the experimental plot was prepared with a power tiller by ploughing and cross ploughing followed by laddering and the soil was brought into good tilth. Fertilizers were applied @ 260-72-148-

48-4-2 kg/ha N-P-K-S-Zn-B in the form of Urea-TSP-MoP-Gypsum-ZnSO₄-Boric acid for both the sole maize and intercrop combinations. One third of urea and full amount of other fertilizers were applied at final land preparation. Remaining urea was applied at 30 and 60 DAS in two equal splits (FRG, 2018). Maize (BARI Hybrid maize-16) was sown on 28 November, 2020 during the conducting years and potato (BARI Alu-36) was sown on 12 November, 2020. Two irrigations were provided after top dressing of urea. Earthing up and other intercultural operations were done when required. Other plant protection measures were taken when required. Yield contributing characters of potato and maize were measured from ten randomly selected plants of the sampling area of each treatment avoiding border plants. Maize grain yield and potato yield were measured from the whole plot and then calculated per hectare basis maintaining standard moisture content. The relative yield was obtained by dividing the intercrop yield of a crop with the respective sole crop yield of that crop using the formula (Dewit and Vander Bergh, 1965). The relative yield of a crop = Yield of component crops / Yield of sole crop. Maize equivalent yield was computed by converting yield of intercrops on the basis of prevailing market price of individual crop following the formula (Bandyopadhyay, 1984): Maize equivalent yield = $Y_{im} + (Y_{ip} \times P_p) / P_m$ Where, Y_{im} = Yield of intercrop maize, Y_{ip} = Yield of intercrop potato, P_m = Market price of maize and P_p = Market price of potato. Collected data were statistically analyzed by using R software packages and mean differences for each character were compared by Least Significant Difference (LSD) test (Gomez and Gomez, 1984).

The highest maize yield was recorded in sole maize. Maize yield was decreased 2-3% due to intercrop competition. All maize equivalent yield (MEY) was higher than that of sole maize. The highest maize equivalent yield, gross return, gross margin and BCR were obtained in maize paired row (30cm/120cm/30cm × 20cm) + 3 rows potato.

Intercropping of other spices with chilli in Cumilla region

M.A.H. Khan, M. Rahman and M.O. Kaisar

An experiment was conducted at the research field of regional agricultural research station, Bangladesh Agricultural Research Institute, Cumilla during 2020-21 to find out the suitable crop combination of onion, garlic and coriander with chilli for increasing total productivity, economic return and maximizing land utilization through intercropping system. Seven treatments were viz., T_1 = Sole chilli (50 cm × 50 cm), T_2 = Two rows of onion in between two rows of chilli (15 cm × 10 cm), T_3 = Two rows of garlic in between two rows of chilli (15 cm × 10 cm), T_4 = 100% coriander (leaf) in between two rows of chilli, T_5 = Sole onion (15 cm × 10 cm), T_6 = Sole garlic (15 cm × 10 cm), T_7 = Sole coriander. The trial was set up in a randomized complete block design with three replications. The unit plot size was 3.0 m × 3.0 m. Chilli (Var. BARI Marich- 3) was the main crop and onion (Var. BARI Piaj- 6), garlic (Var. BARI Rashun- 2) and coriander (BARI Dhonia- 1) were used as intercrops in the study. Sole chilli and intercrop treatments were fertilized with 120-80-120-20-4 NPKSZn kg/ha, respectively. For sole onion, sole garlic and sole coriander were fertilized with 90-45-120-30 NPKS kg/ha, respectively (FRG, 2018). For sole chilli and intercrop treatments; half N and all other fertilizers were used as basal. Rest N was applied at 20 and 50 days after transplanting. For sole onion and other sole crop; half of N, K and full dose of P, S were applied at the time of final land preparation and remaining N and K were top dressed at 25 and 50 days after transplanting followed by irrigation. The sole crop of chilli was planted at a spacing of 50 cm × 50 cm, the sole crop of onion and garlic was planted at a spacing of 15 cm × 10 cm. As intercropping system two rows of onion and two rows of garlic were planted as per treatment. Coriander seed (100%) was broadcast in between two lines of chilli. Chilli (25 days old seedling) was transplanted on 24 November 2020. Onion seedling, garlic clove and coriander seeds were planted/sown on 26 November 2020. Irrigation and pesticide were applied as per necessary. The coriander leaf was harvested on 20 December at 24 days after sowing. Onion and garlic were harvested on 1 March 2021 and 5 March 2021, respectively. Chilli was harvested at three times and it was harvested 10 March, 22 March and 10 April

2021. For chilli data on yield and yield contributing characters were taken and analyzed statistically. The yield component data of chilli was taken from 10 randomly selected plants prior to harvest from each plot. For chilli, onion, garlic, and coriander at harvest the yield data was recorded plot wise. The collected data were analyzed statistically using statistix 10 package and means were adjudged by LSD at 5% level of probability. Results showed that different intercrop combination significantly influenced yield and yield contributing characters of chilli. The yield of chilli was comparatively lower in intercropping than sole chilli but total productivity was increased due to additional yield of onion, garlic and coriander. Increased total productivity in terms of chilli equivalent yield (CEY) was 14.05 to 16.88 t/ha in intercrop combination compared to sole chilli 9.13 t/ha (main crop). All the intercrop combinations showed better performance in terms of chilli equivalent yield, gross return and benefit cost ratio (BCR) over sole crops. Among the intercrop combinations two rows of onion in between two rows of chilli was the most feasible and profitable intercropping system in respect of chilli equivalent yield (16.88 t/ha), gross return (Tk.675200/ha), gross margin (Tk. 526800/ha) and benefit cost ratio (4.32).

Intercropping of vegetables and other spices with chilli in Chattogram

M.M. Alam and M.K.R. Bhuiyan

The experiment was conducted at Regional Agricultural Research Station, Hathazari, Chattogram during December 2020 to March 2021 to assess the performance of raddish, carrot, onion and garlic intercropping with chilli for higher productivity and economic return. The treatments were as T₁= Sole chilli, T₂= Chilli + one row raddish, T₃= Chilli+ one row carrot, T₄= Chilli + one row onion and T₅= Chilli + one row garlic. The experiment was laid out in RCB design with three replications. The unit plot size was 5m × 4m. Raddish and carrot seeds; onion and garlic bulbs and 30 days old chilli seedlings were sown/transplanted/planted on 15 December, 2020. The land was fertilized at the rate of 128- 60-100-20 kg/haNPKS, respectively (FRG, 2018). Half of N and all other fertilizers were applied as basal. Rest N was applied at 30 DAS. Chilli and raddish

were harvested during February to March 2021 but carrot, onion and garlic were harvested on 2nd week of March, last week of March and 1st week of April, respectively. Yield data of chilli, carrot, onion and garlic were recorded plot wise. Collected data were analyzed statistically and mean separations were done by DMRT. All intercrop combinations performed better than that of sole chilli. The highest chilli equivalent yield (CEY: 16.50 t/ha) was recorded in chilli + onion intercropping. The maximum gross margin (Tk.1,30,000/ha) and benefit cost ratio (BCR: 1.69) were obtained from the same intercrop combination. The results revealed that chilli + onion might be agronomically feasible and economically profitable than other intercrop combinations in Chattogram.

Improvement of cropping intensity through relay yard long bean in maize+ bush bean (*khaissa*) intercropping

S. Hasan, M.A.I. Sarker and A.K. Saha

A field trial was conducted at RARS, BARI, Burirhat, Rangpur to observe the performance of relay yard long bean in maize + bush bean intercropping for increasing total productivity and higher economic return during 2019-2020 and 2020-2021. There were four treatments viz., T₁= Maize paired row + 4 row bush bean + relay yard long bean, T₂= Maize single row + 2 row bush bean + relay yard long bean T₃= Maize single row + single row bush bean + relay yard long bean and T₄= Sole maize (60 cm × 20 cm). The size of the unit plot was 3m × 3m. The experiment was laid out in a randomized complete block design with three replications. Fertilizers were applied at the rate of 225-60-120-45-4-1.6 kg/ha of NPKSZnB (FRG, 2018) as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid for sole maize and intercrop. One third of N, whole amount of TSP, MoP, gypsum, zinc sulphate and boric acid were applied as basal. Remaining 2/3 N was top dressed at 20 and 40 days after sowing (DAS) of maize. In intercrop, extra N (20 kg/ ha) was applied at 20 DAS as side dress to bush bean. Yard long bean was fertilized at the rate of 21- 27-33-9-1.2-1.2 kg/ ha of NPKSZnB (FRG, 2018). Two third of N and all other fertilizers were applied as basal. Rest N was applied at 20 and 40 DAS. Weeding, irrigation and spraying were done

as required. The experiment was started on 25 November, 2019 and crop harvested on 10 July, 2020 and in second year, the experiment was started on 25 December, 2020 and crop harvested on 14 July, 2021. Data were taken on grain yield of maize grain, vegetable yield of bush bean, yield of yard long bean. Maize equivalent yield was computed by converting yield of intercrops on the basis of prevailing market price of individual crop. All the combinations of Maize + bush bean + relay yard long bean gave higher maize equivalent yield (MEY: 43.21-44.73 t/ha) than sole maize (11.63 t/ha). These combinations also gave better economic return in respect of gross margin (Tk. 462406/ha- Tk. 489235/ha) and BCR (3.49-3.69). From two years results revealed that Maize + bush bean intercropping + relay yard long bean might be more productive and profitable than sole maize production.

Long term effect of four crop based cropping pattern on soil health and crop productivity

M.R. Karim, A.A. Begum, S.S. Kakon, M.Z. Ali, S. Akhter, M.A.K. Mian and D.A. Chudhury

The experiment was conducted at the Research Field of Agronomy Division BARI, Gazipur (AEZ 28), during 2017-18 to 2019-20 to assess the long term effect on crop productivity and soil health. Four treatments of cropping sequence were as CP₁ = Mustard--Mungbean–T. *aus* – T. *aman*; CP₂ = Potato –Mungbean–T. *aus* – T. *aman*; CP₃ = Garden pea –Mungbean–T. *aus* – T. *aman*; CP₄ = Potato – Red amaranth–Maize – T. *aman*. The experiment was laid out in a RCB design with 3 replications. The unit plot size was 4.8 m × 4.2 m. Different dates of operation and durations followed are described in the following Table:

CP	Crop	Sowing/ Transplanted	Harvesting time	Cropping duration
CP ₁	Mustard (BARI Sarisha-14)	November 15	January 30	340
	Mungbean (BARI Mung-6)	February 1	March 28	
	T. <i>aus</i> (Parija)	April 2	July 11	
	T. <i>aman</i> (BRRI dhan 62)	July 15	November 3	
CP ₂	Potato (cv. Diamant)	November 15	January 24	335
	Mungbean	February 1	March 27	
	T. <i>aus</i>	April 2	July 11	
	T. <i>aman</i>	July 15	November 3	
CP ₃	Garden Pea (BARI Motorshuti-3)	November 15	January 18	315
	Mungbean	February 1	March 27	
	T. <i>aus</i>	April 2	July 11	
	T. <i>aman</i>	July 15	November 3	
CP ₄	Potato	November 15	January 24	331
	Red amaranth (BARI Lalshak-1)	January 27	February 25	
	Maize (BHM- 9)	March 1	July 1	
	T. <i>aman</i>	July 15	November 3	

Fertilizer dose and application methods were followed as per recommendation of crops (FRG, 2018). Key data and crop residue were collected

properly. Dry matter weight was recorded and different nutrients in residue and grain was analyzed in the laboratory following the standard

procedure. Chemical properties of initial and after three year cropping soil were estimated. Soil sample were collected at 15 cm depth with auger. Nitrogen was estimated following modified Kjeldahl method (Subbiah and Asija, 1956). Phosphorus was estimated following Olsen's method (Olsen *et al.*, 1954) as the soil pH was nearly neutral. Potassium was estimated with the help of flame photometer (Toth and Prince, 1949). Sulfur was estimated using barium sulphate precipitation method (Singh *et al.*, 1999). Boron was estimated through hot water extraction of soil as developed by Berger and Truog (1939). Zinc was estimated through extraction method using EDTA + ammonium carbonate extractant (Singh *et al.*, 1999).

Key data was analyzed statistically and mean values were compared by $LSD_{(0.05)}$. The results showed that four crops could be grown successfully one after another in a sequence in all the cropping patterns. The highest rice equivalent yield (REY: 38.44 t/ha) was recorded from the cropping sequence CP₄. The highest gross margin (Tk. 491873/ha) and benefit cost ratio (BCR: 3.46) was also found in CP₄. Nitrogen level was found 54.39%, 20.37% and 3.03% increased in CP₄, CP₃ and CP₁, respectively but 4.76% decreased in CP₂. Amount of phosphorus was increased 46.00%, 24.00% and 4.00% in CP₄, CP₃ and CP₂, respectively but decreased in CP₁ (4.00%). Potassium content was increased in all the cropping patterns (86.33%, 56.67%, 53.50% and 31.43% in CP₄, CP₁, CP₃ and CP₂, respectively). In all the patterns, sulfur, boron and zinc levels were decreased. The lowest decreased of sulfur and boron was found in CP₄ (33.09% and 30.0%, respectively) while the lowest Zn decreased was found in CP₃ (39.47%). Considering crop productivity and soil nutrient changing trends, CP₄ (Potato- Red amaranth-Maize- T. *aman*) was found the most suitable pattern for sustainable crop production and maintaining soil health.

Development of vegetable based cropping pattern for increasing cropping intensity and ensuring nutrition

M.H. Rahman, K.U. Ahammad and D.A. Choudhury

A field experiment was conducted at the Regional Agricultural Research Station, Jashore during 2018-2019 and 2019-2020 consecutive years to find out the suitable cropping pattern for higher productivity and economic return. The cropping patterns were as: CP₁= Transplanted *aman* rice (Binadhan16) – Spinach (local) – Gardenpea (BARI Motorshuti-3) – Mungbean (BARI Mung-6) – Transplanted *aus* rice (Binadhan19); CP₂= T. *aman* rice – Cabbage (Atlas70)–Spinach–Yard long bean (Aduri) – T. *aus* rice; CP₃= T. *aman* rice – Cauliflower (Snowball)–Spinach –Yard long bean–T. *aus* rice; CP₄= T. *aman* rice–Coriander (BARI Dhonia-1) – Gardenpea – Mungbean – T. *aus* rice; CP₅= T. *aman* rice – Cauliflower –Spinach –Mungbean–T. *aus* rice and CP₆ = T. *aman*rice – Cauliflower–Mungbean –T. *aus*rice (Farmer's practice). The experiment was laid out in a Randomized Complete Block (RCB) design with four replications. The unit plot size was 6 m × 4 m. Thirty days old seedlings of Transplanted *aman* (T. *aman*) rice BRRI dhan75 and Binadhan16 was transplanted on 12 August 2018 and 08 August 2019 during the *Kharif*-2 season, respectively and it was the first crop of the sequence. All agronomic activities including sowing/transplanting, harvesting, weeding, irrigation, fertilizer and crop protection management etc. have been done as when necessary following the recommended production technologies of different crops (BARI, 2019). Recommended fertilizer doses (FRG, 2018) along with the application methods were applied to support the normal growth of the crops. Grain and economic yield were taken from whole plot. For economic comparison of these crop sequences, the yield of all crops was converted into rice equivalent yield on the basis of prevailing market price of individual crops. The economic indices i.e. gross return, gross margin, and marginal benefit cost ratio were also calculated on the basis of prevailing market price of the commodities. The results showed that five crops may be grown successfully one after another in a sequence with nutrition enriched vegetable based cropping patterns. The average highest rice equivalent yield (REY) 35.32 t/ha was recorded from the cropping pattern CP₃ which was followed by CP₂ (34.93 t/ha) and CP₅ (32.81 t/ha). The average highest gross return (Tk.7, 06,400 /ha) was recorded from CP₃cropping pattern which was

followed by CP₂ (Tk. 6, 98,600 /ha) and CP₅ (Tk. 6, 57,192 /ha). The average highest gross margin (Tk.3, 97,330/ha) was obtained from CP₂ which was followed by CP₃ (Tk.3, 93,725/ha). The highest marginal benefit cost ratio (MBCR) 3.26 was obtained from the cropping pattern CP₂ which was followed by CP₃ (2.56) and CP₅ (1.53). In terms of rice equivalent yield, it was increased by 15.3% in CP₃ followed by 14.4 % in CP₂ and 8.8 % in CP₅ cropping pattern as compared to Farmers' practice (FP). The gross margin was increased by 17.5% in CP₂ followed by 16.8 % in CP₃ and 5.8 % in CP₅ cropping pattern as compared to Farmers' practice.

Development of fertilizer packages for five crop based cropping pattern in rice based cropping system

M.H. Rahman, K.U. Ahammad and D.A. Choudhury

A field experiment was conducted at the Regional Agricultural Research Station, Jashore, Bangladesh during 2015-16, 2016-17, 2017-18, 2018-19 and 2019-20 consecutive years i) to develop the fertilizer packages for five crop based cropping pattern, ii) to assess the agronomic performance and iii) to estimate economic return of five crop based cropping pattern in rice based cropping systems. The eight fertilizer treatments were as follows: T₁ = 100% NPKSZnB (STB), T₂ = T₁ + 25% N, T₃ = T₁ + 25% NP, T₄ = T₁ + 25% NK, T₅ = T₁ + 25% PK, T₆ = T₁ + 25% NPK, T₇ = 75% of T₁ and T₈ = Native fertility. This cropping pattern is composed with five crops; namely, T. *aman* (Binadhan16)- Mustard (BARI Sharisa-14)- Spinach (Local)- Mungbean (BARI Mung-6) - T. *aus* (Binadhan19). The experiment was laid out in a Randomized Complete Block (RCB) design with four replications. The unit plot size was 6 m × 4 m. All agronomic activities including sowing/transplanting, harvesting, weeding, irrigation, fertilizer and crop protection management etc. have been done as when necessary following the recommended production technologies of different crops (BARI, 2019). Fertilizer application methods were applied to support the normal growth of the crops (FRG, 2018). Grain and economic yield were taken from whole plot. For economic comparison of the crop sequence, the yield of all crops was converted into

rice equivalent yield on the basis of prevailing market price of individual crops. The economic indices i.e. gross return, gross margin, and marginal benefit cost ratio were also calculated on the basis of prevailing market price of the commodities. Rice equivalent yield was differed under different treatments. The highest total rice equivalent yield (REY: 21.89 t/ha) was recorded from the treatment T₆ which was followed by T₄ (19.84 t/ha), T₃ (19.56 t/ha), T₅ (19.56 t/ha) and T₂ (19.29 t/ha). The lowest total REY (10.21 t/ha) was obtained from the native nutrient treatment (T₈). The highest gross margin (Tk.57241/ha) was recorded from the treatment T₆ which was followed by T₄ (Tk.18415/ha) and T₃ (Tk.13338/ha), respectively. The highest marginal benefit cost ratio (MBCR) 10.0 was obtained from the treatment T₆ which was followed by the treatment T₄ (5.6) and T₅ (4.8). Total REY was increased by (T₆) 16.99 %, (T₄) 5.99 %, (T₃) 4.51 % and (T₅) 4.51 % compared to the STB (100%) nutrient treatment (T₁), respectively. The income was increased by (T₆) 114.5 %, (T₄) 94 %, (T₃) 92 % and (T₅) 92 % compared to the STB (100%) nutrient treatment (T₁), respectively.

Development of alternate cropping pattern for increasing cropping intensity and productivity in Rangpur region

M.A.I. Sarker, M.S. Hasan, S.M.A.H.M. Kamal and A. K. Saha

A field experiment of different cropping patterns at Regional Agriculture Research Station, Burirhat, Rangpur during 2019-20 to increase cropping intensity as well as crop productivity. Four cropping patterns viz., Early potato-Potato-T. *aus* rice-T. *aman* rice (CP₁), Early potato-Potato/Maize relay-T. *aman* rice (CP₂), Early potato-Wheat-Mungbean-T. *aman* rice (CP₃) and one farmers' improved pattern Potato-Maize-T. *aman* rice (CP₄) were evaluated. The soil of the experimental field belongs to the agro-ecological zone of Tista Meander Floodplain Soil. The experiment was laid-out in a randomized complete block design with three replications. The unit plot size was 4 m × 4 m. The sowing date or transplanting date, harvesting date and crop duration for all crops in different cropping patterns are presented in the following Table:

Parameter	CP ₁ : Early potato-Potato-T. <i>aus</i> -T. <i>aman</i>				CP ₂ : Early potato-Potato/relay maize-T. <i>aman</i>			
	Early potato (Granola)	Potato (Granola)	T. <i>aus</i> (BRRI dhan48)	T. <i>aman</i> (Binadhan7)	Early potato (Granola)	Potato (Granola)	Maize (BHM-9)	T. <i>aman</i> (Binadhan7)
Sowing /Transplanting date	25.10.19	28.12.19	14.4.20	19.7.20	25.10.19	28.12.19	28.1.20	19.7.20
Harvesting date	26.12.19	18.3.20	13.7.20	15.10.20	26.12.19	18.3.20	30.6.20	15.10.20
Crop duration	62	80	90	88	62	80	153	88
Turn around period	10	2	27	6	10	2	-	19

Parameter	CP ₃ : Early potato-Wheat-Mungbean-T. <i>aman</i>				CP ₄ : Potato-Maize -T. <i>aman</i>		
	Early potato (Granola)	Wheat (BARI Gom-30)	Mungbean (BARI Mung-6)	T. <i>aman</i> (Binadhan7)	Potato (Granola)	Maize (BHM-9)	T. <i>aman</i> (BRRI dhan49)
Sowing date/Transplanting	25.10.19	27.12.19	22.4.20	19.7.20	21.11.19	28.2.20	17.7.20
Harvesting date	26.12.19	14.4.20	25.6.20	15.10.20	20.2.20	13.6.20	07.11.20
Crop duration	62	108	64	80	91	105	113
Turn around period	10	1	8	24	14	8	34

Crops were fertilized with recommended fertilizer (FRG, 2018). In terms of productivity and profitability the CP₁ and CP₂ performed better as compared to the other cropping patterns. The results showed that the highest rice equivalent yield (REY), production efficiency and gross return were recorded in CP₂ and the lowest in CP₄. The REY of CP₂, CP₁ and CP₃ patterns were 30.52, 29.99 and 22.16 t/ha which were 52%, 50% and 11% higher, respectively than that of the CP₄ (20.02 t/ha). The gross margin was higher in CP₂ cropping pattern with system profitability Tk. 1230.81/ha/day. The highest marginal benefit cost ratio (MBCR: 2.55) was obtained in CP₃. Results revealed that the highest land use efficiency (91.51%) was recorded in CP₂ and the highest labour involvement (528) was in CP₁ pattern with an increase of 49% over CP₄ (355). The cropping pattern CP₂ gave the highest additional income (Tk.174900/ha) over the CP₄ pattern. Organic matter was slightly increased in most of the cropping patterns as compared to initial soil. There were little changes with respect to other nutrients but all the nutrients maintained above critical level. So, without deteriorating soil nutrient in intensive crop cultivation, early Potato-Potato/Maize relay-T. *aman*

rice (CP₂), Early potato-Potato-T. *aus* rice-T. *aman* rice (CP₁), Early potato-Wheat-Mungbean-T. *aman* rice (CP₃) cropping patterns would more productive and remunerative cropping patterns for the farmers of Rangpur region.

Unfavourable

Estimation of temperature co-efficient of wheat for adjusting proper sowing time

A.A. Begum, M.A.K. Mian and D.A. Choudhury

The field experiment was conducted at Agronomy Research Field, Gazipur, BARI during *rabi* season of 2020-2021 to observe the growth behavior and yield of wheat as influenced by prevailing air temperature as well as other weather elements based on sowing time. The treatments were five sowing dates: D₁ = 10 November, D₂ = 20 November, D₃ = 30 November, D₄ = 10 December and D₅ = 20 December. The experiment was laid out in a RCB design with three replications and the unit plot size was 5m × 4m. Wheat seeds (var. BARI Gom-30) were sown as per treatment in line with maintaining 20 cm row to row spacing. Fertilizers were applied @ 120-30-90-15-3-1 kg/ha

of N-P-K-S-Zn-B respectively (FRG, 2018), in the form of urea, TSP, MoP, gypsum, zinc sulphate and boric acid. Two third of urea and full doses of other fertilizers were applied at the time of final land preparation. The remaining one third of urea was top dressed at CRI stage followed by irrigation. Data on growth parameters like leaf area and dry matter accumulation were measured at different dates with 15 days' interval. For estimation of physiological maturity and grain growth study, five spikes were harvested from each plot after anthesis starting from 5 days after anthesis at four days' interval. The crop was harvested at physiological maturity. Yield contributing characters were recorded from one linear meter at the time of harvest. Yield data were recorded by harvesting ten square meter area excluding border. Sowing date showed great influence on total dry matter (TDM) production, leaf area index (LAI), physiological maturity, yield and yield components of wheat. The 30 November sowing produced the maximum TDM and LAI followed by 20 November sowing. These parameters finally contributed to higher grain yield compared to earlier and later sowing date. The 30 November sowing took the longest period (105 days) to attain the physiological maturity with the highest GDD (1717) and 20 December sowing took the shortest period (93 days) to attain the physiological maturity with the lowest GDD (1574). It was also found that 30 November sowing produced the higher grain yield (4.80 t/ha). The results revealed that 20-30 November sowing produced higher grain yield might be due to favorable air temperature for growth and development. Late sowing after November 30 produced lower grain yield due to high temperature prevailed at the later growth stage (March) of wheat at Gazipur. The temperature co-efficient of wheat was estimated at 1.41t/ha indicated that grain yield would reduce @ 1.41t/ha per increase of 1°C of air temperature.

Potentiality of BARI tomato varieties under late planting condition in Dinajpur

M. M. Khanum and M. S. Huda

An experiment was conducted at the research field of ARS, BARI, Rajbari, Dinajpur during late *rabi* season of 2019- 2020 and 2020-2021 to observe the effect of planting date and variety on the yield of

late planting tomato. Four planting dates viz. P_1 = 15 January P_2 = 30 January, P_3 = 15 February and P_4 = 28 February and three tomato varieties viz. V_1 = BARI Tomato-15, V_2 = BARI Tomato-16 and V_3 = Local variety were used in the study. The experiment was laid out in a split plot design with 3 replications. Planting dates were assigned in the main plot and varieties in the sub-plot. The unit plot size was 3.6 m × 4 m. Thirty days old seedlings were transplanted maintaining 60 cm × 40 cm spacing between and within rows. The crop was fertilized with cowdung 5 t/ha and 160-60-80-28-3-1.5 kg/ha N-P-K-S-Zn-B, respectively (FRG, 2018) through urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid. Total amount of cowdung, one third of K and full dose of P, S, Zn and B were applied during final land preparation. Urea and rest of MOP were applied in two equal installments at 21 and 35 DAT. Thirty days old seedling were planted as per treatment. Irrigation, weeding, plant protection and other intercultural operation were done as and when necessary. The yield component data was taken from 5 randomly selected plants from each plot. At harvest, the yield data was recorded plot wise from central 8 m² area. The results indicated that January 15 planting with BARI Tomato-16 variety performed better in respect of yield (66.16 t/ha) in two consecutive years. The variety BARI Tomato-16 also showed potential fruiting capability during late winter season and February 28 planting produced 40.08 t/ha of yield. All the three varieties showed potential fruiting capability during late winter season and February 28 planting produced 25.10-40.08 t/ha of potential yield during late season in two years. The maximum gross return (Tk. 1323200/ ha), gross margin (Tk. 1125300/ ha) and maximum benefit cost ratio (6.69) were obtained from P_1V_2 . The results indicated that BARI Tomato-16 with January 15 planting might be suitable combination for higher yield and profit for tomato cultivation in Dinajpur.

Effect of micronutrient on cowpea in southern region of Bangladesh

M.A. Rahman, M.M. Rahman and M.R. Uddin

The field experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during the *rabi* season of 2020-21 to see

the effect of micronutrient on cowpea in southern region of Bangladesh. The treatment consisted of six combinations of micronutrients viz., T₁ = Sowing of non-primed cowpea seeds, T₂ = Sowing of primed seeds (over night soaking with fresh water), T₃ = Seeds treated with boron (0.5 g/kg seed), T₄ = Foliar spray of B solution (2%) at 40 days after emergence (DAE), T₅ = Foliar spray of B solution (2%) + Zn solution (2%) at 40 days after emergence (DAE) and T₆ = Foliar spray of B solution (2%) + Mo solution (2%) at 40 DAE. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 4 m × 3 m. Seeds of cowpea were sown on 9 December 2020 using seed rate 45 kg/ha. The plant spacing was row to row distance 40 cm and plant to plant distance 10 cm. The cowpea variety was BARI Felon-1. Before setting up the experiment, the initial soil sample was collected for chemical analysis for determining the available plant nutrients. Fertilizers were applied at the rate of 15-15-6-2 kg/ha N-P-K-S, respectively in the form of urea, triple super phosphate, muriate of potash and gypsum, respectively (FRG, 2018). All the fertilizers (macronutrients) were applied as basal during final land preparation. However, the micronutrients were applied as per treatment at 40 DAE of the crop plant. Insecticides (namely Emister and Intrapit) were applied for two times to protect the crops from insect attacking. Irrigation was given one time. Crop was harvested after attaining the physiological maturity. The 1st harvest was done on 7 April and 2nd harvest at 15 April 2021. Data were collected on different parameters. The effect of micronutrient showed significant variation in plant height, pod length, number of seed/pod and 1000-seed weight but no significant effect was observed on plant population/m², number of pods/plants, seed yield and biomass yield of cowpea. The result revealed that treatment T₅ (foliar spray of B + Zn) and T₄ (foliar spray of B) produced similar yield (2.61 and 2.52 t/ha, respectively) than other treatments.

Effects of different rates of growth regulator (Gibberellic acid) on cowpea in southern region of Bangladesh

M.A. Rahman, M.M. Rahman and M.R. Uddin

The field experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during the *rabi* season of 2020-21 to determine the effects of growth regulator on cowpea for increasing the yield of the crop in southern region of Bangladesh. The treatment consisted of five doses of growth regulator viz., T₁ = Foliar spray of fresh water at 40 days after emergence (DAE), T₂ = Foliar spray of Gibberellic Acid (GA₃) @ 25 mg/L at 40 DAE, T₃ = Foliar spray of GA₃ @ 50mg/L at 40 DAE, T₄ = Foliar Spray of GA₃ @ 75mg/L at 40 DAE and T₅ = Foliar spray of GA₃ @ 100mg/L at 40 DAE. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 4 m × 3 m. Seeds were sown on 9 December 2020 using seed rate of 45 kg/ha. The plant spacing was row to row distance 40 cm and plant to plant distance 10 cm. The cowpea variety was BARI Felon-1. Macronutrients were applied at the rate of 15-15-6-2 kg/ha N-P-K-S, respectively in the form of urea, triple super phosphate, muriate of potash and gypsum, respectively (FRG, 2018). All the fertilizers (macronutrients) were applied as basal during final land preparation. Insecticides (namely Emister and Intrapit) were applied for two times to protect the crops from insect attacking. Irrigation was given one time. Crop was harvested four times after attaining at the physiological maturity. The 1st harvest was done on 7 April, 2nd on 15 April, 3rd on 26 April and the final harvest was made on 5 May, 2021. Data were collected on different parameters in terms of plant population/m², plant height, number of pod/plant, pod length, number of seed/pod, 1000 seeds weight, seed weight/plot and biomass weight/plot. Among the studied plant characters, statistically significant difference was observed only in plant population and number of seed/pod but there were no significant variations in plant height, number of pod/plant, pod length, 1000 seeds weight, seed yield and biomass yield of cowpea due to different doses of growth regulator. Although no significant variation was observed in seed yield of cowpea due to the effect of growth regulators but treatment T₄ and T₂ gave comparatively better yields (2796 and 2733 kg/ha, respectively).

Performance of different pulse crops under mango orchard in southern region of Bangladesh

M.A. Rahman, M.M. Rahman and M.R. Uddin

The field experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during the *rabi* and late *rabi* season of 2020-21 to select the most appropriate pulse crop(s) for growing under mango orchard in southern region of Bangladesh. The treatments of the experiment were: T₁= Mango + Grasspea, T₂= Mango + Blackgram, T₃= Mango + Mungbean, T₄= Mango + Cowpea, T₅= Mango + Fieldpea. The all pulses except mungbean seeds were sown through line sowing method on 26 November, 2021 under mango orchard. Mungbean seeds were sown on 28 January, 2021. Seed rate for grasspea, blackgram, mungbean, cowpea and fieldpea was 7, 30, 22, 40 and 90 kg/ha respectively. The experiment was laid out in randomized complete block design with four replications. The unit plot size was 7 m × 3 m. The experimental plots were fertilized as per recommendation of Fertilizer Recommendation Guide, 2018. All fertilizers were applied during final land preparation. Irrigation was applied for two times and other intercultural operations were done as and when necessary, following the recommended production technologies (BARI, 2019). Data were collected on different parameters such as plant population/m², days to 50% flowering, days to maturity, plant height, number of pod/plants, number of seeds/pods, 1000-seed weight and seed yield/plot. The results revealed that different pulse crops had significant effect on growing under mango orchard. The highest yield was found in fieldpea in T₅ treatment (1843.7 kg/ha). The highest gross return (Tk. 73748/ha), gross margin (Tk. 43848/ha) and BCR (2.46) were recorded in T₅ (BARI Motor-3) treatment. From the result it might be concluded that T₅ (BARI Motor-3) easily grown as component crop under mango orchard in southern region of Bangladesh.

Effect of tillage and fertilizer on growth and yield of sunflower in southern region of Bangladesh

M.A. Rahman and M.M. Rahman

The field experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during the *rabi* and late *rabi* season of 2020-21 to see the effect of tillage and fertilizer on growth and yield of sunflower. The treatments of the experiment were: T₁F₁= Conventional tillage (Farmers Practice) × Recommended dose, T₁F₂= Conventional tillage (Farmers Practice) × 75% of RDF, T₁F₃= Conventional tillage (Farmers Practice) × 125% of RDF, T₂F₁= Power Tiller Operated Seeder × Recommended dose, T₂F₂= Power Tiller Operated Seeder × 75% of RDF, T₂F₃= Power Tiller Operated Seeder × 125% of RDF, T₃F₁= Strip tillage × Recommended dose, T₃F₂= Strip tillage × 75% of RDF, T₃F₃= Strip tillage × 125% of RDF. The whole plot was subdivided into twenty-seven unit plots. Treatments were set randomly at each plot. Tillage operations was done firstly considering tillage unit plots are maintained correctly. Seeds were sown on 27 December, 2021 in line sowing method at seed rate 12 kg/ha. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 8 m × 5 m. The initial soil moisture was 32% on oven dry basis. The crop was fertilized with N, P, K, S, Mg, Zn and B @ 70-24-56-16-3-1 and 0.8, respectively (FRG, 2018). All fertilizers except half of N was applied during final land preparation. Remaining half N was applied as two equal splits at 20-25 and 40-45 days after planting (before flower initiation stage). Irrigation was applied for two times and other intercultural operations were done as when necessary, following the recommended production technologies BARI, 2019). Data were collected on different parameters such as plant population/m², days to 50% flowering, days to maturity, plant height, number of head/m², number of filled seeds/head, unfilled seeds/head, 1000-seed weight and seed yield/plot, Stover yield/plot. The plot yields were then converted into ton/hectare. Results revealed that unfilled seeds/head, thousand seeds weight, seed yield/ha significantly varied in interaction of tillage method and fertilizer dose. The unfilled seeds/head (188.49 nos.) were found the highest in treatment T₁F₃ i.e. conventional tillage × 125% of RDF combination. Highest thousand seeds weight was derived from treatment T₂F₂ which was combination of power tiller

operated seeder method and 75% of RDF (65.10 gm). The highest yield was found in treatment interaction of PTOS method \times 75% of RDF that meant by T₂F₂ (1.79 kg/ha) and interaction of PTOS method \times RDF that meant by T₂F₁ (1.78 kg/ha). From the economic point of view treatment T₂F₂ might be suitable for cultivation of sunflower (BARI Surjomukhi-3) under Ganges Tidal Floodplain.

Effect of seedling age on yield of transplanted sunflower under zero tillage condition in southern region of Bangladesh

M.A. Rahman and M.M. Rahman

The experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during two consecutive *rabi* seasons of 2019-20 and 2020-21 to find out the optimum age and type of sunflower seedling for higher yield under zero tillage condition in the southern region of Bangladesh. The treatments were of two factors, viz., Factor A: Type of seedling: 2 (T₁ = Seedbed seedling, and T₂ = Water hyacinth ball seedling); Factor B: Age of seedling: 4 (A₁ = 7-day old seedling, A₂ = 14-day old seedling, A₃ = 21-day old seedling, and A₄ = Direct seeding). The experiment was laid out in randomized complete block design with three replications. The unit plot size was 4 m \times 3 m. The variety of sunflower was BARI Sunflower-2. Seedlings were transplanted on 26 December, 2019 in first year and on 3 December, 2020 in second year of the experiment. Previously, seedlings of 7 days, 14 days and 21 days old seedlings were prepared both in seedbed and decomposed water hyacinth made ball as per treatment specifications. Seedlings were transplanted with spacing of 50 cm row to row distance and 25 cm plant to plant distance under zero tillage condition just after harvesting of previous *T. aman* rice (cv. BRRI dhan52). Fertilizers were applied in the experiment field at the rate of 200-180-170-170-10-12 kg/ha urea, TSP, MoP, gypsum, zinc sulphate and boric acid, respectively along with 5 t/ha cowdung (FRG, 2018). Half of urea, all other fertilizers and cowdung were applied as basal at 5 days before seedling transplanting. The rest half amount of urea was applied as side dressing in two equal installments, one at 25 and 45 days after

transplanting. Irrigation was applied for three times and other intercultural operations were done as and when necessary following the recommended production technologies of the crops (BARI, 2019 and BARI, 2020). Data were collected on different parameters such as no. of plant pop/m², plant survive, days to 50% flowering, days to maturity, plant height, head diameter, no. of filled seed/head, 1000-seed weight, seed weight/plot and stover weight/plot. The plot yields were then converted into tonne/hectare. In 2019-20, the effect of seedling age was found to be significant on plant population, days to 50% flowering, days to maturity, plant height, head diameter, number of seed/head and seed yield. The highest yield (3389 kg/ha) was recorded in 7-days old seedling and it was partially at par to 14-day seedling (3198 kg/ha). Direct seeding crop produced the lowest yield (1937 kg/ha). Seed yield increased 74.94%, 65.09% and 38.32% through transplanting of 7-day, 14-day and 21-day seedlings over the direct seeding crop. In 2020-21, plant population, days to 50% flowering, days to maturity, plant height, head diameter, number of seed/head, 1000-seed weight, seed yield and stover yield varied significantly due to different ages of seedlings. Transplanting of 7-day old seedling gave the highest yield of seed (3075 kg/ha), which was statistically similar to that of 14-day old seedling (3010 kg/ha). Direct seeding crop produced the lowest yield (1974 kg/ha) that was statistically at par to 21-day seedling (2186 kg/ha). Experimental results further indicated that transplanting of 7-day and 14-day old seedlings increased the seed yields of 55.81% and 52.50%, respectively over the direct seeding crop. In average (2019-20 and 2020-21), the higher gross returns were found in 7-day and 14-day old water hyacinth ball seedlings (Tk. 232827 and 215799/ha, respectively). The 7-day old water hyacinth ball seedlings contributed the highest gross margin (Tk. 139527/ha) but slightly reduced amounts of gross margins were found in 14-day old water hyacinth ball seedlings (Tk. 122499/ha). The BCR became the highest (2.51) in 7-day old water hyacinth ball seedlings. Comparatively similar BCR was also observed in 14-day old water hyacinth ball seedlings (2.32). Therefore, sunflower can be cultivated through transplanting of 7-14 days old seedbed and water hyacinth ball seedlings under

zero tillage condition just after harvesting of *T. aman* rice in southern region.

Performance of minor cereal under different tillage conditions in rice based cropping systems in southern region of Bangladesh

M.A. Rahman and M.M. Rahman

The experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during *rabi* season of 2020-21 to evaluate the performances of minor cereals under different tillage conditions in rice based cropping systems in southern region of Bangladesh. The treatments were of two factors viz., Factor A: Tillage condition: 3 (T_1 = Zero tillage i.e. relay cropping with *T. aman* rice, T_2 = Minimum tillage i.e. after harvest of *T. aman* rice and T_3 = Conventional tillage i.e. power till: 2-3 pass); and Factor B: Number of minor cereal crop: 6 (C_1 = Barley, C_2 = Kaon, C_3 = Cheena, C_4 = Sorghum, C_5 = Oat and C_6 = Buckwheat). The experiment was laid out in randomized complete block design with three replications. The unit plot size was 4 m × 3 m. The seeds of the selected minor cereal crops were sown on 8 November, 2020 (Zero tillage i.e. relay cropping with previous *T. aman* rice cv. BRRI dhan52), 12 November, 2020 (Minimum tillage i.e. after harvest of *T. aman* rice) and 30 November, 2020 (Conventional tillage condition). The varieties of these crops were BARI Barley-8 (barley), BARI Kaon-4 (kaon), Tusar (cheena), BARI Sorghum-1 (sorghum), exotic variety (oat) and local variety (buckwheat). Seeds of these minor crops were sown as per treatment specifications. The seed rate of barley was 120 kg/ha, kaon 10 kg/ha, cheena 20 kg/ha, sorghum 10 kg/ha, oat 80 kg/ha and buckwheat 80 kg/ha. For minimum or conventional tillage, seeds of minor cereal crops were sown in rows following row to row distance 20 cm for barley, 25 cm for kaon, 25 cm for cheena, 50 cm for sorghum, 20 cm for oat, 10 cm for buckwheat, and 40 cm for bajra. The plant to plant distance was 10 cm for all the crops. Fertilizer nutrients were applied in the plots of the minor cereal crops as per their respective recommended doses and methods (FRG, 2018). Irrigation was applied for two times and other intercultural operations were done as when necessary following the recommended production technologies of the minor cereal crops

(BARI, 2020). The crops were harvested when attained to their respective physiological maturity. Data were collected in relation to phenology, yield attributes and yields of the respective crops. For barley, number of days to 50% flowering and days to maturity differed significantly due to different tillage conditions. In case of kaon, the tillage conditions had significant effects only on the number of days to flowering. In case of cheena, statistically significant differences were found on number of days to flowering, days to maturity and plant height. In sorghum, number of days to physiological maturity and plant height differed significantly by different tillage conditions. In case of oat, statistically significant differences were observed in number of days to 50% flowering, days to maturity, spike/m², number of grain/spike and 1000 grain weight. For buckwheat, significant variation was observed in the number of days to 50% flowering and days to maturity due to different tillage conditions. In case of barley, conventional tillage produced the highest gross return as well as gross margin (Tk. 231951 and 149544/ha, respectively). For kaon, crop grown under conventional tillage showed the highest gross return and gross margin (Tk. 234807 and 160679/ha, respectively). The highest BCR (3.54) was obtained from zero tillage. In cheena, the minimum tillage gave the highest gross return (Tk. 229517/ha) and gross margin (Tk. 165029/ha). Zero tillage exhibited the highest BCR value (3.65). In case of sorghum, conventional tillage produced the highest gross return and gross margin (Tk. 557711 and 483224/ha, respectively). The highest BCR value (8.02) was computed in zero tillage. The minimum tillage and conventional tillage contributed the BCR values of 7.60 and 7.49, respectively. In oat, minimum tillage gave the highest gross return (Tk. 309603/ha) and gross margin (Tk. 241616/ha). The highest BCR (4.55) was obtained from minimum tillage. The experimental results revealed that all the minor cereal crops (barley, kaon, cheena, sorghum, oat and buckwheat) could be cultivated under different tillage conditions in southern region of Bangladesh but zero tillage is best because of relatively higher BCR. The economic analysis revealed that sorghum, oat, kaon and cheena cultivation were

more profitable as compared to other minor cereal crops.

Water stress effect on growth and yield of yard long bean

S. T. Zannat, D. A. Chowdhury and S.S. Kakon

The experiment was conducted at vinyl house of Agronomy division of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, during *kharif* season of 2020-21 to see the effect of water stress on the growth and yield of yard long bean. There were four treatments viz, T_1 = 100% Field capacity, T_2 = 80% Field capacity, T_3 = 60% Field capacity and T_4 = 40% Field capacity. The experiment was laid out in a completely randomized design with twelve replications. The pot was filled with 12 kg air dried soil including cow dung at a ratio of 4:1. Each experimental pot was fertilized with 365, 800, 528, 365, 34, 705 mg urea, triple super phosphate (TSP), muriate of potash (MOP), gypsum, zinc sulphate and boron, respectively corresponding to 28, 26, 44, 12, 2, 2 kg/ha in the form of urea, triple super phosphate (TSP), muriate of potash (MOP), gypsum, zinc sulphate and boron (FRG, 2018). All fertilizers except N was applied as basal dose. N was applied in two equal splits at 2nd and 3rd weeks of germination. Seeds of yard long bean were sown on 09 March 2021. Water was applied as estimated to maintain the field capacity as per treatment. Intercultural operations like thinning were done at 15 DAS and weeding were done two times at 15 and 25 DAS. Crop was harvested on 06 July 2021. Root of single plant was collected for data collection and dry weight was taken by oven drying at 70°C. At harvest, the yield data was recorded pot wise. Growth and yield of yard long bean varied significantly due to water stress. The highest plant height (30.92 cm) was found in T_1 treatment. On the other hand, maximum no. of branch/plant (4.88) and no. of pods/plant (5.75) were found in T_2 treatment. The lowest plant height (20.05), no. of branch/plant (1.12) and no. of pods/plant (1.25) found in T_4 treatment. The longest root length (21.05 cm) was obtained from T_4 and the shortest (15.65 cm) was found in T_1 treatments. Maximum dry matter accumulated both in root (0.78 g) and plant (18.80 g) was recorded in T_2 (80% FC) treatment. The lowest dry matter of

root (0.61 g) and plant (10.27 g) accumulated in T_4 (40% FC) treatment i.e., in maximum stress condition. The highest pod yield/plant (16.41 g) was obtained in the T_2 (80% Field capacity) followed by T_1 (13.67 g pods/plant) treatment, whereas the lowest pod yield/plant (8.18 g) was found in T_4 (40% Field capacity) treatment.

Integrated vegetables and fish cultivation through plastic drum based floating system in flooded ecosystem of Bangladesh

M.A. Rahman, M.M. Rahman, M.R. Uddin and M.M.R. Talukder

The experiment was conducted at RARS, Rahmatpur, Barishal from July, 2020 to June, 2021 to integrate vegetables and fishes under floating agriculture system for increasing the total productivity and net return in flooded ecosystem. The experiment comprised of three treatments viz., T_1 = Sole fish culture into plastic drum based floating cage, T_2 = Year round creeper vegetables (cucumber-bitter gourd bottle gourd) on plastic bag and plastic drum based trellis + Fish culture into floating cage, and T_3 = Year round creeper vegetables (cucumber, bitter gourd, bottle gourd etc.) on water hyacinth floating bed and plastic drum based trellis + Fish culture into floating cage. The floating cage was made with plastic drum and GI pipe. The unit floating cage size was 7.01 x 5.18m (23 ft long x 17 ft wide). Three floating cages were used for integrated vegetables and fish cultivation under each system. Plastic bag filled with fertilized soil was placed on plastic drum (in case of T_1). Seedlings of creeper vegetables were transplanted into the plastic bag and their growth and development were taken place on trellis. In another method (T_2), the end portion of two floating cage was kept on water hyacinth made floating bed. Creeper seedlings were transplanted on the water hyacinth floating bed. The trellis was made on the plastic drum based floating structure. Selected fish species (like tilapia, Thai sarpunti etc.) were released into the floating cage at the rate of 15 kg/cage following the guidelines as recommended by Bangladesh Fisheries Research Institute. The unit floating cage size was 7.01 x 5.18m (23 ft long x 17 ft wide). Three floating cages were used for integrated vegetables and fish cultivation under each system. Data were recorded

on different date of activities and yield of the produces. The experimental results revealed that the treatment T₃ (Year round creeper vegetables on water hyacinth floating bed and plastic drum based trellis + Fish culture into floating cage) gave the highest gross return (Tk. 57164/ system) and the sole fish culture (T₁) produced the lowest gross return (Tk. 40800/system). On the other hand, the gross return computed from treatment T₂ (Year round creeper vegetables on plastic bag and plastic drum based trellis + Fish culture into floating cage) was Tk. 47165/system. The plastic drum based floating cage system could be used for integrated vegetables and fish cultivation in the flooded ecosystem of Bangladesh. The applicability of treatments T₂ and T₃ is subject to availability of water hyacinth in the flooded ecosystem. If water hyacinth is unavailable, treatment T₂ can be applied. Nevertheless, treatment T₃ can be followed in case of available condition of water hyacinth. The treatment T₂ is suitable for cultivation only creeper vegetables crop in plastic bag but it cannot provide space for cultivation of non-creeper vegetable or spice crops. On the other hand, treatment T₃ is suitable for cultivation both creeper and non-creeper crops simultaneously on water hyacinth made floating bed. That is why the production and gross return obtained from treatment T₃ was relatively higher than that of T₂ treatment.

Development of floating bed cum trellis (tidal model) for creeper vegetables cultivation under tidal flooded ecosystem of Bangladesh

M.A. Rahman, M.M. Rahman and M.M.R. Talukder

The experiment was conducted during rainy season of 2020 in the tidal flood prone areas at Zamvita village (Banaripara upazila), Barishal and Balldia village (Nesarabad upazila) of Pirojpur district of Bangladesh to develop floating bed cum trellis (tidal model) for creeper vegetables cultivation under tidal flooded ecosystem of Bangladesh. The treatment of the experiment was three viz., T₁ = Water hyacinth made floating bed cum trellis (tidal model); T₂ = Traditional floating bed + 100% plant population of T₁ and T₃ = Traditional floating bed + 50% plant population of T₁. The floating bed was prepared with water hyacinth and water fern

(topapana) before transplanting of cucurbit seedlings. The experiment was laid out in randomized complete block design with three replications. The size of the whole floating bed (block) was 9.15-meter-long (30 feet), 1.37-meter-wide (4.50 feet) and 1.16 meter (3.80 feet) high. The GI made trellis between two floating bed was 6 meter wide. Two rows of pumpkin were transplanted on floating bed with row to row distance 80 cm and plant to plant distance 110 cm. No. of seedling/hill: 2. The variety of pumpkin was BARI Mistikumra-2. Seedlings of pumpkin were transplanted on floating bed on 7 July, 2020 at Zamvita village (Banaripara upazila) and on 10 July, 2020 at Balldia village (Nesarabad, Pirojpur). Fertilizer nutrients were applied as per the recommended dose (@ 53g urea, 135g diammonium phosphate, 30g muriate of potash, 33g gypsum and 4g boric acid/10 m²). All the chemical fertilizers were applied on the floating bed in liquid form (through mixing with water) surrounding the crop plant or root zone in five equal splits. Irrigation was applied daily at the initial stage of seedling transplanting upto the development of root system of the crop plants. All other agronomic practices were done as per requirement of the crop for its better growth and development. Pumpkin crop was harvested on 6 October, 2020 at Zamvita village and on 27 September, 2020 at Balldia village. Data were recorded on tidal water fluctuation during the experimentation period (July to December, 2020) due to high and low tides both in the experimental fields and river. Data were also collected on different plant characters of pumpkin in terms of final plant population/m², vine length, number of branch/plant, number of fruit/plant, single fruit weight, fruit length, fruit breadth and fruit yield/plot. The plot wise yield data then was converted into tonne/hectare. At Zamvita, Banaripara, Barishal, the tidal water heights of high tide and low tide attained the highest levels (127.20 cm and 65.00 cm, respectively) at the second fortnight of August, 2020. At Balldia, Nesarabad, Pirojpur, the tidal water heights of high tide and low tide reached the highest levels (141.83 cm and 91.70 cm, respectively) at the second fortnight of July, 2020. With the advancement of time, the tidal water heights declined gradually at both the

locations. At Zamvita, Banaripara, Barishal, the effect of floating system was found to be significant differences in terms of final plant population/m², vine length, number of branch/plant, number of fruit/plant, single fruit weight, fruit length, fruit breadth and fruit yield of pumpkin. The highest yield (19.80 t/ha) of pumpkin fruit was obtained from T₁ treatment. The treatment T₂ gave the lowest yield (9.30 t/ha) and the treatment T₃ produced the yield of 10.76 t/ha. At Balldia, Nesrabad, Pirojpur, all the studied parameters of pumpkin differed significantly except fruit breadth. The highest yield (18.83 t/ha) was found in T₁ treatment. The treatments T₃ and T₂ provided the yields of 11.42 and 9.92 t/ha, respectively. In case of water hyacinth based floating bed cum trellis (tidal model), seedlings of cucurbits or creeper vegetables are transplanted on floating bed but their proper growth and development take place on wider trellis that lead to higher yield. However, only on the traditional floating bed, the transplanted creeper or cucurbit vegetables plants do not get required amount space for their proper growth and development that cause reduced yield. The experimental results at both the locations revealed that creeper vegetables could be cultivated through floating bed cum trellis (tidal model) under tidal flooded ecosystem of Bangladesh.

Integrated nutrient management for bitter gourd on floating bed cum trellis

M.A. Rahman, M.R. Uddin, M.M. Rahman and M.M.R. Talukder

The experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal on bitter gourd (hybrid variety) during *kharif* season of 2020 to see the performance of bitter gourd on floating bed cum trellis. The nutrient management in bitter gourd comprised of five treatments (fertilizer doses) viz., T₁ = 65-21-10-5-1 kg/ha N-P-K-S-B, respectively (FRG, 2018); T₂ = 75% of T₁; T₃ = 50% of T₁; T₄ = 25% of T₁; T₅ = No fertilizer. The floating bed was prepared with water hyacinth and water fern (topapana) and then the raised pits were made with dulalilata on floating bed. The initial samples of water hyacinth, water fern (topapana) and dulalilata were collected for determining its chemical composition. The experiment was laid out in

randomized complete block design with three replications. The size of the whole floating bed (block) was 9.15-meter-long (30 feet), 1.37-meter-wide (4.50 feet) and 1.16 meter (3.80 feet) high. Unit floating plot size was 3.35 m² and plant spacing was hill to hill distance 1.0m and number of seedling/hill was 2. Nitrogen and phosphorus were applied on floating bed in the forms of diammonium phosphate and urea, potassium as muriate of potash, sulphur as gypsum, zinc as zinc sulphate and boron was applied in the form of boric acid. The sprouted seeds of hybrid bitter gourd inserted into topapana made balls and were placed on floating bed on 20 September, 2020. All the chemical fertilizers were applied on the floating bed in liquid form (through mixing with water) surrounding the crop plant or root zone. The fertilizers were applied in five equal splits at 15, 25, 35, 45 and 55 days after seedling transplanting on floating bed. Bitter gourd seeds of hybrid variety (namely *Tia*) were primed with pond water for 4 hours on 18 September, 2020 and then drained out the water. The wet seeds were kept into a water glass for 2 days covering with topapana to become sprouting. The hypocotyls (root) portion of the sprouted seeds was inserted into the pre-prepared ball/dolla. The ball/dolla (6-8 cm diameter) was made with topapana wrapping with dulalilata. The sprouted seeds (with ball) were placed on floating bed in two rows on raised pits (2 seedlings/pit) on 20 September, 2020. After transplanting of seedling, trellis was made alongside the floating bed with bamboo pole, nylon rope and dhaincha stick. The trellis between two floating bed was 5 meter wide. The floating bed cum trellis (non-tidal model) is suitable for optimum growth and development of the creeper vegetable crop plants. Fertilizers were applied as per the treatment specifications. Nitrogen and phosphorus were applied on floating bed in the forms of diammonium phosphate and urea, potassium as muriate of potash, sulphur as gypsum, zinc as zinc sulphate and boron was applied in the form of boric acid (T₁ = 100g urea, 105g diammonium phosphate, 20g muriate of potash, 31g gypsum, 6g boric acid/10 sqm area). All the chemical fertilizers were applied on the floating bed in liquid form (through mixing with water) surrounding the crop plant or root zone. The fertilizers were applied in

five equal splits at 15, 25, 35, 45 and 55 days after seedling transplanting on floating bed. The first date of fertilizers application was 5 October, 2020, 2nd application 15 October, 3rd application 25 October, 4th application 04 November and the last date of application (5th) was 14 November, 2020. The liquid form of plant nutrients were applied around the crop plants (bitter gourd) as well as on the floating bed. Irrigation was applied daily at the initial stage of seedling transplanting upto the development of root system of the crop plants. Fruits of bitter gourd were harvested first on 08 November, 2nd harvest on 17 November and final (3rd) harvest was done on 29 November 2020. Fertilizer dose had significant effect on branch/plant, fruit length, fruit diameter, fruit/plant and fruit yield. The highest number of branch/plant (28.33) was observed in T₁. Likewise, the highest length of fruit (23.35 cm) was found in treatment T₁. Fruit diameter became the highest (42.79 cm) in T₄ treatment. The highest number of fruit/plant (5.14) was recorded in T₁ treatment. The result revealed that among the treatments, T₁ produced the highest yield (13.27 t/ha) and it produced 47.09% higher yield than over the control.

Sorjan based integrated farming systems research for increasing agricultural productivity under tidal flooding ecosystem in southern region of Bangladesh

M.A. Rahman, M.M. Rahman and M.R. Uddin

The research programme on sorjan based integrated farming systems had been implementing since July, 2018 to till now through holistic approach at RARS, Rahmatpur, Barishal. Under this farming systems, all the potential and eco-friendly components or enterprises like crops (vegetables, spices and fruits), fisheries, dairy and bio-gas plant (for fuel biogas and bio-slurry production) were integrated for interacting each other towards increasing the total system productivity. The dimension of new sorjan was: bed length \times breadth \times high = 21 m \times 6 m \times 1 meter, canal length \times breadth \times high = 21 m \times 6 m \times 2.13 meters. The vegetable, spice and fruit crops were grown on sorjan beds following the recommended production technologies of the respective crops (BARI, 2020). Fertilizers were applied as per recommendation rate of the respective crops (FRG, 2018). The fisheries,

dairy and poultry (ducks) enterprises were implemented with the help of Department of Fisheries and Department of Livestock. The total sorjan area of RARS, Barishal was 2820 square meter (1200 sq.m. + 1620 sq.m.). The creeper/vine vegetables seedlings were transplanted on the edge of the sorjan beds but their growth and development were taken place on the trellis as made on the sorjan canals. On the other hand, the fishes were cultivated in canal water between two sorjan beds. Fodder crops (cv. German grass, napier grass, packchong, para grass etc.) were grown on slope and outside the sorjan beds. Under the sorjan based integrated farming systems (total area: 2820 square meter), the total harvested summer and winter vegetable/spice crops was 3,840 kg. The amount of fruits harvested from the sorjan area was 237 kg. Harvest of chewing type sugarcane (BSRI Akh 42) was 350 kg. Total of 258 kg fishes were harvested from the sorjan canal water. Besides, 6,709 litre milk, 3,759 number of duck egg, 4,910 kg fodder, 2,400 kg of bio-slurry were obtained from the sorjan area. The gross return computed in vegetable and spice crops from the sorjan area was Tk. 59,032 (Tk. 2,09,333/ha). The fruit crops provided the gross return Tk. 92,240 (Tk. 3,27,092/ha) and sugarcane contributed Tk. 3,500 from the sorjan area (Tk. 12,411/ha). On the other hand, the gross returns from milk was Tk. 4,02,522, duck egg Tk. 37,590, fodder Tk. 24,550, biogas Tk. 24,000 and bio-slurry Tk. 12,000 in the existing sorjan area. The total gross return from vegetables, spices, fruits, sugarcane, fish, milk, duck egg, fodder, biogas and bio-slurry was Tk. 6,63,144 (Tk. 23,51,574/ha). However, gross return obtained from single rice crops was Tk. 1,31,000/ha. Actually, the sorjan based integrated farming systems research is a long-term (5-10 years) research programme. The research findings indicated that sorjan based integrated farming systems are more profitable than that of single cropping system.

Adaptation of BARI released crop varieties in charland

M.A.K. Mian, M. R. Islam, J. Hossain M. M. Mostakim and D. Sarker

The adaptive trial was conducted at charland of the river Pandma, Lakkikunda, Ishurdi during *rabi*

season of 2020-2021 to see the performance of pulses and oilseed varieties of BARI. It was the developed charland of the river of Padma. The names of selected farmers were Abul Malek, Monirul Islam and Md. Rokon. Three mustard varieties like BARI Sarisha-11, BARI Sarisha-14 and BARI Sarisha-17; two lentil varieties viz. BARI Masur-7 and BARI Masur-8; pea variety BARI Motor-3 were grown among the selected farmer fields of Koikunda. Each variety of mustard, lentil and pea were grown in one bigha of land. All the crop varieties were sown on 24-25 November 2020. Crops were sown in residual soil moisture. Crops were fertilized with recommended fertilizer (FRG, 2018). One irrigation was applied at 50 DAS in mustard and no irrigation was applied in pulse crop. Fertilizers were applied as per recommendation for the crops. All fertilizers were applied as basal. Only half N was top dressed in mustard just after irrigation. Yields of different crop varieties were collected. Among three mustard varieties, BARI sarisha-11 gave the highest yield (1365 kg/ha). Between two lentil varieties, BARI Masur-8 showed better performance (1635 kg/ha) at charland of Padma.

Earthing up and sowing time effect on sweet potato in char land ecosystem

J. Rahman, M.R. Ali, A.A. Begum, J.A. Choudhury, D.A. Choudhury and M.M. Kadir

The experiment was carried out at Nawvanger char, sadar, Jamalpur during *rabi* season of 2020-2021 to find out the suitable sowing time and management practice of sweet potato for higher yield in charland. Treatments included in the experiment were two management practices: E_1 = Normal/Flat, E_2 = Earthing up at 25 days after transplanting and Sowing time: S_1 = August, S_2 = September. Design of the experiment was RCBD two factors with three replications having the unit plot size of 3 m × 3 m. Sweet potato variety BARI SP-8 was used as test crop in the experiment. Fertilizers were applied at the rate of 120-36-120-15-1.5-1 kg/ha of NPKSZnB (FRG, 2018) as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid. All of PSZnB and $\frac{1}{2}$ of N and K were applied as basal during final land preparation. Remaining N and K were applied at 30 DAP during earthing up

operation (Ahmmed *et. al.*, 2018). Intercultural operations like irrigation, weeding and spraying insecticides were done as and when necessary. The highest marketable yield of sweet potato (28.70 t/ha) was observed in Earthing up × August sowing followed by Normal × August sowing. The highest gross return (Tk.717500/ha), gross margin (Tk. 649500/ha) and BCR (10.55) were also found in Earthing up × August sowing followed by Normal × August sowing. The result revealed that August sowing with both management practices (normal and earthing up) was suitable for sweet potato cultivation on the basis of marketable yield and economic return at char land in Jamalpur.

Performance of intercropping leafy vegetables with sweet potato in char area of Rangpur

M.A.I. Sarker, M.S. Hasan, S.M.A.H.M. Kamal and A.K. Saha

The experiment was conducted at Mohipur char area, Gangachara, Rangpur during *rabi* season of 2020-2021 to find out suitable combination of sweet potato and leafy vegetables intercropping for higher productivity. Treatments included in the experiment were: T_1 = Sole sweet potato, T_2 = Sweet potato + red amaranth, T_3 = Sweet potato + spinach, T_4 = Sweet potato + raddish and T_5 = Sweet potato + coriander. The experiment was laid out in a randomized complete block design with three replications and the unit plot size was 4m × 4m. Local variety of sweet potato was used in the experiment. Others crop variety were BARI Lalshak-1, BARI Palongshak-1, BARI Mula-1 and BARI Dhonia-1. The experiment was started on 24 November, 2020. The vine of sweet potato was planted in line and other seeds of intercrop were broadcasted. Fertilizers were applied at the rate of 280-170-260-80-12-8 Kg/ha of Urea-TSP-MP-Gypsum-Zinc Sulphate-Boric acid for sole sweet potato and intercrop (FRG, 2018). Half of urea, whole amount of TSP, MP, gypsum, zinc sulphate and boric acid were applied as basal. Remaining urea was top dressed at 20 and 35 days after planting of sweet potato. In intercrop, extra urea (150 kg/ ha) was applied in 2 splits at 20 and 35 DAS to sweet potato. Data on yield contributing characters of sweet potato were taken from randomly selected 5 plants from each plot. Yields of both the crops were taken from whole plot area.

Sweet potato was harvested at 22 March, 2021. On the other hand, intercrops were harvested after 30 to 45 days after sowing. The maximum root yield of sweet potato was observed in sole crop. Sweet potato equivalent yield (SPEY) of intercropping treatments showed better performance than sole sweet potato. The highest SPEY, gross return, net return and marginal benefit cost ratio was observed in T₃ treatment (Sweet potato + spinach).

Performance of sweet potato varieties at char land in Rangpur

M.A.I. Sarker, M.S. Hasan, S.M.A.H.M. Kamal and A. K. Saha

A field trial was conducted at Mohipur char, Gangachara, Rangpur with different varieties of sweet potato to find out the yield performance different sweet potato varieties in char land during *rabi* season of 2019-20 and 2020-21. The design was followed with RCB with three replications. The experiment was started 17 November, 2019 and 18 November 2020. The treatment was four varieties of sweet potato in 2019-20 and five varieties of sweet potato with compare to local in 2020-21. The size of the unit plot was 4 m × 4 m. In 1st year, the four varieties were such as BARI SP-4, BARI SP-8, BARI SP-13 and BARI SP-14. In 2nd year, the five varieties were such as BARI SP-8, BARI SP-12, BARI SP-14 and BARI SP-15 and local. Weeding, irrigation and spraying were done as required. Fertilizers were applied at the rate of 280-170-260-80-12-8 Kg/ha of Urea-TSP-MP-Gypsum-Zinc Sulphate-Boric acid (BARI Krishi Projukti Hand Book, 2017), respectively. Half of Urea, whole amount of TSP, MoP, Gypsum, Zinc and Boron were applied as basal. Remaining rest urea was top dressed at 35 days and mixed thoroughly with the soil as soon as possible for better utilization. Data on yield contributing characters of sweet potato were taken from randomly selected 5 plants from each plot. Yields of the crops were taken from whole plot area. Sweet potato was harvested at 25 March, 2020 and 28 March, 2021. All the newly released BARI Sweet potato varieties showed better performance than local in terms of root yield and economic return in char land area of Rangpur. Among the varieties, the highest yield was obtained in BARI

SP-8 and BARI SP-12 in 2019-20 and 2020-21, respectively.

Performance of potato varieties at Chalan beel area

A.A. Begum, J.A. Chowdhury, S.S. Kakon and D.A. Choudhury

An experiment was conducted at farmers' field of Chalanbeel area of Sirajgonj district during the *rabi* season of 2020-2021 for adaption of BARI released potato varieties in Chalanbeel area. The treatments were five potato varieties viz., BARI Alu-7, BARI Alu-8, BARI Alu-25, BARI Alu-41 and deshal alu (Local). The experiment was laid out in RCB design with three replications. The unit plot size was 12 m × 10 m. The spacing was maintained 60 cm × 25 cm in BARI released varieties and 50 cm × 10 cm in local cultivar. Fertilizers were applied at the rate of 135-30-135-15-3-1 kg/ha of NPKSZnB (Ahmmed *et al.*, 2018) as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid. Half of N, K and whole amount of TSP, MoP, gypsum, zinc sulphate and boric acid was applied as basal for both BARI released and local varieties. Remaining 1/2 N and K were side dressed at 30 days after planting (DAP) during earthing up operation. Three irrigations were applied at 10, 30 and 60 DAP. The crop was planted on 25 November 2020 and HYV were harvested on 2 March 2021 and deshal alu was harvested on 19 February 2021. The yield component data was collected from randomly selected ten plants prior to harvest from each plot. At harvest, yield of potato was recorded plot wise. Higher tuber yield (18.40-21.56 t/ha) was found in BARI released potato varieties. Local variety gave the lowest yield (14.62 t/ha). Farmers were interested to grow BARI released potato varieties for getting higher tuber yield in chalanbeel area if the seed is available.

Evaluation of recent developed maize based intercropping technologies at hilly areas of Khagrachari

S.S. Kakon, G. Paul, S. Mahmud and M. R. Ahmad

A field experiment was conducted at farmer's field of hill valleys in Khagrachori during the *rabi* season, 2020-2021 to evaluate the performance of BARI developed intercrop technologies. Four

developed intercrop technologies were evaluated against sole hybrid maize. There were five treatments viz. T_1 = Hybrid maize normal row + 3 row spinach T_2 = Hybrid Maize normal row + 2 row bushbean T_3 = Hybrid maize normal row + 2 row pea. T_4 = Hybrid maize normal row + broadcast lalshak, T_5 = Sole Hybrid maize. The experiment was laid out in a randomized complete block design (RCBD) with three dispersed (farmer's field) replications. The unit plot size was 12 m × 8 m. Hybrid maize (var. BARI Hybrid Maize-9), spinach (local), bushbean (var. BARI Jharsheem-2), pea (var. BARI motorshuti-3) and lalshak (var. BARI lalshak-1) were used in this intercropping experiment. Pea, maize, spinach, lalshak and bushbean were sown on November 27, 2020. The crop was fertilized with 260-55-40-4-1 kg/ha of NPKSZn (FRG, 2018) were applied in the intercrop technologies. The full amount of P K S Zn and $\frac{1}{3}$ N were applied as basal in the form of triple super phosphate, muriate of potash, zinc sulphate and urea, respectively. The remaining N was top dressed in two equal splits at 30 and 60 days after maize sowing (DAMS). Irrigation was given after sowing/planting for proper establishment of crops. Subsequently three irrigations were applied at 30, 60 and 90 DAS. Two hand weeding were done at 20 and 40 DAS to keep the crops reasonably weed free. Yield components of all the crops were taken from randomly selected 10 plants from each plot. The component crop was harvested in 12-16 February 2021 and maize harvested from 09-15 April 2021 and yields were taken from whole plot. Equivalent yields were computed using the formula of Bandyopadhyaya (1984). Yield of hybrid maize was not reduced significantly but considerable yield of companion crops was realized in intercrop situation. Among intercrop technologies, bushbean + hybrid maize was the best in terms of maize equivalent yield (15.57 t/ha). The highest gross return (Tk. 311400 /ha), net return (Tk.196400/ ha) and BCR (2.71) was obtained from intercrop combination T_2 (Maize+ Bushbean). The results revealed that all the intercrop technologies are suitable for farmers. Among those bushbean + hybrid maize ranks first and hybrid maize normal row + 3 row spinach ranks second over sole crop.

Production programme of hybrid maize-garden pea intercropping at char land of Jamalpur

J. Rahman, A.A. Begum, M.R. Ali and M.M. Kadir

A production program was executed at farmer's field of Nawvanger char, sadar, Jamalpur during *rabi* season of 2020-2021 to evaluate the performance of hybrid maize+ garden pea intercropping technology. Hybrid maize (var. 981) and garden pea (var. BARI Motorshuti-3) were used for this production programme. Seeds were sown on 01 November, 2020. The spacing of maize in maize + garden pea intercropping was maintained 60 cm × 20 cm and two row of garden pea were maintained in between two row of maize. Fertilizers were applied at the rate of 250-55-115-40-2-1 kg/ha of NPKSZnB (FRG, 2018) as urea, TSP, MoP, gypsum, zinc sulphate and boric acid, respectively. One-third of urea and full amount of all other fertilizers were applied at the time of final land preparation. The remaining urea was top dressed in two equal splits at 8-10 leaf stage (30-35 DAS) and tasselling stage (50-60 DAS) and mixed thoroughly with the soil as soon as possible for better utilization. Intercultural operations and plant protection measures were taken as and when necessary. Garden pea was harvested on 7 and 14 January 2021 and maize was harvested on 18 March 2021. Maize + garden pea intercropping showed better performance (maize equivalent yield: 23.71 t/ha) and gave higher economic return (gross margin: Tk. 416680/ha and BCR: 4.96). The yield of sole maize was lower (10.50 t/ha) than maize + garden pea intercropping in terms of maize equivalent yield (23.71 t/ha). Farmers showed interest to cultivate maize+ garden pea intercrop for higher productivity and return.

Production programme of mustard- boro-fallow cropping pattern in the Chalan beel area

S.S. Kakon, M. A.K. Mian, M.Z. Ali and D.A. Choudhury

A production program was conducted at farmer's field in chalanbeel of Dobila, Tarash, Sirajgonj during the *rabi* season of 2020-2021 to evaluate the agro-economic performance of improved cropping pattern over farmers' existing cropping pattern. The treatments were i) Mustard (BARI Sarisha-14)-*Boro* – Fallow cropping pattern ii) Fallow-*Boro*

Fallow (existing cropping pattern). The production programme was laid out in RCB disperse with four replications (farmers' field). Unit plot size was 20 decimals. BARI Sarisha-14 and BRRI dhan29 were used as test crop. BARI Sarisha-14 was sown on 10 November 2020 as broadcast and 40 days old seedling of BRRI dhan 29 was transplanted on 10 February 2021 in line maintaining 25 cm×15cm spacing in both pattern. Recommended fertilizer packages (FRG, 2018) following the application methods were used for all the crops. Irrigation, pest managements and other intercultural operations were done as and when necessary. For comparison among the crop sequences, the yields of all crops were converted into rice equivalent yield on the basis of prevailing market price of individual crops (Verma and Modgal, 1983). The economic indices like gross return, gross margin and benefit cost ratio were also calculated on the basis of prevailing market price of the inputs and outputs (produces). Improved cropping pattern produced higher mean rice equivalent yield (10.08 t /ha/ yr) and land utilization index (52 %) than farmers' pattern which were 48 and 52% higher over existing pattern. Average gross return (Tk. 252108.5/ha), gross margin (Tk. 144409/ ha) and benefit cost ratio (2.34) of improved pattern indicate its superiority over farmers' pattern.

Production programme of potato-maize intercropping at char land of Jamalpur

J. Rahman, A.A. Begum, M.R. Ali and M.M. Kadir
A production program was conducted at farmer's field of Nawvanger char, sadar, Jamalpur during *rabi* season of 2020-2021 to evaluate the performance of maize + potato intercropping technology. Hybrid maize (var. NK-40) and potato (var. BARI Alu-25) were used for this production programme. Seeds were sown on 12 November, 2020. The spacing of potato and maize were maintained 60 cm × 20 cm. Fertilizers were applied at the rate of 250-55-115-40-2-1 kg/ha of NPKSZnB (FRG, 2018) as urea, TSP, MoP, gypsum, zinc sulphate and boric acid, respectively. One-third of urea and full amount of all other fertilizers were applied at the time of final land preparation. The remaining urea was top dressed in two equal splits at 8-10 leaf stage (30-35 DAS) and tasselling stage (50-60 DAS) and mixed thoroughly

with the soil as soon as possible for better utilization. Potato was harvested on 10 February 2021 and maize was harvested on 28 March 2021. Maize + potato intercropping showed better performance (maize equivalent yield: 30.19 t/ha) and gave higher economic return (gross margin Tk. 461580/ha and BCR: 3.28). The yield of sole maize was lower (10.90 t/ha) than maize equivalent yield (30.19 t/ha) in maize + potato intercropping. Farmers showed their interest to cultivate maize + potato intercrop for higher productivity and economic return.

Production programme of intercropping chilli with maize in hill valleys of Khagrachari

G. Paul, M.A.A. Malek and M.R. Ahmad

The production programme was conducted at farmers' field at hill valleys in Khagrachori during the *rabi* season, 2020-2021 to evaluate the performance of hybrid maize-chilli intercropping system. Hybrid Maize (var. BARI Hybrid Maize-9) and chilli (BARI Morich-2) were used as testing materials. For maize, spacing was 60 cm × 20 cm and in between two line of maize, chilli seedlings were transplanted maintaining 40 cm distance from plant to plant. Seeds of maize were sown and seedlings of chilli were transplanted on 7 December, 2020. Fertilizers were applied @ 260-60-110-40-5-1.5 of N-P-K-S-Zn-B kg/ha for maize (FRG, 2018). One third urea and full amount of all other fertilizers were applied as basal at final land preparation. The rest urea was applied as top dress in two equal splits at 8 leaves and tasseling stages. Two times weeding were done after each top dress. The crop was irrigated at 20-40-70 and grain filling stage. The component crop (chilli) was harvested in 12-16 February 2021 and maize was harvested from 09-15 April 2021. At harvest, the yield and yield attributes were recorded. Hybrid maize-chilli intercropping showed better performance (maize equivalent yield: 19.46 t/ha) and gave higher economic return (gross margin: Tk.299200/ha and BCR: 4.32). The yield of sole maize was lower (9.56 t/ha) than maize-chilli intercropping in terms of maize equivalent yield (19.46 t/ha). Farmers showed their interest to cultivate hybrid maize-chilli intercropping for higher productivity and returns.

Production programme of intercropping bushbean with maize in hill valleys of Bandarban

J.A. Chowdhury, M.T. Islam and D.A. Choudhury

A production program was executed to evaluate the performance of BARI bushbean intercrop with BARI Hybrid Maize at farmer's field of hill valleys in Bandarban during the *rabi* season, 2020-2021. Two treatments viz. T₁: Sole Maize and T₂: Maize + Bushbean were used for the experiment. It was laid out in randomized complete block design (RCBD) with three dispersed (three farmer's field) replications. The unit plot size was 12 m × 10 m. Hybrid Maize (BARI Hybrid Maize-9) and Bushbean (BARI Bushbean-2) were used as testing material. For maize, spacing was 60 cm × 20 cm and in between two maize line bushbean seed were sown maintaining 10 cm distance from each other. Both seeds were sown on 5 December, 2020. The crop was fertilized with 250-55-110-40-5-1.5 kg/ha of N-P-K-S-Zn-B (FRG, 2018) for maize. One third urea and full amount of all other fertilizers were applied as basal at final land preparation. The rest urea was applied as top dress in two equal splits at 8 leaves and tasseling stages. Two times weeding and earthing up were done after each top dress. The crop was irrigated at 20 DAS, 40 DAS, 70 DAS and grain filling stage. The component crop was harvested on 17 February 2021 and maize harvested from 01-10 April 2021. At harvest, the yield and yield attributes were recorded and analyzed statistically. The results revealed that Maize + Bushbean combination did not influence yield and yield contributing characters of maize as

compared to sole maize. The intercropping combination performed better in terms of maize equivalent yield (24.63 t/ha), gross return (492600 tk/ha) and benefit cost ratio (BCR) (4.48) over sole crop.

Production programme of onion-jute cropping pattern at beel area of Faridpur

M.A.K. Mian and D.A. Choudhury

A production program was conducted at farmer's field of in Beel area (Monglar beel, Vill. Surjack, Boalmari, Faridpur) of Faridpur. The treatments were: 1) Onion-Jute cropping pattern, 2) *Boro* rice-Fallow cropping pattern (Control *i.e.* existing cropping pattern). Onion-Jute cropping pattern, 2) *Boro* rice-Fallow cropping pattern (Control *i.e.* existing cropping pattern). BARI Piaj-1 of onion and local Tossa jute popular variety (*Tara pat*) were used in the production programme trial. Other operations were done as per recommendation and as necessary. Crops were fertilized with recommended fertilizer (FRG, 2018). Onion-Jute cropping pattern showed better performance (Rice equivalent yield 25.38 t/ha) and gave higher economic return (gross margin Tk. 225737/ha). The yield of rice in *Boro* rice-Fallow cropping pattern was lower (5.49 t/ha). REY was calculated about 362% higher in Onion-Jute cropping pattern as compared to *Boro* rice-Fallow pattern. Gross margin was noticed higher (324%) in Onion-Jute cropping pattern as compared to *Boro* rice-Fallow pattern although BCR showed nearly similar values. Farmers are interested to cultivate the crops in Onion-Jute cropping pattern.

IRRIGATION AND WATER MANAGEMENT

Background

Irrigation and Water Management Division is one of the research divisions of BARI. It conducts research on irrigation scheduling, on-farm water management and generation of basic information of BARI mandated crops. It also generate information through research on water quality, agricultural drainage, pumps and tube wells for both ground and surface waters. Irrigation and Water Management Division is also engaged with saline soil and water management research, climate changes, micro irrigation systems and development of hill irrigation. By this time, this division already developed 51 irrigation and water management technologies and most of them are being used at the farm level.

Optimize fertigation management to minimize nitrate leaching from drip irrigated brinjal field

This research was carried out at the research field of Irrigation and Water Management Division (IWM) of Bangladesh Agricultural Research Institute (BARI), Gazipur during 2019-2020 and 2020-2021 to optimize fertigation management for minimizing nitrate leaching from drip irrigated brinjal field. BARI Bt. Brinjal 4 cultivar was used for the experiment. There were four different irrigation treatments comprising two levels of irrigation intervals and two irrigation timings [Drip irrigation at 4-day interval with fertigation at the beginning of the irrigation cycle (T_1), Drip irrigation at 3-day interval with fertigation at the beginning of the irrigation cycle (T_2), Drip irrigation at 4-day interval with fertigation at the end of the irrigation cycle (T_3), and Drip irrigation at 3-day interval with fertigation at the end of the irrigation cycle (T_4)]. It was observed that yield and yield contributing characters varied significantly

among the irrigation treatments for both growing seasons and that yield components followed the similar trend. It was also observed that treatment T_4 received highest amount of irrigation (270 mm) followed by the treatments T_2 , T_3 , and T_1 in 2019-2020 growing season. Although the treatments received different amounts of irrigation water in the growing season 2020-2021, the trend of water application remained the same. Modelling results for optimizing fertigation management will be conducted and presented after obtaining the results of third year.

Multi-step ahead forecasting of potential evapotranspiration using bidirectional long short-term memory (BI-LSTM) networks

Precise estimation and forecast of reference evapotranspiration (ET_0) stand crucial for developing an efficient irrigation scheduling that helps better utilization of scanty water resources. One of the tools to predict ET_0 is to employ machine learning algorithms that predict near future ET_0 values based on past values from the ET_0 timeseries. The aim of this research is to provide multi-step ahead predictions of ET_0 with a deep and machine learning algorithm using calculated past values of ET_0 . In this context, daily values of ET_0 were computed via the FAO-56 Penman-Monteith approach that employ five climatic variables. For predicting multi-step ahead ET_0 , this study evaluates the prediction accuracy and estimation capability of a bi-directional LSTM (Bi-LSTM) network. According to the findings, the Bi-LSTM produced multi-step ahead ET_0 amounts in satisfactory precision and error levels as indicated by different statistical performance evaluation indices. The overall results indicate that the Bi-LSTM model could be successfully

employed to predict multi-step (5-day) ahead ET_0 values quite precisely.

Daily and multi-step ahead forecasting of potential evapotranspiration using machine learning algorithms with limited climatic data

Accurate prediction of potential evapotranspiration (ET_0) is essential for efficient planning and management of limited water resources through judicious irrigation scheduling. The FAO-56 Penman-Monteith approach to ET_0 estimation was adopted to compute ET_0 from data obtained during the period 2004–2019 from a weather station located in Gazipur Sadar Upazilla, Bangladesh. The obtained meteorological variables (e.g., daily maximum and minimum temperatures, wind speed, relative humidity, and sunshine duration) and computed ET_0 values were used as inputs and outputs, respectively, for modelling daily and multi-step ahead ET_0 predictions. These input-output training dataset were used to develop several machine learning based prediction models. Based on the previous years' finding, LSTM and Bi-LSTM models were found to be the best performer over others for daily and one-step ahead ET_0 predictions, respectively. In this effort, the generalization capability of the developed best models was evaluated on a new unseen data obtained from a test station, Ishurdi. The model performance was evaluated on three distinct datasets (entire dataset, first half of the entire dataset, and second half of the entire dataset) obtained from the test dataset spanning over 01 January 2015 to 31 December 2020. Results revealed that the deep learning models performed equally well as with the training station dataset, for which the models were developed. Both models showed very good performance for both daily and multi-step (5-day ahead) predictions as indicated by the computed performance evaluation indices. The findings of this research demonstrated the ability of the developed deep learning models to generalize the prediction capabilities outside the training station.

Effect of drip irrigation and mulching on growth and flowering of chrysanthemum as cut flower

The experiment was conducted in the experimental field of IWM Division, BARI, Gazipur during 2020

–2021 to evaluate the effect of different irrigation amount with different mulching systems. Nine treatments were designed in randomized complete block for the experiment with three replications. The treatments comprised different combinations of three drip irrigation levels (100, 80 and 60% of ET_0) and three mulching systems (no mulch, black plastic and straw mulch). Stem length (33.03 cm), flower diameter (11.11 cm), number of branches/plant (35.87), number of flower/ branches (5.10), number of flowers/plant (38.33), marketable branches/plant (8.33), flowers/marketable branch (5.10) and marketable branches/plot (249.9) were found to be maximum with drip irrigation at 100% ET_0 with black plastic mulch. The highest plant height (70.73 cm) was obtained from drip irrigation at 100% ET_0 with paddy straw mulch followed by drip irrigation at 100% ET_0 with black plastic mulch. And the highest number of plant leaves was obtained from drip irrigation at 80% ET_0 with black plastic mulch followed by drip irrigation at 80% ET_0 with paddy straw mulch. Results of this study revealed that the drip system of irrigation at 100% ET_0 with black plastic mulch showed better performance followed by drip irrigation at 100% ET_0 with paddy straw mulch and drip irrigation at 80% ET_0 with black plastic mulch over drip irrigation at 60% ET_0 with no mulch and drip irrigation at 80% ET_0 with no mulch. The highest BCR of 4.69 was found for treatment T_2 followed by treatment T_3 .

Effect of irrigation on mango fruit cracking in Chattogram region

The study was conducted at existing HRC Mango Orchard of Regional Agricultural Research Station, Hathazari, Chattogram during the Rabi season of 2019–20 and 2020–21 to explore the optimal period of irrigation to mitigate mango fruit cracking. Five treatments were applied: T_1 (rain-fed i.e. local practice), T_2 (irrigation at flowering stage), T_3 (irrigation at fruiting stage), T_4 (irrigation at flowering and fruiting stages T_5 (irrigation at 2-weeks interval)). It is important to mention the age of the plant or canopy. The highest yield (76.5 Kg plant⁻¹ and 74.6 Kg plant⁻¹ in successive years) was found at higher frequency irrigation (T_5). The maximum irrigation (average 1926 litres plant⁻¹) was applied at two-weeks interval irrigation (T_5). In

rain-fed condition (T_1), yield was lowest (56.8Kg plant⁻¹ and 55.2Kg plant⁻¹ in first and second years). The lowest number of fruits dropping (21 and 19no.fruits) was occurred in irrigation at flowering and fruiting stages (T_4). The lowest number of cracking (15 and 13no.fruits) as well as the highest sweetness (average TSS=24%) occurred irrigation at fruiting stage (T_3) and the benefit-cost ratio was also higher in this treatment.

Performance of fertigation system on pumpkin cultivation

An experiment was conducted at the research field of Irrigation and water Management (IWM) Division, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during the rabi season of 2020-21 to determine the performance of pumpkin (var. BARI Hybrid Mistikumra-1) under fertigation systems. Six different irrigation treatments T_1 = Ring Basin irrigation at 7 days interval with recommended fertilizer doses, T_2 = Fertigation at an alternate day with recommended fertilizer doses, T_3 = Fertigation at an alternate day with 20% less N and K than recommended doses, T_4 = Fertigation at an alternate day with 35% less N and K than recommended doses, T_5 = Fertigation at an alternate day with 50% less N and K than recommended doses were selected. The highest yield of 32.41 t/ha was obtained from treatment T_4 by applying 35% less N and K than recommended doses through drip system followed by treatment T_3 (30.71 t/ha) by applying 20% less N and K than recommended doses through drip system. Ring basin method required 413 mm of water during the season whereas only 241 mm water was needed in drip method. The economic analysis revealed that the highest benefit cost ratio (2.60) was obtained from treatment T_4 by applying 35% less N and K than recommended doses through drip system followed by treatment T_3 (2.48) by applying 20% less N and K than recommended doses through drip system. This is the first year results, so the experiment should be continued for the next year.

Yield and water productivity indices of different onion varieties under sprinkler irrigation

To evaluate the performance of four onion varieties under sprinkler irrigation and their sensitivity to water stress, a study was conducted at the

experimental field of IWM Division, BARI during the winter season of 2020-2021. The experiment comprised of five irrigation treatments with sprinkler system based on 60%, 80%, 100%, 120% and 140% of crop water use (ETo) laid out in split-plot design with three replications. Irrigation water was applied at a fixed 6-day interval with sprinkler system throughout the crops growing season. Onion sensitivity to water stress was determined using a yield response factor (K_y) that derived from the linear relationship between relative evapotranspiration deficits ($1-ETa/ETm$) and relative yield decrease ($1-Ya/Ym$). Statistical analysis revealed that plant height was not much affected by the level of irrigation while, leaf number, bulb diameter, bulb unit weight and total bulb yield was affected significantly ($P<0.05$) by the irrigation regimes. Among the four onion varieties, the highest plant height, bulb diameter and unit bulb weight contributed to the highest yield of 31.02 t/ha for BARI Piaj-4 (V_4) while the lowest yield of 19.03 t/ha was obtained from BARI Piaj-1 (V_1). Hybrid variety (V_2) produced the second highest yield of 25.93 t/ha which was comparable to the yield (24.72 t/ha) obtained from Taherpuri King (V_3). For varieties, V_1 and V_3 , highest yields were obtained under 120% ETo water regime while the same were obtained under 140% ETo water regime for V_2 and V_4 . Value of K_y determined for the whole growing season was found higher for V_4 (K_y : 1.08), V_2 (1.044) and V_3 (K_y : 1.05) than BARI Piaj-1 (K_y : 0.93) indicates that the varieties V_4 , V_3 and V_2 are more sensitive to water stress. This fact is also evident by the water productivity (WP) with higher value obtained under higher water regimes (120% ETo) in case of V_4 , V_3 , and V_2 but for V_1 , higher WP was obtained from 100% ETo water regime. The amounts of water used for evapotranspiration under different irrigation regimes ranged from 149 to 269 mm, 150 to 272 mm, 150 to 270 mm and 150 to 272 mm, respectively, for V_1 , V_2 , V_3 and V_4 with minimum at 60% ETo and maximum at 140% ETo water regime. Though seasonal evapotranspiration was higher under wetter water regimes, yield was lower and consequently WP was the lowest. Considering K_y as a limiting factor, application of irrigation at 100% ETo was a marginal for V_1 and V_2 and 100-

120% ETo for V₂, V₃ and V₄, beyond that yield losses are unacceptable.

Effect of fertilizer and irrigation frequency on the yield and quality of export and processing potato

Despite growing demand in home and abroad, Bangladesh lacks in producing export and processing quality potato due to varietal constraints and to a lesser extent, absence of apposite cultural practices. Proper irrigation and nutrient management can play a vital role in achieving higher productivity and quality of potato. With these perspectives, a field experiment was conducted at the research field of Irrigation and Water Management Division of the Bangladesh Agricultural Research Institute, Gazipur, to evaluate the effects of fertilizer and irrigation on dry matter content, tuber yield and water productivity of an export and processing potato variety (BARI Alu-25). The treatments consisted of nine combinations of three fertilizers levels and three irrigation levels. Three fertilizer levels were F₁: Recommended fertilizer dose, F₂: Recommended dose with 75% MOP + 25% SOP + Vermicompost @2t/ha, F₃: Recommended dose with 50% MOP + 50% SOP. Similarly, three irrigation levels were I₁: 3 irrigations at 30, 45 and 60 days after planting (DAP), I₂: 4 Irrigations at 30, 45, 60 and 75 DAP and I₃: 4 Irrigations at 30, 45, 60 and 80 DAP. The results indicated that fresh tuber yields of potato were not significantly influenced either by the irrigation treatments or by the fertilizer treatments. The fertilizer treatment F₂ produced slightly higher tuber yield and dry matter content compared to F₁ and F₃. While the trivially higher yield was obtained from the irrigation treatment I₂ where last irrigation was applied up to 50% of FC. Thus, the combination of I₂ and F₂ contributed the highest tuber yield, dry matter content and water productivity compared to other combinations of irrigation and fertilizer. Water productivity among the treatments ranged from 11.87 to 12.74 t/ha under I₁, from 11.66 to 13.0 t/ha under I₂, and 11.63 to 11.98 t/ha under I₃ irrigation regimes with minimum values in F₁ and maximum in F₂. These results are of considerable importance to the growers of potato and may be preferred for

growing export and processing potato in Bangladesh.

Effect of saline water irrigation with different doses of potassium on crop growth and yield of mungbean

The experiment was conducted at the shade house of IWM Division, BARI, Gazipur during 2018 - 2019 to evaluate the effect of saline water irrigation with different doses of potassium on crop growth and yield of mung bean. Thirteen treatments were designed for the experiment with four replications. The treatments comprised different combinations of three salinity levels (4 dS/m, 8 dS/m and 12 dS/m) with four potassium levels (0%, 100%, 125% and 150% of recommended dose). Results of experimental findings revealed that salinity seriously affected yield and yield contributing characters of mung bean and potassium can eliminate such type of deleterious effects of salinity to some extent. Application of higher amount of K improved the plant fresh weight and dry weight, and chlorophyll content. Application of different levels of potassium did not influence on plant height, number of leaves and root length. However, different levels of potassium application increased the uptake of Ca, Mg, P and K, while decreased Na uptake several fold. Mg accumulation was unchanged due to salinity. It was concluded that application of higher levels (125% or 150% of recommended dose) of K improves growth and yield of mung bean under saline conditions.

Multi-step ahead prediction of groundwater level fluctuations using coupled wavelet transform and long short-term memory networks

Groundwater level prediction is important for sustainable usage of scarce groundwater reserves of an aquifer to ensure the development of a meaningful groundwater abstraction management strategy. This study evaluated the prediction accuracy and estimation capability of a deep learning algorithm, Long-Short Term Memory (LSTM) network, for multi-step forward forecast of groundwater levels at two observation wells in an aquifer system of the Gazipur Sadar Upazilla, Bangladesh. Model independent partial autocorrelation functions-based feature selection

approach was used to recognize appropriate input variables for the prediction models. Root Mean Squared Error (RMSE) criterion was used to calculate the training and test performance of the LSTM models to select the appropriate numbers of hidden layers and hidden neurons within each hidden layer. The prediction accuracy of LSTM network was evaluated using five statistical performance evaluation indices: RMSE, Scatter Index, Maximum Absolute Error, Median Absolute Deviation, and a-20 index. Results revealed that the developed LSTM models could predict one-, two-, and three-week ahead groundwater levels at the observation wells GT3330001 and GT3330002. In general, the prediction performances of the LSTM models at GT3330001 were better than those at GT3330002. The overall results indicate that the proposed LSTM models could be successfully employed to predict multi-step ahead groundwater levels using previous lagged groundwater levels as inputs. For improving prediction accuracy, wavelet transform based data pre-processing was adopted. To achieve this, a maximal overlap discrete wavelet packet transform (MODWPT) was used to decompose the input variables into wavelet packets. Results demonstrate that the MODWPT can be used to generate more accurate forecasts.

Coastal groundwater management using an uncertainty-based coupled simulation-optimization approach

This study demonstrated the influences of reduced recharge, increased groundwater pumping and climate change induced sea level rise on multi-objective saltwater intrusion management strategies in coastal aquifers. Three meta-models were developed from the solution results of a numerical simulation model that simulated the coupled flow and salt transport processes in a coastal aquifer system. Results revealed that the proposed meta-models can predict density dependent coupled flow and salt transport patterns quite accurately. Based on the comparison result, the best meta-model is selected as a computationally cheap substitute of the simulation model in the coupled simulation-optimization based saltwater intrusion management model. To achieve computational efficiency, the optimization routine of the proposed management model is performed in a parallel computing

platform. The performance of the proposed methodology is evaluated for an illustrative multi-layered coastal aquifer system in which the effect of climate change induced sea level rise as well as recharge and pumping scenarios is incorporated for the specified management period. Results show that the proposed saltwater intrusion management model provides acceptable, accurate, and reliable solutions while significantly improving computational efficiency in a coupled simulation-optimization methodology. The developed methodology will be applied in a real-world coastal aquifer system in the southern Bangladesh.

Prediction of saltwater intrusion for different scenarios of aquifer recharge and groundwater extraction under changing climate

The present study intended to evaluate the effects of climate change induced sea level rise and reduced recharge scenarios as well as anthropogenic activity of enhanced groundwater extraction on the inland progression of saltwater wedge in a coastal aquifer study area. The methodology is demonstrated in an illustrative coastal aquifer system resembling a real coastal aquifer study area. The reason why an illustrative coastal aquifer is chosen is that any methodology needs to be evaluated first for a hypothetical study area before applying in a real-life coastal aquifer study area. Simulation is performed with the combination of different scenarios for a period of 50 years. Results demonstrate that there is a significant influence of the future scenarios on the salinity intrusion process and that salinity intrusion in designated monitoring locations increases with the simulation period. The developed methodology will be tested in a real-life coastal aquifer study area in the southern Bangladesh.

Monitoring of ground water level at different BARI stations

This study was conducted at the research fields of Irrigation and water Management Division (IWM), RARS, Rahmatpur, Barisail, and RARS Ishurdi, Pabna of Bangladesh Agricultural Research Institute (BARI) during 2019-2020 and 2020-2021. Two observation wells were installed at IWM Division, BARI, Bazipur and RARS Rahmatpur, Barishal for regular monitoring of groundwater

level fluctuations. On the other hand, an existing well was used to monitor groundwater level fluctuations at RARS, Ishurdi, Pabna. In IWM Division research field, a boring depth of 210 ft. with a strainer length 20 ft. was found sufficient for the purpose of groundwater level monitoring. At RARS, Rahmatpur, Barishal, the boring depth was 860 ft with a strainer length of 20 ft. The existing well at RARS Ishurdi station had a boring depth of 120 ft with a strainer length of 20 ft. It is noted that the boring depth and the strainer length depends on the underlying water bearing strata. The installation of observation wells at other stations is ongoing. The monitoring of groundwater level fluctuations in the installed observation well at IWM Division and RARS, Eahmatpr, Barishal as well as the in the existing well at RARS Ishurdi has been continuing.

Effects of floating agriculture practice on the water body of pond

This experiment was conducted at RARS, Rahmatpur, Barishal to determine the change of water quality of canals for cultivating fish and household uses and to determine the change of water quality of ponds for cultivating fish and household uses. The water samples were collected from three selected ponds of RARS, Rahmatpur, Barishal. The selected ponds were mentioned as; FL-1 (Floating Agriculture practiced since 2015), FL-2 (Floating Agriculture practiced since 2018) and F (Fresh Pond). The water quality parameters were analyzed from TCL and Soil Lab, BRAC, Gazipur. It was not possible to collect water samples in the months of March, April and May of 2020 due to Covid-19 lockdown. For all three ponds the water temperature was observed below 34°C in all months which was good for fish cultivation. The pH level was ranged from 6.66-7.73 at all three selected ponds. It was observed (figure 3) that the (UIA) Un Ionized Ammonia level at all selected ponds were suitable for channel catfish. The total dissolved solids (TDS) were in desirable limit but in case of floating agriculture practice ponds (FL-1 and FL-2) the TDS level was found higher than fresh pond (F). The Ca levels were in affordable range for only channel fish cultivation (Figure 5). The P values (Figure 6) were good for plankton/shrimp production but the P value was crossed the limit in floating agriculture

practiced ponds for other fish production. According to table-7, it was observed that the nitrate values at all months were in tolerable limit.

Project (NATP-2, PBRG):

Groundwater resources management for sustainable crop production in north west hydrological region of Bangladesh

Groundwater aquifers are one of the most vital sources of the freshwater supplies for the beneficial purposes in the northern part of Bangladesh. Recently, over-pumping of groundwater resources leads to continuous depletion of groundwater level causing a variety of problems such as lowering of the suction heads of pumps, reduction of crop yields due to inadequate irrigation water supplies, decrease in potable water supplies to domestic and industrial purposes, and degradation of water quality, among others. Therefore, proper management and sustainable utilization of the scanty groundwater reserves in an efficient manner are imperative to secure continuous supplies of groundwater for the future generations. With these perspective, a coordinated project entitled "Groundwater resources management for sustainable crop production in northwest hydrological region of Bangladesh" was implemented by the different NARS institutes like BARI, BRRI and BINA with BARC as coordinate component with a view to sustainable management of groundwater resources of northwest region through optimizing water demand and supply. The objectives of this study were i) To assess groundwater availability and recharge pattern in different districts of northwest hydrological region of Bangladesh, ii) To optimize groundwater abstraction for irrigation, and iii) To suggest plan for sustainable use of groundwater for crop production. The specified selected locations where this study was conducted were Godagari and Tanore upazila of Rajshahi and Joypurhat sadar and Kalai upazila of Joypurhat district.

Based on an extensive investigation, a few location specific promising cropping patterns based field trials with rice and non-rice crops (T.Aman rice, potato, tomato, mustard, wheat, boro) were conducted with adoption of water saving irrigation technologies in respect of the project aim. Long-

term (1980-2018) historical groundwater level data were collected and prediction model was developed by using discrete Space-state modeling approach for future forecasting of groundwater level. Irrigation, domestic and municipal water requirement were assessed to predict long term yearly groundwater abstraction pattern. A hydrologic model MODFLOW was used to optimize of groundwater abstraction. Groundwater samples were collected from both STWs and DTWs before starting (November/December) and at the end (February/March) of dry season irrigation to examine its suitability for irrigation over the season.

Rice equivalent yield (REY) and water productivity (WP) were found higher in cropping patterns where high yielding rabi crops like tomato, potato and maize were included and water saving irrigation technologies were adopted. Among the cropping patterns, the highest REY and WP were obtained from Tomato-Boro-T.Aus followed by Potato-Boro-T.Aman pattern while the lowest was from Mustard-Boro-T.Aman pattern. Use of water saving irrigation technologies increased REY by 8-24% and saved about 20-25% water over existing farmers' practice. From this study, it was observed that groundwater level declination was more in Tanore upazila than other three upazilas and will be almost double by the year 2040 in Tanore years if the present rate of abstraction continues. In Godagari, Joypurhat sadar, and Kalai upazila, the future trends of groundwater level fluctuations as predicted by the model are quite interesting. While the groundwater level declination was found obvious in most of the observation wells, the groundwater levels showed increasing trends in few observation wells at Joypurhat and Godagari. Groundwater abstraction pattern due to irrigation, domestic and municipal uses has been assessed and it is apparent that total abstraction will increase by 33-35% in Joypurhat area and by 40-45% in Rajshahi area in the next 20 years. The groundwater quality in the study areas has been evaluated for agricultural use. The water quality indices such as SAR, SSP, RSC, KR and WQI were calculated to find out its suitability for irrigation. In respect of all evaluating criteria, groundwater of the study area was found suitable and can safely be used for irrigation purpose.

Sustainable beneficial water abstraction from the aquifer can be ensured by optimizing water abstraction on the basis of the existing and future scenarios of the climatic variability, e.g. recharge through rainfall. In this report, the effects of three scenarios of recharge on the observed head at the designated observation wells at four upazillas in Rajshahi (Tanore and Godagari upazilla) and Joypurhat (Joypurhat sadar and Kalai upazilla) districts was investigated. The three recharge scenarios considered was: (i) actual recharge, (ii) 90% of the actual recharge, and (iii) 110% of the actual recharge. The aquifer processes were simulated using a calibrated 3D finite difference based numerical simulation code MODFLOW. The results revealed that the computed groundwater heads at the three observation wells varied noticeably as a result of the changes in the recharge scenarios. In the business-as-usual case, the MODFLOW computed heads at the three observation wells GT 8194046, GT8194048, and GT8194049 at Tanore upazilla on 24 September 2018 (data obtained from the BWDB) were 16.388m, 18.133m, and 22.215m, respectively. When the recharge was reduced to 90%, the computed heads dropped significantly, and the values were 7.970m, 11.150m, and 18.106m, respectively at the three observation wells. On the other hand, if the recharge would be increased to 110%, the computed heads were found as 20.707m, 21.745m, and 24.413m, respectively which indicates a substantial increase in the quantity of head development. At Godagari upazilla, the MODFLOW computed heads for the business-as-usual case were 9.389m, 11.046m, 6.170m, and 6.112m at the observation wells GT 8134017, GT 8134020, GT 8134021, and GT 8134022, respectively. When the recharge was reduced to 90%, the computed heads dropped, and the values were 6.577m, 5.670m, - 0.475m, and 1.447m, respectively at the four observation wells. On the other hand, if the recharge would be increased to 110%, the MODFLOW computed heads at the observations were found as 12.155m, 16.325m, 12.660m, and 10.682m, respectively which indicates a substantial increase in the quantity of head development. In Joypurhat sadar upazilla, the computed heads for the business-as-usual case were 11.05231m and 3.980m at the observation wells GT

3847001 and GT 3847003, respectively. When the recharge was reduced to 90%, the computed heads dropped, and the values were 9.406m, and 3.335m, respectively at the two observation wells. On the other hand, if the recharge would be increased to 110%, the MODFLOW computed heads at the observations were found as 12.688m, and 4.620m, respectively. In Kalai upazilla, the observed and computed heads were monitored at two observation wells (GT3847001 and GT 3847003). In this upazilla, the MODFLOW computed heads for the business-as-usual case were 11.05231m and 3.980m at the observation wells GT 3861004 and GT 3861005, respectively. When the recharge was reduced to 90%, the computed heads dropped, and the values were 6.306m, and 5.533m, respectively at the two observation wells. On the other hand, if the recharge would be increased to 110%, the MODFLOW computed heads at the observations were found as 7.592m, and 6.943m, respectively. The increased and decreased recharge scenarios were computed using the existing groundwater pumping values in the year 2018. Therefore, it is concluded that groundwater recharge has a significant effect on the head development in the groundwater aquifers of the Tanore and Godagari upazilla, Rajshahi and Joypurhat sadar and Kalai upazilla, Joypurhat.

The sustainable use and management of groundwater is now a great challenge in the northwest region of Bangladesh. Due to cultivation of water intensive crops, irrational irrigation management, indiscriminate installation of pumps and non-availability of modern technologies, the use of groundwater is much higher in this region compared to other parts of the country leading to declination of groundwater table at an alarming rate. Because of this threat, it is important to exploiting groundwater annually not exceeding the replenished amount from annual seasonal rainfall. Therefore, the key challenges are now to increase agricultural productivity without deteriorating the groundwater resources. Safe abstraction of groundwater resources is only possible if the irrigation water is utilized judiciously by implementing apposite irrigation methods, and practicing water saving technologies with low water consuming cropping patterns simultaneously and by optimizing water abstraction on the basis of

the existing and future scenarios of the climatic variability, e.g. recharge through rainfall. Policy intervention is also needed to create awareness among the farmers and other stakeholders about the consequences of indiscriminate use of groundwater. Thus, sustainable groundwater resources management will sustain agricultural production in this region.

Project (SACP-IWM PART):

Dissemination of water saving technologies for non-rice crops in saline prone areas of Bangladesh

Demonstrations of solar powered water saving irrigation technologies on crop production were executed at five upazillas under five districts. In 2019-2020, demonstrations were conducted at three upazillas under three districts of the southern saline prone areas of Bangladesh. In 2020-2021, field demonstrations were extended to two more upazillas in the districts of Bhola and Noakhali. In 2019-2020, twelve demonstrations were conducted at the selected areas whereas in 2020-2021, four additional demonstrations were performed. Two water saving irrigation technologies (AFI and drip irrigation) were compared with the traditional farmer practice. Alternet furrow irrigation (AFI) was used for maize and sunflower cultivation and drip irrigation system was used for tomato and watermelon cultivation. Solar power was also used for mitigating the pumping cost in drip irrigation system. In general, the AFI technology showed superior performance over the traditional farmers' practices for maize and sunflower cultivation in the study areas for both growing seasons of 2019-2020 and 2020-2021. This higher performance was evidenced by the better numeric values of the yield and yield attributing characters of both sunflower and maize crops in AFI adopted plots when compared to the traditional irrigation practice used by the farmers in the study areas. Likewise, statistically significant yield difference was observed among the treatments (solar powered drip irrigation system and farmer's practice) for watermelon and tomato cultivation in the study areas in both 2019-2020 and 2020-2021 growing seasons. AFI and solar powered drip irrigation treatments provided highest BCR for all crops and

for the two growing seasons. The farmers were benefited and interested in using this promising water saving irrigation technologies.

Project (ACIAR-KGF):

Mitigating risk and scaling-out profitable cropping system intensification practices in the salt affected coastal zones of the ganges delta

Conjunctive use of fresh- and saline water for maize and sunflower cultivation in coastal areas of Bangladesh

The experiment was conducted at the two project sites Dacope, (Khulna) and Amtali, (Borguna) during the Rabi season of 2020-21 to make the farmers aware of this proven technology and to promote the use of fresh- and saline water conjunctively for cultivation of two promising crops: maize and sunflower, in saline coastal area of Bangladesh. Two crops (Maize and Sunflower) were used for promoting the technology. BARI Hybrid Maize-9 and BARI Surjomukhi-3 were used as the promoting variety for maize and sunflower, respectively. Two treatments T₁ (Farmers' practice (only two with FW- at 25-30 DAS and at 55-60 DAS)) and T₂ (Conjunctive use of fresh- and saline water (Three- 1 with FW at 25 DAS, and 2 with SW at 50 DAS and 70 DAS)) were applied with three replications to fulfill the targeted objectives. From table 1a, it was observed that all parameters gave given highest result at conjunctive use treatment in both locations. From table 1b, it was observed that all parameters gave highest result at conjunctive use treatment in Amtali, Barguna. For Dacope, Khulna all parameters except grain/cob were obtained highest result at conjunctive use treatment. It was observed from table 2a and 2b that, the irrigation water productivity was found higher in conjunctive use treatments than farmer practice. The water salinity of the canal at Dacope was observed greater compared to Amtali canal due to low and high tide and river water salinity entrance to the canal before protecting the canal for rainwater storage. The soil salinity results showed that slightly higher salt accumulation occurred among the treatments within the top soil layer in 0-15 cm depth than lower depth of soil profiles.

Low cost drip irrigation for tomato and chili cultivation in saline coastal areas of Bangladesh

The experiment was conducted at the two project sites of Dacope, (Khulna) and Amtali, (Borguna) during the Rabi season of 2020-21 to promote the drip irrigation system and to increase the crop productivity and improve livelihood of small farmers for cultivation of two high value crops: tomato and chili, in saline coastal area of Bangladesh. BARI Tomato-3 and local chili variety were used for cultivation. Two treatments T₁ (Farmers' practice) and T₂ (Drip irrigation at 3-day interval) were applied with three replications to fulfill the targeted objectives. From table 1a and 1b, it was observed that all parameters were gave highest result at T₂ treatment in both locations. It can be stated from table 2a and 2b that the effective water use in T₂ treatment were higher than farmer practice treatment. The soil salinity was observed higher at flood irrigation treatments than drip irrigation treatment.

Growth and yield of spinach as affected by different levels of irrigation in coastal saline area of Bangladesh

Water resources are being put under increasing pressure across the globe including Bangladesh. Though most of the vegetable crop, including spinach, requires enough moisture to maintain good yield and quality, improving water productivity is even more important in water scarce situation. With this view, field experiments were conducted in farmers' field of coastal area during 2020 – 2021 to evaluate the effects of different irrigation levels (100%, 80% and 60% ETo) on growth, yield of spinach as well as soil salinity. The experiment was laid out in completely randomized block design with three irrigation regimes (100% ETo, 80% ETo and 60% ETo) replicated three times. Both the yield and yield contributing parameters were found highest under full irrigated treatment, while the highest water productivity was obtained under mild stress treatment of 80% ETo. Mild stress treatment (80% ETo) produced the spinach yield that was at par with full irrigated treatment. Though the most stressed irrigation treatment (60% ETo) produced the lowest yield, water productivity was found even more than full irrigated treatment. Soil salinity recorded in deficit irrigation treatments were

slightly higher than that of full irrigated treatment indicated that deficit irrigation in saline coastal area helped accumulating more salt in the soil. Employing deficit irrigation strategies will enable a reduction in requirement of irrigation water which will, in turn, reduce the scarcity of irrigation water in coastal saline area of Bangladesh

Crop cafeteria with some promising crops in salt-affected coastal areas of Bangladesh

The crop cafeteria was demonstrated at the project site Dacope, (Khulna) during the Rabi season of

2020-21 to make the farmers aware of the cultivation and production technologies of the crops and to motivate farmers to cultivate the demonstrated crops using the adopted technologies. Brinjal, Okra, Chili, Onion, Quinoa were demonstrated with the plot size 20 square meter. The yield was satisfactory. Due to scarcity of irrigation water, it was not possible to cultivate vegetables round the year. Vegetable cultivation is very much profitable in this saline area.



Development and evaluation of four-wheel tractor operated seeder

Power tiller (two-wheeled tractor) is the most prevalent tillage machine in Bangladesh, as well as a prime mover for various seeding machines in agriculture. Sowing is one of the most important components for the establishment and productivity of any crop. Due to the vibration of the power tiller, it is difficult to maintain a consistent seed to seed spacing, depth of seeding, straight line, and so on. Another issue is that the operator feels tired of walking behind the machine. However, recent day's 4WT (four-wheel tractor) are being introduced in farming works, they are also a suitable option to resolve all of the issues described herein. Therefore, this research has been undertaken to develop four-wheel tractor operated seeder. A four-wheel tractor operated seeder was designed and fabricated during 2020-21 at FMP Engineering division, BARI, Gazipur. This seeder can sow maximum 09-lines seed at a time, and tilling width was 180 cm. The effective field capacity of the 4WT operated seeder for maize and chickpea were found to be 0.248 and 0.231ha/h, respectively. The field efficiency of the 4WT operated seeder for maize and chickpea were estimated as 78.73 and 77.77%, respectively. The uniformity of seed distribution was found 97.33%. The mean emergence time of the maize and chickpea were 6.03 and 11.46 days, respectively. The emergence rate index of maize and chickpea were 0.83 and 0.98, respectively. Seed emergence of maize and chickpea were 95 and 93.89 % when the seed were planted with the 4WT seeder. The experiment will be carried out in the coming year in order to improve and evaluate the performance of the four-wheel tractor operated seeder.

Investigators: M. A. Hoque, M. S. Miah, M. R. Karim and M. A. Hossain

Design and development of a power tiller operated vegetable seedling transplanter

The current method for transplanting vegetable seedlings is manual, which requires digging a hole in the soil, placing the seedling at the proper depth, and lastly filling the hole with press. All of these works are time-consuming, labour intensive, and expensive. This experiment was undertaken in context of the present agricultural system for seedling transplantation of vegetable seedling in the field. Three-dimensional projections of dibbler type and furrow opener type transplanter were drawn with SolidWorks 2018. A power tiller operated vegetable seedling transplanter was designed and fabricated with locally available iron materials at Farm Machinery and Postharvest Process Engineering Division of Bangladesh Agricultural Research Institute, Gazipur during 2019-20. After the entire removal of the rotavator tillage assembly, a 2-row semi-automatic vegetable transplanter was developed, taking into consideration the power availability and space availability in the tiller. The dibbler, dibbler pressing sprocket, chain, press wheel, seat, depth adjusting wheel, furrow opener, soil covering device, and hitching arrangement were all part of the transplanter. The machine can transplant seedling two rows at a time. For dibbler type and furrow opener type, the spacing between the rows and seedling to seedling could be adjusted to 50-81 cm, 20-80 cm, and 25.80-62 cm, 12.50 cm - any distance, respectively. During lab test, there was no missing of placement of seedling for both types. Furrow opener type machine planted seedlings had a lower degree of vertical axis inclination following transplanting than dibbler type seedlings. It contains an irrigation system that

provides water in the row to help transplanted seedlings recover from their initial stress. The dibbler type machine was tested for the evaluation of field performance with brinjal during 2020-21, there was no problem in growth and found the same yield as transplanted by hand. The performance of the vegetable transplanter was evaluated for transplanting brinjal at 70×60 cm spacing in the field at a forward speed of 1.2 km h^{-1} . Field capacity of the transplanter was found to be 0.050 ha h^{-1} . The furrow opener type transplanter was not used this year due to time constraints. The experiment will be carried out again next year in order to improve field performance.

Investigators: M. S. Miah, T. N. Barna, M. Z. Hasan and M. A. Hossain

Energy use analysis of conservation tillage systems for the rice-maize cropping pattern

An improved agricultural production system requires the proper amount of energy, as well as its effective and efficient usage. Conservation agriculture (CA) based crop management can considerably cut cost and improve soil health, and so contribute significantly to smallholder farmer's income and food security. System-based evaluation of the conservation tillage with respect to energy and economics is important. Therefore, this programme was undertaken for Rice-Maize cropping pattern in order to estimate productivity, quantify energy flow and determine financial profitability of conservation tillage methods of Rice-Maize pattern. The experiment was conducted with eight treatments at the research field of Farm Machinery and Postharvest Process Engineering (FMPE) Division, BARI during 2018-21. Treatments were: Conventional Tillage (CT) T. Aman-CT Maize, CT Machine transplanted T. Aman-CT Maize, CT T. Aman-Strip Tillage (ST) Maize, CT T. Aman-Zero Tillage (ZT) Maize, STMT T. Aman-ST Maize, Strip till followed by manual transplanting (STMT) T. Aman-ZT Maize, Unpuddled Tillage (UPT) T. Aman-ST Maize, UPT T. Aman-ZT Maize. During 2020-21, the yield of T. aman and maize for different treatments were not significantly varied. Indirect energy of maize shared lower amount in CT than ST and ZT. The highest energy output-input ratio was found for strip tillage followed by manual planted T.aman-ST maize cropping systems. The highest BCR was

found in STMT T.aman-ST Maize cropping pattern. As a result, due to its energy efficiency and economic success, conservation tillage-based agricultural systems could be advocated to farmers.

Investigators: M. A. Hoque and M. I. Hossain

Design and development of onion and garlic detopper

Onion and garlic are important spice crops in Bangladesh. After harvesting, the edible bulb portion is separated from the inedible stem by cutting or detopping by manually leaving only 15–30 mm stem with the bulb, one by one, mostly using a sharp kitchen knife (boty) which is laborious, time consuming and costly. Therefore, an onion and garlic detopper machine was designed and fabricated at the workshop of the Farm Machinery and Postharvest Process Engineering (FMPE) Division of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during 2019-20. It was then improved during the period of 2020–21. Both the detoppers were made with locally available materials with a 0.37 kW electric motor. The detopper was improved by adding tray and wheel. Average capacity of the detopper for onion with previous model and the improved model were found to be 62.70 and 64.92 kg/h, respectively, whereas only 49.96 kg/h could be trimmed by two persons manually. Average capacity of the detopper for garlic with previous model and the improved model were found to be 43.32 and 48.92 kg/h, respectively, whereas only 30.72 kg/h could be trimmed by two persons manually. Stem length of onion and garlic after detopping by the improved machine were near to manual method. However, the capacity of the machine was not as high to attract a user to purchase the machine. Therefore, attempts have been started to develop an alternative design of detopper which will be fabricated in the next year.

Investigators: M. A. Hoque, M. A. Hossain, M. A. Mottalib and S. Brahma

Investigation of long term conservation agriculture at BARI and adaptive trials of conservation machinery and water management systems in the southern delta of Bangladesh

Conservation agriculture (CA) is a tool of sustainable agriculture utilized in many countries.

Sustainable agriculture has different dimensions among which the most important ones are environmental, social, economic, and institutional. Long-term tillage system and site-specific crop management can affect changes in soil properties and processes, so there is a critical need for a better and comprehensive process-level understanding of differential effects of tillage systems and crop management on the direction and magnitude of changes in crop yield, soil carbon storage, and other soil properties. Therefore, the study has been undertaken to evaluate the long term effect of conservation agriculture and conventional tillage on crop yield and soil properties for different cropping system and tillage method. The long term conservation agriculture trials were conducted at CA park established at Bangladesh Agricultural Research Institute (BARI), Gazipur during 2020-21. The maize and mungbean experiments were conducted with four tillage methods such as T₁= Conventional; T₂= Strip tillage; T₃= Zero tillage and T₄= Bed planting. Rice experiment was conducted with the tillage methods as T₁= Manual transplanted in conventional tilled soil; T₂= Mechanical transplanted in conventional tilled soil; T₃= Manual transplanted in unpuddled soil and T₄= Mechanical transplanted in unpuddled soil. The long term CA trials were initiated. Different facilities were created in CA park for long term experiments. The yield of maize, mungbean and Aus rice were not varied with the treatments since advantage of CA could not achieved in absence of residue. About 0.65 ha of mungbean was planted by BARI seeder at Mundopasha, Wazipur, Barishal and 4.70 ha mungbean was planted at Holdibaria, Kolapara, Patuakhali. Significantly the highest yield of mungbean was obtained from strip, zero and conventional tillage methods both in Barishal and Patuakhali. About 2.60 ha of jute was planted by BARI seeder at Dumuria, Khulna and Jute is now in growing stage. The experiments will be continued in the next year to impose the residue treatments and to observe the impact in the long run.

Investigators: M. A. Hossain, M. A. Hoque, M. J. Alam, M. M. Alam and C. K. Saha

Development of a residue clearing device for conservation tillage by precision seeder to prevent blockage of furrow openers and improve seeding uniformity

Crop residue retention in the field after harvesting is an important concept in conservation agriculture for incorporating organic matter, and maintain soil moisture. But crop residues often get entangled with the furrow openers, blades and rotary shaft of conservation tillage and seeding machineries. As a result, they obstruct furrow openers, causing seed dragging, shallow/surface placement of seeds, etc. and reduce rotary blades performance (soil cutting ability, residue hair-pinning, poor seed-soil contact, etc.). It was found to blockage of barley residue (average height of 237 mm) in furrow openers without attachment of residue clearing device for sowing seeds at 20 cm, 30 cm and 60 cm row to row distance 1200 kg/ha, 800 kg/ha and 400 kg/ha respectively. Therefore, this study was undertaken to develop residue clearing device (RCD) consists of a cutting unit connected to the front side of the blades/furrow openers to cut residues in the path of the device. Three-dimensional projection of this device has been drawn and fabricated with locally accessible iron materials in engineering workshop of FMPE Division of BARI in 2020-2021. In this experiment, First-time, three model of residue clearing devices were fabricated and tested with dry run-in presence of barley residue. During the preliminary test of first three models of residue clearing device did not show good performance and several problems were observed. Based on the problems observed, the residue clearing device (model 4) was designed and set up after fabrication. The complete performance evaluation of RCD (model 4) could not be done in 2021 due to the unavailability of residue after completion of its fabrication. The performance of the device will be tested and evaluated in next year and fine-tuned.

Investigators: M. R. Karim, M. Z. Hasan and M. A. Hossain

Development of orchard weeder cum mini tiller

Number of fruit orchards has been increasing and the farmers are searching a suitable power weeder for those orchards to not only till inter row space for weeding but also cultivating vegetables on those space. A diesel engine operated power weeder was

developed during 2010 and a battery-operated weeder was developed for row crops during 2016-19 which were less capable to use in the orchard. Thus, this research programme was undertaken as continuation of the previous study to improve the power weeder suitable for both orchard and kitchen yard. The weeder was improved and redesigned at the workshop of the FMPE Division of BARI, Gazipur during 2020-21. Then the weeder was fabricated according to the design with locally available materials and spare parts with 4hp diesel engine. The weight of the weeder was 100 kg and the width of weeding/tilling was 380mm. The power weeder could be an effective means for fast and low cost weeding of fruit orchard. This machine could be used in all the year round. The effective field capacity of the improved weeder in the orchard and kitchen garden as mini tiller were 0.048 and 0.049 ha/h and field efficiency were 76.19 and 77.78%, respectively. Further field test is required for fine tuning of the machine.

Investigators: M. A. Hoque, M. A. Gulandaz, M. S. Miah, M. R. Karim, M. N. Amin and M. A. Hossain

Design and fabrication of petrol engine operated boom sprayer for field crops

A petrol engine operated boom sprayer was designed and fabricated at the workshop of Regional Agricultural Research Station (RARS), Jashore during 2019-20. It was improved in 2020-21 at the workshop of Farm Machinery and Postharvest Process Engineering (FMPE) Division of Bangladesh Agricultural Research Institute (BARI), Gazipur. A spray pump was incorporated with this improved machine with the replacement of front wheel-based pumping system which was followed by reciprocating action. The machine was tested at the laboratory. The improved sprayer consists of a light weight power unit (6.5 hp, 4 Stroke petrol engine) and a spraying unit. It consists of two narrow rubber wheels in front side and one mild steel (MS) made rear wheel in rear side which is powered from engine through belt, pulley, chains and sprockets. The ground clearance of the machine was 900 mm. The rear wheel which acts as not only a support but also as power wheel. The spray unit consists of one tank made of MS sheet which contains 100-liter (Maximum) spray

liquid, an engine operated spray pump, two booms of 3 nozzles in every boom (totally 6 nozzles) and mounting frame to adjust boom height from 500 mm to 900 mm to suit different crops as per plants height. The nozzle spacing was set at 500 mm in the boom. For lab test, two lines of 12 m apart were marked on the floor and the machine was dry run for 12 m. The forward speed of boom sprayer was 2.6 km/h. Effective width of coverage, theoretical field capacity, effective field capacity and the efficiency were found to be 2.9 m, 0.8 ha/h, 0.7 ha/h and 93 % respectively which were remarkably higher than manually operated electric rechargeable knapsack and manual knapsack sprayer. Detail evaluation, field test and economic analysis could not be completed this year. The experiment will be continued next year.

Investigators: M. R. Karim, M. A. Hoque, Roknuzzaman and M. A. Hossain

Development of an automatic irrigation device

During winter and pre-monsoon (December-May) which coincide with Rabi cropping season, water scarcity poses a big challenge to Bangladesh agriculture. However, water is still regarded as a free commodity to the rural farmers and therefore wastage of irrigation water is a very common practice throughout the country. Use of sensors and automatic devices in agriculture helps prevent wastage of natural resources and benefits farmers in numerous ways. An automatic irrigation device was fabricated in FMPE Division, BARI to initiate precision agriculture practices among Bangladeshi farmers. The device consisted of soil moisture sensors, a control unit and a solenoid valve. The working principle of the device was formulated as that the sensors would measure soil moisture (db) at a given time, control unit would compare the soil moisture content with a predetermined threshold value. If moisture level (db) went below the threshold, the solenoid valve would be switched on to supply water to the plants. When soil would be soaked beyond the threshold value, the control unit would get moisture content from the sensors, compare and switch off the valve to stop irrigation. In the initial stage the sensors were calibrated against soil samples of different soil moisture contents. The graph exhibited a descending trend from high to low moisture contents (db) against

increasing sensor ADC values. Higher sensor value on the display indicated lower moisture content and vice versa. The values of the sensors were found almost similar for respective moisture contents, which is satisfactory. However, there are still some parameters to test. Afterwards, this device will be set up in the field during Rabi season to evaluate its field performance.

Investigators: M. Z. Hasan, M. R. Karim and M. S. Miah

Development of a barley thresher

Barley is becoming an important health food and a functional food product for a large portion of people because of the recognized benefits. It can be profitably grown in the coastal fallows of Bangladesh where soil salinity and water-stress prohibit growing most of the crops during the dry season. However, threshing of barley is a tedious job which is done manually by the farmers. In the Plant Breeding Division of BARI two threshers were used to thresh barley in six steps which is laborious. The present experiment aimed to develop a thresher that would make barley threshing process concise and efficient. In this endeavour, threshing part of the BARI Rice-wheat thresher was modified by attaching two types of rasp bars on the threshing cylinder and adding a perforated MS sheet on the concave. The thresher did not perform satisfactorily as threshing recovery (38%), threshing efficiency (39.8%) and cleaning efficiency (56%) were low. However, percentage of blown grain (3.29%) and damaged grain (1.46%) were found negligible. Further modification and testing of the thresher would be done during the next years.

Investigators: M. Z. Hasan and M. R. Karim

Development of a power operated sunflower thresher

A study was conducted for solving the problem faced by farmers in separating seeds from the sunflower head. Sunflowers are manually threshed by beating the sunflower heads with stick. The aim of the experiment is to design and fabricate a power operated machine which will separate the seeds from the sunflower. The capacity of the previous model of sunflower thresher was 100 kg/h which could not satisfy the farmers' demand. Therefore a power sunflower thresher was developed with

beating action. The thresher was designed and fabricated in FMPE Divisional workshop with available local materials during 2020–21. The main components of the improved model are hopper, threshing cylinder, axial shaft with peg, output hopper, separation sieve, seed output hopper, wheel, engine etc. The threshing was done by beating with the pegs of the rotating cylinder. The thresher was operated with a diesel engine of 2.98 kW (4 Hp). The weight of the thresher was 125 kg (without engine). The capacity of the machine was 600 to 1000 kg/h depending on the moisture contents of the head at Gazipur. A special criterion of this machine is that the machine could be used for both harvested head at maturity and dry head. There was no breakage seed due to use of the machine. The machine was used to operate at 375 to 400 rpm speed of the threshing cylinder to avoid the unshelled seeds. The threshing cost of the sunflower thresher was 494 Tk/ton. The benefit cost ratio for custom hire service of the machine was 3.45:1. The sunflower thresher was evaluated at farmer's field of Noakhali and found similar capacity found at Gazipur. Farmers expressed their satisfaction. The machine could be recommended for the sunflower growers.

Investigators: M. A. Hoque, M. A. Hossain, M. S. Miah and M. M. Ali

Improvement of the sitting type coconut tree climber

Traditional method of coconut harvesting is climbing on a tree directly by hands and feet. BARI has already developed a manual coconut tree climber that was standing type. So, a sitting type coconut tree climber was designed and fabricated at the workshop of the Farm Machinery and Postharvest Process Engineering Division of Bangladesh Agricultural Research Institute, Gazipur during the period of 2019-20. The materials used for the fabrication of different parts of the previous climber were MS square pipe, nut-bolts, rubber, belts, fabrics etc. It was improved during 2020-21 with SS square pipe, nut-bolts, rubber, belts, fabrics, movable cross rail lock etc. The total weight of the previous climber and the improved climber are 15.8kg and 10.8kg respectively. During operation the height of the trees was taken from 6.9m to 9.7m. During operation the highest speed

of the sitting type climber during climbing up a tree was 10.54 m/min and the highest speed of climber during climbing down from a tree was 7.46 m/min when the height of the tree was 9.7m. The average speed of the climber during climbing up was 8.19m/min whereas it was 6.81m/min during climbing down from the tree. During operation blood pressure data was varied from 10 to 20 mmHg of systolic and diastolic pressure. At the beginning it is time consuming but with continuous use and practice it will reduced the time required for the climbing. Though there are some problems in coconut climbing machine but it will be useful for both the residential growers and commercial cultivators. The prices of the previous climber and the improved climber were calculated about 6000 Taka and 12000 Taka, respectively. The weight of the climber can be reduced by the use of alloys or composite materials. The experiment will be continued next year to make it user-friendly.

Investigators: M. Hasan, M. N. Amin, M. S. Miah and M. R. Karim

Development of soymilk making machinery

Soybean provides a cheaper and high protein that can be an alternative substitute to animal protein. In Bangladesh, uses of soybean for these food items are restricted due to unavailability of suitable machines. The design of the soymilk production and pasteurization plant would assist in increasing soybean for human consumption. The experiment was conducted to develop soymilk making machinery to increase consumption of soybean as human food during 2019-2021. A blender and a pasteurizing unit were designed and fabricated for making soymilk. A blender was improved during 2020-21 for making soymilk with increasing blade speed. The capacity of the blender and pasteurizing units were 2 liters and 6 liters, respectively. The operational time of the blender was reduced from 40 to 20 seconds which was selected with 83.68% blending efficiency to prepare soymilk for each batch. Time required for heating the interlayer water up to 100°C was 37.67 minutes. Time for reaching milk temperature up to 100°C was 5 minutes only. The soymilk was prepared with 20 minutes pasteurizing. The soya pioneer was prepared and sensory evaluation was done. The panelists showed their satisfaction on soymilk and

soya pioneer. The experiment will be continued next year to improve the machine performance and financial analysis will be done.

Investigators: M. A. Hoque, M. A. Hossain and M. M. Ali

Adaptive trial of BARI Cream Separator

To separate cream from whole milk, several methods have been devised. The present cream separation method is manual, which means that the milk must be boiled first, then allowed to cool so that the fat can form on the upper surface and be collected. All of these works are time-consuming, difficult, and expensive. In large-scale enterprises, a few imported large-scale cream separating machines are available. A multi-driven, portable, and user-friendly cream separator was designed and fabricated with locally accessible iron materials in the workshop of the FMPE Division of BARI, Gazipur during 2019-2020. It is made up of many components, including a feeding bucket, a uniform distributor, a cream collecting outlet, a skimmed milk collecting outlet, a spinning disc, and a power transmission system, among others. Several adaptive trails of the cream separator in various areas in Sirajganj and Gazipur were conducted to collect user feedback and incorporated it into the final product during 2020-21. The average feeding capacity and separation efficiency of the machine were 150 kg/h and 86%. The fat content of the whole milk was reduced from 3.30% to 0.47%. The operation of the machine has no influence on the protein content of milk. The benefit cost ratio of the machine was found 1.62 for the MS (Mild Steel) model and 1.52 for the SS (Stainless Steel) type. The break-even points of the MS model and SS model were 140 days and 220 days respectively. All the users of Sirajganj and Gazipur were highly satisfied with the performance of the machines. From the users, such as a larger feeding bowl and adjustable seat were incorporated in the machine. Furthermore, because milk is highly perishable, long-term storage is not viable. If there is no electricity or load shedding, then it can be operated by leg or hand without changing any setting. It is a machine that is suitable for women. Without any advanced technical skills, anyone can operate it. This machine is recommended for separating cream from fresh milk all over Bangladesh.

Investigators: M. S. Miah, M. Z. Hossain, T. N. Barna and M. A. Hossain

Development of drum type carrot washing machine

Postharvest quality and safe food are important and prioritized issues of the government of Bangladesh. Proper postharvest handling is essential to reduce postharvest losses and improve overall quality of fruits and vegetables. The integration of improved technologies such as use of simple postharvest machinery and tools, use of plastic crate or innovative packaging system along with the use of sanitizer and the best practices would be able to reduce the postharvest losses to minimum. Higher capacity self-propelled drum type carrot washing machine was designed and fabricated with locally available materials at Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Gazipur during year of 2020-2021. It was fabricated with MS flat bar, MS shaft, wood, bearing, chain-sprocket, wheel, self-starter diesel engine, motor, gear reducer etc. The main parts of it are - main frame, octagonal drum, power transmission system, water circulation system, delivery chute, self-propelled driving system and mechanical stirring system. Overall dimension of the carrot washing machine is 4750×1800×1980 mm. The rotating speed of the drum is 8 rpm. The capacity, washing efficiency and cleaning efficiency were 5.55 t/h, 97.90% and 99.33%, respectively. The washing cost of carrot was 111 Tk./ton. BCR and payback period of the machine were 1.7 and 14 days respectively. The machines would be used by large farmers and traders of carrot for reduction of postharvest losses and drudgery, extension of shelf-life and fetch high price of fresh and safe carrots.

Investigators: M. N. Amin and M. A. Gulandaz

Upscaling and fine tuning of coffee postharvest processing machinery

The coffee growers of Hill Tracts process the green coffee at home the quality of which is very low. They consume it themselves but for commercial purpose the quality must be maintained. Like other processing steps, coffee pulping and dehulling need machines because it is a very labor intensive job.

The coffee growers of Bangladesh usually pulp by hand in pestle and mortar. This practice is very costly, time consuming and laborious and produce low quality products. BARI has developed small scale coffee pulper, dehuller, roaster and grinder. The fresh coffee cherry was pulped by both the pulper and manual (hands) and dried by dryer and sun shine. Mechanical injury of parchment coffee was found to be on an average 0.82% in pulping machine and nil in manual practice for both the drying methods. In respect of colour and moisture content of parchment coffee, no significant difference were observed in both the drying methods. Hue angle of parchment coffee both in the sun drying and solar drying indicated the yellowish lime colour. The dehuller was tested with both dried parchment coffee and dried coffee cherry. The capacity of the dehuller for dried parchment coffee was double compared to dried coffee cherry. On the other hand, whole coffee bean was found to be 1.5 times higher in dried parchment coffee than that of dried coffee cherry and broken coffee bean was 86% lower than that of dried coffee cherry. The capacity of the roaster was 1.70 kg/h. Dark fried coffee bean was obtained by 94% from raw dried coffee bean and losses of bean was found to be 5.50 percent. The capacity of the grinder was 3.07 kg/h. Medium course coffee powder was obtained by 99.19% and losses of powder was found to be 0.81 percent. The study will be continued for better findings and economic analysis.

Investigators: M. N. Amin, M. A. Hossain and M. Hasan

Design and development of a jute decorticator

Jute is called the ‘Golden Fiber’ of Bangladesh. The global demand for jute and related products is being increased because the people are now looking for biodegradable fiber as well as eco-friendly products for replacing synthetics. However, jute cultivation and processing are labor and cost intensive operations. Jute fiber extraction accounts for around 17–20% of total production cost and involves lots of drudgery. With the aim to reduce the drudgery and fiber extraction cost, a small-scale jute decorticator was developed and tested at the FMPE (Farm Machinery and Post-harvest process Engineering) division, BARI, Gazipur during 2019-

20. The decorticator machine was used to test three samples of jute plants ('deshi' variety) harvested from an area of 20 sq m in 2019-2020. The average fresh jute plants input capacity and the fresh fiber output capacity of the prototype jute decorticator were found to be 0.40 ton/h and 0.19 ton/h, respectively. Some problems were identified during performance test of the prototype machine in 2019-20. It was found that thinner plants (bottom diameter < 7.2 mm) tended to wrap around the rollers and recommended to be avoided. The machine could not be tested as per design in 2020-2021 because jute is in pre-maturity stage during the reporting time and will be harvested in the first week of August 2021. The machine has been modified to get unbroken jute sticks. The decorticator will be widely tested in 2020-2021 and 2021-2022.

Investigators: M. R. Karim, M. Z. Hasan and M. A. Hossain

Development and adoption of suitable technology for hygienic potato chips production

Huge production of potato in Bangladesh needs alternate uses and suitable relevant technology. Sun drying is the most commonly used method to dry the agricultural products. The excess moisture in fresh produce causes spoilage and reduced the shelf life of the product. A study was conducted during 2020-21 to design and develop a low cost solar tunnel dryer for efficient and hygienic drying of potato slices, power operated potato slicer and a spiral potato slicer for value addition of potato chips. The development works were done at FMPE workshop and the adaptive trials were done at Magura. The fabrication material was stainless steel. The modified slicer (SS model) was capable to slice variable thickness of slices. Capacity of the power operated slicer was almost double than the manual slicer. The developed dryer took 6.5 hours to dry the potato sliced from initial moisture content of 85% (wb) to final moisture content of 5% (wb), which is suitable for long term storage and marketing. The developed dryer took only 13 hours to dry the mushroom from initial moisture content of 93% (wb) to final moisture content 5% (wb). The dryer temperature was higher than the ambient temperature. The relative humidity in the dryer was decreased with drying time. A spiral

potato slicer was developed which produced instant fresh potato chips for frying that may create income of an entrepreneur. The capacity of the spiral potato slicer was 10 kg/h with 2mm thick slices. The economic analysis and other studies will be done in the next year.

Investigators: M. A. Hoque, T. N. Barna, M. Hasan, M. A. Gulandaz, M. M. Alam, M. G. F. Choudhury and M. A. Hossain

Up-scaling and fine tuning of cashew nut postharvest processing machine and oil extracting machine

Cashew (*Anacardium occidentale* L.) is one of the high value crops of Bangladesh. It is cultivated in limited areas of Chattogram and Chattogram Hill Tracts. The cashew fruit is unusual in comparison with other tree nuts since the nut is outside the fruit. Removal of cashew kernel from its shell is a labour intensive operation. Therefore, The shape of the cashew nut, the toxic cashew nut shell liquid in its mesocarp and brittleness of the kernel make the shelling of the cashew nut difficult. In the processing of the nut, the greatest difficulty is the removal of the shell without damaging the encased kernel. The performance of the jacket vessel, semi-auto cashew nut sheller and oil expeller were evaluated at FMPE Division, BARI, Gazipur during 2020-2021. Raw cashew nuts was boiled at temperature of 105 °C and pressure of vessel of 0.59 kgf/cm² for 30 minutes. The raw cashew nut and water mixture ratio was 1:1. The boiled cashew nut was dried at 60°C for 6 hours using BARI solar cabinet dryer during June 2021. Shelling rate, shelling efficiency and whole kernel recovery of semi auto sheller were 2.84 kg/h, 74% and 82.70% respectively. Shelling rate and shelling efficiency of the sheller were higher in the results of 2019-2020 compared to results of 2020-2021. On the other hand, whole kernel recovery was higher in 2020-21 compared to 2019-20. Kernels were kept in an average for 10 hours at 60°C. Dried kernel were then brought out and the thin layers were manually cleaned. Finally, washed kernel were air dried at 6% moisture content by drier and packed. The expelling capacity of the oil expeller for cashew nut was 18.63 kg/h. Average oil recovery of cashew nut shell was 29.30% and oil cake was found to be 65%.

Investigators: M. N. Amin, M. A. Hossain and M. Hasan

Improvement of chili seed separator

Improvement of BARI chili seed separator was done at the workshop of the Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during 2020-2021. The overall dimension of the machine was 458×6610×1670 mm. The power transmission system of the machine was modified to obtain constant operating speed without flocking of feed materials. It enables constant operating speed of the drive and driven pulley. A gear box (1:1) was used for this purpose. The machine has a provision for continuous feeding and separate ways for outflow of seeds and chili flakes. The separator was tested with dry chili having 11-22.23% moisture content. The throughput capacity was found 47.18 kg/h, seed separation capacity of the separator was 2.07 kg/h and seed separating efficiency was 88.71%. No seed injury was observed as well as no significant effect was found in germination or seedling emergence. The economic analysis shows, a minimum use of 80 hours per year. The BCR of the system was 1.2. Field studies should be conducted for performance verification as well as for dissemination of the machine.

Investigators: T. N. Barna, M. A. Hossain, M. N. Amin and R. Ara

Improvement of tomato seed separator cum pulper

Bangladesh produces 388 thousand tons of tomato per year in an area of 70 thousand acres. There is still no effective mechanical approach of separating tomato seeds from fruits. Moreover, the fruit portion of the tomato is totally wasted in conventional method. The mechanical method is a better solution to this problem. Therefore, a power operated tomato seed separator was designed and fabricated at Farm Machinery and Postharvest Process Engineering Division, BARI during 2019-20 and was improved during 2020-21. Modifications were done on the seed separating unit and power transmission system. The average seed separation capacity was found 2.44 kg/h, average friction loss was 8.45%, average

throughput capacity 49.52 kg/h and average seed separation efficiency was 93.95%. Extracting capacity of machine was 9 times greater than manual extraction. The average pulping capacity was found 45.94 kg/h, average cylinder loss 11.23 % and average cleaning efficiency was 62.12%. The pulp was finely crushed but the pulp outlet got stuck while continuous heavy feeding. The peels got accumulated on the openings of pulper. Modifications need to be done to improve the pulping part. No seed injury was observed as well as no significant effect was found in germination or seedling emergence due to machine extraction. The experiment will be continued to the next year for improvement of its performance.

Investigators: T. N. Barna, M. A. Hossain and M. N. Amin

Performance evaluation of flat bed dryer for maize drying

Drying is the removal of moisture by the application of heat and drying is practiced to maintain the quality of grains during storage to prevent the growth of bacteria and fungi and the development of insects and mites. The safe moisture content for cereal grain is usually 12 to 14% moisture on a wet basis. Seed moisture content is one of the factors which determine whether or not seed can be stored safely without loss of germination and vigor. The maize grains were dried in flat dryer in Farm Machinery and Postharvest Process Engineering Division, BARI, Gazipur during 2019-20. Maize grains were dried in a flat dryer at 60, 50 and 40°C to find out the drying temperature and drying time. The lowest time required to dry from an initial moisture content of 30% (wb) to final moisture of 14% (wb) was 9 hours at 60°C when air velocity was 1.5 m/s and grain thickness was 20 cm. The lowest time required to dry from an initial moisture content of 26% (wb) to final moisture of 12% (wb) was in 5 hours at 60°C when air velocity was 1.5 m/s and grain thickness was 10 cm. Drying characteristics for different loading capacity, air velocity and temperature will be determined and economic analysis will be done in the next year.

Investigators: M. A. Hoque, M. Hossain, S. K. Biswas and M. A. Hossain

Development of a suitable fruit bagging tool

Several good agricultural practices (GAP) are becoming popular throughout the world for the production of high-quality fruit with less dependence on chemicals. Among such practices, pre-harvest fruit bagging has emerged as an effective method for producing good quality fruits. Manual bagging method is the most common method for fruit bagging in the tree. Due to different heights, most of the fruits are not possible to use bag easily. For this reason, this method is very effective for different heights of the trees where the manual bagging is not possible. A bagging tool was fabricated using locally available materials such as plastic pipe, MS sheet, nut-bolts, bamboo, nylon rope, elastic garter, fruit covering bag etc. During operation the minimum time for fruit bagging was 37 sec and the maximum time for fruit bagging was 47 sec and the average time required for bagging of a mango was 42.4 sec. It depends on operators' skill. Though there are some problems in fruit bagging tool, but after improvements it will be useful for both the residential growers and commercial cultivators. The total weight of the machine is 1.0 kg. The price of the machine is calculated about Tk. 1000. The experiment will be continued next year to make it more effective.

Investigators: M. Hasan, M. N. Amin, M. S. Miah and M. R. Karim

Up-scaling and application of solar photovoltaic pump for smallholder irrigation and household appliances in the central coastal region of Bangladesh

Bangladesh is endowed with abundant supply of solar energy. With the advancement of technology, the price of photovoltaic panel is declining remarkably. The uses of solar-powered irrigation system are increasing in developing countries. BARI has developed a solar pump based solar home system (SHS). Six solar pumps along with SHS were installed for field trials in six Upazila of Barguna, Patuakhali and Bhola districts with 1300 Wp solar panel for each pump and one solar pump was installed at BARI, Gazipur. A field experiment was conducted in the research field of FMPE Division, BARI, Gazipur for testing of solar pump drip irrigation system during rabi season of 2020-21. The tested crop was tomato (BARI Tomato-14). A mini solar pump of 280 W motor capacity and

flow rate of 40 L/min was designed, fabricated and installed among 12 farmers in the project areas as per the demands and affordability of the farmers. In farmers' fields, experiments were conducted with three treatments such as drip, alternate furrow and farmers' practice (every furrow irrigation) during the Rabi season of 2020-21 for tomato, brinjal and chilli. For watermelon three treatments such as drip, ring basin irrigation and farmers' practice (every furrow irrigation) were set up. In farmers' fields, the highest yield was obtained from drip irrigated tomato, brinjal, chilli and watermelon than other treatments. Water savings from alternate furrow and drip irrigation methods for tomato were 32% and 49%, brinjal were 29% and 51%, chilli were 35% and 62% respectively. Water savings in watermelon by ring basin irrigation method and drip method over farmers' practice in different locations southern region were 34% and 55%, respectively. For solar irrigation in vegetables MBCR (Marginal benefit cost ratio) of large solar pump, mini solar pump, shallow tubewell and low lift pump was found to be 1.88, 1.28, 1.21 and 1.56, respectively. The selected farmers in the project areas are using solar panel for lighting, operation of fan, supplying of drinking water, sanitation, etc. Therefore, BARI solar pump may be recommended for irrigation and operation of household appliances, especially in the off-grid areas.

Investigators: M. A. Hossain, M. A. Hoque, S. S. A. Kamar and M. A. Rahman

Development and adoption of a solar cabinet dryer for vegetable seeds

Drying of seeds in Bangladesh is normally carried out by traditional sun drying method which is very slow and it often results in inferior quality due to dependence on weather conditions and vulnerability to contaminate with insects, pests, dust and dirt. Sometimes, continuous rain occurs for a few days that spoils the seeds. Two solar cabinet dryers having capacities of 2-6 kg and 10-12 kg per batch were designed and fabricated at Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Gazipur for drying of moist vegetable seeds. The dryer was designed to generate desirable temperature ($<45^{\circ}\text{C}$) from solar radiation suitable for vegetable seeds drying. They were fabricated with locally available materials such as, MS box, MS flat bar, MS angle

bar, MS sheet, GP sheet, SS net, insulation materials, dc fan, PV module, polyethylene sheet, cork sheet etc. These were indirect solar cabinet dryers that consisted of drying chamber, collector and auxiliary heating source (electric heater). The moisture content of sweet gourd seeds was reduced from 41.59% to 9.23% (wb) in 6 hours. The moisture content of the bottom tray containing seeds was 1.13% lower than that of upper tray whereas moisture content reduction was higher than that of upper tray. Germination of seeds were found to be 98% for sweet gourd. The prices of the large and small dryers are Tk.80000.00 and Tk. 50000.00 respectively. Break-even-point, BCR and payback period of the dryers were obtained to be 1100 hours per year, 1.14 over net return and 75 days respectively for large size and 450 hours per year, 1.04 over net return and 64 days for small size respectively. The dryer was introduced and created awareness among the farmers (male:294 and female:66), scientists (60), seed contact growers and manufacturers through conducting inception workshop, trainings, adaptive trials, booklet, electronic media, print media and completion workshop. The dryers (small and large) may be recommended for drying vegetable seeds in Bangladesh.

Investigators: M. N. Amin, M. A. Hossain and T. N. Barna

Development of cost-effective, intensified and sustainable Recirculating Aquaculture System (RAS) in Bangladesh

People are now very much concerned about the food safety issue that influences farmers to produce fish in the contaminant free environment. Recirculating Aquaculture System (RAS) is a healthy fish production system that can be located virtually anywhere. Fishes are grown at high density under controlled environmental conditions. Almost all the RAS used in Bangladesh, have been imported from abroad. The application of RAS for commercial producers in many cases has been found as failure. The small and marginal entrepreneurs could not attempt to use RAS with experiences of traditional fish culture. That is why the present research project was designed to develop a low-cost RAS system using locally available technology for intensive culture and to validate RAS along with business model analysis.

To acquire knowledge about RAS, two imported RASs were visited by the research team. A low cost mini RAS was designed and started to fabricated at FMPE Division, BARI, Gazipur during 2020-21. Fabrication of RAS was started but could not be completed due to fund constraint and COVID pandemic lockdown of the office. The fabrication of the RAS and component wise evaluation and improvement will be done year.

Investigators: M. A. Hoque, M. A. Hossain and A. M. Shahabuddin

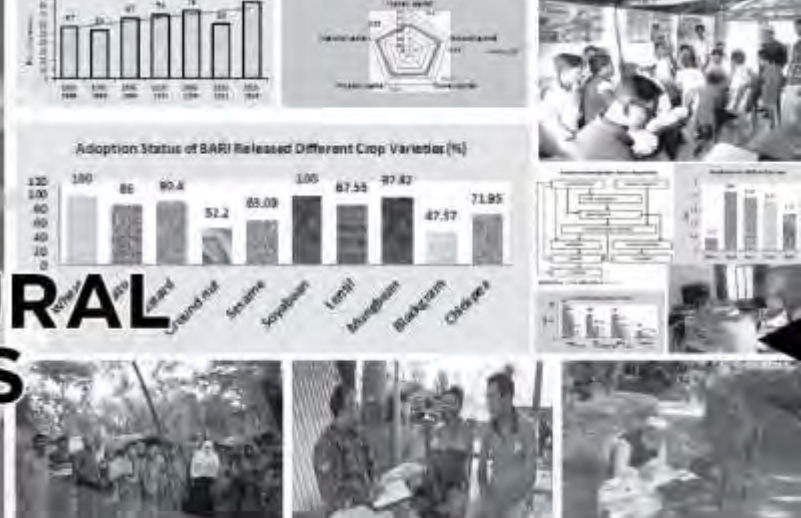
Adaptive trial of BARI developed agricultural machinery for crop production in the coastal areas of Bangladesh

Smallholder Agricultural Competitiveness Project (SACP) has been implemented (especially mechanization part) in six different coastal districts by Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Gazipur during 2020-21. BARI developed six types of agriculture machinery (BARI Seeder, BARI Bed Planter, BARI Weeder, BARI Axial Flow Pump, BARI Sunflower Thresher, BARI Compost Separator) were disseminated to farmers and local service providers through 49 adaptive trials with the help of OFRD, BARI. The selected crops were soybean, mungbean, groundnut, sunflower, mustard, cowpea, maize, and wheat. In each adaptive trial, 40 farmers and service providers participated who were practically demonstrated at least one machine in the farmers' fields. Farmers opined that the machine reduced their drudgery and cost significantly and often obtained higher yields compared to hand sowing. Additionally, sowing in lines by seeder reduced labour requirement for weeding. Seven local service providers (LSPs) in the working areas were developed. They covered 121 ha of crop land during the reporting period. Four consultation workshops on linkage development among GO, NGO and manufacturers were arranged in Satkhira, Patuakhali, Noakhali and Gazipur. This program will be continued next year to train the farmers/service providers/operators to disseminate the machinery, get feedback from farmers' fields and improve the machinery as needed.

Investigators: M. S. Miah, M. R. Karim, M. A. Hossain and A. K. Chowdhury.

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AGRICULTURAL ECONOMICS



Socio-economic study of lentil cultivation in some selected areas of Bangladesh

The study assessed the adoption of improved lentil varieties, estimated the profitability of production, and explored farmers' perceptions on lentil cultivation in Bangladesh. The study analyzed 360 household's data collected from 240 improved variety adopters and 120 non-adopters spread in the six lentil growing districts namely Faridpur, Magura, Kushtia, Jhenaidah, Manikgonj, and Sirajganj. Along with descriptive statistics, the study used different models for analyzing the data. About 71% of lentil growing households adopted improved lentil varieties, and 29% used local cultivars. BARI Masur-8 was the highest adopted variety in the highly-intensive growing areas, whereas BARI Masur-6 and BARI Masur-4 were popular in the medium-intensive and low-intensive growing areas. Pulse training, the profitability of production, farmers' innovativeness, and farmer's extension contact were the major factors of improved variety adoption. The yield of improved variety (1.63 t/ha) was much higher than local cultivars (1.08 t/ha). The highest yield was found in medium-intensive growing areas due to the use of better variety and a higher level of inputs. Human labour, seed, TSP, MoP, other fertilizers, pesticides, irrigation, and variety had a positive and significant effect on the yield of lentils. Improved lentil cultivation was profitable from the financial point of view (Tk. 48,165/ha) and an economic perspective (Tk.15,083/ha). Again, the domestic production of improved lentils had a comparative advantage (DRC= 0.72). Most farmers wanted to increase improved lentil cultivation in the next year considering the higher yield and net benefits. Oppositely, a good portion of lentil farmers also wanted to decrease lentil cultivation due to lack of

suitable land, biotic and abiotic stresses, and seeds of improved variety. Farmers should be encouraged to expand their lands for improved lentil cultivation to increase their benefit, improve soil fertility, and for a better comparative advantage of production.

Baseline survey for smallholder agricultural competitiveness project (SACP) in southern region of Bangladesh

The present study was conducted to develop baseline indicators for facilitating the study to know the impact of adopting BARI developed commodity and non-commodity technologies on livelihood development of smallholder farmers under SACP project in Southern project catchment areas. Primary data collected from farmer was the basis of the study. Secondary data was also collected to complement the primary data. A total of 1000 farmers was surveyed from 20 uapzilas of 11 project districts. Multistage stratified random sampling method was applied to select the survey respondents. Some qualitative study tools viz. focus group discussion and key informant interview were used to collect different information. A list of baseline indicators were predefined on which the data and information were collected. The study revealed that cropping intensity varies among the project catchment areas. Highest cropping intensity was in Feni district (215%) and lowest was in Patuakhali district (142%). Average cropping intensity in all the project area is 175%. Vegetables and cereals were mostly the same in each of the three divisions. Only mungbean was found in Khulna division from the pulses crops while grass pea, felon, mungbean and lentil were available in Barisal division. grass pea, felon and mungbean were cultivating by the farmers of Chattogram division. Among the oilseed crops mustard was found cultivating in Khulna division while sesame,

mustard, ground nut and sunflower were available in the farmers field in Barisal and Chattogram division. A number of spices crop were growing in each of the three division in which onion, coriander leaf, chili and garlic were available in Khulna division while chili, onion and garlic were available in Barisal division. The study proposed some recommendations based on its findings. The first and foremost was to remove communication gap between farm level and BARI. Besides, demonstration of BARI released varieties and technologies should be strengthened as demand for these was very high among the farmers. Farmers training should provide as it was regarded as very important for demonstrating HVCs. Government should take proper care to deliver seed and fertilizer in time. Regular monitoring of input price and quality control should be ensured.

Financial profitability and constraints to the production, processing and marketing of mungbean seed in some selected areas of Bangladesh

Assessment of financial profitability and constraints to the production, processing and marketing of mungbean seed in two southern districts namely Jhalokathi and Barisal was made through an extensive field survey during 2020-2021. The study revealed that the farmers of these areas used very low doses of fertilizers in almost all the areas. Total production cost for mungbean was estimated at Tk.60227/ha where total cash cost occupied about 57 % and non-cash cost covers 43 %. Average per hectare yield of mungbean were 1115 kg/ha. Returns from mungbean were estimated at Tk. 71384/ha where gross return of about Tk. 76050 in Jhalokathi and Tk. 66717 in Barishal district, respectively. Benefit cost ratio (BCR) on total cost basis was 1.19 for seed producers where 1.42 in Jhalokathi and 1.35 in Barishal district. TSP, MoP and human labour were found to be significant impact on yield of mungbean yield. Maximum farmers (94%) responded that labour crisis was the major constraints along with insects' infestation, insecticides not work properly, lack of training, high price of insecticides, lack of labour, lack of good seed, disease infestation.

Profitability and varietal adoption of field pea in some selected areas of Bangladesh

The study was conducted in Pabna, Jashore, and Gopalganj districts to know the varietal adoption of field pea and to estimate the economic and financial profitability of field pea during 2020-2021. Adoption-related data were collected from 16 districts through DAE. Results revealed that the majority of land under field pea cultivation is occupied by local cultivars. The yield of the local cultivar is lower than that of BARI-developed improved varieties. There are ample scopes to expand its cultivation with improved varieties through strengthening its demonstration program throughout the country.

Adoption and profitability of chilli varieties in some selected areas of Bangladesh

The study assessed the adoption and profitability of chilli variety at farm level. Mymensing and Kishoreganj were selected for data collection. Data were collected from 100 randomly selected chilli farmers of which 60 from Kishoreganj area and 40 from Mymensingh area. The findings revealed that among the respondent of Kishoreganj, only 13% farmers are using BARI chilli varieties but no farmers found in Mymensingh areas. The levels of adoption of most crop management technologies were found to be low. Higher level of adoption was observed in ploughing and medium level of adoption was observed in planting time. Chilli production was found profitable in the study locations, where per hectare net return was Tk. 95672.58 and BCR was 1.53. Though the farmers get profit, they had to face some problems. Lack of knowledge, lack of information about BARI chilli varieties, unavailability of BARI chilli varieties seed, capital shortage, lack of farmers association and crop insurance, poor transportation and communication system, lack of market monitoring authority were major barrier for the chilli producers. These problems should be addressed properly to make this crop more profitable.

Socioeconomic study on local cultivar of brinjal and chilli in Chattogram district

The local cultivars of brinjal (Potha Begun) and chilli (Halda Marich) are very much popular for their distinct features. It has high market demand in

the study areas. There are ample scopes of increasing their productivities and developing new varieties for this region. That's why the present study was carried out in nine villages covering 88 farmers of Potha Begun and Halda Marich under Hathazari Upazila in Chattogram District to examine the input use, productivity, profitability, and the perceptions of farmers and consumers to those cultivars. Results revealed that farmers used excessive fertilizer doses in both crops. The yield was recorded at 43.618 tons/ha for Potha Begun where the harvested yield loss was estimated at 7.29% due to infestation of pests & diseases. The yield of Halda Marich was found to be 7.942 tons/ha as green Chilli and 1.981 tons/ha as dried Chilli. The per kilogram (kg) average farm-gate price of Potha Begun was Tk. 30.19, green Chilli Tk. 42.8, and dried Chilli Tk.310.88. The gross margin was calculated at Tk. 8,48,468 for Potha Begun and at Tk. 2,94,628 for dried Chilli, and Tk. 18,850 for green Chilli. The BCR of Potha Begun was found to be 2.56 (total cost basis) and 2.81 (variable cost basis). Again, the BCR was 1.70 for green chilli and 1.92 for dried Chilli. The per kg cost of production was calculated at Tk. 15.32 of Potha Begun, Tk.45.63 for green Chilli, and Tk.182.9 for dry Chilli.

Socioeconomic analysis of exotic hybrid bitter gourd cultivation in Chattogram district

The study was carried out in two villages covering 50 farmers cultivating the exotic hybrid bitter gourd under Hathazari Upazila in Chattogram District to estimate the profitability of hybrid bitter gourd production and assess the farmers' perceptions of hybrid bitter gourd cultivation. Descriptive statistics were used to analyze the data. Results revealed that the average plot size of bitter gourd cultivation was 0.11 ha. The estimated yield was 39.275 tons/ha. The gross margin and net return were calculated at Tk. 13,00,265 and Tk.12,53,956 respectively. The estimated BCRs were respectively 4.01 and 4.52 over full cost and variable cost. The cost of production per kilogram of hybrid bitter gourd was Tk.10.58. On average, farmers sprayed pesticides 25.5 times in the bitter gourd field for controlling the infestation of pests and diseases. The causes of cultivating hybrid bitter gourd were higher yield, high market demand &

price, attractive & bigger size of fruits, seedless & early fruiting attributes, less pests & diseases attack, continuous & prolonged harvests, and the availability of seeds. To popularize the BARI bitter gourd variety, seeds need to be available at the local markets.

Assessment of agricultural market for the high value crops of smallholder farmers under SACP in southern areas of Bangladesh

The study was conducted to analyze value chains of High Value Crops in selected SACP project catchment areas. It also assessed the internal and external governance of the market actors at different levels. Data were collected from key value chain actors and stakeholders using structured questionnaires customized for 550 respondents including farmer, market actors, processors, and transporters. The analysis includes value chain mapping, detailed description and quantification of value chains, governance issues and economic evaluation of value chains. Gendered and Adapted Market Mapping analysis was used to examine the value chain map and value chain governance of selected high value crops. A number of market actors were involved in supplying high value crops from farmer to the end user. It includes farmer, faria, wholesaler, aratdar, aratdar cum wholesaler, retailer, miller, and consumer. The supply chain indicates that very few portion of the products reached to the consumer directly from producer. All of them moved through a number of market actors. Each of the market actors are involved with a number of pre and post harvest activities which creates value to the product. Market involves primary, secondary, terminal and retail but it varies from crops to crops. Among the pulse crops surveyed value addition of mungbean and felon was Tk. 100.84 and Tk. 62.92 per kg of mungbean and felon respectively. On the other hand, total value addition of soybean was Tk. 40.17 per kg of soybean. Among the vegetables surveyed, the highest value addition was found in sweet pumpkin (Tk. 31.52 per kg of sweet pumpkin) and lowest was in cauliflower Tk. 17.71 per kg of cauliflower. Total value addition from mango and guava was Tk. 93.72 and Tk. 136.25 per kg of mango and guava respectively. Price spread was found highest in case of mungbean and lowest for felon indicating

lower and higher market efficiency of the existing marketing system in favor of producer respectively. The highest producers share to consumers' Tk. (90.91%) was found for felon while the lowest was found 40.32% for country bean. In order to make market more comfortable for the producer it is necessary to monitor market functionaries for avoiding any malpractices in the market

Supply chain analysis of malta (sweet orange) in Bangladesh

The study estimated the profitability of malta (sweet orange) cultivation, identified supply chains, measured marketing efficiency, and explored the problems of its cultivation in the Khagrachori Hill district of Bangladesh. A total of 75 respondents consisting of 40 producers and 35 traders were selected for the study. Data were collected through a pre-tested interview schedule during May- June 2021. The analysis revealed that malta cultivation was profitable in the study area. The highest cost was estimated at Tk.7,02,650/ha in 1st year garden and the lowest cost was Tk. 3,94,315/ha in 2nd year garden. Gross return was highest in (5-10)th year garden (Tk. 9,80,000/ha) and the lowest Tk. 5,17,600/ha in 3rd year garden. The benefit-cost ratio at 6.5% rate of interest was 1.89 and IRR 50%. Among the different supply chains, 40% of products flow through longer channel-I (Farmer>Bepari>Arathdar (local)>Arathdar (city)>Retailer>Consumer). However, the longer channel possesses lower marketing efficiency (1.43) compared to the shorter channel (3.33). Lack of improved production technology, poor quality saplings, insect/pest infestation, adulteration of fertilizer and insecticides, lack of adequate market facilities, inadequate storage facilities, and inadequate transport facilities were found to be major problems in malta cultivation.

Production and marketing system of different flowers in selected areas of Jashore district

The study was undertaken to assess the production and marketing system of different flower cultivated in Jashore district during February-April, 2021. Tuberose (100%) and marigold (75%) cultivated at April-May, Gladiolus (74%) July-August, Gerbera (100%) and Rose (100%) were planted at September-October. Agronomic management such

as land preparation, apply fertilizer, weeding, irrigating, spraying, flower plucking was done as per requirement. Highest production cost was Gerbera (Tk. 31,49,259/ha-1) followed by Rose (Tk. 8,82,193 ha-1), Gladiolus (Tk.5,65,422 ha-1), Tuberose (Tk. 3,69,350 ha-1) and Marigold (Tk. 2,12,518 ha-1). Gross return were Gladiolus (10,08,567 Tk.ha-1), Tuberose (6,95,467 Tk.ha-1), Marigold (3,31,680 Tk.ha-1), Gerbera (84,06,303 Tk.ha-1) and Rose (15,98,045 Tk.ha-1) respectively. Net return were Gladiolus (4,43,146 Tk.ha-1), Tuberose (3,26,117 Tk.ha-1), Marigold (1,19,162 Tk.ha-1), Gerbera (52,57,043 Tk.ha-1) and Rose (7,15,851 Tk.ha-1) respectively. Highest BCR at gerbera cultivation (2.67) followed by tuberose (1.88), rose (1.81), gladiolus (1.78) and marigold (1.56) respectively. Most transacted marketing channel was Farmer-Arathdar cum Paiker-Retailer-Consumer. Total marketing cost of thousands flower of paiker was Tk. 319.30 and retailer was Tk. 450.00. Attack on pest and disease, lack of flower storage facilities, price fluctuation etc were the flower production problem of a farmer. Perishability, price fluctuation, transportation, credit sold etc. were the marketing problem.

Perceptions to climate variability, productivity and agricultural adaptation strategies in salinity intrusion coastal areas of Bangladesh: an empirical investigation of watermelon cultivation

Climate change is a major environmental and socioeconomic challenge on rain-fed agriculture in Bangladesh. This study examines the perceptions of major climate risks, gender role in agricultural practices, decision-making process and farmers' adaptation strategies in Docape upazila of Khulna district. Cross-sectional data collected from 100 households producing watermelon in robi season were employed where 46 were project beneficiaries and 54 were non-beneficiary farmers. A binary logit model and the propensity score matching (PSM) techniques were employed to identify the influencing factors and measure the impact on productivity and income of the adaptation strategies, respectively. Seed, fertilizer and pesticide costs of watermelon cultivation were significantly lower in the case of beneficiary farmers. The net profit received by the beneficiary

farmers significantly higher compared with non-beneficiary farmers. Results of the binary logit regression model revealed that membership of a farmer association and perception of decreasing rain influenced farmers' adoption of intercropping as an adaptation strategy, experience in watermelon farming, owned farmland size and perception of increase in soil salinity influenced adoption of mulching. Age, group membership and perception of decrease in rain had a positive influence on farmers' adoption of use of mini pond for irrigation and changing the fertilizer and pesticides application methods. Household size and access to training influenced farmers' adoption of changing sowing time and farming experience had positive influence on change cropping pattern as a climate change adaptation strategy. The findings from the PSM suggested that using these adaptation strategies exert positive effects on crop yield and income of project beneficiary compare with non-beneficiary households. It requires the mindset change of male counterpart and takes few responsibilities of household work for encouraging women to participate more in agricultural activities. Policy further focuses on more investment in research institutes to strengthen the provision of agricultural services by improving support for irrigation, providing recommended agricultural inputs and training to the farmers for enhancing their holistic adaptation to the effect of climate change. National Agricultural Food Policy in Bangladesh should also promote the formation of farmer associations to strengthen the adaptive capacity.

Impact of climate change on crop farming in selected coastal zone of Bangladesh

This study is conducted with the overall objective of analyzing the economic impacts of climate change on crop farming in the coastal region of Bangladesh. The specific objectives of the study were: i) To analyze the impact of climate change on net income from crop farming with climate, soil and socioeconomic variables, ii) To determine the marginal impact of temperature and rainfall on net income from crop farming, and iii) To predict a range of potential future impacts on wheat production. The study used a cross-sectional Ricardian approach to analyze the impact of

climate change on net income from crop farming. The analysis is based on cross-section data of the primary survey conducted to (April-June), 2021 on 300 crop farming sample farmers 'selected randomly and secondary data on average long-term temperature and rainfall data from 1971 to 2020 (49 years) over 3 districts in the coastal region of Bangladesh. Results indicate that climate has a nonlinear effect on net revenue from crop farming. The marginal impact of the temperature and rainfall on farmers' net crop income is significant ($p < 0.01$) and negative. The elasticity results showed that the changes in net crop income are very high for the crop farming season. However, the predicted values of temperature and rainfall for these studies for the year 2030 to 2100 was based on three climate change prediction models (BCC-CSM1-1, CCSM4, and GFDL-CM3) to understand the likely impact of climate change on crop production. The impacts of these AOGCM scenarios were estimated on net crop income for the year 2030 to 2100 and under all scenarios; the negative effects in the net crop income per hectare are more by the year 2100 than in 2070, 2050, and 2030.

Contribution of nutrition garden to cope with covid-19 situation through ensuring food and nutritional security

The study focused on the participation of the nutrition garden to persist with COVID-19 pandemic and ensure food and nutritional security. The study was based on a sample of 200 households, among them 100 were garden owners and 100 had no garden from Pabna and Tangail district. Descriptive statistics were used to analyze the data. A binary Logit model was employed to explore the determinant of food security. About 49% of households grown on an average of 5 to 10 crops throughout the year. Total cost of cultivating crops in a nutrition garden (3.25 decimal) throughout the year was Tk. 9798. Average net return and BCR were calculated Tk. 9552 per garden per year and 1.97 respectively. Many households in the study areas were doing nutrition gardening without any type of training or knowledge about production technology of garden crops. As a result, they faced some difficulties to produce it. All the households in the study areas

were doing gardening mainly for domestic consumption purposes. After satisfying the family need, they (88%) also sold the additional amount to increase their income. Among various food items, rice supplied 54% of the total daily calorie intake of households having nutrition garden followed by edible oil (15%) and vegetables (4%). The per capita per day intake of calories, protein, carbohydrate, calcium, iron, and zinc by garden owners in the study areas were 2655 kcal, 86 gram, 423 gram, 1189 mg, 17 mg, and 15 mg respectively which were higher than that of households having no nutrition garden. Logit model revealed that

education of the household head, household income, and household dummy had a positive and significant impact in attaining food security of the households. Besides, the households with more earning members were more food-secured than large ones. Households and their family members who did not have nutrition garden were suffered more from cold and fever than the garden owners. This might because of having nutrition garden they consumed more fruits and vegetables which had great contribution to their food and nutritional security. Therefore, nutrition garden have a significant role to cope with COVID-19 situation.



Exploration and collection of plant genetic resources during 2020-21

M S Nahar, M S Uddin, R Afroz, S Rahman, M G Hossain, Nasrin Jahan, M F Khatun, Q M Ahmed, Nishat Jahan and M R Islam

Multi-crop exploration and collection program was undertaken in 23 upazilas of 13 districts in Bangladesh during 2020-2021. Four hundred and thirty-nine (439) germplasm of 59 crops were collected from Chattogram, Dhaka, Gazipur, Jhenaidah, Khagrachari, Kishorganj, Manikgonj, Munshigonj, Mymensingh, Narsingdi, Nilphamari, Pabna, Satkhira. The germplasm were 1 cereals, 5 pulses, 5 oilseeds, 353 vegetables, 44 spices, 22 fruits, 10 other crops. These germplasms were collected from home garden, field, threshing floor, farm store, cultivated habitat, market etc. The samples were collected as seeds, seedlings, fruits from individual plant or population. Passport data like collector's number, local/ cultivar name, cultural practices, date of collection, donor's name, name of village, union, upazila and district also GPS reading of the locations were recorded during germplasm collection. The samples were registered in germplasm collection register of PGRC and conserved in active collection following appropriate procedures.

Characterization of sorghum germplasm

M F Khatun, N Jahan, R Afroz, S Rahman, Q M Ahmed, M G Hossain and M S Nahar

Germplasm collection and conservation as well as for crop improvement genetic variability is an important thing. The study was executed to estimate the genetic diversity and to identify the accessions having the useful trait. One hundred thirty-two sorghum germplasm with three checks

were used in this experiment. The germplasm displayed considerable variability except leaf orientation, grain form, grain plumpness, endosperm color and presence of sub coat. The maximum variation was observed in terms of grain color, ear head compactness, glume color, midrib color, ear head shape, glume covering, grain shape and endosperm color. The highest co-efficient of variation was found in the number of seeds per panicle (47%) which was followed by the ear head width (36.5%), Leaf width (29.3%) and 100 seed weight (28.5%). Based on the early maturity, the higher number of seeds in the panicle, non-shattering at maturity stage as well as short stature plant, BD-715, BD-4687, BD-4653, BD-4650, BD-4732, BD-4737, BD-9135 and BD-9137 accessions were found promising among the germplasm which may play a significant role in the future improvement program.

Characterization of chickpea germplasm

M S Kobir, M F Khatun, R Afroz, S Rahman, Q M Ahmed, M G Hossain and M S Nahar

The study was conducted at Regional Agricultural Research Station, Jashore during the Rabi season of 2020-2021 to characterize the germplasm and regenerate seeds for conservation and to develop a photographic monograph with descriptor of the collection. The experiment involved 63 chickpea accessions with three check varieties. Number of pods per plant, seed yield per plant and plants per meter square showed the highest diversity among 08 characteristics for 66 chickpea accessions. Variations were observed in qualitative characteristics like stem color, growth habit, hairiness and stress susceptibility. The chickpea Accession number BD-6187, BD-6192, BD-6193, BD-6194, BD-6199, BD-6200, BD-6202, BD-6204, BD-6207, BD-6208, BD-6209, BD-6210,

BD-6212, BD-6214, BD-6216, BD-6220, BD-6221, BD-6222, BD-6232, BD-6234, BD-6235, BD-6237, BD-6238, BD-6240, BD-6245, BD-6249, BD-6252, BD-6256, BD-6258, BD-6261, BD-6262, BD-6267, BD-6273, BD-6276, BARI Chola-5, BARI Chola-09 gave the highest seed yield with an average of 661 kg ha⁻¹ and these may be considered as better accessions. These accessions may be used in chickpea improvement program.

Characterization of pea germplasm

M Hossain, N Jahan and M S Nahar

The experiment was conducted with one hundred and forty five (145) germplasm of pea (*Pisum sativum*) with three check varieties (BARI Motorshuti-1, BARI Motorshuti-2 and BARI Motorshuti-3) in the experimental field at RARS, Burirhat, Rangpur during winter 2020-21 to find out the variability in the germplasm. All the studied qualitative characters showed distinct variation among the germplasm except leaf pubescence, hypocotyl and petiole colour. The maximum variation was observed in stem colour. In case of stem colour, maximum (70.94%) had light green colour stem, then 27.01% had dark green and the rest 1.35% and 0.68% germplasm had green and greenish purple colour, respectively. The highest quantitative variation was observed in 1000 seed weight (CV-54.37%) which was followed by plant height (CV-28.52%). BD-4158 produced the highest number of fruit per plant (28) whereas BD-4168 and BD-4198 produced the minimum (5.33). Average number of seed per pod was 4.62. The germplasm BD-10722, BD-11202 and BD-4177 gave the highest number of seed per pod. Therefore, selection of these genotypes might play a significant role for future breeding program.

Characterization of coriander germplasm

N Jahan, N Jahan, M G Hossain, M F Khatun, R Afroz, S Rahman and M S Nahar

The experiment was conducted with 73 germplasm of coriander (*Coriandrum sativum*) with two check varieties BARI Dhonia-1 and BARI Dhonia-2 at the Plant Genetic Resources Centre of BARI, Gazipur during winter 2020-21 to know the variability in the germplasm. Two types of leaf colour green (46.67%) and dark green (53.33%)

were observed. Leaf margin colour was found in three categories such as green (60.00%), dark green (21.33%) and reddish tinge (18.67%). Three types of leaf size i.e small, medium and large were observed. 48.00% germplasm had small leaf, 38.67% had medium and 13.33% had large leaf. White flowers were found in 46 germplasm (61.33%) and pinkish white in 29 germplasm (38.67%). Three types of seed color i.e cream (21.33%), light brown (77.33%) and brown (1.33%) were observed among the accession. The highest quantitative variation was observed in seed yield per plant (CV-61.28%) which was followed by number of primary branches (CV-23.13%) and 100 seed weight (CV-19.04%). The germplasm AC-500, AMA-360, ATR-49, KMR-70 and RAI-226 required minimum (44) days for 50% flowering. The germplasm AC-500, AMA-360 and KMR-70 were matured in 101 days which is minimum. The highest numbers of primary branches (7) were observed in germplasm NSR 152, KASI-5 and SA-48. Hundred seed weight was found maximum in NRI-203 (1.80 g), TRMR-15 (1.65 g) and AC-37 (1.5 g) and the highest yield per plant was found in BARI Dhonia-2 (10.94 g) which was followed by germplasm AHM-02 (10.91g), KMR-14 (10.08 g), BARI Dhonia-1 (9.42 g), N-219 (9.34 g), TT-156 (9.23g) and NSR-152 (9.09 g). Considering maturity, yield and yield contributing characters AC-500, AMA-360, ATR-49, KMR-70, NSR-152, NRI-203, TRMR-15, AHM-02, KMR-14, N-219 and TT-156 were selected for future breeding program.

Characterization of pumpkin germplasm

R Afroz and M S Nahar

One hundred twenty germplasm of pumpkin both *Cucurbita moschata* (108) and *Cucurbita maxima* (12) with five check varieties were studied at the Plant Genetic Resources Centre of BARI, Gazipur during winter season 2020-21 to identify the variations in pumpkin germplasm. The maximum variations obtained on fruit shape and mature fruit skin colour. Different types of fruit shape was found among the germplasm like globular 81.60%, flattened 9.60%, oblong blocky 7.20%, elliptical 0.80% and acorn 0.80%. The maximum variation of mature fruit skin colour was observed for deep green 4%, deep brown 13.60%, brown 21.60%,

light brown 4%, green with brown 7.20%, brown with green 12.80%, brown mosaic 16.80%, green mosaic 12.80% and cream 1.60%. Most of the germplasm 62.40% expressed mottled fruit skin pattern and rest of them 37.60% showed uniform. The range of fruit length 9 to 31 cm and fruit breadth 12 to 27 cm were identified. On an average, fruit weight 3.52 kg. The mean value of 100 seed weight 10.91g. Among the germplasm average TSS (Brix) 6.06% was recorded. The maximum coefficient of variation was obtained for number of fruits per 72.01% followed by fruit weight 46.90% and fruit length 26.51%. The minimum CV percentage was found for days to 1st male flower 7.08%. Percent of coefficient of variation indicated the variability among the accessions comparing within the characters. The promising germplasm were selected based on sweetness of fruit on brix percentage like AHM-12 (10% TSS), AHM-16 (10% TSS), NT-46 (10% TSS) and TT-63 (9% TSS), NSR-132(9% TSS), NTR-3 (9% TSS). Some germplasm were selected on number of fruit set or fruit production per plant such as R-345 (19), AHK-133 (18), NSQR-76 (17), NTR-6 (17), NRI-299 (12), SR-5 (10), ZS-29 (10), AHM-263 (10), NTR-28 (9), and ZS-19 (9).

Characterization of hyacinth bean germplasm

Q M Ahmed, R Afroz, S Rahman, N Jahan, M F Khatun and M S Nahar

The experiment was conducted on hyacinth bean (*Lablab purpureus* L. Sweet) at Plant Genetic Resources Centre (PGRC) of BARI, Joydebpur, Gazipur, during October 2020 to May 2021 to estimate the characterization and variability in the germplasm. In present study, 100 germplasm was grown including four check BARI released varieties. Green and purple colors were found in hypocotyl, epicotyl and leaf vein among the germplasm. Leaf anthocyanin was observed 27% among the germplasm. 97% indeterminate climber of growth habit was recorded. Hundred percent glabrous of leaf hairiness and pod pubescence were found. Variations were observed in ramification index and stem pigmentation. Different pod color was obtained such as white, cream, green, purple and purple green among the germplasm. Different pod shapes and pod curvatures were found. Variations of fresh seed color such as cream,

purple, brown and black were exhibited. Days to first flowering were ranged from 34 to 84 days and edible pod stages were ranged from 69 to 125 days. Number of pod per plants were ranged from 17 to 248. The range of harvest duration was found 7 to 29 days. The higher amount of coefficient of variations were observed in leaf length and width which was followed by the edible pod stages, edible pod length and width whereas low variation was found in number of pod per plant and yield per plant. The maximum individual edible pod weight was recorded in 24.9 g whereas minimum was found 1.4 g. The range of hundred dry seed weight was recorded 20 to 76 g. The highest yield per plant were recorded in 1959.75g whereas the lowest in 23.8g per plant. Some promising germplasm were found such as TT-120, TT-137, NSR-31, NQR-9, NTR-17, AC-479, AMA-78, TT-180 and RC-54 might be considered as the good yielder among the study.

Characterization of amaranth germplasm

N Jahan and M S Nahar

Presence of genetic variability in crops is essential for its further improvement by providing options for the breeders to develop new varieties and hybrids. This can be achieved through phenotypic and molecular characterization of PGR. *Amaranthus* species are distributed worldwide with an interesting diversity of landraces and cultivars whose leaves, stems and seeds are consumed. In the current study eighty one accessions of amaranth (*Amaranthus* spp. L.) were studied in augmented block design at the Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur during winter 2020-21 to acquire the knowledge about diversity of this crop. All the accessions demonstrated variations both for qualitative and quantitative characters. Qualitative variation was found in different parameters as early plant vigor, plant growth habit; compactness, shape and spininess of inflorescence; texture of stem and so on. Moreover, different color variations were displayed in leaf (green 12.35%, reddish green 23.46%, red 7.41% and dark red 56.79%), inflorescence (purple 38.27%, reddish green 45.68% and green 16.05%), stem (74.07% red, 14.81% reddish green and 11.11% green), and seed (red 66.67% and black 32.10%). Additionally, in

case of quantitative character, mean plant height was 91.52 cm. Also, the plants of different accessions flourished with 50% flower within 22-88 days giving 11.49 cm long inflorescence on an average. Average seed yield per plant was 7.65 g, where 1000 seed weight ranged from 0.8-0.96 g. Nevertheless, highest CV was found in case of number of days to germination (61.75%) and lowest in 1000 seed weight (6.08%). Lastly, accessions namely, BD-7071, BD-7421, BD-7423, BD-8100, BD-8104, BD-8124, BD-8125, BD-8131, BD-8192 and BD-10848 have been recommended for using in future breeding program.

Characterization of grass pea germplasm (Set-I)

M G Hossain, M R Molla, Nasrin Jahan, M F Khatun, Q M Ahmed, S Rahman, R Afroz and M S Nahar

Three hundred (300) accessions of grass pea (*Lathyrus sativus* L.) were evaluated at Plant Genetic Resources Centre (PGRC), BARI, Gazipur during rabi 2020-21 season to identify the important traits. Qualitative and quantitative variation was observed in all characters except plant type and anthocyanin present in stem. Variations in plant growth habit like prostrate, spreading, semi-erect and erect were observed. Different flower color viz. white for 2 accessions (0.7%), blue for 293 accessions (97.6%), pink for 3 accessions (1%) and red for 2 accessions (0.7%) were recorded. Variations were observed in respect of days to 50% flowering, days to maturity, plant height, number of seeds per pod, 100-seed weight and yield per plant among the tested accessions. Days to 50% flowering were earlier in BD-4933 (65 days) while the earlier maturity was observed in BD-4939, BD-4940, BD-4944, BD-5093 accession that took only 101 days. The accessions BD-5178 possessed the maximum number of pods per plant (130). BD-5178 produced the highest number of seeds per plant (520). The longest pod length was found in BD-4941 (3.8cm). The highest seed yield (53g/plant) was recorded from BD-5178 and the lowest (6g/plant) from BD-5084 and BD-5093 grass pea accession.

Characterization of grasspea germplasm (Set-II)

M I Riad and M M Kadir

Three hundred (300) accessions of grass-pea (*Lathyrus sativus* L.) and four checks were

evaluated at plant Genetic Resources Centre (PGRC), RARS, Jamalpur. In qualitative variation was predominantly present in all characters except pod beak shape and seed shape. In quantitative traits highest plant height was observed both accession and checks BD-3771 (58.67cm) and 64.53cm (C3) followed by the characters length of primary branch in accession BD-3512 (53.31cm) and 45.87cm (C4), pod length in accession BD-3507 (3.92cm) and 2.92cm (C3), pod width in accession BD-3516 (1.04cm) and 1.02cm (C3), 100-seed weight in accession BD-3561 (6.35g) and 5.89g (C1) and number of seeds/pod in accession BD-3702 (6) and 5 (C3). Maximum number of primary branch/plant was present both accessions and checks BD-4802 (23) and 11 (C3) followed by the characters number of pods/plant in accession BD-3738 (36) and 23 (C3). Early flowering and early maturity was found in accessions BD-3513 and BD-3502 and checks C1 and C4. The highest mean, standard deviation (SD) and coefficient of variation (CV %) were observed both accessions and checks in the character days to maturity (118.68 and 128.75), Plant height (6.23 and 6.70) and number of primary branch/plant (34.08 and 36.28). The level of diversity detected and the potential use of this germplasm in breeding programmed and discussed.

Characterization of grasspea germplasm (Set-III)

K U Ahamed, S Rahman, M G Hossain, M R Molla and M S Nahar

The study was conducted at Regional Plant Genetic Resources Center, Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2020-2021 to identify the important traits of grass pea accessions. The experiment involved 301 grass pea accessions. Variations were observed in respect of days to first flowering, days to 50% flowering, days to maturity, plant height, number of seeds per pod, 100-seed weight and yield per plant among grass pea accessions. The first flowering initiation was observed earlier in BD-3316, BD-3390 and BD-3436 (51 days) and day to 50% flowering was earlier in BD-3454 (63 days) grass pea accession. The earlier maturity was found in BD-3375, BD-3376, BD-3435, BD-3436 and BD-3437 (124 days) than the other accessions. Variations among grass

pea accessions were observed in different qualitative characteristics like pigmentation found in stems, leaves and flowers. Stem colour was showed light green for 7.97%, green for 62.13%, purple-green for 20.93%. Plant growth habit found erect for 17.61%, semi-erect for 35.55%, spreading for 67.77% and prostrate for 14.62%. Three types of number of leaflets per leaf was found one pair for 5.98%, two pair for 89.04% and more than two pair for 4.98%. Different flower colour were observed white blue for 1.99%, blue for 90.03%, pink for 0.33%, violet blue for 6.98% and violet flower colour for 0.33%. Seed shape was observed rhomboid for 82.39%, square for 4.98%, triangular for 8.64%, obtriangular for 3.65% and oblate or flattened type seed shape showed 0.33%. Seed size was observed small for 5.32%, medium for 42.52% and large for 52.16%. Seed coat colour varied different categories like grey for 42.86%, brown for 48.50%, yellow-green for 0.66%, pink for 0.66%, red-purple for 3.32%, grey mottled for 3.32% and green mottled for 0.66%. Seed coat pattern observed absent for 3.65%, marbled for 12.62%, dotted for 82.39% and mixture for 1.33%. Two types of cotyledon colour found among accessions as yellow for 77.40% and orange showed 22.59%. Different biotic stress susceptibility on pest and diseases were found among 301 grass pea accessions. Variations were observed in different quantitative characteristics among grass pea accessions as number of secondary branches per plant varied from 8.00 to 30.00, 39 accessions showed highest number of secondary branches per plant (16.00-30.00), The number of pods per plant varied from 52.50 to 338.50, 26 accessions showed highest number of pods per plant (200.00–338.50). BD-3378 produced highest number of pods per plant (338.50) and lowest in BD-3207 (52.50). Yield varied from 4.56 g to 36.63 g per plant, BD-3446, BD-3394, BD-3450, BD-3458, BD-3411, BD-3395, BD-3404 and BD-3428 accessions showed high yielding (34.28–36.63 g/plant) and BD-3207 accession found low yielding (4.56 g per plant).

Characterization of lentil germplasm

K U Ahamed

The study was conducted at Regional Plant Genetic Resources Center, Regional Agricultural Research

Station, Ishurdi, Pabna during Rabi season of 2020-2021 to study the genetic diversity in lentil germplasm and to identify accession having useful traits. The experiment involved 102 lentil accessions. Variations were observed in respect of time to flowering, time to maturity, plant height, number of seeds per pod, 100-seed weight and yield per plant among lentil accessions. Days to 50% flowering was earlier in BD-3983 (53 days) than the other accessions. The earlier maturity observed in BD-3962 (105 days) simultaneously with other 37 accessions. Variations among lentil accessions were observed in different qualitative characteristics like plant pigmentation were observed in stems, leaves and flowers. Maximum Seedling stem pigmentation was present for 44 accessions (43.14%) and absent for 58 accessions (56.86%). Variations in tendril length found prominent maximum 57 accessions (55.88%) and rest accessions showed rudimentary 45 accessions (44.12%). The flower ground colour was white maximum for 41 accessions (40.20%), white with blue veins for 35 accessions (34.31%), blue for 18 accessions (17.65%) and rest accessions showed violet for 8 accessions (7.84%). Pattern of testa was observed as dotted for 87 accessions (85.29%), spotted for 1 accessions (0.98%), marbled found for 10 accessions (9.80%) and rest accessions observed complex for 4 accessions (3.92%). Colour pattern on testa was found grey for 23 accessions (22.55%), brown for 79 accessions (77.45%) and black colour testa pattern was not found. Cotyledon colour found orange-red for 102 accessions (100.00%). Pest and disease susceptibility observed none for 7 accessions (6.86%) but it was observed low, medium and high susceptibility to pest and disease which affected by aphid and stemphylium blight disease symptom found in stem and leaves. Variations were observed in different quantitative characteristics as numbers of pods per plant varied from 51.00 to 309.00 and BD-3988 produced significantly the highest number of pods per plant (309.00). BD-3988 produced significantly the highest number of seeds per plant (618). Yield variations were showed from 1.70 g to 9.89 g per plant and the highest seed yield (9.89 g/ per plant) was recorded from BD-3988 lentil accession. BD-4016, BD-4013, BD-4000, BD-3996, BD-3958, BD-3957, BD-3938 and BD-3923 lentil accessions

showed higher yield (8.00-9.55 g/plant) and the lowest yield (1.70 g/ per plant) found from BD-3954 lentil accession.

Characterization of onion germplasm

Q M Ahmed, M S Uddin, R Afroz, S Rahman, M Jahan, M F Khatun and M S Nahar

The experiment was conducted at the experimental field of Plant Genetic Resources Centre, BARI, Gazipur during 2020-21 to conserved nine collected exotic onion which were successfully grown to assist the regeneration and conservation program. Flower opening ability present all the collected materials. All the collected exotic onion exhibited erect leaf habit and black color seeds at matured stage. There have three leaf arrangement was showed such as regular, alternate and irregular. All the flower color was recorded at Greenish white except SQ-3 which was greenish. The days to first inflorescence appearance ranged from 28 to 47 days. The longest days to 50% flower was found at SQ-8. Flower per head and flowering stalk length were found SQ-4. An Hundred seed weight ranged from 0.25 to 0.51g. The highest co-efficient of variance were recorded Days to inflorescence and days to 50% flowering. Some qualitative and quantitative characters were recorded to know the overall performance of those germplasm aiming to enrich the gene bank with good reproductive units.

Characterization of mung bean germplasm

R Afroz and M S Nahar

One hundred seven (107) germplasm of mugbean (*Vigna radiata*) with four check varieties were characterized at plant Genetic Resources Centre, BARI, Gazipur during 2020-21. The variation was found in terminal leaflet shape, petiole length and seed colour. Deltoid 66.67% and ovate 33.33% were exhibited in the terminal leaflet shape followed by Petiole length such as short 57.66% and medium 42.34%, seed colour such as dark green 97.30% and greenish yellow 2.70% were observed. All germplasm showed green leaf colour. All accessions were showed same parameter in the characters growth pattern and calyx colour. The range of number of pod per plant was 4.40 to 17.60 and mean value 8.67. In plant height, mean 16.97 cm and range, 13.80 to 21.80 cm, in number of seed per pod, the range was 6.20 to 13.80 and mean

was 9.66. The maximum coefficient of variation 23.44% was obtained from number of primary branch per plant followed by 23.13% was number of pod per plant, 22.69% 100 seed weight in gram. Unique selection and trait information is available within the population studied which may offer crop improvement opportunity.

Characterization of sesame germplasm

M R Molla and M S Nahar

The experiment was carried out with 120 germplasm of Sesame (*Sesamum indicum* L.) at Plant Genetic Resources Centre, BARI, Gazipur during Kharif-1 season 2021 to determine genetic diversity using both qualitative and quantitative descriptors. Among the 25 qualitative descriptors 19 showed distinct variation while eight characters were found to be monomorphic as the colour of cotyledons, shape of cotyledons, plant growth type, root system, main stem colour, leaf colour, leaf hairiness and petiole colour. Prostrate (6%) and erect (94%) plant growth habit with absent (93%) and weak (7%) stem hairiness were found among the sesame germplasm. Two type of stem branching viz., alternate (93%) and opposite (7%) were observed while leaf arrangement were observed in three categories i.e., opposite (14%), alternate (81%), mixed (5%) among the studied germplasm. Studied genotypes showed variation in all descriptor states described in leaf lobe, basal leaf margin and number of locules per capsule. Leaf lobe was absent in 10 genotypes whereas strong, medium and weak leaf lobe was found in 7, 5 and 98 genotypes, respectively. Different numbers of locules per capsule (4-8) were recorded in studied genotypes. Basal leaf margin was observed in three categories viz., entire (10), serrate (103) and Dentate (7). The highest quantitative variation was observed in no. of secondary branches (52.75%) which was followed by no. of primary branches (24.01%) and seeds per capsule (22.49%). Plant height ranged from 101.33 cm to 159.33 cm with an average of 127.49 cm. No. of primary branches ranged from 4.33 to 13.33 with an average of 7.83 whereas no. of secondary branches ranged from 1 to 20.67 with an average of 7.71. The studied germplasm initiated infloresces within 36 to 48 days. Both qualitative and quantitative data have an important implication for

sesame germplasm characterization, improvement, agro-morphological evaluation and conservation.

Characterization of cucumber germplasm

M G Hossain, N Jahan, R Afroz, S Rahman, M F Khatun, Q M Ahmed and M S Nahar

Twenty five germplasm of cucumber (*Cucumis sativus* L.) were evaluated at Plant Genetic Resources Centre, BARI, Gazipur during summer 2021. All the germplasm was collected from different areas of Bangladesh. Stem colour was light green and medium pubescence density was observed in all genotypes. Variability also showed in stem end fruit shape, fruit shape and fruit skin colour at edible mature stage. Maximum variation was found in fruit skin colour at table maturity stage. Among the tested genotypes, 28% genotypes had yellowish green, 28% genotypes had green and 24% had yellowish fruit skin colour. Rest 12% had light green and 4% had blackish green and whitish green colour. Whereas brown and yellow fruit skin colour at mature stage were found in all accessions. The highest coefficient of variation was found in number of fruits per plant (39.26%) followed by 100 seed weight (34.11 %) and the lowest (5.15%) in days to mature fruit harvest. Days to mature fruit harvest ranged from 87 to 97 days. Average fruit length and fruit width were 17.73 cm and 5.96 cm, numbers of fruits per plant was ranged from 2 to 8.

Characterization of brinjal germplasm

N Jahan, M S Uddin, R Afroz, S Rahman, M R Islam and M S Nahar

Brinjal is an important vegetable for its commercial and nutritional value in the world as well as in Bangladesh. The experiment was conducted with One hundred and forty nine (149) germplasm of brinjal (*Solanum melongena* L.) with five check varieties (BARI Begun-1, BARI Begun-4, BARI Begun-6, BARI Begun-8 and BARI Begun-10) in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI, Joydebpur, Gazipur, during winter 2020-21 to find out the variability in the germplasm. All the studied qualitative characters showed distinct variation among the germplasm except fruit cross section and fruit position. The maximum variation observed in fruit length/ breadth ratio, fruit calyx prickles, leaf prickles, fruit curvature and fruit colour at ripening. The variability was maximum in fruit

length/ breadth ratio, fruit calyx prickles. In case of fruit length/breadth ratio, six categories fruits were found. 3.25% germplasm had 'broader than long' type which is minimum. 29.22% and 30.52% germplasm had 'as long as long as 'and' slightly longer than broad' type, respectively. 'Twice as long as broad' type was observed in 13.64% germplasm and 'three times as long as broad' in 14.29%. The rest (9.09%) had 'several times as long as broad' type fruit. In case of fruit calyx prickles, 50.65% germplasm had no prickles, 15.58% had very few and few calyx prickles and the rest had intermediate (5.84%) and many (3.25%) fruit calyx prickles. The highest quantitative variation was observed in yield per plant (CV-52.35%), which was followed by individual fruit weight (CV-48.13%) and number of fruits per plant (CV-40.92%). The germplasm SU-208 (4.82 kg), K-47 (4.69 kg), SU-184 (4.69 kg), SU-237 (4.60 kg) and K-18 (4.53 kg) were higher yielder among the tested germplasm. Therefore, selection of these genotypes might play a significant role for future breeding program.

Characterization of tomato germplasm

S Rahman, R Afroz, Q M Ahmed and M S Nahar

The experiment was conducted with 76 germplasm including three check variety of tomato (*Solanum lycopersicum*) in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI, Joydebpur, Gazipur, during winter 2019-20 to find out the variability in the germplasm. Qualitative characters showed distinct variation among the germplasm except hypocotyl pubescence (present), anthocyanin colour of leaf veins (normal), skin colour of ripe fruit (yellow), seed shape (ovate). The maximum variation was found in 'predominant fruit shape' followed by 'fruit size', fruit shoulder shape' and 'flesh colour of pericarp (interior)'. Six categories of predominant fruit shape were observed such as flattened (53.95%), slightly flattened (5.26%), rounded (14.47%), highly rounded (17.11%), hard shape (5.26%) and cylindrical (3.95%). The next higher variation was found in 'fruit size'. very small, small, intermediate, large, very large type of fruit size was found where majority of the germplasm exhibited intermediate type (44.74%). Fruit shoulder shape was observed in four categories viz. flat (17.11%), slightly depressed (39.47%), moderately depressed (13.16%) and strongly depressed (30.26%). Interior

flesh colour of pericarp was exhibited as green (42.11%), yellow (2.63%), pink (44.74%) and red (10.53%). Quantitatively highest variation was observed in number of locules (CV- 45.82%) which was followed by fruit weight (CV-39.94%) and yield per plant (CV-34.99%). Among the germplasm the sweetest tomatoes were SS-21, BD-7257, BD-7290. The germplasm BD-7756, RISA-14413 and SS-18 might be considered as the best yielder among the studied germplasm.

Characterization of chilli germplasm

N Jahan, M S Uddin, R Afroz, S Rahman, M G Hossain and M S Nahar

An experiment was conducted with 56 germplasm of chilli (*Capsicum* spp.) at Plant Genetic Resources Centre (PGRC) of BARI, Joydebpur, Gazipur, during winter 2020-21 to find out the variability in the germplasm. Qualitative characters showed distinct variation among the germplasm except hypocotyle color, nodal anthocyanin, calyx margin shape and calyx annular constriction. Corolla color found in five categories such as white (53.57%), light yellow (30.36%), yellow (10.71%), purple with white base (3.37%) and white with purple margin (1.79%). Anther color found in five categories such as white (03.57%), yellow (12.5%), pale blue (12.5%), blue (62.5%) and purple (08.93%). Quantitatively highest variation was observed in number of fruits per plant (CV-152.20%) followed by yield per plant (144.77%) and fruit length (CV-34.21%). Considering all the character studied the germplasm N-55 (102.8 g), NQR-38 (76.13g), AR-243 (33.4 g), MRI-77 (25.73 g), N-62 (25 g) and N-37 (24.67) were found as the best yielder.

Conservation of germplasm in active and base collection

S Rahman, M S Uddin, R Afroz and M S Nahar

Plant Genetic Resources Centre (PGRC) acts as a germplasm store house of the BARI mandated crops viz., cereals, pulses, oilseeds, vegetables, fruits, spices and other crops etc., since 1987. The accessions were conserved in medium-term storage (at 4 to 6°C) and long-term storage (at -18 to -22°C). Viability (germination %), quantity and moisture were checked before conservation. Accessions having less than 80% viability and/or less quantity of seeds were regenerated. Generally, the seeds were

dried at 6-8% moisture content before storing. Till now, the Centre has conserved 11405 (eleven thousand four hundred and five) accessions of 82 different crops in its gene bank. Among them, 1772 accessions were cereals, 3553 pulses, 616 oilseeds, 487 spices, 4637 vegetables, 283 fruits and 57 other crops. In 2020-21, a total of 217 germplasm was assigned as new accession and were conserved in gene bank of PGRC.

Monitoring of germplasm in active and base collection

S Rahman, M S Uddin, R Afroz and M S Nahar

The monitoring of 1310 accessions from different year (batch references) among six important crops viz. Muskmelon (481), Soybean (54), sponge gourd (236), snake gourd (269), ridge gourd (199) and french bean (71) were tested in 2020-21 by germination test. Among the monitored germplasm 651 accession from active collection and 659 accessions were from base collection. The viability test was conducted on germination paper, sands and pulverized gravels. Combining all data, it was found that 81-100% germination was higher and it was followed by 41-80% germination and less than 40% germination in active collection. Similar trend was found in base collection. Altogether, base collection performance was good over the active collection. The accessions having less than 80% germination and or less quantity will be regenerated in the following year.

Distribution of germplasm

S Rahman, M S Uddin, R Afroz and M S Nahar

Germplasm distribution is one of the important activities of Plant Genetic Resources Centre (PGRC). The centre distributed 993 accessions of 16 crops among the researchers, MS and PhD students, plant breeder, horticulturist and teachers of different Universities and Institutes for conducting research on varietal improvement as well as screening and evaluation like diseases, insect screening, salinity stress, mutation breeding, abiotic stress, fibre production, draught tolerant and molecular diversity analysis during 2020-21. Among the germplasm, 230 accessions were cereals (maize, teff, sorghum, pearl millet and buck wheat), 108 pulses (mungbean only), 86 oil seeds (sesame), 250 spices (chilli), 319 vegetables (field pea, cucumber, pumpkin, red amaranth, okra,

brinjal, ridge gourd and hyacinth bean) and 80 fruits (muskmelon). Ten to hundred seeds or 5-10 g seeds per accession were supplied to the users.

Conservation of gerplasm in field gene bank

M R Molla and M S Nahar

A total of 273 germplasm including 206 accessions of 75 crops both indigenous and exotic germplasm is maintaining at the field genebank of Plant Genetic Resources Centre (PGRC), Bangladesh Agricultural Research Institute, Gzaipur. In 2020-21, new 14 germplasm of 5 crops were collected from different district which has been maintaining in field gene. The fruit germplasm are mango litchi, banana, guava, jackfruit, jujube, aonla, bael, bilimbi, bullocks heart etc. The vegetables germplasm are taro, yam, elephant foot, drumstick etc. The exotic germplasm are rambhutan, pear, tamarind, coffee, passion fruit, dragon fruit and gynura etc. The intercultural practices were done as and when necessary. The field gene bank has been maintained since 1985 and continued for the following years.

Regeneration of pumpkin, hyacinth bean, bottle gourd, cucumber and bitter gourd germplasm

Q M Ahmed and M S Nahar

The experiment was conducted at the experimental field of Plant Genetic Resources Centre, BARI, Gazipur during 2020-21 including some newly collected different crops namely as pumpkin, Bottle gourd, hyacinth bean, cucumber, and Bitter gourd which were successfully grown to assist the regeneration and conservation program. All of the crop such as pumpkin, bottle gourd and hyacinth bean seed sown on 28 December, 2020 except cucumber and bitter gourd sowing on 23 February, 2021. The crops were harvested at time to time for each accession. Some qualitative and quantitative characters were recorded to know the overall performance of those germplasm aiming to enrich the gene bank with good reproductive and for future study.

Regeneration of safflower germplasm

M F Khatun and M S Nahar

Regeneration of germplasm leads to get a sufficient seed quantity with increase viability for future use. The regeneration study was conducted at the experimental field of Plant Genetic Resources

Centre, BARI, Gazipur during the rabi season 2020-21. Six safflower germplasm have been regenerated to fill up seed quantity. Qualitative and qualitative characters were recorded to know the variations among the germplasm. The qualitative variations were observed only in two characters among the studied germplasm. After completing the post-harvest preparation seeds have been conserved in the gene bank for future use.

Regeneration of sunflower germplasm

M G Hossain, M R Molla and M S Nahar

An experiment was conducted at the Plant Genetic Resources Centre, BARI, Gazipur during winter of 2020-21 to regenerate the five conserved sunflower germplasm. Some of the qualitative and quantitative characters were recorded for using as reference data. Variations were also observed among the germplasm in both qualitative and quantitative descriptors. Adequate amount of seeds were harvested for conservation and future use.

Data base development and data entry for germplasm documentation

R Afroz, S Rahman and M S Nahar

The total three thousand six hundred (3600) passport, twelve thousand one hundred thirty one (12131) conservation and some characterization information of germplasm were recorded under documentation system. The information of germplasm on conservation, characterization, regeneration and distribution has been in progress. This database system could be used as an inventory for Genebank accessions, identifying new crops for explorations and developing strategies for conservation and utilization. The proper documentation of plant genetic resources is required to properly conserve, manage and use biodiversity of plant species. For information of germplasm documentation is important for the researcher. PGRC/BARI has been created a new database information software with a powerful, flexible, easy-to-use of the information of plant genetic resource (PGR). The study has been started since October 2017-18. A core set of web services, MySQL has been adopted for data entry and editing forms. The impact of system use will be evaluated by users during and following database implementation and utilization.

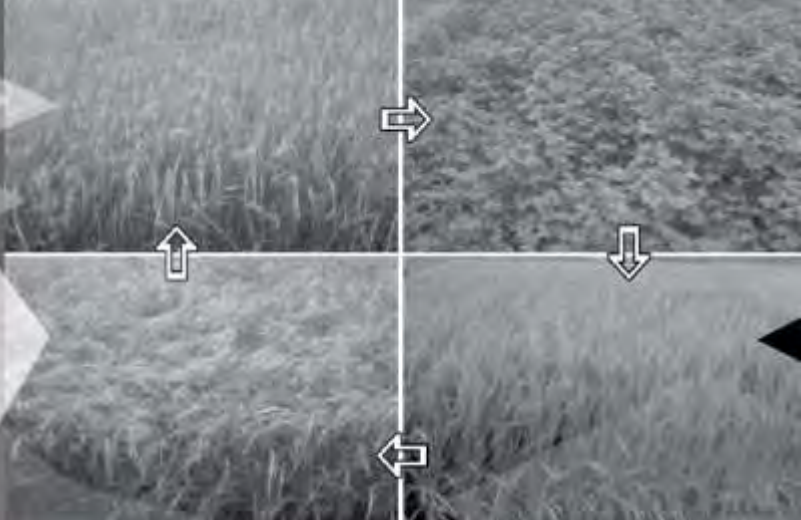
Appendix I. Scientists working at PGRC, BARI, Gazipur and regional stations during 2020-21

Sl. No.	Name	Designation	Discipline	Remarks
01.	Dr. Mossammat Shamsunnahar	CSO	Plant Pathology	
02.	Dr. M. Shalim Uddin	PSO	Plant Breeding	Transfer from PGRC
03.	Dr. Rozina Afroz Chhanda	SSO	Plant Breeding	
04.	M Badiuzzaman Talukdar	SSO	Horticulture	Deputation for higher study
05.	Nazma Pervin	SSO	Horticulture	
06.	Dr. Sajia Rahman	SSO	Plant Breeding	
07.	Mohammad Golam Hossain	SSO	Plant Breeding	
08.	Iftekher Ahmed	SSO	Plant Breeding	Deputation for higher study
09.	Dr. Md. Rezwan Molla	SSO	Plant Breeding	
10.	Dr. Nasrin Jahan	SO	Plant Breeding	
11.	Mst. Fatima Khatun	SO	Agronomy	
12.	Quazi Maruf Ahmed	SO	Horticulture	
13.	Nishat Jahan	SO	Plant Breeding	
14.	Md. Robyul Islam	SO	Plant Breeding	NATP Phase II Project
15.	Dr. Kamal Uddin Ahamed	SSO	Plant Breeding	Working at RARS, Ishurdi, Pabna
16.	Dr. Mukaddasul Islam Riad	SSO	Plant Breeding	Working at RARS, Jamalpur
17.	Md. Mostahed Hossain	SSO	Plant Breeding	Working at RARS, Burihat, Rangpur
18.	Md. Shahriar Kobir	SO	Agronomy	Working at RARS, Jessore

Appendix II. Scientific Assistant working at PGRC, BARI, Gazipur during 2020-21

Sl. No.	Name	Designation	Remarks
01.	Salma Begum	Senior Scientific Assistant	
02.	Mrs. Shimla Arju	Senior Scientific Assistant	
03.	Rizwana Pervin	Senior Scientific Assistant	
04.	Md. Ibrahim Khalil	Senior Scientific Assistant	
05.	Md. Awlad Hossain	Senior Scientific Assistant	
06.	Ferdous Jahan	Senior Scientific Assistant	

APPENDIX III. কর্মসম্পাদন



Program: Farming Systems and Adaptive Research

Project I: On-Farm Soil Fertility Management

Effect of fertilizer application methods on maize grown under strip tillage system in high barind tract

M.S. Hossain, M. A. Haque and J. C. Barman, M Akkas Ali, M Shahiduzzaman

A field experiment was conducted in the farmer's field of FSRD site, Basantapur, Godagari, Rajshahi during Rabi 2019-20 and 2020-21 to develop the best fertilizer application method in conservation agriculture for Maize cultivation in High Barind Tract. The experiment was laid out in randomized complete block design with three replications. There were four treatments namely, T_1 = fertilizer and seeds sown simultaneously on same row by strip machine, T_2 = fertilizer and seeds sown simultaneously on different row by strip machine, T_3 = fertilizer applied on strip manually and T_4 = fertilizer broadcasted on whole plot manually. The maximum germination rate (90%) and grain yield (7.34 and 7.22 t ha⁻¹ in Yr1 and Yr2, respectively) was recorded in T_2 when fertilizer and seed were sown different rows simultaneously with strip machine. Contrarily, treatment T_1 where fertilizer and seed sown on same row simultaneously showed poor performance regarding germination rate (65 and 63% in Yr1 and Yr2, respectively), grain yield (4.11 and 4.09 t ha⁻¹ in Yr1 and Yr2, respectively) and other parameters.

Development of fertilizer package for bitter gourd production in charland

Md. Samim Hossain Molla, Md. Zannatul Ferdous, Md. Al-Amin Hossain Talukder, M Akkas Ali, M Shahiduzzaman

An experiment was conducted in the Charland of Begumganj, Ulipur, Kurigram during the rabi season of 2020-21 to find out the suitable fertilizer package for Bitter gourd production. The experiment comprised with six treatments T_1 : STB fertilizer dose, T_2 : Liquid PGR spray 4 times T_3 : STB fertilizer dose + Liquid PGR (Biofol Super) spray 3 times (5 ml/L water), T_4 : Compost + liquid PGR spray 3 times (compost will be placed at the bottom of pit before 1 week of seed planting, T_5 : Compost + STB fertilizer + liquid PGR spray 3 times, T_6 : Farmers practice (No fertilizer). Local Bitter gourd variety (ucche) was used for this experiment. Among the treatment higher Bitter gourd fruit yield (4.23 t ha⁻¹) and gross margin (Tk 170224 ha⁻¹) was obtained from T_4 treatment followed by T_2 treatment. Fruit yield was lower in both the treatment of T_1 (3.13 t ha⁻¹) and T_6 (3.16 t ha⁻¹) and also the gross margin was lower in these treatments.

Development of fertilizer package for garlic-maize-t.aman rice cropping pattern in the charland

Md. Samim Hossain Molla, Md. Zannatul Ferdous, Md. Al-Amin Hossain Talukder, M Akkas Ali, M Shahiduzzaman

A study was undertaken at stable charland of Ulipur, Kurigram during 2019-20 to find out an optimum and economic fertilizer dose for Garlic-Maize-T.Aman rice cropping pattern. The soil of the experimental field was chemically analyzed, and levels of the fertilizers were calculated on the basis of target yields as per Fertilizer Recommendation Guide' 2018. The treatments were T_1 : Soil test based fertilizer dose, T_2 : IPNS with 5 t cow dung ha⁻¹ as of T_1 , T_3 : T_1 +25% higher NPKS, T_4 : IPNS with 5 t cow dung ha⁻¹ as of T_3 ,

T₅: Farmers' practice employed for the trial. The yield of all crops performed better in T₄: 25% higher doses and IPNS approach nevertheless it gave the highest values of system productivity (25.48 t ha⁻¹), production efficiency (79.87 kg ha⁻¹ day⁻¹), gross return (Tk 662462 ha⁻¹) and gross margin (Tk 351862 ha⁻¹). But the MBCR was higher in T₁ (6.40) treatment. The IPNS including treatments showed more production cost due to relatively higher price of cow dung.

Validation of biofertilizer on groundnut at Jamalpur region

M.F. Islam, A.K.M.Z.U. Noor and M.S. Rahman, M Akkas Ali, M Shahiduzzaman

The experiment was conducted in the farmers' field at Naovanghar Char, Jamalpur during rabi season, 2020-21. The maximum yield of nut (2.42 t ha⁻¹) was found from the T₂ where Rhizobium inoculum was applied which was followed by T₃ treatment where nitrogen was added with PKS₂Zn and the minimum (2.20 t ha⁻¹) from only PKS₂Zn treated treatment (T₁). The higher gross return (Tk 242000 ha⁻¹) and gross margin (Tk 154680 ha⁻¹) were obtained from T₂ treatment due to its higher yield. The lowest gross return (Tk 220000 ha⁻¹) and gross margin (Tk 133986 ha⁻¹) were recorded from T₁ treatment due to its lower yield.

Development of fertilizer recommendation for maize-t. aus-T. Aman cropping pattern in karatoa bangali floodplain

M. A. Islam, M. S. Alam, and M. R. A. Mollah, M Akkas Ali, M Shahiduzzaman

The trial was conducted in the farmers' field of Multi Location Testing Site, Sherpur, Bogura during Rabi season of 2020-21 FY to develop a suitable fertilizer recommendation for Maize-T. Aus-T. Aman rice cropping pattern. For the first crop (Maize) the treatments were T₁: Soil Test Based dose, T₂: T₁ + 25% extra NPK, T₃: T₁ + 50% extra NK, T₄: IPNS based on T₁ @ 5 ton cow dung ha⁻¹ and T₅: IPNS based on T₃ @ 5 t ha⁻¹ of cow dung. According to the treatment specifications the STB and other doses were estimated. Treatments were assigned randomly, and fertilizer doses were applied accordingly following randomized complete block design. Maximum grain yield (8.56 t ha⁻¹) was recorded from T₃ treatment that was statistically similar to T₂ and T₅

and the minimum (6.92 t ha⁻¹) from T₄ treatment. Similar trend was observed in stover yield also. The highest gross return (Tk 182750 ha⁻¹) was amounted from T₃ treatment against the cultivation cost of Tk 110454 ha⁻¹ that together led to the higher gross margin (Tk 72256 ha⁻¹). Lower gross return (Tk 147640 ha⁻¹) as well as gross margin (Tk 38768 ha⁻¹) was obtained from the T₄ treatment.

Development of fertilizer package for maize at charland condition

M. A. Islam, M. S. Alam, and M. R. A. Mollah, M Akkas Ali, M Shahiduzzaman

The trial was conducted in the farmers' field under the Multi Location Testing site, Dhunat for two consecutive years during the Rabi season of 2019-20 and 2020-21 to develop a suitable fertilizer recommendation for Maize cultivation at stable char land condition. The experiment was laid out in a randomized complete block design with three replications. There were five treatments i.e., T₁: STB dose, T₂: T₁ + 25% extra NPK, T₃: T₁ + 50% extra NK, T₄: IPNS based on T₁ @ 5 t ha⁻¹ of cow dung, and T₅: Farmers Practice. Maximum grain yield (11.16 t ha⁻¹ in 2019-20 and 11.65 t ha⁻¹ in 2020-21) was recorded from T₃ that was statistically similar to T₂ and T₁ and the minimum (8.43 t ha⁻¹ in 2019-20 and 8.62 t ha⁻¹ in 2020-21) from farmers practice (T₅) treatment. A similar trend was observed for stover yield. The highest gross return (Tk 241243 ha⁻¹) and gross margin (Tk 127508 ha⁻¹) were recorded from T₃ treatment where 50% N and K were added as extra dose with STB dose and the lowest gross return (Tk 180348 ha⁻¹), as well as gross margin (Tk 82028 ha⁻¹) was obtained from the farmer's practice (T₅).

Effect of ocp compound fertilizer on the growth and yield of lentil

M. A. Islam, M. S. Alam, and M. R. A. Mollah, M Akkas Ali, M Shahiduzzaman

The study was conducted at Ramchandrapur area under Dewli union, Shibganj, Bogura during Rabi season of 2020-21 to find out the effect of OCP compound fertilizer and improved practice on the yield of Lentil with the help of the OCPF-BARI-ICARDA collaborative project. BARI Moshur-8 was used as the test crop. The experiment was laid out in randomized complete block design with four replications. Three different fertilizers management

was considered as the treatment for the trial viz. T₁: OCP compound fertilizer, T₂: Farmers' practice and T₃: Recommended fertilizer dose. The dose of OCP compound fertilizer was adjusted with the recommended fertilizer doses. Most of the parameters were statistically significant among the different fertilizer practices. The highest amount of seed yield (1.79 t ha⁻¹) was weighed from the OCP compound fertilizer application plot and the lower amount (1.52 t ha⁻¹) was weighed from the farmer practice which was identical to recommended fertilizer (1.73 t ha⁻¹). Application of both OCP compound fertilizer and recommended dose of fertilizer showed better performance over farmers' practice and significantly increased seed yield of Lentil. Upon cost and return analysis the highest BCR (2.95) was recorded from OCP compound fertilizer treat plots (T₁) followed by recommended fertilizer treated plots (T₃) and the lowest (2.76) from farmers practiced plots (T₂). This is the second-year trial and similar trends were obtained in the last year's observation.

Effect of ocp compound fertilizer on the growth and yield of onion

M. A. Islam, M. S. Alam, and M. R. A. Mollah, M Akkas Ali, M Shahiduzzaman

The study was conducted at Laxmikhola area under Dewli union, Shibganj, Bogura during the Rabi season of 2020-21 to find out the effect of OCP compound fertilizer and improved practice on the yield of Onion with the help of the OCPF-BARI-ICARDA collaborative project. BARI Piaj-1 was used as the test crop. The experiment was laid out in an RCB design with four replications. Three different fertilizer management were considered as the treatment for the trial viz. T₁: OCP compound fertilizer, T₂: Farmer's practice, and T₃: recommended fertilizer dose. The dose of OCP compound fertilizer was adjusted with the recommended fertilizer doses. Most of the bulb parameters and yield contributing characters were statistically significant among the different fertilizer practices. The numerically higher amount of bulb (12.82 t ha⁻¹) was weighted from the OCP compound fertilizer application plot which was identical to recommended fertilizer (12.22 t ha⁻¹) and the lower amount of bulb (10.16 t ha⁻¹) was weighted from the farmer practice. Upon cost and

return analysis the highest BCR (2.24) was recorded from OCP compound fertilizer treat plots (T₁) followed by recommended fertilizer treated plots (T₃) and the lowest (1.81) from farmers practiced plots (T₂). Application of OCP compound fertilizer exhibited better performance over the other practices regarding bulb yield and similar trends were obtained in the last year's observation. The highest gross return (Tk 448700 ha⁻¹) and BCR (2.24) was obtained from the application OCP compound fertilizer and the lowest gross return (Tk 355600 ha⁻¹) and BCR (1.81) from farmers practice. This is the second year trial and similar trends were obtained in the last year's observation.

Effect of ocp compound fertilizer on the growth and yield of garlic

M. A. Islam, M. S. Alam, and M. R. A. Mollah, M Akkas Ali, M Shahiduzzaman

The study was conducted at Laxmikhola under Dewli union, Shibganj, Bogura during the Rabi season of 2020-21 to find out the effect of OCP compound fertilizer and improved practice on the yield of Garlic funded by the OCPF-BARI-ICARDA collaborative project. BARI Rashun-1 was used as the test crop. The experiment was laid out in an RCB design with four replications. Three different fertilizers management was considered as the treatment for the trial viz. OCP compound fertilizer, recommended fertilizer dose (RFD) and farmer practice. The dose of OCP compound fertilizer was calculated from the SRC recommended dose. Most of the bulb parameters and yield contributing characters were statistically significant among the different fertilizer practices. The higher amount of bulb (8.78 t ha⁻¹) was weighed from the OCP compound fertilizer application plot which was identical to SRC recommended practice (8.22 t ha⁻¹). The lowest amount of bulb (6.32 t ha⁻¹) was weighted from the farmer's practice. Application of OCP compound fertilizer and optimum fertilizer management options showed better performance over the farmer's practice regarding bulb yield of Garlic. Upon cost and return analysis, the highest gross return (Tk 614600 ha⁻¹) and BCR (2.30) was obtained from the application OCP compound fertilizer-based treatment (T₁) followed by improved management practice and the lowest gross return (Tk 442400 ha⁻¹) and BCR (1.69) from

the farmers practiced plots (T_2). This is the second year trial and similar trends were obtained in the last year's observation.

Effect of ocp compound fertilizer on the growth and yield of blackgram

M. A. Islam, M. S. Alam, and M. R. A. Mollah, M Akkas Ali, M Shahiduzzaman

The study was conducted at the on-station, of OFRD, BARI, Bogura during the Rabi season of 2020-21 to find out the effect of OCP compound fertilizer and improved practice on the yield of Blackgram funded by the OCPF-BARI-ICARDA collaborative project. BARI Mash-3 was used as the test crop. The experiment was laid out in an RCB design with four replications. Three different fertilizers management were considered as the treatment for the trial viz. OCP compound fertilizer, recommended fertilizer dose, and farmer practice. The dose of OCP compound fertilizer was calculated from the PRC recommended dose. Most of the yield and yield contributing characters were statistically significant among the different fertilizer practices. Application of OCP compound fertilizer and optimum fertilizer management options showed better performance over the farmer's practice regarding yield and economic return. The higher seed yield (1.46 t ha^{-1}) was weighted from the OCP compound fertilizer application plot which was identical to recommended practice (1.39 t ha^{-1}) and the lower (1.23 t ha^{-1}) from the farmer practice. Upon cost and return analysis, it was observed that the higher seed yield contributed to the higher economic return from OCP compound fertilizer treat plots (T_1) followed by recommended fertilizer treated plots (T_3) and the lower return from the farmers practiced plots (T_2). The highest gross return (Tk 89580 ha^{-1}) and BCR (2.48) was obtained from the application OCP compound fertilizer based treatment (T_1) followed by improved management practice and the lowest gross return (Tk 76050 ha^{-1}) and BCR (2.18) from the farmers practiced plots (T_2). This is the second-year trial and similar trends were obtained in the last year's observation.

Effect of different fertilizer management packages on yield of soybean in chandpur

M.M. Bashir, M.H. Hossain and S.K. Bhowal, M Akkas Ali, M Shahiduzzaman

The fertilizer trial was carried out in the Dakkhin Gobindia village of Chandpur Sadar upazilla of Chandpur district during the Rabi season of 2021 with a view to test the performance of different fertilizer packages on Soybean. There was no statistical difference in any parameter except plant height and plant population m^{-2} . Plant height (92.27cm) was the highest in farmers practice treatment, which produced numerically more yield, gross return and gross margin than BARI Recommended Dose and STB fertilizer treatment. STB gave numerically the lowest yield, gross return and gross margin, but it had highest plant population.

Nutrient management for bulb production of bari piyaj-4 in faridpur

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

A trial was conducted at the Farming System Research and Development site, Sholakundu, Faridpur during the rab, 2020-21 to find out optimum fertilizer packages for higher sustainable productivity of BARI Pijaj-4 under farmers' field condition. Four treatments were considered as T_1 (STB following FRG, 2018) = $N_{144} P_{30} K_{47} S_9 Z_n 2B_{0.7} \text{ kg ha}^{-1}$, T_2 (IPNS basis Recommended Fertilizer Dose with cow dung as per FRG, 2018) = $N_{115} P_{53} K_{49} S_{30} Z_n B_{1.5} \text{ kg ha}^{-1}$ + cow dung (5 t ha^{-1}), T_3 (150% of chemical fertilizer) = $N_{210} P_{90} K_{90} S_{45} Z_n 4.5B_{2.2} \text{ kg ha}^{-1}$ and T_4 (Farmer's practice) = $N_{205} P_{125} K_{100} S_{30} Z_n B_{1} Mg_{1.5} \text{ kg ha}^{-1}$. The experiment was laid out in randomized complete block design with five dispersed replications. BARI Pijaj-4 was used as planting material in the study. The highest bulb yield was obtained from farmers practice (T_4) (21.95 t ha^{-1}) followed by T_3 . The lowest bulb yield (19.90 t ha^{-1}) was recorded in soil test based treatment (T_1). Maximum gross return (Tk 549000 ha^{-1}) and gross margin (Tk 360065 ha^{-1}) obtained from farmer's practice. But, T_1 gave the highest benefit cost ratio (2.92).

Integrated nutrient management for bitter gourd cultivation in calcareous soil in faridpur

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

A trial was conducted at the Farming System Research and Development site, Sholakundu,

Faridpur during the kharif-I, 2020 to find out a suitable nutrient package and to increase sustainable yield of Bitter gourd under farmers' field situation. BARI Korola-2 was used as planting material in the study. The experiment was laid out in randomized complete block design with three dispersed replications. Seven (7) treatments were considered as T₁ (Soil Test Based following FRG' 2018) = N₈₀P₂₅ K₂₅S₅Zn₁B_{0.5} kg ha⁻¹, T₂ (120% of STB) = N₉₆P₃₀ K₃₀S₆Zn_{1.2}B_{0.6} kg ha⁻¹, T₃ (IPNS basis T₁ with cow dung) = N₅₅P₁₈K₁₄S₅Zn₁B_{0.5} kg ha⁻¹ + cow dung (5 t ha⁻¹), T₄ (IPNS basis T₁ with vermicompost) = N₅₅P₄₀ K₄S₁₃Zn₁B_{0.5} kg ha⁻¹ + vermicompost (2 t ha⁻¹), T₅ (T₁ + 8 kg ha⁻¹ Mg) = N₈₀P₂₅ K₂₅S₅Zn₁B_{0.5}Mg₈ kg ha⁻¹, T₆ (T₁ + 10 kg ha⁻¹ Mg) = N₈₀P₂₅ K₂₅S₅Zn₁B_{0.5}Mg₁₀ kg ha⁻¹, and T₇ (Farmer's practice) = N₁₁₅P₅₀K₅₀S₄₅Zn₄B₂ kg ha⁻¹. The highest fruit yield was obtained from farmers practice treatment, T₇ (18.09 t ha⁻¹) for cumulative effect of the highest yield contributing parameters followed by STB dose with 8 kg ha⁻¹ Mg treatment, T₅ (17.84 t ha⁻¹). The maximum gross return (Tk 814050 ha⁻¹) and gross margin (Tk 615200 ha⁻¹) were obtained from farmer's practice followed by T₅. But, the highest benefit cost ratio was calculated from T₅ (4.23) followed by T₇ (4.09). The chemical fertilizer dose used in farmers practice treatment (T₇) was many times higher than all treatments that was irrational and may harmful to environment. Whereas treatment, T₅ (T₁ + 8 kg ha⁻¹ Mg) = N₈₀P₂₅ K₂₅S₅Zn₁B_{0.5}Mg₈ kg ha⁻¹ gave the statistically similar fruit yield in against of farmers treatment (T₇) with rational use of fertilizer and reducing production cost.

Effect of variety and fertilizer of onion bulb production under zero tillage condition in shariatpur

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

An experiment was carried out at farmers' field of Uttar Dubaldia under Jajira upazilla, Shariatpur during the rabi 2019-2020 to 2020-21 to find out the suitable variety and fertilizer dose for increasing bulb yield of Onion under zero tillage condition. Six treatments i.e. T₁: BARI Paj-1 + Soil Test Based Fertilizer dose, T₂: BARI Paj-1 + 150% STB, T₃: BARI Paj-1 + Farmer's fertilizer dose (FFD), T₄: Local variety + STB, T₅: Local

variety + 150% STB and T₆: Local variety + FFD were used. It was laid out in randomized complete block design with four dispersed replications. The average highest bulb yield (17.91 t ha⁻¹) was obtained from T₄ followed by T₅ (16.72 t ha⁻¹). The average lowest bulb yield was found in T₂ treatment (15.08 t ha⁻¹). The average highest gross return (Tk 1035100 ha⁻¹) and gross margin (Tk 735388 ha⁻¹) were accounted from T₄ due to obtain the highest yield.

Validation of biofertilizer of lentil

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

A field trial was conducted at the Farming Systems Research and Development site, Faridpur during the rabi of two consecutive year 2019-20 to 2020-21 to find out the effects of rhizobial biofertilizers on the performance of Lentil. The trial was laid out in randomized complete block design with four dispersed replications. The Lentil variety BARI Masur-8 and peat based rhizobium strain (BARI RLC-104) were used for the experiment. Unit plot size was 6 m × 5 m. Three treatment combinations viz., T₁ (without Rhizobium inoculant+ P₂₂K₄₂S₂₀ Zn₅ kg ha⁻¹), T₂ (with Rhizobium inoculant+ P₂₂K₄₂ S₂₀ Zn₅ kg ha⁻¹) and T₃ (N₅₀P₂₂K₄₂S₂₀Zn₅ kg ha⁻¹) were tested in this regard. From the average of two years result, the higher seed yield was obtained (1.90 t ha⁻¹) where Rhizobium inoculant along with P₂₂K₄₂ S₂₀Zn₅ kg ha⁻¹ was used (T₂). The highest gross return (Tk 133950 ha⁻¹) and gross margin (Tk 90589 ha⁻¹) was also accounted from the treatment T₂.

Validation on biofertilizer of groundnut

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

A field trial was conducted at Dikrirchar, Faridpur during the kharif-I, 2020 to find out the effect of rhizobial biofertilizers on the performance of Groundnut. The BARI Chinabadam-8 and inoculum BARI RAh-801 were used as the trial materials. The trial was laid out in randomized complete block design with seven dispersed replications. Three treatments viz., T₁ (without Rhizobium inoculant+ P₅₀ K₃₀S₃₅Zn₂B_{1.5} kg ha⁻¹), T₂ (with Rhizobium inoculant+ P₅₀K₃₀S₃₅Zn₂B_{1.5} kg

ha⁻¹) and T₃ (N₅₀P₅₀K₃₀S₃₅ Zn₂B_{1.5} kg ha⁻¹) were considered in this regard. It is observed that, the nut yield obtained (1.42 t ha⁻¹) was the highest in plots where Rhizobium inoculant along with P₅₀K₃₀S₃₅Zn₂B_{1.5} was used (T₂). Benefit cost ratio was also higher in T₂ treatment (1.27) over those of other two treatments.

Nutrient management of zero tillage potato in saline areas

Mustafa Kamal Shahadat, Md. Harunor Rashid, Md. Kamrul Islam and Md. Mashfiqur Rahman, M Akkas Ali, M Shahiduzzaman

An experiment on nutrient management of zero tillage potato production was conducted at Dacope upazila of Khulna district during 2020-21. Since, under zero tillage practice efficiency of conventional top dress nutrient application is poor, hence nutrient combination of foliar spray and top dress with soil were tested. Four nutrient combinations were tested on two potato varieties viz. BARI Alu-46 and BARI Alu-72. The treatments were T₁: 50% N and K + All P, S, Zn, Mg, B at basal + 25% N and K top dress with soil at 30 and 45 DAP (control); T₂: All Basal + only NPK top dress with spray at 30, 45, 60 DAP; T₃: 75% NPKS Basal+ 12.5%NPKS and 50% Mg, Zn, B top dress with soil at 30 and 45 DAP and T₄, All Basal NPKSMgZnB top dress with spray at 30, 45, 60 DAP. It was found that only foliar spray of NPK at 30, 45 and 60 DAP (T₂) produced highest tuber yield (20.0 t ha⁻¹) in BARI Alu-72. Between the varieties BARI Alu-72 gave highest yield (16.33 t ha⁻¹), where BARI Alu-46 was less responsive to spray treatments.

Validation on biofertilizer of different legume crops in kushtia

J A Mahmud, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at Kushtia sadar and Multi Location Testing site, Chuadanga during the rabi season of 2020-21 to observe the effect of rhizobial biofertilizers of Lentil, chickpea and mungbean. The effect of rhizobial biofertilizers of Lentil, chickpea and mungbean was found positive. The yield of Lentil (1.84 t ha⁻¹), chickpea (1.73 t ha⁻¹) and mungbean (1.25 t ha⁻¹) was higher in rhizobial applied field than other treatments.

Effect of nutrient management and storage methods on the yield and storability of sweet potato in kushtia

J A Mahmud, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at Kumarkhali, Kushtia during 2020-2021 in farmer's field to observe the nutrient management of sweet potato. Three treatments viz. T₁= 126-15-115-8 kg NPKS ha⁻¹+3 ton poultry manure ha⁻¹ (IPNS), T₂= 128-13-118-12 kg NPKS ha⁻¹+ 6 ton cow dung ha⁻¹ (IPNS), T₃= Farmer's practice (100-20-110 kg NPK ha⁻¹) were applied in this experiment. BARI sweet potato variety BARI SP-8 was used in this trial. The highest tuber yield was obtained from T₁ (24.36 t ha⁻¹) and the lowest from T₃ (20.50 t ha⁻¹).

Effect of different fertilizer doses on sesame in charland condition in kushtia

J A Mahmud, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at Multi Location Testing site Bheramara in Kushtia during 2020-21 to observe the effect of different fertilizer doses on Sesame in charland condition. BARI Til-4 was used in this experiment. The treatments were: T₁= Soil test based fertilizer dose, T₂= 58-26-23-14-3-0.43 kg NPKSZnB ha⁻¹+5 ton cow dung ha⁻¹, T₃= Farmer's practice were observed. The highest seed yield was obtained from T₂ (1.45 t ha⁻¹) and the lowest from T₃ (1.40 t ha⁻¹).

Validation of fertilizer management on fruit yield of bt brinjal

M R Amin, M Akkas Ali, M Shahiduzzaman

The field experiment was conducted at Ramnagar village under Shibaloya upazila of Manikganj district during Rabi season of 2020-21 to observe the response of fertilizers on the yield performance of BARI Bt Begun-4 in the farmers' field. The experiment was conducted in randomized complete block design with three replications. Three fertilizer treatment combinations T₁=180-54-135-22-3-1.50 kg NPKSZnB ha⁻¹ +5 ton cow dung ha⁻¹ (STB Recommended dose+50% NPK); T₂=150-45-112-18-2.5-1.25 kg NPKSZnB ha⁻¹+10 t cow dung ha⁻¹ (STB Recommended dose+25% NPK+5 t cow dung ha⁻¹); T₃= 150-45-112-18-2.5-1.25 kg N-P-K-S-Zn-B ha⁻¹ +5 t cow dung ha⁻¹(STB Recommended dose+25% of NPKSZnB) were

evaluated. Among the treatments $T_2=150-45-112-18-2.5-1.25$ kg NPKSZnB $ha^{-1}+10$ t cow dung ha^{-1} (STB Recommended dose + 25% NPK+5 t cow dung ha^{-1}) gave the highest fruit yield (33.33 t ha^{-1}) followed by soil test based fertilizer dose $T_3=150-45-112-18-2.5-1.25$ kg NPKSZnB ha^{-1} of +5 t cow dung ha^{-1} (STB Recommended dose+25% of NPKSZnB) produced 31.46 t ha^{-1} and $T_1=180-54-135-22-3-1.50$ kg NPKSZnB $ha^{-1}+5$ t cow dung ha^{-1} (STB Recommended dose + 50% NPK) gave the lowest (30.00 t ha^{-1}) fruit yield. But, treatment T_3 ($150-45-112-18-2.5-1.25$ kg NPKSZnB $ha^{-1}+5$ t cow dung ha^{-1} of) was the best in respect of economic return with higher BCR (3.49).

Effect of nutrient management on the performance of onion

M R Alom, M Akkas Ali, M Shahiduzzaman

The trial was conducted at Farming Systems Research and Development (FSRD) Site, Ganggarampur, Pabna during the rabi season of 2020-21 to find out the effect of nutrient management package on the performance of Onion. Different nutrient management packages viz. T_1 = Recommended fertilizer (RF) (FRG' 2018), T_2 = IPNS with 2 tonvermicompost ha^{-1} , T_3 = IPNS with 5 ton cow dung ha^{-1} , T_4 = IPNS with 1.5 t rice husk ash ha^{-1} and T_5 = Farmers practice ($159-45-113-7$ kg NPKS ha^{-1}) were tested on Onion (BARI Pijaj-1). The application of IPNS with 1.5 t ha^{-1} rice husk ash exhibited better performance on bulb yield of Onion which was statistically similar with IPNS with 2 t vermicompost ha^{-1} and IPNS with 5 t cow dung ha^{-1} . Maximum gross return and gross margin was obtained from IPNS with 1.5 t rice husk ash ha^{-1} followed by IPNS with 2 t vermicompost ha^{-1} and IPNS with 5 t cow dung ha^{-1} .

Effects of tillage, residue retention and phosphorus management on the performance of mustard in rice based system of northwest bangladesh

M R Alom, M Akkas Ali, M Shahiduzzaman

Performance of mustard under three tillage treatments such as conventional tillage (CT), no tillage (NT) and strip planting (SP), two levels of residue retention–high residue (HR) and low residue retention (LR) and three levels of phosphorus (50% of recommended P, 100% of

recommended P and 150% of recommended P) were evaluated in rice based system of Bangladesh. The field experiment was initiated in November 2015 and continuing for a longer term period at Pulses Research Centre Ishurdi, Pabna. The cropping sequence Mustard-Mungbean-T.Aman is practicing since November 2018 at Ishurdi, Pabna. In the present report, only the crop number 16 (mustard) grown in rabi season (cool dry season) of 2020-21 are presenting. The results showed that the application of SP resulted in higher number of plant population m^{-2} , siliquaplant $^{-1}$ while decreasing alternaria leaf spot diseases, which may lead to increase seed yield by 16% and straw yield of mustard by 24% over CT. The HR increased seed yield by 6% and straw yield by 11% over LR. In case of P levels, the increased dose of P (150% of recommended P) increased plant height, siliquaplant $^{-1}$, seeds plant $^{-1}$ while decreasing alternaria leaf spot diseases and consequently, the seed and straw yield of mustard finally increased. However, this study will be continued for a long-term period to concrete conclusion.

Development of fertilizer management package for onion

M R Alom, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at Multi Location Testing (MLT) Site, Sujanagar, Pabna during the rabi season of three consecutive years (2018-19 to 2020-21) to find out the optimum fertilizer package for Onion cultivation. Different fertilizer management packages viz. T_1 = Recommended fertilizer (RF) (FRG' 2018), T_2 = RF + Extra 25% NPKS, T_3 = RF + 1.5 ton rice husk ash ha^{-1} , T_4 = RF+ 2 ton poultry manure ha^{-1} and T_5 = Farmers fertilizer package ($159-45-113-7$ kg NPKS ha^{-1}) were tested on popular variety of onion (BARI Pijaj-1). The application of RF + 1.5 ton rice husk ash ha^{-1} and RF+ 2 ton PM ha^{-1} exhibited better performance on yield attributes and bulb yield of Onion. Maximum gross return (Tk 596150 ha^{-1}) and gross margin (Tk 447294 ha^{-1}) was obtained from RF + 1.5 ton rice husk ash ha^{-1} followed by RF + 2 ton PM. ha^{-1} Therefore, application of RF + 1.5 ton rice husk ash ha^{-1} and RF + 2 ton PM ha^{-1} is found viable fertilizer management package for Onion production regarding bulb yield and economic return.

Effect of organic fertilizer to mitigate soil salinity and maximize yield of potato in coastal saline soil

K.N. Islam, M.M. Islam, P. Chakraborti, and M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at Multi Location Testing site Kuakata, Patuakhali in the rabi season of 2020-21 to observe the effect of different organic matter of potato production under farmers field condition. Different types of organic matter along with soil test based inorganic fertilizers were used in the trial. The treatments of the trials were as T_1 =STB+3 ton cow dung ha^{-1} , T_2 = STB+5 t cow dung ha^{-1} , T_3 = STB+1.5 ton Compost ha^{-1} , T_4 = STB+2 t Compost ha^{-1} , T_5 = STB+ 2 ton Vermicompost ha^{-1} , T_6 = STB+2.5 t Vermicompost ha^{-1} and T_7 = Farmers practice. The significant effect was found in yield and yield contributing parameters in combination of various level of organic fertilizer with inorganic fertilizer for potato production in coastal region. Soil EC was found lower in organic fertilizer treated plots. Vermicompost reduced salinity more than compost and cow dung. The highest gross return (Tk415380 ha^{-1}), gross margin (Tk 249680 ha^{-1}) and BCR (2.51) was recorded from T_6 treatment, followed by T_5 and T_4 . The lowest economic return was recorded from control plot (farmers practice) (Tk 307160 ha^{-1}) and BCR (2.00).

Effect of different fertilizer management on the performance of bari bt brinjal

M. Anwar and M. M. I. Chowdhury, M Akkas Ali, M Shahiduzzaman

The experiment was conducted in the farmers field of Shibpur, Puthia, Rajshahi during the robi season of 2017-18, 2018-19, 2019-20 and 2020-21 to evaluate the effect of nutrients management packages on Bt begun cultivation and to find out a suitable combination of different fertilizers for Bt Brinjal production. The experiment was laid out in Randomized Complete Block design with six fertilizer doses viz. T_1 = STB fertilizer splitting as per recommendation (FRG, 2018), T_2 = T_1 +25% NPK (NK splitting 5 times), T_3 = T_1 +50% NPK (NK splitting 5 times), T_4 = T_1 +75% NK (NK splitting 5 times), T_5 = T_1 +25% NPKS and

T_6 =Farmers dose. Brinjal variety BARI Bt Begun-4 was used as test crop. Among the treatment, the highest yield 48.08 t ha^{-1} in 2017-18, 47.7 t ha^{-1} in 2018-19, 47.2 t ha^{-1} in 2019-20 and 40.5 t ha^{-1} in 2020-21 was obtained from T_4 followed by T_3 . Based on four year data maximum gross return (Tk 550440 ha^{-1}), gross margin (Tk 367471 ha^{-1}) and BCR (3.01) were recorded in T_4 . The fertilizer dose T_4 (187-26-135-8-1-1 kg ha^{-1} NPKSZn and B respectively) with 5 t cow dung ha^{-1} can be extensively used for BARI Bt Begun-4 production in AEZ-11.

Development of fertilizer recommendation for mukhikachu production in aez-11

M. Anwar and M. M. I. Chowdhury, M Akkas Ali, M Shahiduzzaman

The experiment was conducted in the farmer's field of Mohanpur, Rajshahi during the kharif season of 2019-2021 to evaluate the effect of nutrients management packages on mukhikachu cultivation and to find out a suitable combination of different fertilizers for mukhikachu production. The experiment was laid out in Randomized Complete Block design with four fertilizer treatments viz. T_1 = Soil test based dose (FRG, 2018), T_2 = 25% higher NPK of soil test base dose, T_3 = 50% higher NPK of soil test base dose, and T_4 =Farmers dose. Local mukhikachu variety 'sonamukhi' was used as test crop. Among the treatment, the highest yield was obtained from T_3 (22.99 t ha^{-1}) followed by T_4 (20.84 t ha^{-1}) and T_2 (20.27 t ha^{-1}). Maximum gross return (Tk 574750 ha^{-1}) found in T_3 where maximum gross margin (413735 Tk ha^{-1}) and BCR (3.57) were recorded in 2019-20. On the other hand the highest yield was obtained from T_3 (33.23 t ha^{-1}) followed by T_4 (28.75 t ha^{-1}), T_3 (28.3 t ha^{-1}) and minimum obtained from T_1 (26.55 t ha^{-1}). Maximum gross return (Tk 764290 ha^{-1}), gross margin (Tk 592539 ha^{-1}) and BCR (4.44) found in T_3 treatment in 2020-21.

Effect of rice straw burn ash on the yield of mustard

M. I. Nazrul, M Akkas Ali, M Shahiduzzaman

A field experiment was conducted during 2020-21 in winter season at Madhobpur under MLT site, Habigonj. Four different cultivation practices T_1 = Rice straw burn + no tilth, T_2 = Rice straw burn +

no tilth + water spray, T_3 = Rice straw burn + one tilth and T_4 = Rice straw burn + two tilths were used in this experiment. The experiment was setup in randomized complete block design with three replications. Among the cultivation practices the treatment Rice straw burn + two tilths contributed higher seed yield (1.64 t ha^{-1}) with maximum gross return (Tk 123000 ha^{-1}), gross margin (Tk82200 ha^{-1}) and also higher benefit cost ratio (3.02). Whereas the lowest benefit cost ratio (2.54) was obtained from cultivation practice Rice straw burn + one tilth.

Effect of lime and fertilizer management on yield of onion in sylhet region

M. I. Nazrul, M Akkas Ali, M Shahiduzzaman

Liming in acidic soil is a common practice in many countries, but not yet successfully in Bangladesh. Field experiments were carried out in 2020-21 at the farmer's field on an area with acidic clay loam soil at farming system research and development (FSRD) site, Kamalbazer, South Surma, Sylhet. Two factors experiments viz. A) Fertilizer management, M_1 : Soil test based (STB) fertilizer recommendation, M_2 : 80% of STB dose and M_3 : Farmers practice (FP) and B) Level of limes viz. L_1 : 0 t ha^{-1} , L_2 : 1 t ha^{-1} and L_3 : 2 t ha^{-1} were considered as treatments. These was tested on Onion variety BARI Piaj-1. Trials were laid out in split plot design with three replications, where lime levels were allotted to main plot and level of fertilizers were distributed in the subplots. The bulb yield of onion from total of nine treatment combinations varied significantly with different lime doses and fertilizer management practices. The highest bulb yield of onion (13.78 t ha^{-1}) was obtained from treatment combination L_2M_1 (1.00 t ha^{-1} lime and STB fertilizer dose) followed by L_3M_1 . The highest gross margin (Tk 31878 ha^{-1}) was obtained from L_2M_1 , but the maximum MBCR (6.60) was recorded in L_1M_1 , where the lime was absent though it is essential for onion cultivation in acidic soil. Considering the overall benefit of lime in relation to soil acidity and nutrient availability for crop production the economic loss in term of MBCR might be over looked. So the application of lime (1.00 t ha^{-1}) along with STB fertilizer dose contributed higher bulb yield (13.78 t ha^{-1}) over all other treatment combinations.

Effect of lime and fertilizer management on yield of maize in acidic soil of sylhet region

M. I. Nazrul, M Akkas Ali, M Shahiduzzaman

An experiment was carried out in 2020-21 at the farmer's field on an area with acidic clay loam soil at multi location testing (MLT) site, Moulvibazer. Two factors experiments viz. A) Fertilizer management, M_1 : Soil test based (STB) fertilizer recommendation M_2 : 80% of STB dose and M_3 : Farmers practice (FP) and B) Level of limes viz. L_1 : 0 t ha^{-1} , L_2 : 1 t ha^{-1} and L_3 : 2 t ha^{-1} were considered as treatments. These were tested on BARI Hybrid Maize-9. Trials were laid out in split plot design with three replications, where lime levels were allotted to main plot and level of fertilizers were distributed in the subplots. The grain yield of Maize in a total of nine treatment combinations varied significantly with different lime doses and fertilizer management practices. The highest grain yield of Maize (8.67 t ha^{-1}) was obtained from treatment combination L_3M_1 (2.0 t ha^{-1} lime and STB fertilizer dose) followed by L_3M_2 . The highest gross margin (Tk 273585 ha^{-1}) was obtained from L_2M_1 , but the maximum MBCR (20.93) was recorded in L_2M_2 , where the lime was 1.0 t ha^{-1} . Which is essential for Maize in acidic soil. Incorporation of higher lime dose and fertilizer levels increased higher cost and provided lower MBCR. So, moderate lime dose (1.0 t ha^{-1}) along with 80% of STB fertilizer might be useful for Maize cultivation in acidic soil.

Effect of zinc and boron on chilli production in char areas of gaibandha

Md. Jahangir Alam and, Abdullah Al Mahmud, M Akkas Ali, M Shahiduzzaman

An experiment was conducted in the farmers' field at Chinirpotol char, Saghata, Gaibandha during the rabi season of 2019-20 and 2020-21 to find out the suitable fertilizer dose for chilli cultivation in char areas. The experiment comprised with five treatments T_1 : Soil Test Based (FRG' 2018), T_2 : $T_1 + \text{Zn}_1\text{B}_1 \text{ kg ha}^{-1}$, T_3 : $T_1 + \text{Zn}_2\text{B}_{1.5} \text{ kg ha}^{-1}$, T_4 : $T_1 + \text{Zn}_3\text{B}_2 \text{ kg ha}^{-1}$ and T_5 : Farmers practice (average of 10 farmers'). Among the treatment combinations the highest green chilli yield 12.47 t ha^{-1} (12.43 t ha^{-1} in 2019-20 and 12.50 t ha^{-1} in 2020-21) and gross return (aver. Tk 373950 ha^{-1}), gross margin

(av Tk 243847 ha⁻¹) was obtained from T₃ treatment with BARI Morich-3, similar to the T₄ treatment. The lowest green chilli yield 7.98 t ha⁻¹ in 2019-20 and 8.10 t ha⁻¹ in 2020-21 with an average of 8.04 t ha⁻¹, having the lowest gross return (av Tk 241200 ha⁻¹), gross margin (Tk 112208 ha⁻¹) was recorded from farmers' practices (T₅) treatment. The highest marginal benefit cost ratio (MBCR) was also recorded in the same T₃ treatment (119.5), more compared to the other treatment combinations.

Determination of suitable zinc fertilizer dose for maize production in char areas of gaibandha

Md. Jahangir Alam and, Abdullah Al Mahmud, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at Chinirpotol char of Saghata, Gaibandha under the supervision of OFRD, Gaibandha during the rabi season of 2019-20 and 2020-21 to determine the suitable dose of zinc fertilizer for better yield of Maize in char areas. The experiment was laid out in a randomized complete block design with six dispersed replications. Five zinc fertilizer doses i.e. T₁= Zn₀ kg ha⁻¹, T₂= Zn₂ kg ha⁻¹, T₃= Zn₄ kg ha⁻¹, T₄= Zn₆ kg ha⁻¹ and T₅= Zn₈ kg ha⁻¹ were tested on hybrid Maize variety (BHM-9). Other fertilizers were used as soil test based (STB). The significant highest grain yield 10.30 t ha⁻¹ in 2019-20 and 10.50 t ha⁻¹ in 2020-21 with an average of 10.40 t ha⁻¹ was recorded in T₄ treatment where 6 kg Zn ha⁻¹ was applied, similar to T₅ (Zn₈ kg ha⁻¹) treatment and the lowest yield recorded in T₁ treatment with an average of 5.56 t ha⁻¹ (5.50 t ha⁻¹ in 2019-20 and 5.63 t ha⁻¹ in 2020-21). Similar trends were also observed in all the yield contributing characters. The highest gross return (Tk. 208000 ha⁻¹), gross margin (Tk 115036 ha⁻¹) was observed in the same T₄ treatment (Zn₆ kg ha⁻¹) due to highest Maize yield and the lowest gross return (Tk 111267 ha⁻¹) and gross margin (Tk 19143 ha⁻¹) in control (T₁) treatment. Although, the highest marginal benefit cost ratio (MBCR) was also recorded in the same T₃ treatment (121.2), more compared to the other treatment combinations.

Performance of water hyacinth residue for cauliflower production at aez-14

The experiment was conducted at FSRD site, Gopalganj and Nazirpur, Pirojpur during rabi

season 2020-21 to determine the amount of residue of water hyacinth as an organic source for production of cauliflower. There are four doses of different organic fertilizer viz. T₁= 5 ton cow dung ha⁻¹ (control) T₂= 5 ton water hyacinth residue ha⁻¹, T₃= 8 ton water hyacinth residue ha⁻¹, T₄= 11 ton water hyacinth residue ha⁻¹ as treatment. Result revealed that treatment T₁ gave the highest yield (44.30 t ha⁻¹) where 5 t cow dung ha⁻¹ as organic fertilizer was used and its statistically similar yield (42.89 t ha⁻¹) was found by T₄ treatment where residue of water hyacinth was used @ 11 t ha⁻¹ with recommended chemical fertilizer. The lowest yield (33.64 t ha⁻¹) was observed in T₂ treatment where 5 t ha⁻¹ residue of water hyacinth was applied.

Project II: Improvement of Cropping Systems

Development of four crop based cropping pattern Mustard-Boro/Jute- T. Aman Against Mustard-Boro-T. Aman

M. K. Shahadat, M.H. Rashid, M. M. Rahman and M. F. Hossain, M Akkas Ali, M Shahiduzzaman

An on-farm trial has been conducted at MLT site, Satkhira under AEZ-13 to increase cropping intensity and productivity through a four crop-based cropping pattern against farmer's existing practice of Mustard-Boro-T. Aman. The four crop-based cropping pattern was Mustard- Boro/Jute-T. Aman and variety of each crop were BARI Sarisha-14, BRRI dhan28, NSC and GRO-524, and Binadhan-7, respectively. Jute was relayed into Boro rice for the accommodation of an extra crop in the pattern. It was observed that four crop patterns produced the highest rice equivalent yield (REY) (33.77, 37.74, and 42.78 t ha⁻¹) than farmer's practice (15.24, 18.00, and 20.31 t ha⁻¹) during 2019-20. Likewise, production efficiency was also higher in four crop patterns (95.12, 104.60, and 117.84 kg ha⁻¹day⁻¹) than farmer's practice (55.40, 74.70, 108.47 kg ha⁻¹day⁻¹). Cost-benefit analysis over three years showed that the four-crop pattern gave the highest gross return (Tk. 753243 ha⁻¹) and gross margin (Tk. 562180 ha⁻¹). The marginal benefit-cost ratio of the four crop patterns over the existing pattern was 4.08, which indicates four crops are a profitable one. However, there are

challenges in the timely establishment of crops due to variability in the weather pattern, seed availability, sources of irrigation water, shortage of laborers, credit facilities, farm machinery etc.

Development of four crops based Fieldpea-Boro-T. Aus-T. Aman cropping pattern against Mustard-Boro-T. Aman cropping pattern

K U Ahammad, M Akkas Ali, M Shahiduzzaman

A field trial was conducted at the farmers' field of Jhikargacha MLT Site, Jashore during 2019-20 and 2020-21 to develop Field pea-Boro-T. Aus-T. Aman rice cropping pattern against Mustard-Boro-T. Aman rice cropping pattern. There were two treatments i.e., T₁: Existing cropping pattern; Mustard (var. Tori-7)-Boro (var. BRRI dhan28)-T. Aman (var. Binadhan-7) and T₂: Alternate cropping pattern: Field pea (var. BARI Motor-3)-Boro (var. BRRI dhan28)-T. Aus (var. BRRI dhan48)-T. Aman (var. BRRI dhan75). Higher Rice Equivalent yield and gross margin were obtained from alternate cropping pattern over existing cropping pattern due to inclusion of new crops and the marginal benefit-cost ratio was 2.05.

Development of cropping pattern Black Gram/Grass Pea-Jute-T. Aman Rice against existing cropping pattern Grass Pea-T. Aman in charland

Md. Samim Hossain Molla, Md. Zannatul Ferdous and Md. Al-Amin Hossain Talukder, M Akkas Ali, M Shahiduzzaman

The field experiment was conducted during 2019-20 and 2020-21 to increase the cropping intensity and productivity by developing four crop-based cropping patterns against the existing two or three crop-based cropping patterns. The four crops-based alternate cropping patterns (Jute-T. Aman-Black gram/Grass pea) were tested against the existing cropping pattern (T. Aman rice-Grass pea) in the farmer's field under stable Charland of Chilmari, Kurigram. Fiber or grain or seed yield of Jute, T. Aman, Blackgram, and Grass pea were recorded as 2.08, 4.89, 1.33, and 1.25 t ha⁻¹, respectively with rice equivalent yield (REY) 21.47 t ha⁻¹ in the improved cropping pattern whereas 3.23 and 1.28 t ha⁻¹ grain or seed yield of T. Aman and grass pea with REY 7.11 t ha⁻¹ were recorded in the existing cropping pattern during 2020-21. Production

efficiency was 62.42 and 30.26 Kg ha⁻¹day⁻¹, and land-use efficiency was 94.25 and 64.38% in alternate and existing cropping patterns, respectively. The whole pattern gross margin was higher in the alternate pattern (Tk. 317700 ha⁻¹) than the existing pattern (Tk. 90420 ha⁻¹). The MBCR was 3.56 in an alternate pattern over the existing pattern.

Development of alternate four crops based cropping pattern to increase cropping intensity in rangpur region

Md. Samim Hossain Molla, Md. Zannatul Ferdous and Md. Al-Amin Hossain Talukder, M Akkas Ali, M Shahiduzzaman

A set of four crop-based alternate cropping patterns (ACP) were tested against farmers existing three crop-based cropping patterns (FCP) at FSRD site, Ajoddhapur, Rangpur and MLT site, Gobindaganj, Gaibandha under On-Farm Research Division, BARI, Rangpur during the year of 2017-18 to 2019-20 to increase the cropping intensity and productivity and also to disseminate those ACPs among the farmers of respective locations. In all locations, ACP consist of 4 crops was compared with 3 crop-based farmers existing cropping pattern (FCP). In most cases, the results exposed that the ACP with four crops could be established successfully with short-duration crop varieties. In these studies, ACPs were more profitable and viable than those of FCPs in terms of the agronomic and economic points of view. Irrespective of locations, rice equivalent yield (REY), crop productivity, and profitability were higher in ACPs than FCPs. The inclusion of new crops in the existing cropping pattern and replacing old and traditional varieties with modern varieties enhanced productivity and profitability.

Development of alternate cropping pattern Potato-Maize + Coriander-T. Aman Rice against Potato-Maize-T. Aman Rice cropping pattern

S. K. Bhowal, M. H. Hossain and M. M. Bashir, M Akkas Ali, M Shahiduzzaman

A field experiment was conducted at the farmers' field of Daudkandi under AEZ 19 of Cumilla during (2019-20) to fit Coriander in the existing cropping pattern and also to increase cropping intensity and productivity. Two treatments i.e., T₁:

Existing cropping pattern (Potato-Maize-T. Aman) and T₂: Alternate cropping pattern (Potato-Maize+Coriander-T. Aman) were evaluated in the farmer's field. From the research findings, it was found that Rice equivalent yield (REY) in alternate cropping pattern (51.1 t ha⁻¹) was 63% higher over existing pattern (31.4 t ha⁻¹). Higher gross return (Tk. 1022000.00 ha⁻¹) and gross margin (Tk. 791620.00 ha⁻¹) as well as higher MBCR (4.43) were also obtained from alternate cropping pattern over existing cropping pattern due to additional yield of hybrid coriander leaves and higher yield of modern potato variety BARI Alu-40.

Development of black gram-boro rice-fallow cropping pattern against fallow-boro rice-fallow cropping pattern in upper catena of haor area in kishoreganj

M. Mohiuddin and M.N. Sarker, M Akkas Ali, M Shahiduzzaman

Changing single crop system to double crops pattern can play a potential role for achieving countries food security. With this view to increase crop productivity, production efficiency, land use efficiency and economic return through intensifying cropping intensity as well as crop diversity by transforming single cropping pattern to two crops, the experiment was conducted in Old Meghna Estuarine Floodplain Soils under the Agro-Ecological Zone (AEZ) 19 at Nunir haor, under the Multi-location Testing Site, Nikli, Kishoreganj, for two consecutive years 2019-20 and 2020-21. Two crops pattern black gram-Boro rice-fallow was tested at on-farm condition over the existing single crop pattern only Boro rice after flood water receded. Findings revealed that the mean crop duration of 185-189 days were required for one cycle in a year in improved cropping pattern which implied that two crops based cropping pattern was agronomically feasible to replace existing cropping pattern. Total grain yield in terms of REY of improved cropping pattern was 9.742 t ha⁻¹/year which was 29.38% higher than that of existing pattern (7.53 t ha⁻¹/year). Mean production efficiency of improved cropping pattern (52.09 kg ha⁻¹/day) which was 39% less than that of existing pattern due to more time involvement in improved pattern. Land use efficiency of improved cropping pattern was 51.23% i.e. 79.81% higher than that of

existing cropping pattern. The gross return and gross margin were higher in the improved cropping pattern compared to existing cropping pattern due to additional yield of black gram and Boro rice with improved management practices. Therefore, farmers of haor region of Bangladesh could follow alternate cropping pattern in their medium high land to high land where lands remain fallow for 81-86 days after flood water receded for higher crop productivity and profitability.

Development of maize-kenaf-fallow cropping pattern against existing fallow-boro-fallow cropping pattern in upper catena of haor area

M. Mohiuddin and M.N. Sarker, M Akkas Ali, M Shahiduzzaman

An attempt was taken to transform Fallow-Boro rice-Fallow cropping pattern into Maize-Kenaf-Fallow to develop two crops-based cropping patterns in upper catena of haor areas and its agro-economic performance through modern variety and improved technology. With the inclusion of maize and kenaf against rice based pattern was compared in farmers' field at haor region of Kishoreganj during 2019-20 and 2020-21. The inclusion of maize and kenaf against Boro rice increased the rice equivalent yield (REY) 68% than the farmers' existing pattern. The gross return was increased by 67% in Maize-Kenaf-Fallow sequences compared to existing Fallow-Boro rice-Fallow cropping pattern. The marginal benefit cost ratio, land utilization index and production efficiency indicated the superiority of the improved pattern over the farmers' practices.

Development of red amaranth-Garden Pea-Okra-T. Aman Rice cropping pattern against existing Red Amaranth-Okra-T. Aman in mymensingh region (aez 9)

N. Sultana, M.A.H. Khan and M.M. Zaman , M Akkas Ali, M Shahiduzzaman

The experiment was conducted at Multilocation Testing Site (MLT) Trishal under On-Farm Research Division, Bangladesh Agricultural Research Institute, Mymensingh during 2018-19 and 2019-2020 to study the comparative agro-economic performance of four crop based pattern and farmers' existing cropping pattern for increasing cropping intensity and productivity.

Four crop based cropping pattern (Red amaranth-Garden pea-Okra-T. Aman) and farmers' existing cropping pattern (Red amaranth-Okra-T. Aman) with one rice crop as control were tested. Four crops can be grown successfully one after another in sequence of the tested pattern. The highest rice equivalent yield (43.69 t ha^{-1}) was obtained from 4-crop based cropping pattern. Gross return of the improved pattern was Tk. 709962.5 ha^{-1} which was 98% higher over farmers' pattern. The marginal benefit cost ratio (MBCR) was found 3.74. The marginal benefit cost ratio (MBCR) analysis showed that inclusion of garden pea and improved production technology of other existing crop in the existing pattern might be profitable and acceptable to the farmers.

Development of alternate cropping pattern Vegetable-Boro-T. Aman Rice against Vegetable-Fallow - T. Aman

M. Asaduzzaman, M Akkas Ali, M Shahiduzzaman
The experiment was conducted at OFRD, BARI, Shibpur, Narsingdi during the year of 2018-19 and 2019-2020 to improve the existing cropping pattern by inclusion of vegetable and to increase crop yield and farmers income. The experiment was laid out in 4800 m^2 of land under 6 farmers. Alternate cropping pattern Cauliflower (Var. 770) - Boro (BRRI dhan50) - T. Aman (BRRI dhan57) gave higher whole pattern gross margin (Tk. 123890 ha^{-1}) against the existing pattern Vegetable (White snow)- Fallow-T. Aman (BRRI dhan39) (Tk. 101430 ha^{-1}).

Study on vegetable based cropping pattern in narsingdi

M. Asaduzzaman, M Akkas Ali, M Shahiduzzaman
A field experiment was conducted at OFRD, BARI, Shibpur, Narsingdi during the year of 2017-18, 2018-2019 and 2019-2020 to study an economically profitable vegetable based cropping pattern in Narsingdi region for increasing cropping intensity and productivity as well as to meet the vegetable demand for farm family as well as the country. The studied vegetable based cropping patterns were CP1: Radish-Cauliflower-Danta-Indian spinach-Red amaranth, CP2: Red amaranth - Cauliflower-Ladies finger-Brinjal and CP3: Bottle gourd-Snack gourd-Country bean-Cucumber

respectively. The results showed that five vegetable crops could successfully be grown one after another in a sequence in the farmer's field instead of two or three crops in a pattern. Study revealed that on an average the highest Bottle gourd equivalent yield (BEY) $162.92 \text{ t ha}^{-1} \text{ yr}^{-1}$ was obtained from CP3 followed by CEY ($129.63 \text{ t ha}^{-1} \text{ yr}^{-1}$) of CP1 where as the lowest CEY ($124.4 \text{ t ha}^{-1} \text{ yr}^{-1}$) from CP2 during 2018-20. From the economic analysis, it was observed that the highest gross return Tk. 1629200 ha^{-1} was obtained from vegetable crop based cropping pattern CP3: Bottle gourd-Snack gourd-Country bean-Cucumber which leads to the highest gross margin (Tk. 1354200 ha^{-1}) as well as the highest MBCR (4.92)

Development of four crops based cropping pattern Rice- Rice Vegetable-Vegetable against Rice- Rice- Vegetable at Narsingdi

M. Asaduzzaman, M Akkas Ali, M Shahiduzzaman
A trial was conducted at the Shibpur, Narsingdi during 2018-19, 2019-2020 and 2020-2021 to increase cropping intensity and productivity through inclusion of crop in the rice based existing cropping system. The alternate cropping pattern T. Aus (BRRI dhan-48) -T. Aman (BINA-7) -Potato (BARI ALU-40) - Danta (BARI Danta-1) was tested against the existing cropping pattern, Boro Rice (BRRI dhan-29) -T. Aman (BRRI dhan-49) -Lalshak (BARI Lalshak-1). The average yield of different crops in alternative cropping pattern of T. Aus, T. Aman, Potato and danta was 4.3, 4.54, 39.39 and 26.4 t ha^{-1} while that in the existing pattern of Boro, T. Aman and lalshak 5.61, 4.33 and 10 ha^{-1} respectively. The higher gross return (Tk. 908370 ha^{-1}) and gross margin (Tk. 642380 ha^{-1}) were obtained in alternative T. Aus, T. Aman, Potato and danta cropping pattern. The rice equivalent yield of alternate cropping pattern increased by 158 % and over existing cropping pattern, respectively. The MBCR was 2.42 over existing cropping pattern.

Development of alternate cropping pattern Sunflower- T. Aus Rice -T. Aman Rice against farmers existing pattern relay Cowpea - Fallow - T. Aman Rice

K.N. Islam, M.M. Islam, P. Chakraborti and M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at MLT site Bauphal and MLT site Kalapara, Patuakhali during 2020-21 to determine the profitability of the alternate cropping pattern Sunflower (BARI Surjomukhi-2)- T. Aus (BRRI dhan-48) - T. Aman rice (BRRI dhan52) against the farmers' existing pattern Cowpea (BARI Felon-1) - Fallow - T. Aman rice (Sarnogota). The alternate cropping pattern was found agronomically and economically more profitable than the existing pattern. The highest gross return (Tk. 248520 ha⁻¹ and Tk. 278600 ha⁻¹), gross margin (Tk. 132560 ha⁻¹ and Tk. 124450 ha⁻¹) and MBCR (2.68 and 1.87) were obtained from alternate cropping pattern over existing pattern.

Development of alternate cropping pattern Groundnut- T. Aus -T. Aman Rice against farmers existing pattern Groundnut- Fallow-T. Aman Rice

K.N. Islam, M.M. Islam, P. Chakraborti & M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at MLT site Bauphal and MLT site Kalapara, Patuakhali during 2020-21 to determine the profitability of the alternate cropping pattern Groundnut (BARI Chinabadam -8) - T. Aus (BRRI dhan-48) - T. Aman rice (BRRI dhan52) against the farmers' existing pattern Groundnut (Dhaka-01) - Fallow - T. Aman rice (Sarnogota). The alternate cropping pattern was found agronomically and economically more profitable than the existing pattern. The highest gross return (Tk. 354830 ha⁻¹ and Tk. 348290 ha⁻¹), gross margin (Tk. 139830 ha⁻¹ and Tk. 155290 ha⁻¹) and MBCR (2.63 and 2.79) were obtained from alternate cropping pattern over existing pattern.

Development of alternate cropping pattern through Gardenpea-Boro- T. Aman against Fallow- Boro- T. Aman

M.H. Rashid, M. K. Islam, M. K. Shahadat and M. M. Rahman, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at the MLT site, Satkhira during 2017-'18, 2018-'19, 2019-'20 for improving the productivity and profitability of an existing cropping pattern Fallow - Boro- T. Aman by introducing garden pea variety after T. Aman harvest. Results revealed that improved cropping

pattern Garden pea - Boro- T. Aman produced the highest total rice equivalent yield (28.71 t ha⁻¹) than farmers practice (12.78 t ha⁻¹). An improved cropping pattern brought the highest gross return (Tk. 5,63,417) and gross margin (Tk. 2,98,828) with MBCR of 1.76 over existing pattern meaning superiority of improved pattern over existing pattern.

Development of alternative cropping pattern Mustard- T. Aus- T. Aman Rice against Fallow-Boro- T. Aman cropping pattern in Rajshahi region

M. Anwar and M. M. I. Chowdhury, M Akkas Ali, M Shahiduzzaman

A field trial was conducted at the farmers' field of Paba, Rajshahi during 2020-2021 to develop Mustard- T. Aus- T. Aman cropping pattern. There were two treatments i.e., T₁: Existing Cropping pattern: Fallow- Boro-(BRRI dhan-28)- T. Aman (Sharna) and T₂: Alternate Cropping pattern: Mustard (BARI Sarisha-18)- T. Aus (BRRI dhan 82). T. Aman (BRRI dhan 87). Higher Rice Equivalent yield (14.25 t ha⁻¹) and gross margin (Tk. 284394 ha⁻¹) were obtained from Alternate cropping pattern over existing cropping pattern (11.13 t ha⁻¹, Tk. 215640 ha⁻¹), due to introduction of new crops and varieties.

Development of alternate cropping pattern relaying of sweet gourd with bushbean-fallow against fallow-fallow-bushbean cropping pattern in haor area

M. I. Nazrul, M Akkas Ali, M Shahiduzzaman

An experiment was executed at Hakaluki haor under multilocation testing (MLT) site, Moulvibazar, during 2020-21 to see the performance of improved cropping pattern and to increase the productivity and income of farmers. The existing and improved cropping patterns was Bushbean-Fallow- Fallow (CP₁: Existing cropping pattern) and Bushbean-Sweet gourd-Fallow (CP₂: Improved cropping pattern). The higher pod yield (4.47 tha⁻¹) of bushbean was produced by improved pattern. In case of productivity, the bushbean equivalent yield was increased 27% in improved pattern. Land use efficiency (200%) and production efficiency (192%) was increased in Bushbean-

Sweet gourd-Fallow cropping pattern than existing one.

Development of alternate cropping patterns proso millet-fallow-T. Aman and safflower-fallow-T. Aman against existing fallow-fallow-T. Aman cropping pattern in saline char areas

A.H. Md. Amir Faisal and M. M. U. Chowdhury, M Akkas Ali, M Shahiduzzaman

The experiment was conducted to evaluate the agro-economic performance of alternate (Proso Millet-Fallow-T. Aman and Safflower-Fallow-T. Aman) cropping patterns against farmers existing cropping pattern (Fallow- Fallow-T. Aman) for increasing cropping intensity and productivity at farmers' field of FSRD site, Subarnachar upazilla under Noakhali district during 2019-2020 and 2020-2021. During Rabi season one crop can be grown successfully in the fallow land by using suitable salinity tolerance or escaping crops which was tested in the alternate cropping patterns (ACPs). The highest rice equivalent yield (7.81 t ha^{-1}) was obtained from Safflower-Fallow-T. Aman (ACP2) cropping pattern. Gross return of that pattern was TK..156230 ha^{-1} which was 6.30% higher over Proso millet-Fallow-T. Aman (ACP1) pattern. The higher gross margin (TK..72,444 ha^{-1}) from ACP2 pattern was achieved mainly higher price of the safflower (TK.. 45 Kg^{-1}). In case of mean production efficiency, 54.41 and 47.60 $\text{kg ha}^{-1} \text{day}^{-1}$ were obtained from Proso millet-Fallow-T. Aman and Safflower-Fallow-T. Aman cropping patterns. Moreover, 2.95 (ACP1) and 2.17 (ACP2) marginal benefit cost ratio of the alternate cropping patterns indicate their superiority over farmers' existing patterns.

Development of alternate cropping pattern sweet sorghum-fallow-T. Aman against existing fallow-fallow-T. Aman cropping pattern in saline char areas

A.H. Md. Amir Faisal and M. M. U. Chowdhury, M Akkas Ali, M Shahiduzzaman

The experiment was conducted to evaluate the agro-economic performance of alternate (Sweet Sorghum-Fallow-T. Aman) cropping pattern against farmers' existing cropping pattern (Fallow-Fallow-T. Aman) for increasing cropping intensity and productivity at farmers' field of Kellar Char,

Companiganj upazilla under Noakhali district during 2019-2020 and 2020-2021. During Rabi season one crop can be grown successfully in the fallow saline land by using suitable salinity tolerance crop which was tested in the alternate cropping pattern (ACP). The highest rice equivalent yield (6.86 t ha^{-1}) was obtained from Sorghum-Fallow-T. Aman alternate cropping pattern whereas it was 3.34 t ha^{-1} in existing cropping pattern. Average gross margin of alternate pattern was Tk. 55,470 ha^{-1} which was above 57% higher over farmers' existing cropping pattern.

Development of alternate cropping pattern maize-t. Aus-T. Aman against boro-fallow-T. Aman

K U Ahammad, M Akkas Ali, M Shahiduzzaman

The trial was conducted in the farmers' field of Multilocation Testing (MLT) site, Kaliganj, Jhenidah during 2019-20 and 2020-21 to develop a alternate cropping pattern Maize (BHM-9)-T. Aus(BRRI dhan-48)-T. Aman (BRRI dhan-75) against Boro (BRRI dhan28)-Fallow-T. Aman (Binadhan-7). There were two treatments i.e, T₁: Existing cropping pattern: Boro (BRRI dhan28)-Fallow-T. Aman (Binadhan-7) and T₂: Alternate cropping pattern: Maize (BHM-9)-T. Aus(BRRI dhan-48)-T. Aman (BRRI dhan-75). Higher Rice Equivalent yield (19.25 t ha^{-1}) and gross margin (Tk. 208560 ha^{-1}) were obtained from alternate cropping pattern over existing cropping pattern due to inclusion of new crops and marginal benefit cost ratio was 3.46.

Intercropping of vegetables, spices and red amaranth with chewing type sugarcane

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

A trial was carried out at the FSRD site, Sholakundu, Faridpur during the Rabi 2020-21 to find out profitable intercrop combinations with chewing type sugarcane and to intensify use of land for growing vegetables and spices crops in AEZ-12. Four treatments viz T₁: red amaranth (Lalshak) in between four rows of onion bulb, T₂: red amaranth in between three rows of coriander (leaf purpose), T₃: red amaranth in between three rows of radish, and T₄: red amaranth and radish in between four rows of onion bulb (farmer's

practice). It was laid out in RCB design with six compact replications. BARI Piaz-1, BARI Lalshak-1, BARI Mula-1, BARI Dhonia-2 and Gendari (local) were used as planting materials of onion, red amaranth, radish, coriander and sugarcane, respectively. The highest onion equivalent yield (OEY) was calculated from T_1 (8.66 t ha⁻¹) followed by T_4 (6.77 t ha⁻¹). The lowest OEY was found in T_3 (4.23 t ha⁻¹). The highest gross return (GR) was calculated from T_1 (Tk 259800 ha⁻¹) and the lowest from T_3 due to lowest OEY. The highest Gross margin (GM) was found from T_1 (Tk 134353 ha⁻¹) followed by T_2 where red amaranth was cultivated in between two rows of coriander (Tk 109165 ha⁻¹). The lowest GM was observed in T_4 (Tk 44742 ha⁻¹).

Performance of mungbean and sesame intercropping in southern district of bangladesh

K.N. Islam, M.M. Islam P. Chakraborti and M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at MLT site Kuakata, Patuakhali and MLT site Amtoli, Borguna during Rabi season of 2020-21 to find out suitable intercrop combination in southern district and to increase the total crop productivity of the farmers. Four treatments namely: T_1 = 100% mungbean in rows (30cm × 5 cm) + 50% sesame as broadcast, T_2 = 100% mungbean in rows (30cm × 5 cm) + 25% sesame as broadcast, T_3 = Sole crop of mungbean in row (30 cm × 5 cm) (100% mungbean) and T_4 = Sole crop of sesame in row (30 cm x 5 cm) (100% sesame) were evaluated at each location. Sole mungbean and sesame gave higher yields than intercrop treatments in all the locations. Among the intercrop treatment the highest seed yield (1680 kg ha⁻¹) of mungbean was obtained from T_2 treatment in all the locations while the lowest from T_1 . Among intercrop treatment, sesame gave higher seed yield in T_1 treatment. Intercropping increased mungbean equivalent yield (MEY) compared to sole cropping. Over the locations, the highest MEY (2656 kg ha⁻¹) was found in T_1 treatment and similarly the highest BCR was also (2.15) found from same treatment.

Intercropping of vegetable with chilli in southern region of bangladesh

K.N. Islam, M.M. Islam, P. Chakraborti and M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

A field experiment on intercropping of vegetables with chilli was executed at saline area of Kuakata in Patuakhali district during Rabi season of 2020-21 to find out an appropriate crop to cultivation with chilli for higher productivity and maximum economic return. The trial was consisted of three crop combinations viz., T_1 : Sole chilli, T_2 : chilli + Kangkong, T_3 : chilli + Indian Spinach. Significantly the highest yield (dry chilli) was obtained from sole chilli (1.92 t ha⁻¹). Among the intercropping treatments, the highest chilli equivalent yield (2.84 t ha⁻¹) was obtained from chilli + Indian Spinach and the lowest chilli equivalent yield (1.92 t ha⁻¹) was found from sole chilli.

Intercropping of foxtail millet with groundnut in the charland

Md. Samim Hossain Molla, Md. Zannatul Ferdous and Md. Al-Amin Hossain Talukder, M Akkas Ali, M Shahiduzzaman

The experiment was conducted in the farmers' field at Char Thetrai, Ulipur, Kurigram under AEZ-2 during the Kharif season of 2021 to verify the performance of foxtail millet and ground nut intercropping system in charland areas and to increase yield and economic return. The treatment combinations used for the experiment were T_1 : Sole Foxtail millet (100%), T_2 : Sole Groundnut (100%), T_3 : Groundnut (100%) + Foxtail millet (25%) and T_4 : Groundnut (100%) + Foxtail millet (50%). The maximum LER (1.36) was found in Groundnut (100%) + foxtail millet (25%) treatment followed by Groundnut (100%) + foxtail millet (50%) treatment. The highest groundnut equivalent yield (2.23 t ha⁻¹) was obtained in the treatment combination of Groundnut (100%) + foxtail millet (25%) and it gave the highest gross return (Tk.155933 ha⁻¹) and gross margin (Tk. 85183 ha⁻¹). The sole foxtail millet (100%) and sole groundnut (100%) gave the lower gross return (Tk. 77867 and 131833 ha⁻¹) and gross margin (Tk.46517 and 62583 ha⁻¹), respectively.

Intercropping of onion with groundnut at the charland of tangail

A. H. Khan, S. Roy and M. M. Rahman, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at MLT site, Bhupur during the Rabi season of 2020-21 to find out a suitable intercrop combination of groundnut and onion to increase the productivity and income of farmers. Four treatments viz., T₁= Sole groundnut (100%), T₂= Sole onion (100%), T₃= One row of onion between two rows of groundnut, T₄= Two rows of onion between two rows of groundnut were considered. In intercropping groundnut with onion, groundnut yield was not significantly affected; however, onion yield was significantly reduced (38.05 to 55.71%). Groundnut equivalent yields were recorded higher from all intercrop treatments as compared to sole groundnut and sole onion. Analysis of intercropping treatments revealed that two rows of onion in between two rows of groundnut gave the highest groundnut equivalent yield (6.86 t ha⁻¹) as well as gross margin (Tk. 193955 ha⁻¹) followed by two rows of onion in between two rows of groundnut and the lowest groundnut equivalent yield (2.00 t ha⁻¹) as well as gross margin (Tk. 52955 ha⁻¹) was obtained from sole groundnut treatment.

Intercropping of short duration vegetables and spices with bushbean in sylhet region

M. I. Nazrul, M Akkas Ali, M Shahiduzzaman

A field experiment was laid out during 2020-21 in winter season at MLT site, Moulvibazar. Four different intercropping combinations, T₁ = Bush bean (100%) + Radish (100%), T₂ = Bush bean (100%) + Coriander (100%), T₃= Bush bean (100%) + Chilli (100%) and T₄= Bush bean sole (100%) were considered. The experiment was randomized complete block design with three replications. Highest bush bean equivalent yield (18.82 t ha⁻¹) was obtained from the combination of Bush bean + Radish, whereas, the lowest yield (12.62 t ha⁻¹) was found from the Bush bean + Chilli. The highest gross return (Tk. 8,46,900 ha⁻¹) and gross margin (Tk. 5,85,988 ha⁻¹) was obtained from the combination of Bush bean + Radish whereas the lowest gross return (Tk. 2,04,750 ha⁻¹) and gross margin (Tk. 50,088 ha⁻¹) was obtained from Bush bean sole cultivation. Maximum percent increased of bush bean equivalent yield (314) and highest benefit ratio (3.25) was obtained from the inter crop combination of bush bean + radish.

Intercropping of coriander with groundnut on yield and economics of system productivity in haor areas of sylhet

M. I. Nazrul, M Akkas Ali, M Shahiduzzaman

The trial was conducted at farmer's field during winter 2020-21 under MLT site, Moulvibazar. Six intercrop combinations viz. T₁: Groundnut sole, T₂: Coriander sole, T₃: Groundnut + coriander (100%), T₄: Groundnut + coriander (90%), T₅: Groundnut + coriander (80%) and T₆: Groundnut + coriander (70%) were considered as treatments. The variety BARI Chinabadamm-8 and Local coriander was used in this trial. The experiment was setup in randomized complete block design with three replications. Among the combinations, the highest pod yield (2.57 t ha⁻¹) of groundnut and green leaf yield of coriander (3.95 t ha⁻¹) was found in their respective sole crops. On the contrary, in intercrop situation the maximum yields of coriander leaf (3.58) and GEY (7.17 t ha⁻¹) was obtained in T₃ (groundnut+ 100% coriander) which was increased over 178 % than sole groundnut. This intercropping combination also gave the maximum gross margin (Tk. 315200 ha⁻¹) with higher marginal rate of return (MRR) followed by T₄ (groundnut + 90 % coriander).

Intercropping pea with hybrid maize at varying planting system

M R Amin, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at Ramnagar village under Shibaloya upazila of Manikganj district during Rabi season of 2020-21 to validate the developed pea and hybrid maize intercropping in farmers' field and its economic performance. Three intercrop combinations, T₁ = Maize normal row (60cm x 25cm) +two row pea, T₂= Maizepaired row (120cm x 25cm) + four rowpea, T₃= Sole maize (60cm x 25cm) were evaluated. The experiment was laid out in RCB design with three replications. The variety of hybrid maize was BARI Hybrid maize-16and the variety of field pea was BARI Motor-3. The highest maize equivalent yield (11.45 t ha⁻¹), Land equivalent ratio (1.43), gross return (Tk.206100.00ha⁻¹), gross margin (Tk. 84915.00ha⁻¹) and MBCR (1.26) were obtained from treatment T₁= Maize normal row (60cm x 25cm) +two row pea).The lowest maize equivalent

yield (10.43 t ha⁻¹), gross return (Tk.187740.00 ha⁻¹), gross margin (Tk.81080.00ha⁻¹) were obtained from sole cropping of maize.

Suitability of intercropping short duration winter vegetables with sweet gourd in hill valleys of bandarban

Mohammad Tanharul Islam, M Akkas Ali, M Shahiduzzaman

A field experiment on intercropping of five winter leafy vegetables viz. radish, Chinese cabbage (batishak), red amaranth, spinach and bushbean with sweet gourd was conducted at farmer's field of hill valleys of Bandarban hill district during Rabi season of 2020-2021 and to evaluate the performance of sweet gourd production, land use efficiency and best intercrop combination. Five intercrop combinations such as T₁= Sweet gourd + Radish (leaf), T₂= Sweet gourd + Chinese cabbage, T₃= Sweet gourd + Red amaranth, T₄= Sweet gourd + Spinach, T₅= Sweet gourd + bushbean and sole sweet gourd (T₀) were used in the study. Intercropping short duration winter vegetables with pumpkin i.e. T₃= Sweet gourd + Red amaranth, T₄= Sweet gourd + spinach and T₅= Sweet gourd + bushbean combinations performed better than sole sweet gourd. However, the results indicating that highest sweet gourd equivalent yield (43.77 t ha⁻¹), gross return (Tk. 875400 ha⁻¹), net return (Tk. 677400 ha⁻¹) and BCR (4.42) was obtained from T₃= Sweet gourd + red amaranth crop combination which indicating that this intercropping system might be suitable for higher crop productivity, better land and time utilization as well as economic return for the hilly areas of Bandarban.

Performance of intercropping black cumin with groundnut at bandarban hill district

Mohammad Tanharul Islam, M Akkas Ali, M Shahiduzzaman

The experiment was carried out at the farmers' field of On-Farm Research Division, Bangladesh Agricultural Research Institute (BARI), Bandarbanduring the rabi season, 2020-2021 to find out the suitable intercropping system for increasing crop productivity and profitability of black cumin with groundnut intercropping system. The treatments were T₁=sole groundnut, T₂=sole black cumin, T₃= One row of black cumin in

between two rows of groundnut and T₄= Two rows of black cumin in between two rows of groundnut. Treatments were arranged in a randomized complete block design with three replications. Between intercropped treatments, single row of black cumin within paired rows of groundnut (T₃) showed higher groundnut equivalent yield (2503.69 kg ha⁻¹), highest land equivalent ratio (1.42), gross return (Tk. 125184 ha⁻¹), gross margin (Tk. 86084 ha⁻¹) and benefit cost ratio (3.20) over the respective sole groundnut crop. The result showed that groundnut + black cumin (single row) intercrop system was most productive and profitable than sole groundnut cultivation in Bandarban region.

Intercropping of bushbean with maize in hill valleys of bandarban

Mohammad Tanharul Islam, M Akkas Ali, M Shahiduzzaman

A field experiment was conducted to evaluate the suitability and economic performance of BARI Bushbean intercrop with BARI Hybrid Maize at farmer's field of hill valleys in Bandarban during the rabi season, 2020-2021. Two treatments viz. T₁: Sole Maize and T₂: Maize+Bushbean were used for the experiment. The results revealed that Maize+Bushbean combination did not influence yield and yield contributing characters of maize as compared to sole maize. The intercropping combination performed better in terms of maize equivalent yield (24.63 t ha⁻¹), gross return (492600 tk ha⁻¹) and benefit cost ratio (BCR) (4.48) over sole crops.

Intercropping mungbean with mukhikachu at varying planting system in kisoreganj

M. Mohiuddin and M.N Sarker, M Akkas Ali, M Shahiduzzaman

A field experiment was conducted at the MLT site Karimganj, Kishoreganj during 2019-20 to validate the developed mungbean and mukhikachu intercropping at farmers and to increase yield and economic profitability of farmers. Three treatment combinations viz., T₁ = Mukhikachu normal row (100%) + 2 rows mungbean (80%); T₂ = Mukhikachu normal row (100%) + 2 rows mungbean (60%) and T₃= Sole mukhikachu were considered. The average highest mukhikachu

equivalent yield was recorded from the treatment (Mukhikachu normal row (100%) + 2 rows mungbean (60%) (28.76 t ha⁻¹) and the lowest mukhikachu equivalent yield from the treatment (mukhikachu normal row (100%) + 2 rows mungbean (80%) (28.57 t ha⁻¹). The highest gross return (Tk. 287600 ha⁻¹) was obtained from the treatment T₂ but highest gross margin (Tk. 158573 ha⁻¹) and BCR (2.87) was obtained from the treatment T₃ and the lowest gross return (Tk. 285700 ha⁻¹) and gross margin (Tk. 155855 ha⁻¹) and BCR (2.20) was obtained from treatment T₁.

Intercropping of soybean with maize in bhola

Gazi Nazmul Hasan and Md. Rashidul Hasan Anik, M Akkas Ali, M Shahiduzzaman

A field trial was conducted at Bhola sadar during the rabi season of 2021 at the farmer's field under AEZ-18 to verify the agro-economic performance of intercropping of Soybean with Maize and to ensure the maximum yield and economic return. The experiment was laid out in Randomized Complete Block Design on farmer's field at Bhola sadar, Bhola. Four treatments combination of different seed rate of mustard and cowpea viz., T₁= Sole maize, T₂= Sole Soybean, T₃= Two row maize (60cm x 25cm) with 2 row Soybean (30cm x 6cm), T₄= Pair row maize (120cm x 25cm) with 4 row Soybean (30cm x 6cm). Variety was BARI Hybrid Maize-16 and BARI Soybean-6. The highest grain yield (7.83 t ha⁻¹) was obtained from sole maize followed by T₃ (7.46 t ha⁻¹) and the lowest was obtained from T₄ (6.50 t ha⁻¹). Seed yield (1.72 t ha⁻¹) of sole soybean was higher followed by two rows soybean intercropped with maize (1.54 t ha⁻¹) and lowest grain yield (1.38 t ha⁻¹) from four row soybean intercropped with paired row maize. The Land Equivalent Ratio (LER) was higher 1.85 & 1.63 in two row soybean with two row maize and four row soybean with paired row maize respectively as compared with sole cropping. The highest gross return (Tk. 248000 ha⁻¹), gross margin (Tk. 161650 ha⁻¹) and BCR (2.87) was obtained from intercrop combination T₃ (2 row soybean +2 row maize) over sole soybean of Tk. 68750, 26575 ha⁻¹ and 1.63 respectively.

Intercropping of cauliflower with bt. Brinjal

K U Ahammad , M Akkas Ali, M Shahiduzzaman

An experiment was carried out at MLT site Tularampur, Narail during 2020-21. Four treatments viz. T₁= 1 row cauliflower between 2 rows of brinjal, T₂= 2 row cauliflower between 2 rows of brinjal, T₃= 1 cauliflower between 2 brinjal plant and T₄= Sole brinjal were used in the experiment. The experiment was laid out in RCB with 3 replications. Cauliflower (White Snow) was intercropped with Bt begun. The highest Bt begun yield (27.48 t ha⁻¹) was produced from T₄ (Sole brinjal) followed by T₂ (2 row cauliflower between 2 rows of brinjal), T₁ (1 row cauliflower between 2 rows of brinjal) and this was lowest (25.77 t ha⁻¹) from T₃ (1 cauliflower between 2 brinjal plant). The highest equivalent yield (49.52 t ha⁻¹) of Bt begun was obtained from T₂ and this was lowest (27.48t ha⁻¹) from T₄. The highest gross margin (1012500 Tk.ha⁻¹) and benefit cost ratio (5.51) was found from T₂ (2 row cabbage between 2 rows of brinjal). and the lowest gross margin (651750 Tk.ha⁻¹) and benefit cost ratio (3.99) was found from T₄ (Sole Bt begun).

Mixed intercropping of black cumin with groundnut at the charland of tangail

S. Roy, M. A. H. Khan and M. M. Rahman, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at MLT site, Bhuapur during the Rabi season of 2020-21 to verify the agronomic and economic performance of mixed cropping of groundnut with kalozira and also ensure the maximum utilization of the land for higher yield and income. There were five treatments viz., T₁= Sole groundnut (100%), T₂= Groundnut (100%) + 20% black cumin, T₃= Groundnut (100%) + 30% black cumin, T₄= Groundnut (100%) + 40% black cumin, T₅= Groundnut (100%) + 50% black cumin. Higher groundnut equivalent yields were recorded from all intercropping treatments as compare to sole groundnut production. The highest average groundnut equivalent yield (4.16 t ha⁻¹) as well as gross margin (Tk. 225144 ha⁻¹) was recorded from T₅ and the lowest yield (2.09 t ha⁻¹) as well as gross margin (Tk. 79494 ha⁻¹) was obtained from sole groundnut.

Effect of seed rate of mustard and cowpea mixed cropping in bhola

Gazi Nazmul Hasan and Rashidul Hasan Anik, M Akkas Ali, M Shahiduzzaman

A field trial was carried out at Daulatkhan and Bhola sadar during the rabi season of 2019-20 and 2020-21 at the farmer's field under AEZ-18 to evaluate the performance of mixed cropping of cowpea with mustard and to ensure the maximum utilization of the land for higher yield and economic return. Four treatments combination of different seed rate of mustard and cowpea viz., T₁= Sole mustard (100% seed rate), T₂= Mustard (100% seed rate + 20% of cowpea seed rate), T₃= Mustard (100% seed rate + 30% of cowpea seed rate), T₄= Mustard (100% seed rate + 40% of cowpea seed rate) were tested. In case of mustard yield T₁ treatment gave the highest seed yield in both the year (in 2019-20 1.05 t ha⁻¹ and 1.34 t ha⁻¹ in 2020-21) on the other hand cowpea yield was obtained higher consecutive two years (in 2019-20 yield 0.49 t ha⁻¹ and 0.65 t ha⁻¹) in T₄ treatments. On an average the highest Mustard Equivalent Yield (1.52 t ha⁻¹), gross return (Tk.76000) and gross margin (Tk.27020) was obtained from T₄ treatment. The highest average BCR (1.55) was also obtained from T₄ treatment.

Performance of mixed cropping in char areas of gaibandha

Md. Jahangir Alam and, Abdullah Al Mahmud, M Akkas Ali, M Shahiduzzaman

The experiment was undertaken at Chinirpotol char, Saghata, Gaibandha during 2019-20 and 2020-21 to find out the suitable ratio of chilli, brinjal, radish and coriander under mixed cropping and ensure higher yield and economic return. The experiment was designed in a randomized complete block design with three dispersed replications. In this experiment, chilli (BARI morich-3), brinjal (BARI bt begun-4), radish (BARI mula-1) and coriander (BARI dhania-1) were grown mixed using additive percentages. Four mixed cropping ratios with one sole chilli viz: T₁: 100% chilli + 70% brinjal + 20% Radish + 10% coriander, T₂: 100% chilli + 50% brinjal + 30% radish + 20% coriander and T₃: 100% chilli + 30% brinjal + 40% radish + 30% coriander, T₄: Sole chilli (100%) and T₅: Farmers practices' (100% chilli + 80% brinjal + 70% radish + 50% coriander). The maximum chilli equivalent yield 29.9 t ha⁻¹ (29.7 t ha⁻¹ in 2019-20 and 30.1 t ha⁻¹ in 2020-21), gross return (aver. Tk. 897000 ha⁻¹) and gross margin (aver. Tk. 782700

ha⁻¹) was found from T₃ (100% chilli + 30% brinjal + 40% radish + 30% coriander) treatment. The minimum chilli equivalent yield 11.8 t ha⁻¹ (11.7 t ha⁻¹ in 2019-20 and 11.9 t ha⁻¹ in 2020-21), gross return (aver. Tk. 353250 ha⁻¹) and gross margin (aver. Tk. 241200 ha⁻¹) was found from T₄ (Sole chilli) treatment. The maximum MBCR (241.7) was also recorded from the same T₃ treatment where 100% chilli mixed cropped with 30% brinjal+ 40% radish + 30% coriander. It was found that 100% chilli mixed with 30% brinjal, 40% radish and 30% coriander produced the highest crop and system yield and economic return.

Determination of optimum sowing time of jute as relay with onion under onion/jute-T. Aman cropping pattern

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at Saltha upazilla of Faridpur during the Kharif I, 2020 to find out suitable sowing time of jute as relaying with onion in Faridpur. The tested variety of jute was JRO-524. The experiment was laid out in randomized complete block (RCB) design with five replications. Four treatments were considered as T₁: Jute seed sowing 6 days before of onion harvest as relay, T₂ (farmers practice): Jute seed sowing 13 days before of onion harvest as relay, T₃: Jute seed sowing 19 days before of onion harvest as relay, T₄: Sole jute. Higher fiber yield was obtained from T₁ (2.78 t ha⁻¹) followed by T₂ (2.47 t ha⁻¹) where jute seed was sown 13 days before of onion harvest as relay. The lowest fiber yield was calculated from sole jute (2.31 t ha⁻¹). The maximum stick yield was calculated from T₃ (5.02 t ha⁻¹) followed by T₄ (4.86 t ha⁻¹) and T₁ (4.70 t ha⁻¹). The highest gross margin (57800 Tk ha⁻¹) was calculated from T₁ and the lowest from T₂.

Performance of mustard varieties as relay crop with T. Aman rice

Gazi Nazmul Hasan and Rashidul Hasan Anik, M Akkas Ali, M Shahiduzzaman

A field trial was conducted in the farmer's field at Alinagar, Char-Kumaria under Bhola sadar and at Doulatkhan upazila in Bhola district during 2020-21 cropping season to know the performance of Mustard varieties as relay crop with T. Aman.

Three varieties of mustard viz. BARI Sharisha-14, BARI Sharisha-15 and BARI Sharisha-17 were tested in the farmer's field. Among the tested varieties, BARI Sharisha-17 gave the maximum seed yield (1.30 t ha^{-1}) and BARI Sharisha-15 gave the minimum one (1.19 t ha^{-1}).

Performance of lentil relay with T. Aman rice in bhola

Gazi Nazmul Hasan and Rashidul Hasan Anik, M Akkas Ali, M Shahiduzzaman

The experiment was carried out at Sadar, Bhola during rabi season of 2020-2021 under AEZ-18. BARI Moshur-8 was tested in two different sowing methods like relaying with T. Aman and traditional methods under farmers' field condition to select suitable and profitable planting method for Bhola region. The experiment was laid out in a RCB design with three dispersed replications. Lentil variety BARI Masur-8 produced higher seed yield (1.38 t ha^{-1}) at relay methods than traditional method (1.12 t ha^{-1}). Higher gross return (Tk. 82800 ha^{-1}) and gross margin (Tk. 35000 ha^{-1}) was found in relay method than traditional method. The benefit cost ratio of BARI released lentil variety in relay method and traditional method were 1.72 and 1.24 respectively.

Performance of grass pea varieties relaying with T. Aman rice in bhola

Gazi Nazmul Hasan and Rashidul Hasan Anik, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at Sadar, Bhola under AEZ-18 in Rabi season 2020-21 to observe the performance of BARI developed grasspea varieties and to compare it with local variety in relay with T. Aman rice under farmers' field condition. BARI Khesari-2, BARI Khesari-3 and local variety was tested in this study. The experiment was laid out in a RCB design with three dispersed replications. BARI Khesari-3 produced higher seed yield (1.31 t ha^{-1}) followed by BARI Khesari-2 (1.19 t ha^{-1}). The lowest seed yield (0.96 t ha^{-1}) was obtained from local grasspea variety. Due to higher seed yield BARI Khesari-3 showed higher gross return (Tk. 52400 ha^{-1}) gross margin (Tk. 28635 ha^{-1}) and higher BCR (2.20).

Performance of grass pea varieties as relay with T. Aman rice in low lying areas

K U Ahammad, M Akkas Ali, M Shahiduzzaman

An experiment was carried out at Tularampur MLT site, Narail during 2020-21. Five treatments viz. T_1 = BARI Khesari-1, T_2 = BARI Khesari-2, T_3 = BARI Khesari-3, T_4 = BARI Khesari-5 and T_5 = Local were used in the experiment. The experiment was laid out in RCB with 3 replications. Yield and yield contributing characters of of khesari were influenced significantly due to relay cropping with T. Aman. The maximum yield (1.75 t ha^{-1}) was obtained from variety BARI Khesari-5 variety followed by BARI Khesari-3 (1.56 t ha^{-1}), Local (1.53 t ha^{-1}) and the lowest from BARI Khesari-2 (1.32 t ha^{-1}). The maximum gross margin (Tk. 51250 ha^{-1}) was found from BARI Khesari-5 followed by BARI Khesari-3. The minimum gross margin (Tk. 34050 ha^{-1}) was found from BARI Khesari-2.

Relay cropping of kenaf with maize in kishoreganj

M. Mohiuddin and M. N Sarker, M Akkas Ali, M Shahiduzzaman

A field study was conducted at MLT site Karimganj under OFRD, BARI, Kishoreganj during 2020-21 to observe the performance of BJRI Kenaf-2 in relay with BARI hybrid Maize-9 under farmers field condition. The experiment was laid out in a RCBD with three replications with three treatments i. e; a. Single row kenaf with maize, b. Double row kenaf with maize and c. broadcast kenaf with maize. Among the treatments, higher fibre yield was found from broadcast kenaf with maize (2.50 t ha^{-1}) followed by single row kenaf with maize (1.61 t ha^{-1}) which is statistically at par to the double row kenaf with maize (1.50 t ha^{-1}). The highest gross return (150200 Tk ha^{-1}), gross margin (107944 Tk ha^{-1}) and BCR (2.79) was calculated from broadcast kenaf with maize followed by single row kenaf with maize.

Effects of crop establishment method on yield and yield attributes of different new varieties of lentil

M.A. Islam, M. R. Alam and M. Maniruzzaman, M Akkas Ali, M Shahiduzzaman

On-farm field experimnt was conducted at Multi Location Sites of OFRD, BARI, Kolabagan, Atghoria, Pabna during rabi season 2020-21 to evaluate the performance of different varieties of lentil under different crop establishment method in low land rice growing areas. The experiment was laid in a RCB design with two sowing methods (relay sowing and conventional method) in factor A and three varieties (BARI Masur-6, BARI Masur-7 and BARI Masur-8) in factor B. Seeds of all varieties of lentil were sown on 9 November for relay and 22 November for conventional method, and harvested at a time on 20-22 March, 2021. The highest seed yield was obtained from BARI Masur-8 under conventional method, however, the lowest seed yield was obtained from BARI Masur-6 and BARI Masur-7 under relay sowing method. The straw yield was also higher from BARI Masur-8 under conventional method and lower in BARI Masur-6 under relay method. From the economic analysis it was found that BARI Masur-8 had the highest gross return (Tk. 98538 ha⁻¹), gross margin (Tk. 60222 ha⁻¹) and the highest BCR (2.6) under relay sowing method.

Performance of tomato hybrids in high barind tract

M. S. Hossain, J. C. Barman and M.E.A. Pramanik, M Akkas Ali, M Shahiduzzaman

Six tomato hybrids were evaluated in the farmer's field of FSRD site, Basantapur, Rajshahi during early Rabi 2019-20 and 2020-21 to find out the yield potentiality and adaptability of tomato hybrids in High Barind environments. The tomato hybrids were namely BARI Hybrid Tomato-8, BARI Hybrid Tomato-10, BARI Hybrid Tomato-11, VL-642, Bipul plus and Maharaja. The BARI released tomato hybrids took shortest time for flowering and fruit maturity. Among the six hybrids significantly the highest yield was found from BARI Hybrid Tomato-11 in both the years (48.72 t ha⁻¹ in Yr1 and 91.63 t ha⁻¹ in Yr2) followed by Bipul plus (43.74 and 84.95 t ha⁻¹ in Yr1 and Yr2, respectively). The BARI Hybrid Tomato-10 (45.30 t ha⁻¹) gave similar fruit yield to BARI Hybrid Tomato-11 in Yr1 but later year performed inferior. The hybrids VL-642 and BARI Hybrid Tomato-8 produced significantly lower yield than BARI Hybrid Tomato-11 but they were

identical each other regarding fruit yield in both the years. On the other hand. Maharaja contributed the lowest yield (22.07 and 66.07 t ha⁻¹ in Yr1 and Yr2, respectively). In later year, no. of total fruit harvest was eight while it was six in 1st year. In respect of economic analysis, the maximum gross return (Tk. 941162 and 1514567 ha⁻¹ in Yr1 and Yr2, respectively), gross margin (Tk. 795937 and 1313092 ha⁻¹, in Yr1 and Yr2, respectively) and BCR (6.48 and 7.5 in Yr1 and Yr2, respectively) were obtained from BARI Hybrid Tomato-11. The lowest gross, Gross margin and BCR were found from Maharaja in both the years.

Weed management for dry direct seeded aus rice in high barind tract

M. S. Hossain, J. C. Barman and M.E.A. Pramanik, M Akkas Ali, M Shahiduzzaman

Conservation agriculture (CA) is based on minimum soil disturbance, permanent soil cover, and crop rotation; it is promoted as a sustainable alternative to systems involving conventional tillage. Direct seeded rice (DSR) is one of the CA technologies. A field experiment was conducted at Farming System Research and Development (FSRD) site, Basantapur, Godagari, Rajshahi during 2020 to develop effective weed management strategies for DSR Aus rice in High Barind Tract. Six weed management strategies such as-WM₁: Pre-emergence (no spray) +post-emergence (no spray); WM₂: Pre-emergence (Pendimethalin)+post-emergence (no spray); WM₃: Pre-emergence (no spray) + post-emergence (Bispyribac + Pyrazosulfuron Ethyl), WM₄: Pre-emergence (Pendimethalin) +post-emergence (Bispyribac + Pyrazosulfuron), WM₅: Pre-emergence (Pendimethalin)+post-emergence (Penoxulam) and WM₆: Pre-emergence (Pendimethalin)+post-emergence (Hand weeding). A randomized complete block design with three replications was used with strip tillage system. Weed management treatment WM₄ recorded the highest grain (4.63 t ha⁻¹) and straw yield (5.10 t ha⁻¹) of Aus rice. The WM₅ was identical with WM₄ considering the yield performance. The WM₄ and WM₅ also showed minimum weed population and dry weed biomass. Considering cost and return analysis these two packages also gave higher gross return and gross margin.

Effect of transplanting time on onion bulb yield loss of bari piaz-4

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

A trial was conducted at the FSRD site, Sholakundu, Faridpur during the Rabi, 2020-21 to find out optimum planting time of BARI Piaz-4 for reducing bulb yield. The experiment was laid out in randomized complete block (RCB) design with four compact replications. Four treatments were considered as T₁ = seedling transplanting at 20 December, T₂ = seedling transplanting at 30 December, T₃ = seedling transplanting at 10 January and T₄ = seedling transplanting at 20 January. BARI Piaz-4 was used as planting material in the study. The highest bulb yield (31.13 t ha⁻¹) was obtained from T₁ followed by T₂ (28.79 t ha⁻¹). The lowest bulb yield (18.82 t ha⁻¹) was recorded in T₄. Considering economic benefit, maximum gross return (Tk. 778250 ha⁻¹) and gross margin (Tk. 577135 ha⁻¹) were obtained from early transplanted seedling. The minimum gross margin (Tk. 187440 ha⁻¹) was observed in late transplanted seedling (20 January). The bulb yield loss gradually increasing 8%, 30% and 65% in 30 December, 10 January and 20 January, respectively in against of 20 December seedling transplanting.

Identification of critical weed competition periods for black cumin in faridpur

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

A field trial was conducted at the FSRD site, Faridpur during the Rabi 2020-21 to find out the critical weed competition periods for black cumin. Five treatments were considered as T₁: weeds are allowed to compete with black cumin for 30 days after emergence (DAE), T₂ (farmers practice): weeds are allowed to compete with black cumin for 40 DAE, T₃: weeds are allowed to compete with black cumin for 50 DAE, T₄: weeds are allowed to compete with black cumin for 60 DAE and T₅: No weeding (control). Among the weed species, *Chenopodium album* (Bathua), *Convolvulus arvensis* (Bindu), *Vicia sativa* (Bon masur) and *Saussurea affinis* (Bon shimul) were the most dominant broad leaf weeds. The highest number of

weed density (432 m⁻²) were recorded from T₁ followed by T₂ and the lowest from T₅ (74 m⁻²). The highest weed biomass (51.06 g m⁻²) was obtained from no weeding (control) plot and the lowest dry weight (9.8 g m⁻²) T₁. Weed persistence index (WPI) was also varied from 0.03 (T₁) to 0.55 (T₅). The maximum seed yield (1087 kg ha⁻¹) was recorded in T₁ treatment which was at par with T₂. The seed yield decreased with increase in competition periods. The lowest seed yield (604 kg ha⁻¹) in no weeding plot. The highest gross margin (Tk 139329 ha⁻¹) was obtained from T₁ and the lowest from no weeding plot (Tk 60144 ha⁻¹). Weeds must be controlled within 40 days after emergence of black cumin to avoid the risk of economic yield loss as 30 and 40 DAE had been found to be the critical period of weed crop competition in black cumin.

Performance of garlic with zero tillage method in coastal region

K.N. Islam, M.M. Islam, P. Chakraborti and M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at MLT site Bauphal, Patuakhali in the Rabi season of 2020-21 to observe the performance of garlic production under zero tillage condition. Two types of sowing methods i.e. T₁ = Sowing in zero till field and T₂ = Sowing in ploughed field (traditional) was tested in the trial. It was observed that all the studied traits were higher in zero-tillage condition. Plant establishment was higher in zero tillage plots as the plants absorbed required moisture during early growing stage. Higher bulb yield (9.37 t ha⁻¹) was obtained from zero tillage field compared to tillage system (8.43 t ha⁻¹). Zero tillage system also gave higher gross return (Tk. 421650) and gross margin (Tk. 337650) as its production cost was lower than tillage system.

Effect of mulching on yield of watermelon in coastal area

N. Islam, M.M. Islam, P. Chakraborti and M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at MLT site, Kuakata, Patuakhali in the Rabi season of 2020-21 to observe the effect of seedling transplantation in different mulch materials for watermelon production under farmers field condition. Three

different mulch materials e.g., T₁= Silver color polythene mulch, T₂= Straw mulch, T₃= No mulch with three planting methods viz., P₁=15 days old polybag seedling, P₂=20 days old poly bag seedling and P₃= direct seeding were tested in the experiment. Plant growth and yield was the better in mulch treated plots. Silver polythene with 20 days old polybag seedling gave the highest yield (32.69 t ha⁻¹) while plants without mulch (control) and direct seeding treatments gave with poor growth and yield (26.77ton ha⁻¹). With economic point of view, silver mulch and 20 days old poly bag seedling gave the highest gross return (Tk. 394420) as well as highest benefit-cost ratio (3.03).

Performance of mulching to mitigate soil salinity in tomato field in coastal area

K.N. Islam, M.M. Islam, P. Chakraborti and M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at MLT site, Kuakata, Patuakhali in the Rabi season of 2020-21 to investigate the effects of drip mulches to mitigate soil salinity, water use efficiency and yield performance of tomato. Two different treatments were as follows: T₁: polythene mulch, T₂: conventional practice was used. The yield and yield-contributing characters in the polythene mulch treatment were significantly higher compared to those in the unmulched treatment. The lowest level of salinity & high moisture content was recorded from T₁ treatment in every growth stage of crops ranges from 1.27-5.65 whereas soil salinity was much higher in the treatment T₂ (1.26-10.21dS/m). The yield of mulching treatment was 84.13 t ha⁻¹ for polyethylene. Lower yield from conventional system with no mulch was 71.78 t ha⁻¹. Higher gross margin Tk. 805950 and BCR (2.77) was obtained from T₁ treatment and lower performance from T₂.

Effect of border trees on potato in northern region of bangladesh

Md. Zannatul Ferdous, Md. Samim Hossain Molla and Md. Al-Amin Hossain Talukder, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at multi-location testing (MLT) site Gobindaganj, Gaibandha during the rabi season of 2018-2019, 2019-2020 and 2020-2021 to evaluate the effect of border trees on crop

production in northern region of Bangladesh. The experiment consisted of two treatments viz. T₁=Normal potato field, T₂=Tree surrounded potato field a popular potato variety was used in this study. The experiment was laid out in randomized complete block design with three replications. Open field potato cultivation produced higher tuber yield compare to tree surrounded potato field. In 2018-2019, the highest tuber yield was recorded in T₁ (31.10 t ha⁻¹). The lowest tuber yield was recorded in T₂ (18.45 t ha⁻¹). The highest gross margin (Tk.114219 ha⁻¹) was found from T₁ and lowest was in T₂. It was found that border trees reduced the crop yield as well as decreased the economic income of the farmers. Similar results also found in 2019-2020 and 2020-2021.

Effect of different plating time and variety on the yield of gladiolus

S. Roy, M. A. H. Khan and M. M. Rahman, M Akkas Ali, M Shahiduzzaman

An experiment was conducted in the farmers field at FSRD site, Atia during the two consecutive years of 2019-20 and 2020-21 to find out the effect of planting time and variety on the yield of flower and corm of gladiolus to increase productivity and economic return of farmers'. The treatment combinations used for this experiment were three sowing time (T₁: 15 October, T₂: 30 October, T₃: 15 November) with three variety (V₁: BARI Gladiolus-3, BARI Gladiolus-4, and BARI Gladiolus-5). Among the treatment combinations the highest spike yield (184000) was found in BARI Gladiolus-4 planted 30 October. But the maximum gross return (1767997 Tk. ha⁻¹) and gross margin (1495642 Tk. ha⁻¹) were recorded from BARI Gladiolus-5 planted in 15 October.

Performance of garlic varieties under zero tillage method with mulch in tangail

S. Roy, M. A. H. Khan and M. M. Rahman, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at FSRD site Atia, Tangail during rabi 2019-20 and 2020-21 to evaluate the performance of garlic cultivation under zero tillage and conventional method as well as to introduce conservation agricultural technique. The treatments comprised with three variety of garlic viz. BARI Rashun-2, BARI Rashun-3, and farmers'

variety along with two mulching material rice straw and water hyacinth. Among the treatment combinations the highest average bulb yield (10.27 t ha^{-1}) and gross margin (Tk. 345640 ha^{-1}) were obtained from BARI Rashun-2 along with rice straw mulch in two consecutive years. The lowest yield (6.52 t ha^{-1}) and gross margin (Tk. 161890 ha^{-1}) were obtained from BARI Rashun-3 along with water hyacinth mulch.

Effect of different planting methods on the yield and maturity duration of sunflower in the haor area of kishoreganj

M. Mohiuddin and M.N Sarker, M Akkas Ali, M Shahiduzzaman

A field study was conducted at Guroy, Nikli upazilla under OFRD, BARI, Kishoreganj during 2020-21, to observe the effects of different ages poly bag seedlings on yield and maturity duration of sunflower in the haor areas of Kishoreganj. The experiment was laid out in a RCBD with three replications with three treatments i. e; a. Poly bags seedling at 7 days, b. Poly bags seedling at 14 days and c. Direct seeding. The variety was BARI Surjomukhi-3. Among the treatments the highest yield was found from direct seeding (1.83 t ha^{-1}) followed by poly bags seedling at 7 days (1.75 t ha^{-1}) and poly bags seedling at 14 days (1.73 t ha^{-1}). The highest gross return (91500 Tk ha^{-1}), gross margin (41361 Tk ha^{-1}) and BCR (1.83) was calculated from direct seeding followed by Poly bags seedling at 7 days but maturity is earlier in poly bags seedling at 14 days.

Effect of spacing on potato yield under zero tillage in coastal saline soil of bangladesh

M. K. Shahadat, M.H. Rashid, M. K. Islam and M. Rahman, M Akkas Ali, M Shahiduzzaman

Zero tillage potato cultivation could be an alternative way of crop intensification in the coastal fallow land of Bangladesh. However, tuber yield in zero tillage practice is lower and less economically viable in comparison to conventional practice if followed recommended spacing of 60 cm X 25 cm. Since canopy coverage and plant growth is lower in zero tillage practice in comparison to conventional tillage practice. An experiment was conducted at farmer's field at Dacope, Khulna during rabi, 2019-20 and 2020-21 by determining an optimum

spacing of zero tillage potato. There were four spacing treatments viz. S1= 60 cm X 20 cm, S2 = 50 cm X 20 cm, S3= 40 cm X 20 cm and 30 cm X 20 cm and two potato varieties viz. BARI Alu-72 and 73. The experiment was conducted following the randomized complete block design with three replications. Results showed that the highest tuber yield was produced from S3 (23.6 t ha^{-1}) followed by S4 (20.15 t ha^{-1}) in 2019-20 and 2020-21, respectively. Based upon tuber yield, cost of production and potato price @15 Tk. kg^{-1} , the highest benefit-cost ratio was also calculated from S3 (3.30 and 2.59 in 2019-20 and 2020-21, respectively) treatment.

Effect of cover crops for salinity management in sunflower

Mustafa Kamal Shahadat, Harunor Rashid, Kamarul Islam and Mashfiquir Rahman, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at farmer's field at Dacope, Khulna during rabi, 2019-20 and 2020-21 in order to evaluate yield performance of sunflower with different leafy vegetables as cover crops so that soil salinity is reduced and increase system productivity. The experiment treatment consisted five treatment in 2019-20 viz. T₁= Sunflower with rice straw, T₂= Sunflower + Spinach, T₃= Sunflower + Ghee Kanchan (Shobuj Shak), T₄= Sunflower + Red Amaranth and T₅= Sunflower without mulch (control) and six treatments in 2020-21 viz. T₁ = Sunflower + No Mulch, T₂ = Sunflower + Rice straw, T₃ = Sunflower + Spinach, T₄ = Sunflower + Ghee Kanchan, T₅ = Sunflower + Red Amaranth, T₆ = Sunflower + Kangkong. Treatments were designed in randomized complete block design with three replications. Growth, yield and yield components of sunflower did not varied significantly in both the years. However, in 2019-20, numerically highest seed yield (2.51 t ha^{-1}) of sunflower was recorded from T₃ treatment and 2020-21, highest seed yield recorded from sunflower+red amaranth (1.11 t ha^{-1}). Highest sunflower equivalent yield (2.95 t ha^{-1}) was calculated from T₂ treatment in 2019-20 and from T₆ (2.18 t ha^{-1}) in 2020-21. As a result, both the treatments produced higher benefit cost ratio 4.10 and 3.92, respectively.

Effect of foxtail millet as influenced by different weeding method

M. S. Rahman, M. F. Islam and A.K.M.Z.U. Noor, M Akkas Ali, M Shahiduzzaman

The experiment of Foxtail millet was conducted at Melandah, Jamalpur during rabi season of 2020-21. Three treatments viz., T_1 = Control (No weeding), T_2 = Hand weeding and T_3 = Chemical control (Affinity) were tested at the farmer's field of Melandah, Jamalpur during 2020-21. Results obtained from the study indicated that the highest grain yield (2.70 t ha^{-1}) was produced in T_2 treatment and the lowest grain yield (2.33 t ha^{-1}) in T_1 treatment. The highest gross return (Tk. 45,900 ha^{-1}) and gross margin (Tk. 9,741 ha^{-1}) were found from T_2 treatment and T_1 treatment, respectively. The lowest gross return (Tk. 39,610 ha^{-1}) and gross margin (Tk. 7,231 ha^{-1}) were observed from T_1 and T_2 treatments, respectively.

Effect of irrigation on sweet potato in char land of Jamalpur

M.F. Islam, A.K.M.Z.U. Noor and M.S. Rahman, M Akkas Ali, M Shahiduzzaman

The experiment of sweet potato was conducted at Melandah, Jamalpur during the rabi season of 2020-21. Four treatments viz., T_1 = Control (No irrigation), T_2 = One irrigation after 30 days of planting, T_3 = One irrigation after 50 days of planting and T_4 = Two irrigations after 30 and 50 days of planting were tested in the farmers field. The highest tuber yield was obtained from T_3 treatment (34.75 t ha^{-1}) and the lowest (25.66 t ha^{-1}) in T_1 treatment. It revealed that the highest gross return (Tk. 6,95,000 ha^{-1}) and gross margin (Tk. 5,46,930 ha^{-1}) were found from T_3 treatment. The lowest gross return (Tk. 5,13,200 ha^{-1}) and gross margin (Tk. 3,67,630 ha^{-1}) was recorded from T_1 treatment.

Performance evaluation of power operated seeder in Faridpur

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

Power operated seeder (POS) was carried out at farmers' fields of the Farming System Research and Development (FSRD) site, Sholakundu, Faridpur during 2019-20 and 2020-21. The seeder

performed (av. 1095 decimal) seeding operation utilizing the soil moisture after harvesting T. Aman rice along with the use of Hi-speed Rotary Tiller (HSRT). Seed of wheat, lentil, black cumin and coriander were sown. It maintained uniform seeding depth, uniform seed distribution and better seed soil contact which transferred soil moisture to seeds quickly for enhance better plant establishment and yield. Power operated seeder was able to complete seeding and laddering operation in a single pass with an average field capacity of average 22.5 dec.h^{-1} . The increase yield percentage in POS over conventional was 33, 25, 20 and 13 % in lentil, black cumin, coriander and wheat, respectively. The gross return, gross margin and benefit cost ratio was higher in all crops due to higher yield and lower cultivation cost. The BCR percentage was 30, 21, 14 and 10 % higher in black cumin, coriander, lentil and wheat in POS over conventional, respectively.

Bio-rational based management techniques for the control of mango fruit fly, *Bactrocera Dorsalis* in rajshahi region

J.C. Barman, M.E.A. Pramanik and M.S. Hossain, M Akkas Ali, M Shahiduzzaman

Adaptive trials were conducted at farmer's field of Charchhat and Bagha upazilla of Rajshahi district during the mango fruiting season of 2021 in a randomized complete block design with 3 treatments and 10 replications. Among the treatments, Methyl eugenol pheromone trap was more effective in catching mango fruit fly male adult populations as compared to attract and kill method. But attract and kill method can catch both of male and female populations. Maximum abundance of male populations was found during mid-May to mid-June while that of female populations during mid-May to first week of June. The lowest fruit infestation (3.1–4.4%) was found in attract and kill method as compared to methyl eugenol pheromone trap (3.9–4.7%). The highest infestation was found in farmer's practice (7.6–10.9%). Both of methyl eugenol and attract & kill method effectively reduced mango fruit fly infestation as compared to farmer's practice. Considering marginal cost benefit ratio, attract & kill method produced the highest marketable fruit yield (122.7 kg/tree) and higher MBCR (11.45).

ICM techniques in reducing flower and fruit dropping of mango in high barind tract

J.C. Barman, M.E.A. Pramanik and M.S. Hossain, M Akkas Ali, M Shahiduzzaman

On-farm trials of Integrated Crop Management (ICM) techniques were conducted during 2020-21 mango season at farmer's field of two different regions of high Barind tract (HBT) to increase mango production by reducing flower and fruit dropping following randomized complete block design (RCBD). ICM package includes: application of recommended fertilizer dose; two sprays with imidacloprid (Confidor) 70 WG @ 0.2 g/litre of water with mancozeb (Indofil) M 45 @ 2.0 g/litre of water- 1st spray within 10 days of flowering and 2nd after one month of the first application; three irrigations starting from full bloom to fruit maturity at 15 days interval; two sprays with 2% urea solution at pea and marble stages of fruit growth were done. On the other hand, non-ICM package includes farmer's practice only. Results indicated that 28 to 32.35% mango fruits by number and 9.12 to 17.15% yield by weight were increased in ICM packages as compared to non-ICM practices at two different study areas.

Incidence of chickpea pod borer, *Helicoverpa Armigera* hubner on the promising varieties of chickpea

J.C. Barman, M.E.A. Pramanik, M.S. Hossain And M.A. Hossain, M Akkas Ali, M Shahiduzzaman

The trial was conducted at farmer's field at Basantapur FSRD site, Godagari, Rajshahi during Rabi 2020-21 crop season to find out the abundance of chickpea pod borer and to provide indication of chickpea pod borers infestation level/status and its effect on seed yield of chickpea following randomized complete block design (RCBD) with 6 promising varieties and 3 replications. First appearance of chickpea pod borer larvae was found 76 days after sowing which was rapidly increased just two weeks after the first appearance. The highest appearance of pod borer larvae was recorded 2nd and 3rd week after first appearance. The infested pod ranged from 7.30 to 13.71% and the highest pod damage was obtained from BARI chola-11 where the lowest from BINA chola-8. BARI chola-9 produced the highest grain

yield (1260 kg ha⁻¹) though a moderately higher per cent pod damage (11.12%) was found on it.

Survey and documentation of insect pests attacking potato in rajshahi region

J.C. Barman, M.E.A. Pramanik and M.S. Hossain, M Akkas Ali, M Shahiduzzaman

Survey was conducted at farmer's field of Godagari, Tanor and Mohanpur upazilla of Rajshahi district during Rabi 2020-21 crop season to document insect pests attacking potato. Six different insects were found and among them, two insects e.g. cutworm and aphids were major. Other insects like crickets, leaf miner and Spodoptera were minor pests in potato fields. In response of the farmers in the surveyed area, the maximum farmers used BARI alu-7 (Diamant) comprising about 95% crop areas and rest 5% area comprised by other varieties including BARI alu-25 (Asterix). Farmers reported insect pests attack and disease infection as major hurdle of potato production. Most of the farmers reported that the potato was infested in the field by cutworm, which was followed by aphid infestation. Some farmers also reported that the potato was attacked by potato tuber worms, followed by leaf miner, mole cricket, field cricket, leaf hoppers and whitefly. The insect pests attacking potato in the fields in Bangladesh. The potato farmers faced high incidence of disease (late and early blight of potato, fusarium and brown rot, leaf roll virus, common scab, black heart, root knot etc.) and insect/pests (cut worm, aphids, tuber moth, cricket, leaf hopper etc.)

Survey, monitoring and documentation of major insect pests of pulse crops in high barind tract

M.E.A. Pramanik, M.S. Hossain and J.C. Barman, M Akkas Ali, M Shahiduzzaman

A field survey was conducted in western region of Bangladesh during rabi season 2020-21 to record the infestation and major pest of pulse crops in High Barind Tract. Insects have not been a major problem in lentil production in HBT. But Aphid and pod borer occasionally cause some problems. Six pests are recorded in lentil crops, e.g., cutworms, aphid, pod borer, whitefly, green sting bug and thrips. Besides, several insects live and feed on chickpea plant. Foliage, buds, flowers, pods, roots and even root nodules are eaten by one

or more insect pests. In Barind area, seven pests are seldom infested in the chickpea field, e.g., black cutworm, common cutworm, green semilooper, green sting bug, aphid, whitefly and pod borer. On the other hand, four types of insect pests were observed in grasspea, e.g., aphid, green sting bug, thrips and cowpea weevil/bruchid.

Controlling of bird pests in sunflower crop using different repellent tools at coastal areas of bangladesh

K.N. Islam, M.M. Islam, P. Chakraborti and M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

The experiment for controlling of bird pests in sunflower production was conducted at farmer's field condition in Patuakhali sadar, Patuakhali and Amtoli, Borguna during *Rabi* season of 2020-21 to find out the appropriate repellent options. Five management techniques (MT) namely: MT₁= Hanging red ribbon, MT₂= Making scarecrow, MT₃= Plastic bottle windmill, MT₄= Bird repellent mechanical device and MT₅= Control were evaluated. Among the different repellent tools the maximum seed yield of sunflower was obtained from Plastic bottle windmill (1.91 t ha⁻¹) as repellent tool which was followed by Bird repellent mechanical device (1.90 t ha⁻¹), Hanging red ribbon (1.82 t ha⁻¹) and Making scarecrow (1.80 t ha⁻¹) while the minimum was in control (1.50 t ha⁻¹). Similarly different repellent tools showed increase in yield of sunflower over control. Over the using different repellent tools, the maximum BCR was obtained from Plastic bottle windmill (1.50) used plot followed by Hanging red ribbon (1.46), Bird repellent mechanical device (1.40), Making scarecrow (1.40) while the minimum one from control (1.23).

Management of pod borer, *Maruca Vitrata* using chemicals, botanicals and biopesticides in mungbean at southern districts

K.N. Islam, M.M. Islam P. Chakraborti and M.S.I. Khan, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at Patuakhali Sadar, Patuakhali during late *Rabi* 2020-21 to find out effective control measure against pod borer, *Maruca vitrata* of mungbean by various means, including chemicals, botanicals and bio-pesticides. Mungbean variety, BARI Mung-6 was grown in the

field and five treatments viz., T₁ [Azadirachtin (Fytomax aza 3%)], T₂ [Spinosad (Success 2.5SC)], T₃ [Chlorpyrifos + Cypermethrin (Nitro 505EC)], T₄ [Thiamethoxam + Chlorantraniliprole (Voliam flexi 300SC)] and T₅ [Untreated control (water spray)] were set in randomized complete block design (RCBD) with three replications. The insecticidal treatment options showed significantly different performance against pod borer, *Maruca vitrata* on mungbean. The lowest population of pod borer was found in Fytomax aza 3% treated plot and the lowest percent of pod infestation observed by the same treatment. The maximum yield (1.51 t ha⁻¹) and the highest (5.09) marginal benefit cost ratio (MBCR) were obtained from Fytomax aza 3%. Considering effectiveness and marginal benefit cost ratio, Fytomax aza 3% was more effective among the treatments for controlling pod borer of mungbean followed by Nitro 505EC.

Integrated management of sigatoka leaf sport and panama disease of banana in kushtia

J. A. Mahmud, M Akkas Ali, M Shahiduzzaman

The experiment was conducted in the farmers' field at Kushtia sadar upazila during 2020-2021 to control Sigatoka leaf sport and Panama disease of banana in Kustia to increase yield and farmers' income. The treatment combinations used for the experiment were T₁: Furadan 5G during pit preparation+ refuse/mustard oil cake @ 2kg/pit+Deep plantlet before planting in 1.0% Autostin solution+Spray Tilt 1ml/L with soap, T₂: Farmers' Practice (Only Spraying Tilt) and T₃: Control. Plant mortality was lower (4.33%) in T₁ (Furadan 5G during pit preparation+ refuse/mustard oil cake @ 2kg/pit+Deep plantlet before planting in 1.0% Autostin solution+Spray Tilt 1ml/L with soap) which the treatment package suggested by BARI was followed. The highest plant mortality was recorded from T₃ (control) and that was 13.67%. Plant mortality was found 8.67% in farmers' practice. The highest yield was obtained from T₁ (34.66 t ha⁻¹) followed by farmers' practice (31.34 t ha⁻¹) and control (23.64 t ha⁻¹).

Management of tip burn of garlic

M. S. Alam, M. A. Islam, M. R. A. Mollah, and K.M. Khalequzzaman, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at Agriculture Research Station, BARI, Bogura during 2019-20 and 2020-21 to observe the effect of various treatments on the tip burn, a leaf blight disease of garlic. To assess the efficacy of different control measures on tip burn of garlic. There were 10 treatments including control. The tip burn incidence varied with the different management approaches ranging from 75.32 -90.54% in 2019-20 and 85.15-97.38% in 2020-21 cropping season. From the two years study, it was observed that application of ash, soil amendment with Zn, timely irrigation schedule, application of K_2SO_4 and $CaSO_4$, spraying with a fungicide like Amistar Top and Nutraphos-N3 were helpful for a slight reduction in burning of the tips of garlic plants as compared to no spray (control) condition. However, the highest tip burn incidence was obtained from T_{10} (Control) treatment, and the lowest incidence was obtained from T_8 (Amistar Top @ 1 mL⁻¹ of water) and T_9 (Nutraphos-N 3 times foliar spraying @ 4 gL⁻¹). Boron application either in soil or by spray as Solubor did not affect reducing burning incidence. More burning resulted in the reduction of bulb yield of garlic and vice versa. The highest number of cloves per bulb and single bulb weight were obtained from T_9 treatment followed by T_8 treatment, but the control treatment resulted in the lower number of cloves per bulb and single bulb weight with which burning incidence was the maximum. Yield varied from 7.77-10.42 t ha⁻¹ in 2019-20 and from 6.72-7.53 t ha⁻¹ in 2020-21. Higher yield was recorded in T_9 and T_8 which were statistically identical to the yield secured from other treatments except for T_{10} (control). Higher bulb yield contributed to the higher gross return and gross margin. Maximum gross return and gross margin were recorded from T_9 treatment followed by T_8 and the minimum from T_{10} treatment.

Incidence of chickpea pod borer, *Helicoverpa armigera* hubner on the promising varieties of chickpea

Selim Ahmed and A F M Ruhul Quddus, M Akkas Ali, M Shahiduzzaman

The field trial was conducted at the FSRD site, Faridpur under the project “Strengthening of oil seed and pulses research and development project in Bangladesh” with supervision of Pulses Research Centre, Ishurdi, Pabna during the rabi

2020-21 to find out the abundance of chickpea pod borer, to provide indication of chickpea pod borers infestation level/status and its effect on pod yield of different chickpea varieties. The experiment was laid out in a randomized complete block design with three compact replications. Six (6) promising chickpea varieties i.e. BARI Chola-5, BARI Chola-9, BARI Chola-10, BARI Chola-11, Binachola-4 and Binachola-8 were evaluated at farmer’s field condition against the incidence of chickpea pod borer. The highest yield loss was observed from BARI Chola-5 (227.83 kg ha⁻¹) due to might be the highest number (28.47) of pods plant⁻¹, higher number (4.84) of pod borer m⁻² and number (5.22) of bored pods plant⁻¹. Statistically the highest pod yield (1069.66 kg ha⁻¹) was found from BARI Chola-5 and the lowest pod yield (540.33 kg ha⁻¹) was calculated from BARI Chola-10. The highest percentage of yield loss was obtained from Binachola-8 (21.98%) and lowest from BARI Chola-10 (16.7%).

Performance of pulses in mango based agroforestry system in high barind tract

M. S. Hossain, J. C. Barman and M. E. A. Pramanik, M Akkas Ali, M Shahiduzzaman

Fruit orchards are the principal agricultural crops that generate sustainable economic income to the farmers in High Barind Tract. An experiment was conducted at the FSRD site, Basantapur, Godagari, Rajshahi during 2020-21 with a view to assess the performance of mango based agroforestry with pulse crops to increase cropping intensity and productivity in the High Barind Tract. Four pulse crops i.e. pea, grass pea, chickpea and lentil were evaluated in mango orchard. The mango+chickpea system recorded the highest mango equivalent yield (MEY) (11.26 t ha⁻¹) than rest of the system. The mango+grass pea (9.30 t ha⁻¹) and mango+pea (9.21 t ha⁻¹) systems were found to be equally effective. However, the sole mango system (7.85 t ha⁻¹) recorded the lowest MEY. Among the different system, mango + chickpea had a maximum gross return (Tk. 394100 ha⁻¹), gross margin (Tk. 300070 ha⁻¹) and MBCR (4.04) than all other system. The mango + lentil ranked second in respect of gross return (Tk.362600 ha⁻¹), gross margin (Tk. 267450 ha⁻¹) and MBCR (2.87). The minimum gross return (Tk. 274750ha⁻¹) and gross

margin (Tk. 210250 ha⁻¹) was found in sole mango system.

Performance of intercropping jute leaf with summer vegetables under mango based agroforestry system

M. M. Bashir, M. H. Hossain and S. K. Bhowal, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at the farmers' fields of Sadar Dakkhin of Cumilla and Kachua of Chandpur during the summer season of 2020 to evaluate the performance of intercropping jute leaf with mukhikachu, bottle gourd, sponge gourd and okra under mango based agroforestry system, to increase the production of vegetables by using unutilized space of mango garden and income of the farmers. The highest mango equivalent yield (16.08t ha⁻¹), gross return (1125.60 ThTk ha⁻¹), net return (1011.43Th.Tk ha⁻¹) and BCR (9.86), were found from inter cropping jute leaf with mukhikachu followed by inter cropping jute leaf with sponge gourd and the lowest from inter cropping jute leaf with bottle gourd in mango based agroforestry system. Sole mango gave much lower yield and economic return than all the agroforestry systems.

Performance of intercropping jute leaf with turmeric under mango based agroforestry system

M. M. Bashir, M. H. Hossain and S. K. Bhowal, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at the farmers' fields of Sadar Dakkhin, Cumilla and Kachua, Chandpur during April 2020 to March 2021 to evaluate the performance of intercropping jute leaf with three BARI developed turmeric varieties with one local as check variety under mango based agroforestry system, to increase the production and income. The highest mango equivalent yield, net return and BCR (15.91 t ha⁻¹, Tk 828800 ha⁻¹ and 7.59, respectively) were found from intercropping jute leaf with BARI Halud-3 under mango based agroforestry system and the lowest were found from sole mango. All agroforestry system gave much higher yield and economic return than sole mango.

Performance of inter cropping coriander with tomato and sweet gourd varieties under mango based agroforestry system

M. M. Bashir, M. H. Hossain and S. K. Bhowal, M Akkas Ali, M Shahiduzzaman

An experiment was conducted at the farmers' fields of Debidwer, Chandina and Sadar Dakkhin of Cumilla and Kachua of Chandpur during the Rabi season of 2020-21 to evaluate the performance of intercropping coriander with tomato and sweet gourd varieties under mango based agroforestry system, to increase the production of culinary herb by using the fallow land under mango garden and income of the farmers. Intercropping coriander with Tomato var. BARI Tomato-19 in agroforestry system gave the highest yield as well as economic return among the six tested crops/varieties which was similar to the yield of intercropping coriander with BARI Tomato-16 and intercropping coriander with BARI Hybrid Mishtikumra-2 in agroforestry system. All the combinations of tomato gave higher yield and economic return than sweet gourd except BARI Hybrid mishtikumra-2 in agroforestry system.

Development of guava based agroforestry system with high value crops

M. Robiul. Alam, M.A. Islam and M. Maniruzzaman, M Akkas Ali, M Shahiduzzaman

The experiment was carried out at FSRD site Ganggarampur, Pabna Sadar, Pabna during 2020-21 to evaluate the performance of high value crops in agroforestry system and to increase productivity of farmer's income. Different high value crops such as tomato, cauliflower and cabbage were grown with existing guava orchard under guava based agroforestry system. Maximum fruit equivalent yield was obtained from guava+ tomato (18.65 t ha⁻¹) which was at par with guava + cauliflower (16.56 t ha⁻¹) and guava+ cabbage (13.86 t ha⁻¹). Regarding economic benefit, higher gross return (Tk. 727400 ha⁻¹) and gross margin (Tk. 569100 ha⁻¹) was achieved from guava + tomato followed by guava+ cauliflower and guava+ cabbage. Considering total system productivity and economic benefit guava+ tomato followed by guava+ cauliflower agroforestry system was found more profitable and economic viable at Pabna region.

Production of fodder crop under mango based agroforestry system

M. Robiul. Alam, M.A. Islam and M. Maniruzzaman, M Akkas Ali, M Shahiduzzaman

The production program was carried out at farmers field of FSRD site Ganggarampur, Pabna Sadar, Pabna during 2020-21 to evaluate the performance of fodder crop in agroforestry system and to increase fodder production and farmers income. The mango equivalent yield (MEY) of the agroforestry system with fodder crop was 5.16 while relatively lower MEY (3.60) was noted in sole mango cultivation. Higher gross return (309600 Tk. ha⁻¹) and gross margin (218260 Tk. ha⁻¹) was also obtained from agroforestry system. The results indicated that this agroforestry technology with mango and fodder crop was found more profitable with higher production and economic return as compared to farmer's traditional sole mango cultivation.

Development of mango based agroforestry with pulse crop

M. Robiul. Alam, M.A. Islam and M. Maniruzzaman, M Akkas Ali, M Shahiduzzaman

The experiment was carried out at farmers field of FSRD site Ganggarampur, Pabna during 2020 to evaluate the performance of pulse crop in agroforestry system and to increase productivity and farmers' income. Blackgram (var. BARI Mash-3) was selected for growing with mango orchard in this study. The mango equivalent yield (MEY) of the agroforestry system with blackgram was 5.65 while relatively lower MEY (3.50) was recorded in sole mango cultivation. Higher gross return (339000 Tk. ha⁻¹) and gross margin (274300 Tk. ha⁻¹) was also obtained from the agroforestry system.

Performance late blight resistant potato variety at rangpur under mango based agroforestry systems

M. Z. Ferdous, M. S. H. Molla and Md. A. H. Talukder, M Akkas Ali, M Shahiduzzaman

The trial was conducted at farmers field during the rabi season of 2020-2021 to promote and disseminate newly released late blight resistant potato variety, BARI Alu-46, BARI Alu-53 and BARI Alu-77 among the potato growers of

Rangpur under OFRD, BARI, Rangpur under mango based agroforestry systems. BARI Alu-46 and BARI Alu-53 showed excellent performance against late blight and produced higher yield compared to BARI Alu-25. Farmers were happy to observe the performance of the varieties and demanded quality seed for next year cultivation.

Production of cauliflower under mango based agroforestry system

M. Z. Ferdous, M. S. H. Molla and M. A. H. Talukder, M Akkas Ali, M Shahiduzzaman

The trial was conducted at farmers field during the rabi season of 2020-2021 to evaluate the performance of cauliflower at mango based agroforestry systems at Ajodhapur, FSRD site Rangpur. The cauliflower under mango based agroforestry system exhibited satisfactory yield (33.88 t ha⁻¹), gross return (Tk 271040 ha⁻¹) as well as the gross margin (Tk.109140 ha⁻¹).

Production of cabbage under mango based agroforestry system

M. Z. Ferdous, M. S. H. Molla and Md. A. H. Talukder, M Akkas Ali, M Shahiduzzaman

The trial was conducted at farmers field during the rabi season of 2020-2021 to evaluate the performance of cauliflower at mango based agroforestry systems at Ajodhapur, FSRD site Rangpur. The cabbage under mango based agroforestry system exhibited satisfactory yield (54.55 t ha⁻¹), gross return (Tk 381850 ha⁻¹) as well as the gross margin (Tk.219950 ha⁻¹).

Development of cropping pattern in mango based agroforestry system

M. A. Siddique and M. Anwar, M Akkas Ali, M Shahiduzzaman

The field experiment was conducted at Multi-Location Testing (MLT) site, Shibpur, Puthia, Rajshahi during 2019-2020 to find out the performance of different cropping patterns in the context of increase productivity and income under mango based agro-forestry systems. The experimental area was medium land of silty clay loam –loamy soils and belongs to the Agro Ecological Zone 11 (FRG, 2018). The experiment was laid out in a Randomized Complete Block

Design with three replications. There were four treatments under mango orchard viz. T_1 = Control (Mango orchard without any associated crops), T_2 = High value crops (Onion-sweet gourd- T Aman) in association with mango orchard, T_3 = High value crops (Garlic-sweet gourd- T Aman) in association with mango orchard and T_4 = High value crops (Lentil-sweet gourd- T Aman) in association with mango orchard. The sole treatments of the patterns were conducted in the adjacent open fields. The highest rice equivalent yield 41.39 t ha^{-1} was achieved in treatment T_3 followed by 35.85 t ha^{-1} in T_2 and 27.44 t ha^{-1} in T_4 . The lower REY was found in all sole crop treatments compare to their respective agro-forestry system. The maximum gross margin of Tk. 421237 ha^{-1} was achieved in treatment T_3 followed by Tk. 349562 in T_2 and Tk. 294676 in T_4 . The sole patterns are produced the lower gross margin compare to their respective agro-forestry system. The farmers' preference rank was $T_3 > T_4 > T_2$.

Development of sorjan-based agroforestry system with quick growing fruits and vegetables in coastal area

Abstract

The research work was carried out at Jamla village of FSRD site, Dumki, during 2020 to evaluate sorjan based agroforestry system with quick growing fruits and vegetables for increasing production and farmers income. Cultivation of high value vegetables with quick growing fruits in sorjan based agroforestry system showed satisfactory yield of vegetables ($230 \text{ kg sorjan}^{-1}$) and fruits ($245 \text{ kg sorjan}^{-1}$) with total gross return of Tk 14325 sorjan^{-1} and gross margin of Tk 10325 sorjan^{-1} . Moreover additional income may be possible from fish cultivation in the sorjan ditch.

Performance of sweet gourd varieties under fruit tree based agroforestry system in hill slopes of bandarban

Mohammad Tanharul Islam, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at the farmers' field of Tetulia para hill slopes of Rowangchari upazilla in Bandarban during the rabi season of 2020-21 to evaluate the performance of different sweet gourd varieties viz. V_1 =BARI Mistikumra-2, V_2 =BARI

Hybrid Mistikumra-2 and V_3 =Hybrid Maya under Mango+Papaya based agroforestry system. However, the results indicating that highest sweet gourd yield (11.89 t ha^{-1}), mango equivalent yield (25.00 t ha^{-1}), gross return (Tk. 998210 ha^{-1}), gross margin (Tk. 670210 ha^{-1}) and BCR (3.04) was obtained from mango+papaya+BARI Mistikumra-2 agroforestry system and this might be suitable for the hilly areas of Bandarban because of higher crop productivity, better land and time utilization as well as economic return.

Performance of bottle gourd varieties under fruit tree based agroforestry system in hill slopes of bandarban

Mohammad Tanharul Islam, M Akkas Ali, M Shahiduzzaman

The experiment was conducted at the farmers' field of Tetulia para hill slopes of Rowangchari upazilla in Bandarban during the rabi season of 2020-21 to evaluate the performance of different bottle gourd varieties viz. BARI Lau-3, BARI Lau-4, BARI Lau-5 and Commercial hybrid Lau under mango+papaya based agroforestry system to increase the total system productivity and economic return farmers. The maximum mango equivalent yield (29.22 t ha^{-1}), gross return (Tk. 1168800 ha^{-1}), gross margin (Tk. 848800 ha^{-1}) and BCR (3.65) was obtained from mango+papaya+BARI Lau-4 agroforestry system and this might be suitable for the hilly areas of Bandarban because of higher crop productivity, better land and time utilization as well as economic return.

Performance of different creeper vegetables under mango based agroforestry system in hill slopes of bandarban

Mohammad Tanharul Islam, M Akkas Ali, M Shahiduzzaman

The experiment was set up at the farmers' field of Tetulia para hill slopes of Rowangchari upazilla in Bandarban during the rabi season of 2020-21 to evaluate the performance of different creeper vegetables viz. sweet gourd, bottle gourd and marpha under mango+papaya based agroforestry and to increase the production and income of the farmers in this region. Highest intercrop vegetable yield (27.38 t ha^{-1}) was found from bottle gourd followed by sweet gourd (13.39 t ha^{-1}) and lowest

yield (10.09 t ha⁻¹) from marpha under agroforestry system. Highest mango equivalent yield was found from bottle gourd (27.79 t ha⁻¹), sweet gourd (25.89 t ha⁻¹), marpha (21.31 t ha⁻¹) and lowest in sole mango (2.08 t ha⁻¹). Highest gross return, gross margin and BCR (Tk. 1111600 ha⁻¹, Tk. 786600 ha⁻¹ and 3.42 respectively) was obtained from mango+papaya+bottle gourd combination.

Monthly variation on the yield of *Gracilaria* seaweed in relation with different essential water parameters at nuniarchara, cox's bazar

M. Sarfuddin Bhuiyan, M Akkas Ali, M Shahiduzzaman

Seaweeds are crops of winter season. The best time to cultivate seaweed is from October to March of the year, i.e. six months a year. During these six months six cuts can be made which means that we can harvest seaweeds after one month of each seeding. But each harvest did not produce the same yield because of variation in water quality and wave pressure from month to month during the cultivation season. To find out this yield variation along with the variation in water quality, this experiment has been carried out. At Nuniarchara sand-flat, Cox's Bazar during October 2020 to March 2021. The highest yield was obtained in the month of December (fresh yield- 10.60 ton ha⁻¹ and dry yield 1.87 ton ha⁻¹). On the other hand, the lowest yield was obtained in October (fresh yield- 3.68 ton ha⁻¹ and dry yield 0.68 ton ha⁻¹).

Performance of *Ulva lactuca* in open sea using laboratory raising seedlings at nuniarchara, Cox's bazar

M. Sarfuddin Bhuiyan , M Akkas Ali, M Shahiduzzaman

This experiment has been conducted to find out the yield of *Ulva lactuca* in open sea at Nuniarchara under Cox's Bazar district during rabi season (2020-2021). Seedlings were raised in the laboratory from multi-step seeds of *Ulva lactuca*. Seeds were prepared by cutting seedlings into pieces and attached into ropes. Ropes were placed in open sea three days after full moon and harvested three days prior to next full moon. The highest yield (4.92 ton ha⁻¹ fresh, equivalent to 0.79 ton ha⁻¹ dry) was obtained in March. Average fresh yield was 4.05 ton per hectare per month.

Adaptive trial of seaweed species collected from saint martin's island in open sea

M. Sarfuddin Bhuiyan, M Akkas Ali, M Shahiduzzaman

The experiment was conducted during late winter season (March-April, 2021) at Nuniarchara sea beach and Rejukhal to find out the suitable seaweed species. After few days of transplanting all species were died due to high temperature, turbidity and rainfall. Two species, *Chrysomenia* and *Caulerpa maxicana* survived relatively more days than other species. Survival rate was relatively higher in Rejukhal area than Nuniarchara.

Extraction and characterization of agar from *Gracilaria tenuistipitata*

M. Sarfuddin Bhuiyan, M Akkas Ali, M Shahiduzzaman

Seaweeds are sources of different important hydrocolloids such as agar, carrageenan, alginate etc. Agar has the highest usage among these hydrocolloids. Agar is mainly a solidifier which is used as raw materials in food and pharmaceutical industries. *Gracilaria tenuistipitata*, a red seaweed, is the most abundant seaweeds in our country has the potential to produce agar. This study was conducted to develop protocols to produce agar from locally available seaweed- *Gracilaria tenuistipitata* and characterize the agar produced. Eight (08) grams agar from 50 grams dry *Gracilaria* (i.e. 16%) were produced.

Project III: On-Farm Trials with Advanced Lines and Technologies

Adaptive trials of bari developed barley varieties in different regions of bangladesh

Adaptive trials were conducted at three different locations such as Debidwer, Titas Upazillas of Cumilla and Sadar Upazilla in Chandpur, Kuakata in Patuakhali, Ramnagar village under Shibaloya upazila of Manikganj during Rabi season 2020-2021 to evaluate the better performance of BARI developed Barley varieties and to popularize among the farmers under on-farm situation in different AEZ's. A total of four varieties of barley viz. BARI Barley-6, BARI Barley-7, BARI Barley-8 and BARI Barley-9 were tested in the trial.

Among them, the average highest yield of BARI Barley-9 were recorded from two locations (Cumilla and Manikganj) (3.13 t ha⁻¹). The highest yield of BARI Barley-8 was received from Patuakhali (2.45 t ha⁻¹). The lowest yield (1.97 t ha⁻¹) from BARI Barley-9 in Patuakhali, BARI Barley-6 (2.30 t ha⁻¹) in Manikganj and BARI Barley-8 (3.1 t ha⁻¹) in Cumilla, respectively.

Adaptive trial with barley advance lines in barind tract

The trial was conducted at the farmer's field of FSRD site, Basantapur, Godagari, Rajshahi during the Rabi season of 2020-21 with a view to select high yielding barley advance lines for drought areas. The trial consists of three advance lines viz. BHL-25, BHL-26 and BHL-28 and three barley varieties namely BARI Barley-6, BARI Barley-7 and BARI Barley-8. The genotypes were evaluated for yield, and yield components like days to flowering, days to maturity, plant height, No. of spike m⁻², thousand grain weight (TGW) and grain yield with the close supervision of OFRD, Barind Station, Rajshahi. Out of six barley varieties/lines BARI Barley-6 gave the highest grain yield (2.17 t ha⁻¹) followed by BHL-26 (2.04 t ha⁻¹). The lowest grain yield was produced by BARI Barley-8 (1.44 t ha⁻¹). Considering the yield and yield contributing characters BARI Barley-6 is the suitable one for Barley production in High Barind Tract.

Adaptive trials with proso millet variety in char areas in different season

An adaptive trial was conducted at five different locations in different AEZ such as Barura, Chandina and Debidwer of Cumilla and Saharasti of Chandpur, FSRD site Basantapur, Godagari, Rajshahi, Saghata, Gaibandha, Bonogram, Chilmari, Kurigram and Bhuapur, Tangail during the Rabi season of 2020-21 to evaluate the better performance of different millet varieties and to popularize among the farmers under on-farm situation. A total of four BARI developed varieties; BARI Kaon-1, BARI Kaon-2, BARI Kaon-3, BARI Kaon-4 and local were used in different locations. Among them, two varieties were used in all locations except Gaibandha. They used three variety. Four different varieties were used in different locations. Among them, the average

highest yield over the location was recorded from BARI Kaon -3 (2.95 t ha⁻¹), the second height in BARI Kaon-4 (2.48 t ha⁻¹) and the lowest from local (1.49 t ha⁻¹). In case of locations where the tested Cumilla gave maximum grain yield (2.78 t ha⁻¹) and Tangail gave minimum grain yield (1.35 t ha⁻¹).

Effect of foxtail millet variety as influenced by different weeding method

The experiment of Foxtail millet was conducted at Melandah, Jamalpur during the Rabi season of 2020-21. Three treatments viz., T₁ =Control (No weeding), T₂= Hand weeding and T₃ = Chemical control (Affinity) were tested at the farmer's field of Melandah, Jamalpur during 2020-21. Results obtained from the study indicated that the highest grain yield (2.70 t ha⁻¹) was produced in T₂ treatment and the lowest grain yield (2.33 t ha⁻¹) was produced in T₁ treatment. The highest gross return (Tk. 45,900 ha⁻¹) and gross margin (Tk. 9,741 ha⁻¹) were found from T₂ treatment and T₁ treatment, respectively. The lowest gross return (Tk. 39,610 ha⁻¹) and gross margin (Tk. 7,231 ha⁻¹) were observed from T₁ treatment and T₂ treatment, respectively.

Adaptive trial with newly released potato varieties in different locations

A set of trials were conducted at farmers' fields of fifteen different locations (Chandpur, Faridpur, Manikganj, Gaibandha, Bhola, Patuakhali, Borguna, Rangpur, Rajshahi, Khulna, Sherpur, Tangail, Mymensingh, Norshingdi and Kishorganj) under the supervision of the On-Farm Research Division during the rabi season of 2020-21 to evaluate the performance of the recently released high yielding potato varieties and to know farmers' assessment about the varieties. Ten potato varieties viz. BARI Alu-36, BARI Alu-37, BARI Alu-40, BARI Alu-41, BARI Alu-47, BARI Alu-48, BARI Alu-49, BARI Alu-56, BARI Alu-62, and BARI Alu-63 was used across the locations except for Faridpur and Manikgonj (used 9 varieties) of Bangladesh. In all trial sites, trials were laid following RCB design with four-five dispersed replications. The yield performance of most of the varieties appeared to be promising in the tested location. Among the tested potato varieties BARI Alu-40 produced the highest average tuber yield

(34.65 t ha⁻¹). Followed by BARI Alu-62 (33.80 t ha⁻¹) and BARI Alu-41 (33.73 t ha⁻¹) whereas it was lowest in BARI Alu-37 (29.56 t ha⁻¹). Considering the location, the highest tuber yield (41.26 t ha⁻¹) was recorded in Norshingdi, followed by Sherpur (39.41 t ha⁻¹) and Kishoregonj (38.78 t ha⁻¹) whereas it was the lowest in the southern region of Bangladesh like Patuakhali (21.16 t ha⁻¹) and Borguna (22.23 t ha⁻¹). No variety was found tolerant to Late Blight and the foliage infestation was a wide range from 0-40% across the locations among the tested varieties. The average foliage infection by late blight was the highest in BARI Alu-63 (16.06%) and the lowest in BARI Alu-47 (7.69%). In the case of locations, the average highest late blight infestation was recorded in Gaibandha (23%) and the lowest in Rajshahi with a very minimum by only 0.6%. On the contrary, the virus infection was the highest in BARI Alu-49 (1.66%), similar to BARI Alu-37 (1.63%) and the lowest in BARI Alu-62 (0.57%). The average highest virus infection was recorded in Rangpur (1.77%) and the lowest in Rajshahi (0.37%). The average highest gross return (Tk. 591090 ha⁻¹) and gross margin (Tk. 420980 ha⁻¹) recorded in Sherpur and the lowest (Tk. 288960 ha⁻¹) and gross margin (Tk. 101147 ha⁻¹) in Tangail, and the variation founded mainly due to the variation of the local market price of potato across the locations.

On-farm trials with newly release potato varieties in different locations

The On-farm trials were conducted at farmers' fields of MLT site in Noakhali, Faridpur and Sherpur during 2020-21 to evaluate the performance of tuber yield of some selected potato varieties and to know farmers' opinions about the varieties. Four potato varieties were tested in Noakhali, five varieties in Faridpur and nine varieties tested in Sherpur. The tuber yield was varied among the tested potato varieties across the locations. In Noakhali, BARI Alu-72 (40.48 t ha⁻¹) performed the best. In Faridpur, BARI Alu-41 observed the significant highest tuber yield (38.18 t ha⁻¹), like BARI Alu-36 (38.02 t ha⁻¹). In case of Sherpur, BARI Alu-41 yielded the highest (41.74 t ha⁻¹) like Faridpur, followed by BARI Alu-47 (39.95 t ha⁻¹). The highest gross return and gross margin were also recorded from the respective

varieties across the locations due to the significant highest tuber yield. The choice of farmers varied across the locations. In Noakhali, farmers preferred BARI Alu-72 and BARI Alu-62; in Faridpur it was BARI Alu-36 and BARI Alu-41 and in Sherpur it was BARI Alu-41 and BARI Alu-47. Farmers' choice of potato variety varied with locations mostly for yield performance and skin color.

Promotion and dissemination of late blight resistant potato varieties in different locations

The trial was conducted at farmers' field of MLT site of OFRD, Gaibandha, MLT site of Lalmonirhat; MLT site Kurigram and MLT site of Rangpur during the Rabi season of 2020-21 to evaluate the field performance of BARI released three late blight resistant Potato varieties (BARI Alu-46 and BARI Alu-53) and to know farmers' judgement about the varieties. Among the tested Potato varieties BARI Alu-53 and BARI Alu-46 performed better at all locations and gave 37.44% and 33.98% higher tuber yield than check variety (BARI Alu-25). These are two-variety showed less than 0-5% late blight infection in the foliage. Regarding Common Scab susceptibility, its severity was very low (<3%). Farmers' judgement about Potato varieties varied with locations mostly for yield performance and skin color. According to farmers' judgement the popular BARI Alu-46 and BARI Alu-53 were highly resistant to the late blight of Potato disease, which cut the fungicide cost greatly and reduced the cost of production without hampering tuber yield. Considering yield, the skin color of the tuber, market demand, and cost-benefit analysis farmers in all locations choose BARI Alu-53.

Promotion and dissemination of climate smart potato varieties in the southern districts

BARI released three climate-smart varieties viz. BARI Alu-72, BARI Alu-73 and BARI Alu-78 were evaluated at the farmer's field in the southern region Patuakhali, Borguna, Noakhali, Coxsbazar, Khulna (Koiria and Dumuria), Satkhira, Bagerhat, Bhola and Borguna to observe their yield performance in the southern districts of Bangladesh. Soil Salinity was recorded for the locations of Coxsbazar, Khulna (Koiria and Dumuria), Satkhira and Bagerhat locations. The

average of soil salinity level ranged from 2.86 to 8.15 dSm⁻¹ in all locations. The trial location of Borguna, Patuakhali, Bhola, and Noakhali was found non-saline. Among the varieties, BARI Alu-72 (29.12 t ha⁻¹) was the average highest yielder and BARI Alu-72 was the 2nd highest yielder and BARI Alu-78 was the lowest yielder. In all locations, BARI Alu-72 performed better due to its higher adaptability to heat and saline conditions. Higher average gross return, gross margin and BCR were accounted from BARI Alu-72 for its higher yield.

Adaptive trial of promising sweet potato varieties in different locations

Field trials were conducted in Sylhet, Jamalpur, Mymensingh and Kishoreganj during the year of 2020-21 to evaluate the comparative performance of sweet potato varieties and to know the farmer's view about these cultivars in the respective locations. In Sylhet, four sweet potato varieties viz. BARI Mistialu-8, BARI Mistialu-12, BARI Mistilu-14 and BARI Mistialu-16; in Jamalpur four sweet potato varieties viz. BARI Mistialu-8, BARI Mistialu-12, BARI Mistilu-14 and BARI Mistialu-15; In Mymensingh, four sweet potato varieties viz. BARI Mistialu-11, BARI Mistialu-12, BARI Mistilu-14 and BARI Mistialu-16; and in Kishoreganj three sweet potato varieties viz. BARI Mistialu-8, BARI Mistialu-10 and BARI Mistilu-15 were used in the trial. The root yield of sweet potato varieties was ranged from 20.34 to 38.45 t ha⁻¹, where BARI Mistialu-12 produced the highest average tuberous root yield in Sylhet and local cultivar produced the lowest tuberous root yield in Mymensingh. BARI Mistialu-12 produced the highest root yield in Mymensingh and Jamalpur and produced the average highest root yield (36.78 t ha⁻¹) compared to other sweet potato varieties. Among the BARI released sweet potato varieties BARI Mistialu-15 produced the lowest average tuberous root (25.02 t ha⁻¹) in Jamalpur. The highest gross return (Tk. 626935 ha⁻¹) and gross margin (Tk. 514435 ha⁻¹) were calculated from BARI Mistialu-11 in Mymensingh.

On-farm trial of bari released sweet potato varieties in saline areas

On-Farm trial of sweet potato varieties and lines were conducted at nine farmers' field at Koyra

Upazilas of saline affected areas of Khulna district during 2020-21. The objective of the trial was to popularize BARI-released sweet potato varieties. The tested varieties were BARI Misti Alu- 4, 6, 7, 8, 12. The varieties had different skin and flesh colors, which attracted farmers. Most of the farmers chose BARI Misti Alu-8 for its red attractive color and its highest yield (31.40 t ha⁻¹) production purpose. Soil types and management variation determined sweet potato yield in coastal saline areas.

Adaptive trials with newly released panikachu varieties in different locations

The experiment was conducted at three locations such as MLT site of Shimakhali, Magura, Sherpur Sadar and Kishoregonj under OFRD during the Kharif season of 2019-20 to evaluate the performance of seven panikachu varieties which was BARI Panikachu-1, BARI Panikachu-2, BARI Panikachu-3, BARI Panikachu-4, BARI Panikachu-5, BARI Panikachu-6 and local under farmers' field and to popularize among the farmers. Among them, two were in Sherpur, four were in Kishoregonj and seven were in Jashore including local check. The stolon yield of panikachu ranged from 5.70 to 24.31 t ha⁻¹, where the highest was recorded from BARI Panikachu-1 in Sherpur and the lowest from BARI Panikachu-5 in Simakhali, Magura. Among the varieties, the average stolon yield was the highest (23.89 t ha⁻¹) in BARI Panikachu-1 and the lowest (6.33 t ha⁻¹) for BARI Panikachu-5. The average highest stolon yield (22.24 t ha⁻¹) was observed in Sherpur and the lowest (11.30 t ha⁻¹) was recorded in Kishoregonj. Similarly, in the case of rhizome yield, the highest rhizome yield (36.32 t ha⁻¹) was recorded from BARI Panikachu-4 and the lowest yield from BARI Panikachu-1 (15.38 t ha⁻¹). Considering the location, the highest rhizome yield (32.73 t ha⁻¹) was observed in Simakhali, Magura and the lowest in Sherpur (20.08 t ha⁻¹). The average highest gross margin (Tk. 602900 ha⁻¹) was founded from BARI Panikachu-3 followed by BARI Panikachu-2 (Tk. 562195 ha⁻¹) across the locations.

Adaptive trials with mukhikachu varieties in different locations

The experiment was conducted at MLT site Shimakhali, Magura and MLT site Karimganj,

Kishoregonj during the Kharif season of 2019-20 to evaluate the performance of Mukhikachu varieties (BARI Mukhikachu-1 and BARI Mukhikachu-2) under farmers' field and to popularize and commercialize BARI developed aroid varieties among the farmers. The corm yield ranged from 9.25 to 26.15 t ha⁻¹ across the location and variety. The highest corm yield (18.34 t ha⁻¹) was found from BARI Mukhikachu-2, due to the much corm weight per plant (587 g) and the lowest from local cultivar (13.23 t ha⁻¹). The mean corm yield was comparatively higher (21.91 t ha⁻¹) in Kishoregonj compared to Magura (10.48 t ha⁻¹). The average highest gross margin (Tk. 132,600 ha⁻¹) was recorded in Jashore due to the high market price (Tk. 30 kg⁻¹) and lowest in Kishoregonj (Tk. 108127 ha⁻¹). There was not much difference in gross margin between the two locations in case of varietal difference.

On farm trial of advanced lines of rapeseed

An adaptive trial was conducted in the farmer's field of Pabna, Tangail and Cumilla during the Rabi season of 2020-21 with a view to evaluate the yield performance of some advanced lines of short duration mustard so that these lines could fit in the existing cropping pattern. The trial consisted of different advanced lines in the tested locations. Four lines viz. BC-100614(3)-1, BC-120114, BC-100614(4)-10 and BC-20-GS-1 along with BARI Sarisha-14 as check at Pabna; advanced lines viz. BC-100614(3)-1, BC-120114, BC-100614(4)-10, BC-20-GS-1 with one variety as check viz. BARI Sarisha-14 at Tangail; and four advanced lines viz. BC-120114, BC-100614(3)-1, BC-100614(4)-10 and BARI Sarisha-14 as check were used at Cumilla in the trial. The experiment was laid out in RCB design with three replications. Among the tested lines/varieties, the higher grain yield was obtained from BC-100614(3)-1 (1.86 t ha⁻¹) and the lowest from BC-100614(4)-10 (1.37 t ha⁻¹) in the farmer's field of Pabna. At Tangail, the highest seed yield was observed in BC-20-GS-1 (1.84 t ha⁻¹) followed by BC-100614(4)-10 (1.45 t ha⁻¹), and BARI Sarisha-14 (1.45 t ha⁻¹) whereas the lowest seed yield in BC-120114 (1.18 t ha⁻¹). At Cumilla, the advanced line BC-100614(4)-10 produced the highest seed yield (2.4 t ha⁻¹) as compared to other

lines (1.9 to 2.3 t ha⁻¹) and check variety BARI Sarisha-14 (1.8 t ha⁻¹).

On farm trial of mustard genotype in high barind tract (hbt) and level barind tract

A field trial was conducted in the farmer's field at FSRD site, Basantapur, Godagari, Rajshahi under High Baring Tract (HBT) and at MLT site, Joypurhat under Level Barind Tract (LBT) during the Rabi 2020-21 cropping season to assess the performance of mustard genotypes. Two lines and one check variety of mustard viz., BJDH-12, JUN-536 and BARI Sarisha-16 were tested in the trial. In HBT, among the tested genotypes BJDH-12 gave maximum seed yield (1.84 t ha⁻¹) followed by BARI Sarisha-16 (1.67 t ha⁻¹) and the JUN-536 gave minimum yield (1.64 t ha⁻¹). In Level Barind Tract, the highest seed yield 1.96 t ha⁻¹ was recorded from BJDH-11 followed by Jun-536 (1.37 t ha⁻¹) whereas the lower seed yield 1.24 t ha⁻¹ was obtained from BARI Sarisha-16.

On-farm trial of long duration bari mustard varieties

The trial was conducted at the MLT site, Shibpur, Puthia, Rajshahi during the rabi season of 2020-21 to evaluate the performance of long duration mustard varieties in the farmers' field. BARI sarisha-11, BARI Sarisha-16 and BARI sarisha-18 were included in the study. The experiment was designed in RCB with six dispersed replications. The highest yield (2.42 t ha⁻¹) and gross margin (Tk. 116255 ha⁻¹) was obtained from BARI Sarisha-11. The lower yield (2.23 t ha⁻¹) obtained from BARI Sarisha-18 in the farmers' field at Rajshahi.

Adaptive trial of advanced lines of mustard

An adaptive trial was conducted at the farmer's field of Noapara, Sadar Dakkhin, Cumilla, during the Rabi season of 2020-21 with a view to select short duration high yielding variety of rapeseed to fit in between T.Aman – Boro rice. Six advanced lines i.e. NAP-15029, NAP-16041, NAP-16064, NAP-16068, NAP-0865 and NAP-0876 with two mustard variety (BARI Sarisha-8 and BINA Sarisha-9) were used in the trial as a check. Among the tested varieties/lines, NAP-0876 and NAP-16041 produced higher seed yield (1.68 t ha⁻¹ and

1.673 t ha⁻¹, respectively) with slightly lower days to maturity compared to BARI Sarisha-8 and BINA Sarisha-9.

On farm trial of bari sesame varieties

An experiment was conducted at Monipur, Sadardakh, Cumilla; Shauta and Vadalía village under Sadar upazila of Kushtia and the FSRD site, Faridpur during the Kharif I season of 2020 to evaluate the performance of advanced lines of sesame in the farmers' field and to select suitable varieties for the tested locations. Four varieties i.e BARI Til-3, BARI Til-4, Binatil-1 and Binatil-2 were used at Cumilla. Three BARI released Sesame varieties viz. BARI Til-3 and BARI Til-4 with local variety as check at Vadalía, Kushtia; three advanced lines of sesame viz. Ses-MR-20, Ses-PR-20, Ses-2010-OIR with BARI Til-4 and Binatil-1 were tested at Shauta, Kushtia; and four advanced lines viz. Ses-9768, Ses FR-20, Ses-PR-20 and Ses MR-20 along with a check variety BARI Til-4 at Faridpur were evaluated in the study. In Cumilla, BARI Til-4 produced the highest seed yield compared to other varieties. At Vadalía of Kushtia, BARI Til-4 (1.59 t ha⁻¹) produced the highest seed yield followed by BARI Til-3 (1.41 t ha⁻¹). At Shauta of Kushtia, Ses-MR-20 produced the highest seed yield (1.61 t ha⁻¹) and economic return than other varieties and advanced lines. In Faridpur, Ses MR-20 (0.8 t ha⁻¹) provided the higher yield than BARI Til-4. The yields of all varieties were poor due to water logging condition at seed formation stage in this season.

On farm trial of bari sunflower varieties

The experiment was conducted at Cumilla, Sylhet and Patuakhali during the Rabi seasons of 2020-21 in the farmers' field to select suitable variety of Sunflower and to increase production and farmers income. Three Sunflower varieties viz. BARI Surjamukhi-2, BARI Surjamukhi-3 and Hysan-33 at Cumilla and Sylhet; five varieties/lines viz. BARI Surjomukhi 2, BARI Surjomukhi-3, SC-01, SC-02 and Hysun-33 were evaluated at Patuakhali. The experiment was conducted in RCB design with three to six dispersed replications in each location. Significant difference was found in grains head⁻¹, 1000-grain weight and grain yield. The yield of BARI Surjamukhi-3 (2.31 t ha⁻¹) was

the higher than other varieties at Cumilla. At Sylhet, the highest seed yield (1.81 t ha⁻¹) was obtained from BARI Surjomukhi-3 and the lowest seed yield (1.49 t ha⁻¹) was obtained from BARI Surjomukhi-2. At Patuakhali, the highest yield was observed from the lines SC -01 (3.15 t ha⁻¹) followed by lines SC-02 and Hysun33, and the lowest yield was obtained from the variety BARI Surjomukhi-03 (1.58 t ha⁻¹).

Adaptive trial of soybean varieties

The experiment was conducted in the farmer's field at West Al-Amin, Subarnachar upazilla in Noakhali district during Rabi season of 2020-2021 to select suitable soybean variety for char lands under rainfed condition. Among the tested varieties the highest seed yield was obtained from BARI Soybean-6 (2.26 t ha⁻¹) which was statistically similar with BU Soybean-1 (2.20 t ha⁻¹) and BINASoybean-5 (2.19 t ha⁻¹) and the lowest yield (1.74 t ha⁻¹) was obtained from local variety (Shohag). Highest gross margin was obtained from BARI Soybean-6 (TK. 63820 ha⁻¹).

Preliminary yield trial of advanced lines of soybean in chandpur

A preliminary trial was carried out in the farmer's field of Dakkhin Gobindia of Chandpur Sadar upazilla of Chandpur district during the Rabi season of 2020-21 with a view to test the yield performance of advanced lines (BS-29, USDA-4, USDA-40, USDA-53, USDA-72, USDA-95, USDA-107 & GMOT-13) with BARI developed two soybean varieties (BARI Soybean-6 and BARI Soybean-7) in the farmers field level in that area. From the trial, it was revealed that USDA-4 had the highest branch plant⁻¹ (5.2), pods plant⁻¹ (80.6) and seed yield (2.92 t ha⁻¹) with less field duration (99 days). BARI Soybean-7 and BARI Soybean-6 had second and third highest seed yield (2.60 and 2.54 t ha⁻¹, respectively). The lowest seed yield (1.65 t ha⁻¹) was obtained from USDA-107.

On-farm trial of bari groundnut varieties

The experiment was conducted at North channel (char land area) of Faridpur Sadar, Faridpur; and MLT site Barura, Cumilla during the Rabi season of 2020-21 to find out the suitable Groundnut variety for the charlands and to popularize the

varieties among the farmers. At Faridpur, three BARI developed Groundnut varieties viz., BARI Chinabadam-8, BARI Chinabadam-9, BARI Chinabadam-10 and one local variety (Dhaka-1); three BARI developed Groundnut varieties viz. BARI Chinabadam-8, BARI Chinabadam-9, BARI Chinabadam-10 and one BINA developed variety viz. Binachinabadam-4 were evaluated at Cumilla. At Faridpur, the highest average nut yield (2.75 t ha⁻¹) was recorded in BARI Chinabadam-10 and 100 kernel weights were associated with the nut yield. The lowest nut yield (1.72 t ha⁻¹) was obtained from the local variety, Dhaka-1. The yield was 60% higher in BARI Chinabadam-10 over Dhaka-1. In the farmer's field of Cumilla, the highest nut yield was recorded in BARI Chainabadam-9 (2.58 t ha⁻¹) and the lowest in Binachinabadam-4 (1.59 t ha⁻¹).

Adaptive trial of bari released lentil varieties

The experiment was conducted at farmer's field of Kushtia sadar, MLT site: Bheramara, Mujibnagar, Gangni and Chuadanga during the Rabi season of 2020-2021 and at MLT site, Tularampur, Narail during the Rabi season of 2019-20 and 2020-21 to observe the performance of BARI released lentil variety in those area. Four BARI released lentil

varieties viz. (BARI Masur-6, BARI Masur-7, BARI Masur-8, BARI Masur-9 with local check variety were tested at different regions of Kushtia and two BARI released lentil varieties such as BARI Masur-9, BARI Masur-8 and a local lentil variety were tested in the farmers' field of Narail. Among the tested varieties, BARI Masur-8 performed better and gave the highest seed yield and economic return in all locations.

Regional yield trial of chickpea in high barind tract

The field trial was carried out at the farmer's field of FSRD site, Basantapur, Godagari, Rajshahi during the Rabi season 2020-21 to select suitable chickpea variety through Regional Yield Trial (RYT) under drought prone area. Three genotypes of chickpea viz. BCX-13005-3, BCX-13004-4, BCX-13002-2 and two varieties namely BARI Chola-5 and BARI Chola-10 as a check were tested in the farmer's field. Among the tested genotypes, BCX-13002-2 gave maximum seed yield (1.74 t ha⁻¹) followed by BCX-13005-3 (1.57 t ha⁻¹) and minimum seed yield obtained from BARI Chola-5 (1.48 t ha⁻¹) and BCX-13004-4 (1.49 t ha⁻¹) which are statistically similar.

Table 1. Yield and yield attributes of Chickpea genotypes at Basantapur under FSRD site, Godagari, Rajshahi during the rabi season of 2020-2021

Treatment	Days to Flowering	Days to maturity	Plant ht.(cm)	Plants m ⁻²	Pods plant ⁻¹	Seeds pod ⁻¹	1000 grain wt. (g)	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)
BARI Chola-5	81a	117b	47c	24	68ab	1.7a	13.0c	1.48b	1.42
BCX-13005-3	79b	118a	55b	24	62b	1.4b	19.3b	1.57ab	1.47
BCX-13004-4	81a	118ab	56b	22	63b	1.5b	20.5b	1.49b	1.51
BCX-13002-2	77c	118a	60a	23	77a	1.7a	22.7a	1.74a	1.68
BARI Chola-10	76c	115c	53b	24	63b	1.3b	20.5b	1.56ab	1.66
CV (%)	0.84	0.53	3.2	5.1	7.9	8.7	3.8	6.3	11.9
LS	**	**	**	NS	*	**	**	*	NS

LS= Level of Significance, NS= Non-significant, *= Significant at 5% level, **= Significant at 1% level.

The performance of variety BARI chola-10, line BCX-13002-2 and BCX-13005-3 appeared to be promising among the lines tested at FSRD site, Basantapur, Godagari, Rajshahi during the study

period. So, it can be concluded that the experiment may be repeated for further evaluation in the next year.

Adaptive trial of chickpea varieties in charland

A field trial was conducted in the farmer's field under stable Charland of Bonogram, Chilmari, Kurigram during the Rabi season of 2020-21 to identify the suitable variety under stable Charland environments. Four varieties of chickpea BARI Chhola-5, BARI Chhola-9, BARI Chhola-10, and BARI Chhola-11 were tested in the farmer's field. The varieties were evaluated for yield and yield components like days to flowering, days to maturity, plant height, no. of pods plant⁻¹, 1000 seed weight, grain and stover yield etc. with the close supervision of OFRD, BARI, Rangpur. Among the tested entries, BARI Chhola-9 (1.41 t ha⁻¹) gave maximum seed yield and 2nd highest seed yield produced by BARI Chhola-5 (1.23 t ha⁻¹) and BARI Chhola-10 (1.19 t ha⁻¹), respectively. BARI Chhola-11 gave minimum yield (1.07 t ha⁻¹). The maximum gross margin (60375 Tk. ha⁻¹) was obtained from BARI Chhola-9.

Yield performance of different garden pea varieties at sherpur region

The experiment of garden pea was conducted at Tarakandi, Sherpur Sadar, Sherpur during rabi season of 2020-21. Three varieties viz., V₁ = BARI Motorsuti-1, V₂ = BARI Motosuti-3 and V₃ = Natore local were tested in the farmers field. The highest green pod yield (12.9 t ha⁻¹) was obtained from BARI Motorsuti-1. The lowest green pod yield (7.48 t ha⁻¹) was recorded in Natore local.

On-farm trial of bari developed eggplant varieties at manikganj

The adaptive trial was conducted at Boinna Prashad village under Ghior upazila of Manikganj district during Rabi season of 2020-21 to evaluate the performance of BARI released eggplant varieties against local variety. Three eggplant varieties viz. BARI Begun-4, BARI Begun-10 and a farmer's variety (Lalteer hybrid) were tested in the study. The experiment was conducted in RCB design with 5 dispersed replications. Out of the tested varieties, farmers' variety Lalteer hybrid gave higher yield (39.53 t ha⁻¹) than another BARI Begun-4 (32.81 t ha⁻¹) and BARI Begun-10 (22.30 t ha⁻¹). BFSB was the main constraint to achieve higher yield and appropriate measures were taken to control the pest. The higher gross return Tk. 328100.00 ha⁻¹

and gross margin (Tk. 199559.00 ha⁻¹) was also obtained from Lalteer hybrid followed by BARI Begun-4 (Tk. 328100.00 ha⁻¹ and Tk. 99559 ha⁻¹).

On-farm trial of bari developed hybrid eggplant variety

An on-farm trial was conducted at MLT site, Barura, Chandina and Debidwer of Cumilla and Saharasti of Chandpur during rabi season of 2020-21 to evaluate the performance of BARI developed hybrid Eggplant variety and to popularize the varieties among the farmers. BARI released high yielding hybrid brinjal variety BARI Hybrid Begun-4 was evaluated against commercial Hybrid begun (Chaity) in farmer's field condition. BARI Hybrid Begun-4 (29.99 t ha⁻¹) gave 5.7% higher fruit yield than farmers variety Chaity (24.99 t ha⁻¹). Higher gross margin (Tk. 507288.00 ha⁻¹) was also obtained from BARI Hybrid Begun-4.

On-farm trial of bari winter bottle gourd variety

The trial was conducted at Noakhali and Bandarban during rabi season of 2020-21 to evaluate the performance of BARI developed high yielding winter bottle gourd varieties in the farmer's field. BARI Lau-4 was tested against farmer's variety (Martin) under non-saline condition next to homestead at Noakhali. BARI Lau-3, 4 and 5 were tested against farmers variety (Hybrid Lau) in the hill valleys of Bandarban. The experiment was laid out in Randomized Complete Block design with six dispersed replications. BARI Lau-4 (7.05 t ha⁻¹) produced 7.63% higher fruit yield compared to farmers variety (6.55 t ha⁻¹) at Noakhali. In the hill valleys of Bandarban, BARI Lau-5 (25.25 t ha⁻¹), BARI Lau-3 (31.65 t ha⁻¹) and BARI Lau-4 (40.92 t ha⁻¹) gave 40.43, 76.02 and 127.58% higher yield than farmers variety (17.98 t ha⁻¹). The maximum gross margin was also obtained from BARI varieties at all the tested locations.

On-farm trial of bari summer bottle gourd variety

The experiment was conducted at Jashore and Noakhali during Kharif-I season of 2020 to evaluate the performance of BARI summer Bottle gourd variety at farmers' field. BARI developed summer bottle gourd variety BARI Lau-4 was evaluated

against farmers' variety as check at both the location. BARI Lau-4 produced statistically higher yield 48.25 t ha⁻¹ at Jashore and 42.85 t ha⁻¹ at Noakhali in Kharif season than local variety 42.93 and 38.94 t ha⁻¹, respectively. Higher gross margin (Tk. 468320.00 and Tk. 337055 ha⁻¹) was also obtained from BARI Lau-4 than farmers variety (Tk. 388520.00 and 280360.00 ha⁻¹) in the tested locations.

On-farm trial of bari developed hybrid pumpkin variety

The trial on hybrid pumpkin varieties were conducted at Mymensingh, Cumilla, and Manikganj during rabi season of 2020-21 to evaluate the performance of BARI developed pumpkin varieties in the farmers' field. BARI developed hybrid sweet gourd variety viz. BARI Hybrid Mistikumra-2 was tested against farmers' variety Sweety hybrid at Mymensingh and Maxima hybrid at Cumilla as check. BARI developed three open pollinated varieties viz. BARI Mistikumra-1, BARI Mistikumra-2 and BARI Mistikumra-3 were tested against farmers variety Lalteer hybrid at Manikganj. The experiment was laid out in RCB design with six dispersed replications. BARI Hybrid Mistikumra-2 produced fruit yield 30.00 and 36.56 t ha⁻¹ at Mymensingh and Cumilla, respectively which were 14.41 and 38.85% higher than farmers' variety Sweety hybrid (26.22 t ha⁻¹) and Maxima hybrid (26.33 t ha⁻¹). At Manikganj, commercial variety Lalteer hybrid gave higher yield ((32.60 t ha⁻¹) than BARI Mistikumra-3 (29.30 t ha⁻¹), BARI Mistikumra-1 (24.30 t ha⁻¹) and BARI Mistikumra-2 (20.80 t ha⁻¹). Higher gross margin (Tk. 110395 and Tk. 421840 ha⁻¹) was also obtained BARI Hybrid Mistikumra-2 at Mymensingh and Cumilla but Lalteer hybrid (Tk. 273055.00 ha⁻¹) at Manikganj.

On-farm trial of bari developed bitter gourd variety

The experiment was conducted at Cumilla, Faridpur, Jashore and Rajshahi during the Kharif-II season of 2021 to evaluate the yield performance of BARI Bitter gourd varieties against commercial hybrid varieties as check. BARI Korola-2 and BARI Korola-3 against farmers' variety (Tia hybrid) at Cumilla and Faridpur; BARI Korola-2,

BARI Korola-3 against farmers' variety (Goj Korola) at Jashore; BARI Korola-2 and BARI Korola-3 against local variety at Rajshahi were evaluated. The experiment was laid out in RCBD with six dispersed replications. BARI Korola-2 gave the highest yield (17.32 t ha⁻¹) at Rajshahi followed by Jashore (9.15 t ha⁻¹), Faridpur (5.79 t ha⁻¹) and the lowest at Cumilla (5.05 t ha⁻¹). BARI Korola-3 gave 4.12, 7.70 and 8.33 t ha⁻¹ yield in the farmers field at Faridpur, Cumilla and Jashore, respectively. The yield of commercial hybrid (Tia) ranged from 4.82 to 12.11 t ha⁻¹ and BARI varieties performed better at all the tested locations compared to local hybrids. Higher gross margin was also obtained from BARI Bitter gourd varieties.

On-farm adaptive trial of bari developed okra variety

The on-farm trial was conducted at Cumilla during Kharif season of 2020 and Pabna during Kharif season of 2021 to evaluate the performance of BARI Dherosh-1 and BARI Dherosh-2 against farmers' variety as check. The experiment was laid out in RCB design with six dispersed replications. BARI Dherosh-2 produced higher marketable yield 10.10 and 15.10 t ha⁻¹ at Cumilla and Pabna, respectively whereas local variety gave 9.7 and 10.70 t ha⁻¹. BARI Dherosh-2 was resistant to YVMV in the farmers' field at Pabna but 10.1% infestation was recorded at Cumilla compared to local variety (9.7%). Higher gross margin was also obtained from BARI Dherosh-2 at both the tested locations.

On-farm trial of bari developed winter tomato varieties

The trial was conducted at Manikganj, Tangail, Narsingdi, Rajshahi, Cumilla, Noakhali, and Bandarban during rabi season of 2020-21 to evaluate the performance of BARI developed winter Tomato varieties. Eight BARI Tomato varieties viz. BARI Tomato-14, BARI Tomato-15, BARI Tomato-16, BARI Tomato-17, BARI Tomato-18, BARI Tomato-19, BARI Tomato-20 and BARI Tomato-21 were evaluated against farmer's varieties as check grown in different locations in the study. BARI developed Tomato varieties performed better in different locations compared to farmers varieties. BARI Tomato-14

produced higher and similar yields in the farmers field at Rajshahi (66.47 t ha⁻¹) and Satoria, Manikganj (59.51 t ha⁻¹). BARI Tomato-15 gave higher average yield 80.05 t ha⁻¹ at three locations of Tangail followed by Rajshahi (70.21 t ha⁻¹). Similarly, higher average yield 80.60 t ha⁻¹ was obtained from BARI Tomato-16 at Tangail, Narsingdi (75.50 t ha⁻¹) and the lowest (59.87 t ha⁻¹) at Rajshahi. BARI Tomato-17 performed better at Narsingdi (84.67 t ha⁻¹) and Satutia, Manikganj (79.72 t ha⁻¹). BARI Tomato-18 provided average 75.30 t ha⁻¹ in three locations of Tangail with the maximum yield at Atia, Tangail (90.06 t ha⁻¹) followed by Narsingdi (70.50 t ha⁻¹), Noakhali (69.45 t ha⁻¹) and the lowest at Rajshahi (55.64 t ha⁻¹). The higher fruit yield was recorded from BARI Tomato-19 (93.56 t ha⁻¹) and BARI Tomato-21 (85.78 t ha⁻¹) in the hill valleys of Bandarban. Farmers' variety produced lower yields (24.12 to 58.84 t ha⁻¹) at all the tested locations except at Bandarban (82.89 t ha⁻¹). Higher gross margin was obtained from BARI winter Tomato varieties in all locations compared to farmers variety.

On farm trial of bari developed summer tomato varieties

The experiment was conducted at Char-Kumaria in Bhola sadar and at Char-Gumani under Doulatkhan upazila in Bhola district during Kharif season of 2020. Four summer hybrid tomato varieties viz. BARI Hybrid Tomato-8, BARI Hybrid Tomato-10, BARI Hybrid Tomato-11 and Hitom-2 (Check) were used in the study. The trial was laid out in RCB design with 3 dispersed replications. BARI Hybrid Tomato-10 (25.35 t ha⁻¹) gave 4.32% higher yield than Hitom-2 (24.30 t ha⁻¹). The highest fruit yield (22.35 t ha⁻¹) was obtained from BARI Hybrid Tomato-8 and the lowest in BARI Hybrid Tomato-11 (20.65 t ha⁻¹). Higher gross margin (Tk. 1031500 ha⁻¹) was also obtained from BARI Hybrid Tomato-10.

On-farm trial of bari developed winter hybrid tomato varieties

The field experiment was conducted at Tangail and Manikganj during rabi season of 2020-21 to evaluate the performance of BARI winter hybrid Tomato varieties and to popularize the varieties among the farmers. The experiment was laid out in

RCB design with six dispersed replications. BARI Hybrid Tomato-5 and BARI Hybrid Tomato-7 against Safol hybrid at Tangail and BARI hybrid Tomato-5 against Lalteer hybrid as check at Manikganj were evaluated in the study. BARI Hybrid Tomato-5 produced the maximum fruit yield 98.00 and 94.00 t ha⁻¹ at Delduar and Modhupur of Tangail, respectively which were 27.27 and 23.68% higher than Safol hybrid grown in the same locations. On the other hand, BARI Hybrid Tomato-5 at Satoria and Ghiorupazila of Manikganj produced yields 87.04 and 51.84 t ha⁻¹, respectively which were 8.47 and 3.74% higher than Lalteer hybrid. The fruit yield 77.00 and 76.00 t ha⁻¹ were recorded from BARI Hybrid Tomato-7 at Delduar and Modhupur of Tangail but farmers variety gave lower yields 77.00 and 76.00 t ha⁻¹, respectively. Higher gross margin was also obtained from BARI Hybrid Tomato varieties compared to farmers variety.

On-farm trial of bari developed pointed gourd varieties in kushtia

An experiment was conducted at MLT site, Chuadanga during 2019-20 in farmer's field to observe the performance of BARI released pointed gourd varieties. Three BARI released pointed gourd varieties viz. BARI Potol-1, BARI Potol-2 and BARI Hybrid Potol-1 were tested against farmer's variety as check. BARI Hybrid Potol-1 gave highest yield (39.70 t ha⁻¹) and the lowest yield was obtained from BARI potol-2 (33.83 t ha⁻¹).

On-farm adaptive trial of bari developed capsicum varieties

The trial was conducted at MLT site, Chandina of Cumilla and Saharasti of Chandpur during Rabi season of 2020-21 to evaluate the performance of BARI developed capsicum varieties viz. BARI Capsicum-1 and BARI Capsicum-2 in the farmer's field. Higher fruit yield (11.75 t ha⁻¹) was obtained from BARI Capsicum-2 compared to BARI Capsicum-1 (10.35 t ha⁻¹). The highest gross return (Tk. 822500 ha⁻¹), gross margin (Tk. 702500 ha⁻¹) and BCR (6.85) were also obtained from BARI Capsicum-2.

On-farm trial of bari broccoli variety in hill valleys of bandarban

An on-farm trial was conducted at Bakichara hill valleys of Bandarban sadar and Chaingya of

Rowangchhariupazila during the rabi season of 2020-21 to evaluate the performance of BARI Broccoli-1 in farmers' field. A hybrid variety of Broccoli was used as check. The experiment was laid out in RCB design with three dispersed replications. BARI Broccoli-1 took less time to harvest (63 days) than hybrid variety (65 days). BARI Broccoli-1 gave higher single head weight (251.13 g) and yield (11.16 t ha⁻¹) than farmers variety (229.42 g and 10.20 t ha⁻¹). The highest gross margin (Tk. 343775 ha⁻¹) was found from BARI Broccoli-1 than farmers variety (Tk. 305375 ha⁻¹).

On-farm trial of bari developed sponge gourd variety

An experiment on sponge gourd varieties was conducted at MLT site, Debidwer of Cumilladuring Rabi season of 2020-21 to evaluate the performance of BARI Sponge Gourd-1 at farmer's field condition. BARI Dhundol-1 showed higher yield potentiality and gave higher yield (10.22 t ha⁻¹) compared to farmers variety Raka (8.90 t ha⁻¹). Higher gross margin (Tk. 68300.00 ha⁻¹) was also obtained from BARI Dhundol-1 than commercial variety Raka (Tk. 48500.00 ha⁻¹).

On-farm trial of bari released garlic varieties

The experiment was conducted at MLT site Bhuapur, Tangail during the rabi season of 2019-20 and 2020-21 and Tungipara, Kashiani, Gopalganj sadar during the rabi season of 2020-21 to introduce BARI released garlic varieties in the area and to increase the economic return of the farmers. The trial was laid out in RCB design with dispersed replications. In Tangail, the highest average bulb yield of 7.87 t ha⁻¹ was obtained from BARI Rashun-4 whereas BARI Rashun-3 gave highest bulb yield (9.75 t ha⁻¹) in Gopalganj. BARI Rashun-1 produced minimum yield in all the location.

On farm trial of turmeric varieties

On farm trial of Turmeric varieties were conducted at the farmers' field of Binatti and Satarpur union of Kishoreganj sadar and Karimganj upazila under Kishoreganj district and Rajbari during the rabi season of 2020-21 to find out the suitable Turmeric variety for the area. Two BARI developed

Turmeric varieties viz. BARI Halud-4, BARI Halud-5 and farmers variety were tested in Rajbari whereas BARI Halud-4 and one local variety were used in Kishoregonj. The highest yield was found from BARI Halud-4 gave the highest rizome yield in both the location. The lowest rizome yield was recorded from local variety in both the location. BARI Halud-4 gave the highest gross return, gross margin followed by other varieties.

On farm adaptive trial of chilli varieties in faridpur

A trial was conducted at the farming System Research and Development (FSRD) site under On-Farm Research Division (OFRD), Faridpur under AEZ-12 during the kharif I season of 2020 to find out the suitable chilli varieties and to increase the chilli production and productivity. It was laid out in RCB design in seven dispersed replications. BARI released chilli variety named BARI Morich-2 was evaluated in the trial against two local cultivar named Sholakundu and khalkhula. The highest fruit yield was calculated from BARI Morich-2 (7.36 t ha⁻¹) followed by local Sholakundu (7.29 t ha⁻¹) and the lowest fruit yield was found from local Khalkhula (7.05 t ha⁻¹). The highest gross return was obtained from BARI Morich-2 (Tk. 956800 ha⁻¹) due to highest yield. The lowest gross margin (Tk. 706043 ha⁻¹) was calculated from local khalkhula due to the lowest yield.

On-farm trial of bari onion varieties

The experiment was carried out at the FSRD site, Faridpur, Kushtia sadar and Gopalganj during the winter season of 2020-21 under farmer's field condition to evaluate the performance of Onion varieties against local cultivar. Two BARI released Onion varieties viz. BARI Piaz-1 and BARI Piaz-4 were evaluated in the trial against local cultivars at all the locations. At Faridpur, the highest bulb yield was calculated from BARI Piaz-4 (22.42 t ha⁻¹) followed by Lalteer king (18.29 t ha⁻¹) and the lowest from BARI Piaz-1 (13.70 t ha⁻¹). At Kushtia, the highest bulb yield was calculated from BARI Piaz-4 (19.37 t ha⁻¹) followed by BARI Piaz-1 (15.75 t ha⁻¹) and the lowest from Local King (15.63 t ha⁻¹). At Gopalganj, the highest bulb yield was calculated from Local variety Red King (18.50

t ha⁻¹) followed by BARI Piaz-4 (17.40 t ha⁻¹) and the lowest from BARI Piaz-1 (12.75 t ha⁻¹).

On farm adaptive trial of chilli varieties in faridpur

A trial was conducted at the farming System Research and Development (FSRD) site under On-Farm Research Division (OFRD), Faridpur under AEZ-12 during the kharif I season of 2020 to find out the suitable chilli varieties and to increase the chilli production and productivity. It was laid out in RCB design in seven dispersed replications. BARI released chilli variety named BARI Morich-2 was evaluated in the trial against two local cultivar named Sholakundu and khalkhula. The highest fruit yield was calculated from BARI Morich-2 (7.36 t ha⁻¹) followed by local Sholakundu (7.29 t ha⁻¹) and the lowest fruit yield was found from local Khalkhula (7.05 t ha⁻¹). The highest gross return was obtained from BARI Morich-2 (Tk. 956800 ha⁻¹) due to highest yield. The lowest gross margin (Tk. 706043 ha⁻¹) was calculated from local khalkhula due to the lowest yield.

On-farm adaptive trial of bari developed capsicum varieties

An on-farm trial was conducted at MLT site, Chandina of Cumilla and Saharasti of Chandpur during Rabi season of 2020-21 to evaluate the performance of BARI developed capsicum varieties; eg. BARI Capsicum-1 and BARI Capsicum-2 in farmer's field condition. From the research trial it was documented that, numerically higher yield (11.75 t ha⁻¹) was obtained from BARI Capsicum-2 compared to BARI Capsicum-1 at Cumilla region. From the economic analysis, it was found that, higher gross return (822500 Tk ha⁻¹), net return (702500 Tk ha⁻¹) and BCR (6.85) were also obtained from BARI Capsicum-2.

Integrated nutrient management for turnip on ex-situ floating bed waste incorporated land

A nutrient management trial was conducted at the Aamgram, Sadar, Madaripur during the rabi, 2020-21 to determine fertilizer dose for turnip on ex-situ floating bed waste incorporated land and to increase the yield and economic return of turnip through minimum use of chemical fertilizers. The

experiment was laid out in randomized complete block (RCB) design. Four treatments were considered as T₁ (Recommended Fertilizer Dose; RFD) = N₁₀₁P₆₀K₄₀S₂₅Zn₃B₁ kg ha⁻¹ (FRG, 2018), T₂ (RFD+Organic) = T₁ + 8 tha⁻¹ decomposed floating bed waste, T₃ (RFD+Organic) = T₁ + 4 tha⁻¹ decomposed floating bed waste and T₄ (Farmer's practice) = N₉₂P₅₆K₄₀S₂₅Zn₃B₁ kg ha⁻¹. Combination of chemical fertilizer and floating decomposed waste in T₂ treatment exhibited relatively higher single card weight. The highest card yield (19.66 t ha⁻¹) was obtained from T₂ followed by T₃. The lowest card yield (16.62 t ha⁻¹) was recorded in farmer's practice (T₄). Maximum gross return (Tk. 196600 ha⁻¹) and gross margin (Tk. 117350 ha⁻¹) were obtained from that treatment where combination of recommended fertilizer dose and 8 t ha⁻¹ decomposed floating bed waste was incorporated in soil.

Adaptive trial of winter hybrid tomato on floating bed in madaripur (non-tidal method)

A trial was conducted at Hijalbari under Rajoir upzilla of Madaripur during the winter season, 2020-21 to find out the suitable hybrid tomato variety for cultivation on floating bed and to popularize BARI developed varieties among the neighbor farmers under floating agriculture system in Madaripur areas. Each floating bed was considered as one treatment with RCB design. Three hybrid tomato varieties (BARI Hybrid Tomato-5, BARI Hybrid Tomato -9 and local hybrid) were selected for this program. The fruits yield (tha⁻¹) were 65.50, 72.85 and 55.10 of BARI Hybrid Tomato-5, BARI Hybrid Tomato -9 and local hybrid variety, respectively.

Adaptive trial of winter onion on floating bed in madaripur

The experiment was conducted at Hijalbari under Rajoir upzilla of Madaripur during the winter season, 2020-21 to find out the suitable onion variety for cultivation on floating bed and to popularize BARI developed variety among the neighbor farmers under floating agriculture system in Madaripur areas. Each floating bed considered as one treatment (variety) with following RCB design. Three onion varieties (BARI Piaz-1, Lal Teer and local variety) were selected for this program. The highest bulb yield (12.07 tha⁻¹)

obtained from Lal Teer variety and the second highest was BARI Piaz-1 (10.20 tha^{-1}). The local variety yield (9.31 tha^{-1}) gave the lowest yield among all the planted variety due to all yield attributes showed the lowest value.

Intercropping of non-creeper with creeper vegetables on floating bed cum trellis (non-tidal model)

The intercropping based activity was conducted at Amgram and Hijalbari area under Rajoir upzilla of Madaripur district and Kishorgonj sadar and Karimgonj upzila under Kishorgonj district during 2020-21 to increase the vegetable crop productivity using floating agriculture technology and to popularize among the neighbor farmers for extending floating agriculture system. Four treatments were considered as T_1 = Bottle gourd + Redish, T_2 = Cucumber + Red amaranth, T_3 = Sweet gourd + coriander leaf and T_4 = Yard long bean + spinach at Kishorgonj and T_1 = Bottle gourd + Red amaranth, T_2 = Sweet gourd + Red amaranth, T_3 = Yard long bean + Red amaranth and T_4 = Ash gourd + kangkong. Each floating bed considered as one treatment following RCB design. The highest gross margin (Tk. 2,20,529 ha^{-1}) was obtained from T_1 treatment at Kishorgonj whereas ash gourd (54.60 tha^{-1}) intercropped with kangkong (32 tha^{-1}) combination at Madaripur produced highest yield.

Adaptive trial of bari winter brinjal varieties on floating bed

Adaptive trial of BARI winter brinjal varieties was conducted at the Kishoreganj sadar and Karimganj upazilla of Kishoreganj district during 2020-21 to examine a suitable brinjal variety for the area. Two BARI developed varieties such as BARI begun-6 and BARI begun-10 were tested. The significantly highest yield was found from BARI begun-10 (38.77 t ha^{-1}) and the lowest from BARI begun-6 (35.78 t ha^{-1}). From financial analysis, BARI begun-10 gave the highest gross return (387654 Tk ha^{-1}), gross margin (219134 Tk ha^{-1}) and benefit cost ratio (2.08) followed by BARI begun-6.

Adaptive trial of bari tomato varieties on floating bed

Adaptive trial of BARI tomato varieties was conducted at the Kishoreganj sadar and Karimganj

upazilla of Kishoreganj district during 2020-21 to examine a suitable tomato variety for the area. Two BARI developed varieties such as BARI tomato-17 and BARI tomato-21 were tested. The significantly highest yield was found from BARI tomato-21 (54.19 t ha^{-1}) and the lowest from BARI tomato-17 (43.58 t ha^{-1}). From financial analysis, BARI tomato-21 gave the highest gross return (541880 Tk ha^{-1}), gross margin (377645 Tk ha^{-1}) and benefit cost ratio (3.08) followed by BARI tomato-17.

Production program of non-creeper vegetables on floating bed and ex situ in madaripur

Production program with different vegetable crops like cabbage (var. hybrid Sundori), cauliflower (var. Hybrid), turnip (var. Hybrid), tomato (BARI Hybrid Tomato-9), lettuce (BARI Lettuce-1), Okra (BARI Dherosh-2) and stem amaranth (BARI Data-1) were conducted on floating bed and ex situ (okra and stem amaranth) at Hijalbari & Amgram, respectively under Rajoir upazilla of Madaripur during the year, 2020-21 to observe the performances and to popularize those varieties among the farmers. The work was performed in floating bed and each floating bed considered as one treatment. The size of each floating bed was 10 m X 1.0 m (10 m^2). The two rows of each vegetables were grown on each floating bed maintaining standard spacing of 60 cm x 45 cm for cabbage, cauliflower, turnip & tomato and 60 cm x 30 cm for lettuce. For okra and stem amaranth, unit plot size was 16 m x 2.4 m with a planting spacing of 60 cm x 50 cm (okra) and continuous seeding for stem amaranth. Weeding and cleaning of bed was done timely and pest management was also done by use of organic pesticide like sex pheromone trap, bio-pesticide etc. Yield and economy of different crops were showed in Table 2 and 3. Vegetable yield and cost return analysis were calculated from the unit plot. The plot wise (10 $\text{m}^2 \text{plot}^{-1}$) yield of cabbage, cauliflower, turnip, tomato, lettuce, okra and stem amaranth was 36 kg, 30kg, 15kg, 56kg, 17kg, 16.25kg and 14.50 kg, respectively. It was early mentioned that, all vegetables except okra with stem amaranth was sown in floating bed. Considering cost return analysis on the basis of individual plot, tomato and okra with stem amaranth were profitable. The rest vegetables showed non profitable due to might be getting

lower gross return than that of total variable cost (Table 3). Thus, gross margin of non-profitable vegetables was negative. The higher profitable vegetables (Tk 460 plot⁻¹) were calculated from Okra with stem amaranth because of higher plot yield (30.75 kg) for long-term harvesting and lower total variable cost from ex situ (Tk 400 plot⁻¹). Though, the other profitable vegetable like tomato produced higher plot yield (56 kg) as well as higher gross return (Tk 1008 plot⁻¹), lower gross margin (Tk 108 plot⁻¹) was accounted due to higher total variable cost for floating bed preparation (Tk 900 plot⁻¹).

Production program of spices using floating bed, in situ bed and ex situ in madaripur

Production program with different spices crops like turmeric (BARI Halud-1) on floating bed, onion (BARI Piaz-1) on in situ bed and garlic (BARI Rasun-1) & onion (BARI Piaz-1) on ex-situ bed were conducted at Amgram and Hijalbari area under Rajoir upzilla of Madaripur during 2020-21 to study the performances of selected spices crops using different floating agriculture technology and to popularize those varieties among the neighbor farmers. The work was performed in floating, in-situ and ex-situ bed and each floating bed considered as one treatment. The size of each floating bed was 10 m X 1.37 m. The two rows of turmeric were grown maintaining 25 cm plant to plant spacing. The ten rows of onion and garlic were grown in each floating bed maintaining standard spacing. Weeding and watering of bed was done timely and pest management was also done by use of organic pesticide like sex pheromone trap, bio-pesticide etc. Yield and economy of different spices crops were showed in Table 2 and 3. Spices yield and cost return analysis were calculated from the unit plot. The plot wise (10 m² plot⁻¹) yield of turmeric on floating bed, onion on in situ bed, onion & garlic on ex situ bed was 16 kg, 10 kg, 12 kg and 8.5 kg, respectively. About 20% increased bulb yield of onion was found from ex situ bed than that of in situ bed. Considering cost return analysis on the basis of individual plot, turmeric was profitable. The rest spices showed non profitable due to might be getting lower gross return than that of total variable cost (Table 3). Thus, gross margin of non-profitable

spices was negative. The higher profitable spices (Tk 700 plot⁻¹) were calculated from turmeric because of higher plot yield (16 kg) and higher gross return (Tk 1600 plot⁻¹). Though, the gross margin of onion and garlic showed negative and non-profitable but could be considered as an alternate growing place for onion/garlic on floating bed.

Project IV: Integrated Farming Systems

Integrated farming research and development for livelihood improvement in the plainland ecosystem

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Integrated farming is now gaining priority to ensure food, nutrition and income security of resource poor farm households with the rapid increasing of population and declining of agricultural land. The program was undertaken to develop integrated farming technologies, fine tune the technologies generated by NARS institutes, integrate component technologies with efficient use of farm resources and thereby improve family income and livelihoods. The programs were conducted during the year of 2018-19 to 2020-21 at 5 Farming Systems Research and Development (FSRD) Sites viz., Ajoddhampur (Rangpur), Ganggarampur (Pabna), Sholakundu (Faridpur), Atia, Delduar (Tangail) and Tarakandi (Sherpur). A total of fifty-four types of activities were done for maximizing the total productivity using the existing resources of sixty farmers, where twelve from each location comprising of four from each of marginal, small and medium farmers group considering homestead vegetables and fruits, field crops, poultry and livestock, fisheries and off-farm component of farming systems. Over the location, the average vegetables produced per homestead 624 kg after intervention (AI), which was only 167 kg before intervention (BI). The average vegetables consumption during AI was 254 g head⁻¹day⁻¹, which was 388% higher than BI. The average fruits produced per homestead 500 kg, which was only 279 kg during BI. The average consumption of

fruits was also increased (Avg. 83%). The daily nutritional requirements of a family members were supplemented considerably. Animal product from fish, chicken, pigeon, Turkey and livestock also could help to minimize the protein deficiency. A total of 611 fruit trees were brought under pest management and a total of 3811 saplings of different fruits were distributed in different FSRD sites. Women participation (25-80%) in different agricultural activities increased to a great extent that showed some positive effect on gender equity within the family. In field crops component two or three crops-based cropping pattern (CP) could be successfully replaced by three to four crops-based CP. Among them Potato included 4 crop-based CP T. Aus-T. Aman rice-Potato/Sweet gourd and T. Aus-T. Aman-Potato-Mungbean produced higher REY 51.39 and 29.99 t ha⁻¹, respectively. In pilot production program, sole crop Tomato gave maximum gross margin (Tk. 605200 ha⁻¹) at Rangpur than other location. In the livestock component, after deworming and vaccination, the frequency of major diseases of cattle were reduced and attained below 7% and addition of vitamin ADE injection increased the lactation period and yield remarkably. Cattle fattening and calf rearing programs were created interest among the farmer due to remarkable gain of cattle body weight (18-46%). Goat rearing was found promising as low cost required for rearing. In poultry system, Sonali breed, Naked-neck (Garchila) chicken, Khaki Campbell Duck, Turkey bird and pigeon rearing in the homestead area created a good impact among the farm families as a good source of income and child nutrition. Mortality of poultry reduced (70-99%) after vaccination. Moreover, farmyard manure (FYM) production (3050 kg homestead⁻¹) and vermicompost production (320 kg homestead⁻¹) and their utilization, and green fodder production (53 t ha⁻¹) were created a good impact among the farm families. Seasonal fish culture with carp polyculture in seasonal pond was found promising than monoculture. Carp polyculture gave a satisfactory fish yield (avg. 171 kg per 13-decimal size pond) and gross margin (avg. Tk. 12513 per 13-decimal size pond) at farmers' level. From different types of off-farm activities farmers also earned some extra money (avg. gross margin Tk. 5173 household⁻¹). Among the different production

components, field crop sector gave maximum gross margin (Tk. 103647-250910 farm⁻¹) but gross margin increased maximum at homestead vegetable production sector (53-646%), where total gross margin increased 59-385% per farm. The activities (seed and seedling collection, production, and distribution/sell) of Local Service Provider (LSP) were found promising for home gardening, vaccination and other activities at FSRD site, Ajoddhapur, Rangpur. Partial integration among the farm components was found as a cost saving technology especially compost pit-based integration activities were found promising.

Keywords: farming system, food security, homestead model, integrated farming, livelihood, plainland.

Improvement of farm productivity through intervention with improved agricultural technologies in char land ecosystem

Charland is one of the most vulnerable ecosystems characterized by a deposit of mud mostly sand as islands within the river, face the flash flood along with other natural disasters due to climate change. The modern agricultural technologies are not properly disseminated in the char land due to scattered, isolated and disconnected transport network. Char areas of Bangladesh are also a hub of hydro meteorological disasters like unpredictable flash flood, seasonal drought, soil erosion and so on. To keep the above issues in the mind, the project activities were identified and prioritized to maximize the farm productivity and farmers benefits with efficient use of farmer's existing resources. The activities of the project were initiated from early February 2018 at the FSRD Site, Charkharicha, Mymensingh and FSRD Site, Charpara, Sonatala, Bogura.

Farming system research and development program is an integrated farming approach for sustainable resource management approach to maximize farm productivity, farm resource use efficiency, employment opportunity, farmers' income and nutrition as well as livelihood of the resource poor farm households of char land ecosystem. With rapid increasing population and declining agricultural land, food and nutrition security of resource poor farm households through integrated farming are gaining priority. The integrated farming activities

were carried out in Char land ecosystem of Mymensingh and Bogura during the year of 2020-21. The research areas were i) Homestead production system ii) Crops and cropping system iii) Poultry and livestock production system, iv) Fisheries production system and v) Off-farm activities. All components of integrated farming such as vegetables, fruits, cereal crops, livestock, fish and off-farm activities were brought under improved technological intervention and accordingly income was generated from these components. In Charland ecosystem of Mymensingh and Bogura overall results of homestead production program revealed that intake of vegetables was markedly increased (av485%) by all families included in this system. Average intake of fruits per year was also increased (av 279.50%) after intervention of the technology. Existing fruit tree management and new plantation has created a good impact on farm households. In Charland ecosystem of Mymensingh and Bogura farmers obtained higher yield and economic return from their alternative or improved cropping pattern with high yielding variety (s) and better management approaches. Two improved cropping pattern viz. Mustard-Boro-T. Aus -T. Aman and Wheat-Jute-T. Aman was conducted in FSRD site Char Shyampur, Bogura and Mustard-Boro-T. Aman and Potato-Boro-T. Aman pattern were conducted in FSRD site, Char Kharicha and Char Anondipur, Mymensingh. Newly released high yielding crop varieties were also introduced through on farm validation program where farmers obtained higher crop yields and gross margin. Due to deworming and vaccination program body weight and milk was increased of cattle over pre intervention. Average mortality of poultry declined from 21.20% at pre-intervention to 6.6% at post-intervention conditions. Among the seasonal fish culture carp polyculture gave higher gross margin (av Tk. 11090/pond) which was 451% higher over traditional fish culture at farmers' level. Women participation in agricultural activities increased to a great extent that showed some positive effect on gender equity within the family. The daily nutritional requirements of the family members were supplemented considerably due to increased consumption of vegetables and fruits from the homestead gardening and also from fish, Chicken

and livestock production. Active participation of the farmers' and integration of their available resources in planned way has created a positive impact on improving livelihood of resource poor farm household. Finally, it can be concluded that interventions made in different components exerted a visible positive impact in improving farmers' socio-economic condition and livelihood of the char households under both char land ecosystem as well.

Integrated farming for improving livelihood of resource poor farm households in drought and rainfed ecosystem

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Prolonged drought, high temperatures, uneven distribution of rainfall due to climate change, soil acidity and low soil fertility are major stresses affecting agricultural production in drought and rainfed ecosystem. It needs to manage properly all the resources of poor farm household under integrated approach due to increasing of human population and decreasing of agricultural land. The activities under integrated farming were carried out at Farming Systems Research and Development (FSRD) and Multi-location Testing Sites viz., Basantapur (Rajshahi), Amnura (Chapainawabganj), Chanduria (Rajshahi), Ziaroki (Kushtia) and Kamalbazar (Sylhet) under different station of OFRD, BARI during the year 2019-20 to develop integrated farming technologies, fine tune the technologies generated by NARS institutes, integrate component technologies with efficient use of farm resources and thereby improve family income and livelihoods. The research areas were i) Homestead production system ii) Crops and cropping system iii) Poultry and Livestock production system iv) Fisheries production system and v) Off-farm activities. All components of integrated farming such as vegetables, fruits, cereal crops, livestock, fish and off-farm activities were brought under improved technological intervention and accordingly income was increased from these components. Two villages have been considered under FSRD activities in each site. A total sixty (60) farm households selected considering twelve (12) from each site. On the basis of PRA and base line survey report, farmers need based technologies

were intervened among small, marginal and medium sized resource-poor farmers. Year-round homestead vegetables and quick growing fruits production are going on. Some improved cropping patterns have been selected in each site (e.g. Mustard-Boro-T. Aman, Wheat-Sesame-T. Aman and Tomato-Boro-T. Aus; and Lentil-Fallow-T. Aman and Wheat-Mungbean-T. Aman; Lentil-Maize-T. Aman and Mustard (long duration)-T. Aus-T. Aman; Lentil-Sesame-T. Aman and Onion/Sweet gourd-T. Aman; Potato-T. Aus-T. Aman and Mustard-T. Aus-T. Aman rice for FSRD site, Basantapur, Rajshahi; MLT site, Amnura, Chapainawabganj; FSRD site, Shympur, Rajshahi; FSRD site, Kushtia; and FSRD site, Sylhet). Fodder production, De-worming and vaccination program, fish (carp polyculture) culture have been brought under the program. It is revealed that vegetables production increased by 300-500% after project intervention, where intake of vegetables was markedly increased (avg. 200-300%) as compared to before intervention by all families included in this system. Average intake of fruits per year was also increased (Avg. 100-150%) after intervention of the technology as compared to before intervention. Existing fruit tree management and new plantation has created a good impact on farm households. In case of field crops, farmers obtained higher yield and economic return from their alternative or improved cropping pattern with improve variety(s) and better management approaches. The increment of rice equivalent yield in improve cropping pattern was 50-100% over existing pattern. Newly released high yielding crop varieties were also introduced through on farm validation program. In livestock system, gross margin was increased around 50-100% over pre-intervention due to deworming, vaccination, beef fattening, improve management of diet for cattle and poultry. Mortality of poultry reduced (76-88%) after vaccination. Moreover, farm Yard manure (FYM) production and utilization are continued among the farm families. Green fodder (Napier grass) production is continued on pond bank, road side and fallow space of homestead. Farmers normally did not use their seasonal pond scientifically. The project took them under best management practice. The carp polyculture gave a satisfactory gross margin (Tk. 13000-40000 pond⁻¹)

at farmers' level. From off-farm activities, farmers also earned some extra money (Tk. 25000-35000 household⁻¹). Women participation in agricultural activities was observed remarkable that may help to create positive effect on gender equity within the family. Local service provider (LSP) was involved directly in mechanization activities. The LSP gave their service for seeding of crop under conservation agricultural system on custom hiring basis. The results of FSRD activities imply that by implementing the program of integrated farming at FSRD site has created an opportunity to improve livelihood of the resource-poor farmers.

Climate resilient farming systems research and development for the coastal ecosystem

A.H. Md. Amir Faisal, Md. Akkas Ali, and M.S.I. Khan

Coastal areas of Bangladesh are also a hub of hydro meteorological disasters including cyclones, tidal surges, floods, drought, soil salinity, saline water intrusion, waterlogging, and land subsidence. This has a direct bearing on livelihoods as agriculture provides employment for over 60 percent of the population in Bangladesh and it is a key economic activity for the 40 million inhabitants in the coastal zone. The agricultural system is heavily dependent on environmental factors. In this context, it has become an urgent need to demonstrate modern agricultural technologies through "Integrated farming or Mixed Crop-Livestock System Approach" rather than seasonal or crop specific approach at Coastal areas. The subsistence farms in coastal areas are highly diversified with complex relationships among the various sub-system and the enterprises within a subsystem. While there are different production alternatives, farmers have a limited set of resources. A holistic approach to technology generation and packaging is essential to achieve this result through maximizing the complementary interactions among the different farming enterprises/ production system and the biophysical and socio-economic environment. The activities were implemented in two new Farming System Research and Development site (FSRD) located at West Al-Amin, Subarnachar in Noakhali and Jamla, Dumki in Patuakhali where two villages from Subarnachar (Char Wapda and Katabunia) and one village (Jamla) from Dumki Upazilla were

selected as target sites. According to the aim, resource poor farmers viz. marginal, small and medium having major components of farming and sizable homestead under single ownership are targeted and twelve farm households from each site covering four farmers from each category were selected. Prior to implement the activities, a baseline survey of individual households was carried out. Based on the potentials, suitable technological options were addressed to the farmers, and accordingly farmers selected suitable technologies were adjusted with their need for livelihood improvement. For developing sustainable cropping patterns on-farm verification trials on cash crop were conducted in both the locations during Rabi season of 2020-2021 cropping year. Besides on-farm trials, Aus crop was established (06 farmers field) with the modern variety such as BRRI dhan48, BRRI dhan82, BRRI dhan83, BRRI dhan85 and Binadhan-19 which was compared with local Hydra variety at Noakhali site. On the other hand, BRRI dhan48 was cultivated at Patuakhali site (05 farmers field). With the aim of improving soil health, eight farmers field were selected for green manuring crops cultivation and eventually, incorporated just before flowering in Noakhali site. High value crops like summer Tomato cultivation were introduced (among 04 farmers) with modern variety of BARI Hybrid Summer Tomato-8. On the other hand, Sorjan method was implemented in Patuakhali. For improvement of cropping pattern, land type-based T. Aman rice varieties (BRRI dhan23, BRRI dhan52 and BRRI dhan87) were cultivated at all farmers field in Noakhali whereas BRRI dhan23, BRRI dhan52, BRRI dhan49 and BRRI dhan76 were cultivated in Patuakhali site. In Noakhali site, three alternate cropping patterns were introduced such as Groundnut (Dhaka-1)-D./T. Aus ((BRRI dhan85)-T. Aman (BRRI dhan87), Proso millet (BARI Cheena-1)-Green manure-T. Aman (BR23) and Soybean (BARI Soybean-6)-T. Aus (BRRI dhan85)-T. Aman (BRRI dhan52). Moreover, Potato (BARI Alu-72)-Mungbean (BARI Mung-6)-T. Aman (BRRI dhan52) and Sunflower (BARI Surjomukhi-2)-T. Aus (BRRI dhan48)-T. Aman (BRRI dhan52). For vegetables production, moveable seed bed was introduced for winter vegetables seedling production in Noakhali.

Several farmers of Noakhali cultivated Cabbage, cauliflower, broccoli and Tomato in the small-scaled. All farmers in Noakhali site, cultivated onion with a land vary 1 to 1.5 dec. For preservation of high yielding varieties seed, plastic drum (180 kg) along with plastic bag (40 kg) were also distributed among the farmers in both locations. A total of 168 saplings were distributed to enrich agroforestry system with 05 types of fruit trees (Noakhali) whereas 06 types of fruit trees (total 204) were distributed in Patuakhali site. Year-round vegetable production through modified “Atkapalia” Model and “Lebukhali” Model are being practiced among the co-operative farmers. Vaccination of livestock and poultry was done as when necessary for sustaining the production system. Moreover, chick, Duck and pigeon were distributed with the aim of more meat and egg production. Sonali chicken rearing system was followed by the farmers in Patuakhali site whereas in-house pigeon rearing system was practiced by one farmer in Noakhali site. Despite poultry, fodder production was done among six farmers and hydroponic which increased milk production. Furthermore, calf rearing gaining popular in Patuakhali site where farmer could earn 37,000 TK. (average). Nevertheless, vermicompost through ring (Noakhali) and chari (Patuakhali) methods were practiced. To increase farmer’s income through aquaculture system, carp poly culture was practiced among the farmers depending on the pond size and other existing frameworks in both the locations. Furthermore, co-operative farmers were encouraged to weaving attractive design Shital Pati in Noakhali site and swing of cloths in Patuakhali site. Continuous follow up evaluation were made by the concerned scientist for sustaining and integrated function of the system.

Floating agriculture based integrated farming research and development for livelihood improvement of farmer

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Integrated farming is termed as integrated resource management. Sustainable local natural resource management in the submerged areas through floating agriculture based integrated farming

practices may be a good option for improving livelihood and coping up with the climate change situation. From these views, the program was undertaken to generate floating agriculture based modern and appropriate technologies, to develop the management technologies of different crops under floating agriculture system, and thereby to increase the yield and economic return of floating agriculture through vegetables, spices, forage, livestock, fisheries and homestead gardening under integrated approach. The research and development activities under floating agriculture based integrated farming were carried out in 5 locations of low-lying areas of southern Bangladesh (Tungipara, Gopalganj sadar and Kotalipara upazilla under Gopalganj district; Nazirpur upazilla under Pirojpur district; and Mollahat upazilla under Bagerhat district) during the year of 2017-18 to 2020-21.

A total of nineteen types of activities were done for maximizing the total productivity using the existing resources of 120 farmers (60 farmers under OFRD, BARI and 60 farmers under Palli-Bangla Unnayan Shahojogita Sangstha -PBUSS). Among them 12 farmers from each location comprising of 6 from each of marginal and small farmers group considering floating agriculture and mainland crops, homestead vegetables and fruits, poultry and livestock, fisheries and off-farm component under OFRD, BARI. All components were brought under improved technological intervention and accordingly incomes were increased from these components. The average waterlogged land size per farmer was 27, 25, 24, 15 and 15 decimals in Nazirpur, Gopalganj Sadar, Tungipara, Kotalipara, and Mollahat, respectively. In waterlogged land, floating agriculture based a total of 9 types research and development activities were conducted focusing screening of vegetables, spices, and forage; standardization of bed size; nutrient management; agronomic management; pest and disease control etc.

In *kharif* season of 2020-21 four vegetable crops viz. Bottle gourd, Bitter gourd, Sweet gourd and Okra were cultivated in floating bed and in *rabi* season of 2020-21 Broccoli, Cabbage, Cauliflower and Knolkhol were cultivated to observe their suitability and profitability. The experiment was conducted on Water hyacinth

based floating bed at Tungipara and Kotalipara under Gopalganj district; Nazirpur under Pirojpur district and Mollahat, Bagerhat. Among these vegetables, Bottle gourd gave highest BCR at each location and it were 1.76 in Tungipara, Gopalganj; 1.72 in Kotalipara, Gopalganj; 1.85 in Nazirpur, Pirojpur and 1.91 in Mollahat, Bagerhat. In *rabi* season of 2020-21, four vegetable crops (viz. Broccoli, Cabbage, Cauliflower and Knolkhol) were cultivated at same bed of same area to observe their suitability and profitability. Among the vegetables cauliflower gave highest BCR in each trial area and it was 1.81 76 in Tungipara, Gopalganj; 1.71 in Kotalipara, Gopalganj and 1.85 in Nazirpur, Pirojpur. At the same season the lowest BCR was recorded from cauliflower and it were 1.25 in Tungipara, Gopalganj; 1.13 in Kotalipara, Gopalganj; 1.22 in Nazirpur, Pirojpur.

The experiment was carried out on Water hyacinth based floating bed at Kotalipara and Tungipara under Gopalganj district; Nazirpur under Pirojpur district and Mollahat, Bagerhat during the year of 2020-21. Under this experiment three turmeric varieties were used to evaluate their performance in floating bed viz. BARI Holud-3, BARI Holud-5 and local. In case of Kotalipara and Tungipara under Gopalganj district and Nazirpur under Pirojpur BARI Holud-5 gave highest yield and it were 155 kg, 176 kg and 160 kg/bed, respectively. Also the highest BCR were found from the same variety it were 2.28, 2.46 and 2.35, respectively. In case of Mollahat, Bagerhat the same variety BARI Holud-5 gave highest yield and BCR which were 135/bed and 1.99, respectively.

An experiment was carried out to develop new cropping pattern at Kondorpogati, Kotalipara and Tungipara in Gopalganj and at Nazirpur in Pirojpur district during the year of 2020-21. The aim of the study was to find out the suitable cropping pattern over the existing one. The cropping pattern *Boro*-Floating bed-fallow introduced against traditional cropping pattern fallow-Floating bed-fallow. The highest gross margin and BCR was obtained from improve pattern which were 339195.33 taka and 1.48, respectively while from the existing cropping pattern gross margin and BCR were found 214500 and 1.36, respectively.

The experiment was carried out at Kotalipara and Tungipara in Gopalganj, Nazirpur in Pirojpur and Mollahat in Bagerhat district during the *rabi* and *kharif* season of 2020-21. The aim of the experiment was to evaluate the performance of sowing and transplanting method in vegetable crops on floating agriculture. Bottle gourd was cultivated under this experiment. The highest yield/bed 212.2 kg, 236.2 kg were found from transplanting method at *rabi* and *kharif* season, respectively also highest BCR 1.42 and 1.67 were found at *rabi* and *kharif* season from the same method while from sowing method yield 170.7kg, BCR 1.42 were found at *rabi* season and yield 199.9kg and BCR 1.67 were found at *kharif* season.

The experiment was carried out on Water hyacinth based floating bed at Kotalipara and Tungipara in Gopalganj, Nazirpur in Pirojpur during *kharif* season of 2020-21. The aim of the study was to observe the response of vegetables to macro- and micronutrient. Okra (variety-chyanika) was taken as vegetable crop. Four fertilizer doses were taken as treatment viz. $T_1 = \text{N-P-K-S-Zn-B: } 75\text{-}21\text{-}15\text{-}5\text{-}1\text{-}0.5 \text{ kg/ha}$, $T_2 = 75\%$ of T_1 , $T_3 = 50\%$ of T_1 and $T_4 = \text{Farmers' practice}$. The highest mean yield (68.3 kg/bed), gross margin (820 Tk./bed) and BCR (1.45) were recorded from the bed where N-P-K-S-Zn-B were applied @ 75-21-15-5-1-0.5 kg/ha while the lowest yield (53.3 kg/ha), gross margin (255.00 Tk./bed) and BCR 1.14 were found from farmers' practice where no fertilizer was applied.

Four intercropping system viz. Bottle gourd + Red amaranth, Sweet gourd + Red amaranth, Cucumber + Red amaranth and Bitter gourd + Red amaranth were taken to test the suitability for intercrop in floating agriculture. The experiment was conducted at Kotalipara and Tungipara in Gopalganj, Nazirpur in Pirojpur and Mollahat, Bagerhat during 2020-21. Among the four intercropping, Bottle gourd + Red amaranth found suitable in regards of its profitability. The highest mean gross margin (Tk. 1205/bed) and BCR (1.63) were calculated from Bottle gourd+ Red amaranth intercropping while the lowest gross margin (Tk.-90/bed) and BCR (0.95) were recorded from Cucumber+ Red amaranth intercropping.

Bottle gourd and Country bean seedling were grown on Water hyacinth made floating bed at

Nazirpur, Pirojpur during the year of 2020-21. The highest gross margin (Tk.8000/bed) and BCR (2.33) found from Bottle gourd seedling bed whereas 6000/- gross margin and 2.00 BCR was found from Country bean seedling bed.

In the mainland, the research and development activities were conducted using the residue (compost) of floating bed. Winter vegetables viz. Broccoli, Cauliflower, Knolkhol, Cabbage, Red amaranth and Spinach were cultivated by using residue of floating bed at Tungipara and Kotalipara in Gopalganj district and Nazirpur, Pirojpur to observe their suitability and profitability. Among the vegetables, cauliflower gave the highest mean gross margin (618400.00/ha) and BCR (3.30) which followed by Broccoli with gross margin 396300.00/ha and BCR 2.48. At the same time the lowest gross margin (Tk. 83300) and BCR (1.69) were recorded from Red amaranth

Tilapia fish culture in cage (size: 20ft x 10ft x 6ft) besides of floating bed in waterlogged area was found promising and 75.25, 752.10, 76.27 and 79.00 kg fish/cage were produced in Tungipara, Kotalipara, Nazirpur and Mollahat, respectively. Besides of cage fish culture, open water also a good source of natural fish.

Five types of activities are going on in the livestock component. In case of floating system, Duck was reared by the farmers and for this regard five Ducklings were supplied to each farmer at all locations and after rearing five months the monthly income was calculated 115 Tk./Duck.

In case of homestead area, after deworming and vaccination of cattle, the frequency of major diseases e.g. Anthrax, FMD, PPR, BQ etc. were reduced to below 10%. In poultry system, Sonali chicken and pigeon rearing in homestead created a good impact as a good source of income and child nutrition. Mortality of poultry reduced (50-85%) after vaccination. Average compost produced from Water hyacinth based floating bed ranged 20.10-36.18 t/farmer under floating system and farm-Yard manure produced (1900 kg/homestead/yr) in compost pit in homestead area were found promising.

The average homestead size was 13, 11, 10, 12 and 12 decimals in Nazirpur, Gopalganj Sadar, Tungipara, Kotalipara, and Mollahat, respectively.

In homestead component, four types of activities were done with year-round vegetables and fruits production, new plantation, and fruit tree management. The average vegetables produced per homestead in rabi 828 kg and kharif 540 kg after intervention (AI), which was only 143 kg before intervention (BI). The average vegetables consumption during AI was 196 g/head/day, which was 239% higher than BI. Fruit tree management has created a good impact and a total of 235 fruit trees were brought under pest management and a total of 720 saplings of different fruits were distributed in different locations.

Women participation in agricultural activities increased to a great extent that showed some positive effect on gender equity within the family. From different types of off-farm activities (e.g. Pati weaving with Hoglapata, Diar making with bamboo, Kantha sewing etc.), farmers also earned some extra money (avg. gross margin Tk. 7200/household). On an average, the gross margin of a household from different components was increased 68.22%. Integration among the farm components especially floating agriculture-based integration activities are going on. However, the possibility to develop floating agriculture based integrated farming technology would undoubtedly open up opportunities to raise farm income, livelihood and food security in poor people who can benefit of locally available materials and by-products to run sustainable farming.

Project V: Socioeconomic Studies

Productivity, profitability and opportunity of lentil production in rajshahi district of bangladesh

Dr. MD. Mazharul Anwar

A survey was undertaken on lentil producers in the two upazilas (Paba and Godagari) of Rajshahi district to know the socio-economic characteristics, input use, costs, returns problems and opportunities of lentil production. Total eighty lentil producers where forty from Paba Upazila and forty from Godagari Upazila of Rajshahi District were selected using random sampling technique. There is little variation in the age of householders of the two upazilas. Among the sample farmers, highest

percentage of the farmers education was in secondary level whereas the lowest in illiterate level. Average farm sizes of the sample farmers were 0.56 hectare. Labour, Seed, Urea, TSP, DAP, MP, Boric Acid, Gypsum, Pesticide, Irrigation are the main inputs for lentil production. Most of the farmers used family labour in lentil production. At the times of harvesting and threshing sometimes farmers used higher labour. BARI released lentil varieties adopt in the two upazilas of Rajshahi district and recently released variety (BARI Masure-8) covered most of the area of the sample farmers. Per hectare gross return and gross margin on full cost basis were Tk. 124400, and Tk 46916, respectively whereas gross margin of variable cost and cash cost basis were Tk 100965 and Tk 103128. Variable and cash cost basis gross margin were much higher compared to full cost basis due to higher land cost (opportunity cost of land). Similarly benefit cost ratios were higher in variable cost and cash cost basis compared to full cost basis. Most of the farmers reported that root rot disease at growing stage was the main problems of the farmer followed by not available of HYV/quality seed at sowing time, lack of technological knowledge of HYV lentil production, low product price at harvesting period and not found power tiller or tractor in proper time. Again, HYV lentil provide higher yield as well as more profitable. So, lentil areas (acreage) are increasing in the Rajshahi regions. In the conclusion it can be said that lentil is not only technically feasible but also economically viable in Rajshahi region. More efforts should be made to transfer HYV lentil varieties among the farmers.

Adoption and profitability of chilli varieties in some selected areas of bangladesh

N. Akter and M. Mohiuddin

The study assessed the adoption and profitability of Chilli variety at farm level. Mymensingh and Kishoreganj were selected for data collection. Data were collected from 100 randomly selected Chilli farmers of which 60 from Kishoreganj area and 40 from Mymensingh area. The findings revealed that among the respondent of Kishoreganj, only 13% farmers are using BARI Chilli varieties but no farmers found in Mymensingh areas. The levels of adoption of most crop management technologies

were found to be low. Higher level of adoption was observed in ploughing and medium level of adoption was observed in planting time. Chilli production was found profitable in the study locations, where per hectare net return was Tk. 95672.58 and BCR was 1.53. Though the farmers get profit, they had to face some problems. Lack of knowledge, lack of information about BARI Chilli varieties, unavailability of BARI Chilli varieties seed, capital shortage, lack of farmers association and crop insurance, poor transportation and communication system, lack of market monitoring authority were major barrier for the Chilli producers. These problems should be addressed properly to make this crop more profitable.

Study on production and marketing of seaweed in Cox's bazar

The survey was conducted at Nuniar chara and Charpara of sadar upazila under Cox's Bazar district during February-March 2021 to examine the profitability level of seaweeds cultivation, to know the existing marketing channel of seaweeds, to identify constraints in seaweeds production and marketing and to derive some policy implications for seaweeds production and marketing. Based on higher concentration of seaweed production, Cox's Bazar was selected purposively for the survey. Two local markets namely Bandarban Sadar and Cox's Bazar were also purposively selected for data collection. The participant involved in production

and marketing were farmers, faria/bepari, wholesaler and retailer. Primary data were collected during February-March 2021 with pre-designed questionnaire by face to face interview. Total cost, profit and benefit cost ratio, marketing channels, different intermediaries such as faria/bepari, wholesalers and retailers were investigated. The results showed that, the highest marketing cost was found Tk. 950 for wholesaler followed by faria/bepari Tk.600 and retailer Tk. 530 per mond respectively. The highest net marketing margin was found from retailer Tk. 820 per mond followed by faria/bepari Tk. 360 and wholesaler Tk. 270 per mond. The major problem in the seaweeds industry of Bangladesh include poor communication and transportation facilities, higher labor wage and marketing cost, lack of information on seaweeds cultivation, lack of technology, socio-economic constraints and shortage of skilled manpower for seaweed production, harvesting and marketing facilities. Farmers received low price for seaweed due to presence of number of intermediaries and long distance from seaweed production unit to sale point. Different type of tolls as municipality tax, market tax etc. caused lower return to the farmers. In order to overcome these problems, farmers may be encouraged to enhance the capacity building and awareness, to gather knowledge and technologies and techniques on commercially seaweeds production for industrial use, processing and develop marketing facilities in the study area.



Screening of organic composts for mass culturing of *Trichoderma harzianum* to be used against soil-borne pathogen *Sclerotium rolfsii* and *Fusarium oxysporum* of chickpea

Md. Iqbal Faruk

Chickpea (*Cicer arietinum* L.) is an important legume crop in the semi-arid tropics of the world and it is the third major pulse crop in Bangladesh. Diseases including foot & root rot and wilt diseases are the major limited factor for the chickpea production in Bangladesh. So, the present research has been taken to observe the suitability of organic compost and vermi-compost for mass culturing of bio-control agent, *Trichoderma harzianum* and its effectiveness against foot & root rot and wilt diseases of chickpea caused by *Sclerotium rolfsii* and *Fusarium oxysporum*. The experiment was conducted in the field of Plant Pathology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur with 6 treatments viz. (i) Seed treatment with Provax (ii) Soil amendment with organic compost (iii) Soil amendment with Tricho-organic compost (iv) Soil amendment with vermi-compost and (v) Soil amendment with Tricho-vermi-compost and (vi) Untreated control. The formulated *T. harzianum* cultured in two different compost viz. organic compost and vermin-compost is designated as Tricho-organic-compost and Tricho-vermi-compost. The experimental field soils were inoculated with *S. rolfsii* colonized substrates @ 100g/m² soil before seed sowing. Tricho-composts were added @ 3 t/ha after inoculation with pathogens. Seeds were treated with Provax @ 2.5 g/kg seeds before seed sowing. BARI Masur-5 variety was used in this study. Results of the present study revealed that all the treatments has significant effect against foot & root rot and wilt diseases of chickpea and increasing plant growth

parameters such as shoot height, shoot weight, root length and root weight of chickpea as well as yield of chickpea compared to control. Among the treatments soil amendment with Tricho-vermi-compost and Tricho-organic-compost are considered to be the best treatments in reducing seedling mortality (reduced 66.38% and 62.72%, respectively compared to control) and in increasing plant growth parameters as well as yield (gave 30.38% and 29.02% higher yield compared to control) of chickpea. Seed treatment with Provax showed better performance against the disease and its effect at per the soil amendments with organic compost and vermi-compost in reducing seedling mortality and increasing plant growth and yield of chickpea. From this study it may be concluded that soil amendment with Tricho-organic-compost and Tricho-vermi-compost are to be the best treatment for management foot & root rot and wilt diseases of chickpea and getting higher yield of chickpea than control. Seed treatment with chemical fungicide Provax also better treatment for management foot & root rot and wilt diseases of chickpea.

Screening of composts and biochars against seedling disease caused by *Sclerotium rolfsii* of barley

Md. Iqbal Faruk

Tricho-compost, composts and biochars have the potential to improve soil fertility and crop productivity. A field experiment was conducted at the experimental field of Plant Pathology Division, Bangladesh Agricultural Research Institute, Gazipur during 2019-20 cropping season to observe the efficacy of Tricho-compost, vermin-compost, organic compost and three different biochars viz. biochar-1, biochar-2 and biochar-3 against soil borne pathogen *Sclerotium rolfsii* of barley. The field soil was inoculated with *S. rolfsii* colonized

substrate @ 100g/m² of soil and allowed the pathogen establishment in the soil for 7 days. Then the *S. rolfsii* inoculated soil was challenged with organic compost, vermi-compost, Tricho-compost and biochars @ 3 t/ha kept for 5 days. In case of chemical treatment, seeds were treated with Provax @ 2.5 g/kg seeds before seed sowing. The seeds of barley var. BARI Barley-2 were sown @100 kg ha⁻¹ in the experimental plots with maintaining row to row distance of 20 cm. Proper intercultural operations were done for better growth of barley in the field. Results from this study revealed that all the treatment have significant effect in reduction of seedling disease range from 50.38% to 65.93% of barley compared to control caused by soil borne pathogen *S. rolfsii* and increasing the plant growth parameters such as shoot height, shoot weight, root length and root weight and gave 23.71% to 31.92% higher yield of barley compared the control. Seed treatment with Provax was found similar effect for reducing seedling mortality and enhancing plant growth and yield of barley. The findings revealed that utilization of Tricho-compost, composts and biochars have positive effect on the improvement plant growth and crop productivity as well as disease suppression of barley.

Screening of composts and biochars against seedling disease caused by *Sclerotium rolfsii* and *Fusarium oxysporum* of lentil

Md. Iqbal Faruk

Lentil (*Lens culinaris*) is the second major pulse crops of Bangladesh in respect of acreage and production. Diseases are one of the most important factors for mortality of the plant and yield losses. Among the major of pathogens, *Fusarium oxysporum* and *Sclerotium rolfsii*, causing foot and root rot disease of lentil. Sometimes it causes about 100% yield loss. Therefore, the present study has been taken to screen the available biochars and composts against against foot and root rot disease of lentil. A pot experiment was conducted in the pot house of Plant Pathology Division, BARI, Joydebpur, Gazipur during 2019-20 with 8 treatments viz. (i) seed treatment with Provax (ii) soil amendment with organic compost (iii) soil amendment with vermin-compost (iv) soil amendment with Tricho-compost, (v) soil amendment with biochar-1 (vi) soil amendment

with biochar-2 (vii) soil amendment with biochar-3 and (viii) control. Sterilized soil was inoculated with *S. rolfsii* and *F. oxysporum* colonized mixture of Grasspea and wheat bran along with mustard oilcake substrates @20 g/kg soil and kept 7 days for pathogens multiplication. Then the *S. rolfsii* and *F. oxysporum* inoculated soil was challenged with organic compost and vermi-compost @ 100 g/kg soil. Tricho-compost and biochars were used @ 5% (w/w). In case of chemical treatment, seeds were treated with Provax @ 2.5 g/kg seeds before seed sowing. CRD design was followed with 5 replications. Results of the present study revealed that soil amendment with Tricho-compost, vermi-compost, organic compost, biochar-1, biochar-2 and biochar-3 are effective for reducing seedling mortality range from 46.43% to 75.71% compared to control and increasing seed germination and plant growth of lentil under pot house condition. Seed treatment with Provax also better treatment for management of foot and root rot disease of lentil.

Screening of composts and biochars against root-knot nematode *Meloidogyne incognita* of tomato

Md. Iqbal Faruk

Tomato (*Lycopersicon esculentum* L.) is one of the important and popular vegetables in Bangladesh. Several yield limiting factors of tomato are enumerated. Among them diseases caused by fungi, bacteria, nematodes and viruses play major role. The root-knot disease caused by *Meloidogyne incognita* is highly damaging and yield reducing factor of tomato throughout the country. Therefore, the present study was taken to observe the effect of biochars and organic compost on root-knot nematode infestation of tomato. The experiment was conducted in the pot house of Plant Pathology Division, BARI with 8 treatments viz. (i) Furadan 5 G @ 5 g/kg soil (ii) soil amendment with organic compost @ 100 g/kg soil (iii) soil amendment with vermi-compost @ 100 g/kg soil (iv) soil amendment with Tricho-compost @ 5% (w/w) soil (v) soil amendment with biochar-1 @ 5% (w/w) soil (vi) soil amendment with biochar-2 @ 5% (w/w) soil (vii) soil amendment with biochar-3 @ 5% (w/w) soil and (viii) control. CRD design was followed with 5 replications. To ensure inocula of

the nematode, chopped severely galled tomato roots infected with *M. incognita* were mixed with sterilized soil @ 5 g/kg soil. Organic compost, vermi-compost, Tricho-compost and biochars were added in the pot soil 7 days before seedling transplanting. In case of chemical treatment, Furadan 5G was added in the pot soil at the time of seedling transplanting. Twenty five days old and apparently tomato seedlings of variety Bari Tomato-15 were transplanted in the pot and each pot received 5 seedlings. During crop season necessary weeding, irrigation and other intercultural operations were done as per recommendation of the crop. Results from the present study revealed that soil amendment with Tricho-compost, vermi-compost, organic compost, biochar-1, biochar-2 and biochar-3 gave appreciable reduction of gall development on roots of tomato caused by root knot nematode *M. incognita* and increased plant growth parameters such as shoot and root growth of tomato. Among the treatments, soil amendment with Tricho-compost appeared to be the best amended materials for reduction of root knot nematode disease incidence and improvement of plant growth. Soil amendments with vermi-compost, organic compost, biochar-1, biochar-2 and biochar-3 also appeared better treatment for reduction of root knot nematode disease incidence and improvement of plant growth of tomato compared to control and chemical nematicide Furadan 5G.

Screening of bio-pesticides against root-knot nematode *Meloidogyne incognita* of tomato

Md. Iqbal Faruk

Tomato (*Lycopersicon esculentum* L.) is one of the most popular and important commercial vegetable crops grown throughout the world including Bangladesh. The root-knot disease caused by *Meloidogyne incognita* is one of the major limiting factors for tomato production in Bangladesh. Chemical control of these diseases is hardly successful. So, the present study has been undertaken with the objective of investigating the effect of bio-pesticides on root-knot nematode infestation of tomato. The experiment was conducted in the pot house of Plant Pathology Division, BARI to observe the efficacy of new bio-pesticides viz. Soil recharge, Decoprima (bio-

fungicide), Bio-lead (bio-fungicide), Bio-nematon (bio-fungicide), Microblas (bio-fungicide), Paenamaxi (bio-fungicide) and Orizaplas (bio-fungicide) against root knot nematode of tomato caused by *M. incognita*. Root knot nematode infested pot soils were treated with those bio-pesticides as well as chemical nematicide Furadan 5G. The present study revealed that all bio-pesticides gave appreciable reduction of gall development on roots and increased plant growth parameters such as shoot and root growth of tomato. Among the treatments, application of Decoprima and Bio-nematon performed better for reduction of root knot nematode disease incidence and improvement of plant growth compared to other bio-pesticides.

Development of biorational management package against root knot nematode and bacterial wilt of tomato

Md. Iqbal Faruk

Tomato (*Lycopersicon esculentum* L.) is one of the most popular and important commercial vegetable crops grown throughout the world including Bangladesh. The root-knot disease caused by *Meloidogyne incognita* and bacterial wilt caused by *Ralstonia solanacearum* are soil borne pathogens and major limiting factor in the production of tomato throughout the world including Bangladesh. Chemical control of these diseases is hardly successful. So, the present study has been undertaken to develop biorational based eco-friendly integrated management packages against root knot and bacterial diseases of tomato. The experiment was conducted during Rabi 2020-21 in the field of Plant Pathology Division BARI, Joydebpur, Gazipur. There were 7 treatments viz. There were 7 treatments viz. (i) BARI Tricho-compost-2+ Dynamic (bio-fungicide) (ii) Soil recharge + Dynamic (bio-fungicide) (iii) Decoprima (bio-fungicide) + Dynamic (bio-fungicide) (iv) Decoprima (bio-fungicide) + Soil recharge (v) Bio-lead (bio-fungicide) (vi) Bio-nematon (bio-fungicide) (vii) Farmers practices. The experiment was laid out in a randomized complete block design with 3 replications. The field soil were inoculated with @ 1 gm galled chopped roots of Indian spinach per plant at the time of seedling transplanting. Tricho-compost was

added in the field soil 5 days before seedling transplanting. Bio-fungicides viz. Soil recharge, Dynamic, Decoprima, Bio-lead and Bio-nematon were used twice, one is 5 days before seedling transplanting and second time was 40 to 45 days after seedling transplanting. Furadan 5G was added before seedling transplanting. The variety BARITomato-15 was used in this study. During this year bacterial disease was not observed in the experiment field. Results from this study revealed that all the treatments gave appreciable reduction of root knot nematode disease severity range from 53.09-57.67% and increased plant growth parameters such as shoot and root growth and also gave 22.94-33.51% higher yield of tomato compared to control. Among the treatments, integration Tricho-composts with Dynamic and Soil recharge with Decoprima are the best treatments in reducing root-knot nematode disease as well as increasing plant growth and yield of tomato. Integration of Decoprima with Dynamic, Soil recharge with Dynamic and new bio-fungicide Bio-lead alone were also performed better in reducing root knot nematode disease incidence and increasing plant growth as well as yield of tomato.

Development of biorational management package against root knot nematode and bacterial wilt of eggplant

Md. Iqbal Faruk

Brinjal (*Solanum melongena* L.) is an important vegetable crop in all over the World especially in south Asia (Bangladesh, India, Nepal and Sri Lanka). But the yield is quite low in Bangladesh compared to other country. Several diseases caused by fungi, bacteria, nematodes and viruses play major role in reducing yield per unit area. Among the diseases Bacterial wilt caused by *Ralstonia solanacearum* and root-knot nematode disease caused by *Meloidogyne spp.* is highly damaging and yield reducing factor throughout the country. So, the present study has been undertaken to develop biorational based management packages against root knot and bacterial diseases of eggplant. The experiments were conducted in the field of Plant Pathology Division, BARI during 2020-21 cropping season to develop eco-friendly integrated management technology against bacterial wilt caused by *Ralstonia solanacearum* and root knot

nematode caused by *Meloidogyne incognita* diseases of eggplant. Root knot nematode infested field soils were treated with different combination of *Trichoderma* based Tricho-compost with commercial biofungicide Decoprima, Dynamic and Soil recharge and also integration of Soil recharge with Decoprima and Dynamic as well as two new bio-fungicide bio-lead and bio-nematon. Bacterial wilt was not recorded during cropping season. It was revealed that all the treatments gave appreciable reduction of gall development on roots range from 33.93% to 54.05% compared to control and increased plant growth parameters such as shoot and root growth as well as also gave 24.78% to 39.75% higher yield of eggplant than control. Among the treatments, integration Trichoderma based bio-fungicides Tricho-composts with Decoprima and Soil recharge as well as Soil recharge with Decoprima are the best treatments in reducing root-knot nematode disease as well as increasing plant growth and yield of eggplant. Integration of Tricho-composts with Dynamic and Decoprima with Dynamic also better in reducing root knot nematode disease incidence and increasing plant growth as well as yield of eggplant.

Development of bio-rational based disease management package against root knot nematode and powdery mildew diseases of pumpkin

Md. Iqbal Faruk

The experiments were conducted in the field of Plant Pathology Division, BARI during 2020-21 cropping season to develop eco-friendly integrated management technology against root knot nematode caused by *Meloidogyne incognita* and powdery mildew caused by *Erysiphe cichoracearum* of pumpkin. Root knot nematode infested field soils were treated with different bio-pesticides viz. Soil Recharge, Decoprima, Bio-lead, Bio-nematon, Microblas and Orizaplas. After initiation of powdery mildew disease, bio-fungicides Bordeaux mixture, Dynamic, Microblas and Orizaplas as well as chemical fungicides were sprayed 3 times at 10-12 days interval. It was revealed that all the treatments gave appreciable reduction of root knot gall development on roots, powdery mildew disease severity and increased

plant growth parameters such as shoot and root growth as well as yield of pumpkin. Among the treatments, integration of Soil Recharge with Bordeaux mixture or Decoprima with Dynamic or Bio-lead with chemical fungicide or Bio-nematon with chemical fungicide are better treatment for reducing both root knot nematode and powdery mildew diseases and increasing plant growth as well as yield of pumpkin. Application of only Microblas and Orizaplas bio-fungicides are effective only root knot nematode and also increasing yield of pumpkin.

Screening of bio-fungicides against root knot nematode diseases of bottle gourd

Md. Iqbal Faruk

Bottle gourd (*Lagenaria siceraria* (Mol.) Standl.), a paratropical species of cucurbitaceous family is one of the popular vegetable in Bangladesh. The bottle gourd crop is in variably attacked by economically important diseases. Among them, the root- knot nematodes (*Meloidogyne* spp.) adversely affect both yield as well as quality of bottle gourd. Use of chemical nematicides and fungicides to control these diseases always poses a serious health hazards and environmental pollution. Hence, an attempt was made to screen available bio-fungicides against the root knot nematode disease. The experiments were conducted in the field of Plant Pathology Division, BARI during 2020-21 cropping season to screen available bio-fungicides against root knot nematode caused by *Meloidogyne incognita* of pumpkin. Root knot nematode infested field soils were treated with different bio-pesticides viz. Soil Recharge, Decoprima, Bio-lead, Bio-nematon, Microblas, Paenamaxi and Orizaplas. Powdery mildew disease was not observed. So, other bio-fungicides and chemical fungicides were not applied. It was revealed that all the treatments gave appreciable reduction of root knot gall development on roots and increased plant growth parameters such as shoot and root growth as well as yield of bottle gourd. Among the treatments, soil application with bio-fungicides Soil Recharge, Decoprima, Microblas and Bio-lead performed better treatment for reducing root knot nematode and increasing plant growth as well as yield of bottle gourd. Application of Bio-nematon, Paenamaxi and Orizaplas bio-fungicides are also

effective against root knot nematode and increasing yield of bottle gourd than control.

Integrated management of gummosis disease of bael

Md. Iqbal Faruk

Bael *Aegle marmelos* is one of the edible fruit native to India and parts of Bangladesh, Pakistan, Sri Lanka and Southeast Asia east to Java. This fruits are grown throughout the country and can be cultivated along both peninsulas of the country. In Bangladesh gummosis disease is on the most serious disease all over the country. At present research report about the management of gummosis disease of bael are not available in Bangladesh. Therefore, the present study has been taken to develop integrated management technology of gummosis disease of bael. The experiments were conducted at Breeder Seed Production Center, BARI, Debiganj, Panchagarh and Hill Agricultural Research Station, Raikhali, Kaptai, Rangamati for the management of gummosis disease of bael. From these studies it was revealed that Scoping of diseased area with some portion of healthy areas+ cover the scoping areas with Bordeaux paste or Coal tar and foliar spray with Bordeaux mixture are effectively reduced 68.75% to 83.33% gummosis disease of bael in all the locations compared to control.

Survey on pre-harvest and post-harvest diseases of onion in Bangladesh

Dr. Md. Monirul Islam

Onion (*Allium cepa* L.) is one of the most important spices in Bangladesh. At present the shortage of onion in Bangladesh is about 8-9 lakh metric tons per year. But, onion is prone to different pre-harvest and post-harvest diseases and cause severe yield loss in every year. Limited study is available on this issue. A comprehensive survey on purple blotch and black mould diseases of onion was conducted at Bogura, Pabna, Faridpur, Magura, Lalmonirhat and Gazipur districts during 2020-2021 cropping season to observe the present status of the diseases. From the survey it was found that purple blotch and black mould disease of onion are predominant in all surveyed locations. The highest incidence of purple blotch disease 75% and black mould disease 30% of onion were found in

Gazipur and Lalmonirhat, respectively. The lowest incidence of purple blotch disease 53% and black mould disease 18% of onion were found in Magura. Purple blotch and black mould diseases of onion are predominant in most of the places of country. So, appropriate integrated management practices against these diseases of onion could be developed.

Survey on diseases of fruit crops

Dr. Md. Monirul Islam

Fruit cultivation is gaining popularity into commercial production from many years in Bangladesh. Fruit crops are prone to different diseases and cause severe yield loss every year. Among the diseases, gummosis of mango and jackfruit, greening of citrus, die back and anthracnose of guava, panama and sigatoka of banana, leaf spot of coconut etc. are the major diseases of fruit crops. But there is no organized research on this issue in Bangladesh. A systemic survey on major diseases of major fruit crops was conducted at Tangail, Rajshahi, Mymensingh, Gazipur and Khagrachori districts during 2020-2021 cropping season to observe the present status of the diseases. From the survey it was found that gummosis disease of jackfruit and greening disease of citrus are predominant in all the locations. The highest incidence of gummosis disease of jackfruit 72%, greening disease of citrus 58%, panama disease of banana 40% and sigatoka disease of banana 70% were found in Khagrachori. The highest incidence of die back of guava 38% was observed at Gazipur. Incidence of other fruit diseases are low to medium at the irrespective of surveyed locations. Major diseases of fruit crops are predominant in most of the places. Special attention should be taken to develop the appropriate management practices against gummosis of jackfruit and greening of citrus diseases of fruits crops.

Management of bacterial wilt disease of ginger through physical seed sorting

Dr. Md. Monirul Islam

Ginger is a high value spice but ginger cultivation is threatened by various diseases such as rhizome rot, bacterial wilt, leaf spot, anthracnose, leaf blight, leaf blotch etc. Among the diseases of

ginger, bacterial wilt is most damaging one. In Bangladesh, sometimes total production falls if infection initiates at early stage of plant growth. The situation drastically aggravates if water logging condition prevails. An experiment was conducted at experimental field of Plant Pathology Division, BARI, Gazipur during the cropping season 2020-2021 with six categories of ginger viz, T₁= 5% seed infection, T₂= 10% seed infection, T₃= 20% seed infection, T₄= 100% seed infection, T₅= Control (Farmer's practice/Farmers saved seed) and T₆= healthy seed having three replications to observe the seed health effect on bacterial wilt disease of ginger. Local variety of ginger was sown. The spacing was maintained 50 cm x 25 cm in the experiment. All those categories of seeds had significant effect on seed germination, yield and disease incidence of the crop. Healthy seed showed the highest germination percentage and yield with lowest disease incidence. The highest disease incidence with lowest percentage of germination and yield were observed in 100% seed infection. The yield was increased with the decreased of percent seed infection. So, Seed health had a significant effect on incidence of bacterial wilt disease and yield of ginger.

Effect of fungicides in controlling phomopsis blight and fruit rot disease of brinjal

Dr. Md. Monirul Islam

Brinjal (*Solanum melongena* L.) belongs to the family solanaceae is an important vegetable in Bangladesh. There are a number of diseases that can cause yield reduction of brinjal. Among the diseases, phomopsis blight and fruit rot caused by *Phomopsis vexans* is found to be major disease of brinjal. An experiment was conducted at the experimental field of Plant Pathology Division, BARI during 2020-21 cropping season with 8 treatments viz: T₁ = Solo Plus (1g/L), T₂ = Carben (1g/L), T₃ = Blastin (0.5g/L), T₄ = Kemo Zole (1ml/L), T₅=Purbitazim (1g/L), T₆= Healer (1g/L), T₇= Autostin(1g/L) and T₈=Control to select the effective fungicide in controlling the disease. The design of the experiment was RCBD. Variety of BARI begun-4 (Kazla) was sown in the experiment. The spacing was maintained 100 cm x 75 cm. Results revealed that all the fungicides had significant effect in controlling phomopsis blight

and fruit rot of brinjal. Among the fungicides, carbendazim group of fungicide was more effective against phomopsis blight and fruit rot of brinjal than other group of fungicides.

Management of leaf spot and vine rot diseases of betel vine

Dr. Md. Monirul Islam

Betel vine (*Piper betle*) is an important cash crop of Bangladesh. It is masticator having important socio-cultural use in Bangladesh and also having significant medicinal properties and nutritional values. It is cultivated all over the country but this crop has been found to be infected by a number of serious fungal diseases viz. leaf spot, leaf rot, vine rot/foot rot/root rot and curvularia leaf spot. These diseases are found in all the seasons in Bangladesh but affect severely in rainy season. Farmers are facing yield reduction as well as the deterioration of leaf quality and reduced market price. Under such situation to save the crop an experiment was conducted at SRC, Shibgonj, Bogura during 2020-2021 cropping season having seven treatments viz. T₁= Arenastar (Azoxystrobin 20% + Difenconazole 12.5% @ 1g/L), T₂ = Sunzox (Azoxystrobin 20% + Difenconazole 12.5% @ 1g/L), T₃=Zacob(Mancozeb + Cymoxanil @ 2g/L), T₄= Revus 250SC (Mendipropacid @ 1g/L), T₅= Decoprima (Bio-fungicide @2g/L), T₆=Autostin(Carbendazim @1g/L) and T₇=Control under natural condition in an established orchard. Among the fungicides, Arenastar, Autostin and Sunzox were effectively controlled the leaf spot and vine rot diseases of betel vine. Decoprima(Bio-fungicide) also showed the satisfactory result in controlling leaf spot and vine rot diseases of betel vine.

Evaluation of fungicides in controlling powdery mildew of pumpkin

Dr. Md. Monirul Islam

Pumpkin is an important vegetable crop in Bangladesh. This vegetable can grow everywhere easily and it has good nutritional value. There are a number of diseases that can causes yield reduction of pumpkin. Among the diseases, powdery mildew ranked at the top. Many vegetable crops are affected by powdery mildew. But the frequency of occurrence and severity of crop damage

experienced in Bangladesh are the highest in the cucurbits. Early infection by powdery mildew may causes death of the plants. Therefore an experiment was conducted in Plant Pathology field of BARI, Gazipur during the cropping season 2020-21 having ten different new fungicides viz. Select 72 wp @2g/L, Agistar 35 SC @1ml/L, Antivo 75 WDG @0.5 /L, Fungistar Top 32.5SC @1ml/L, Hundred 35 SC @1ml/L, Tahoe 27 SC ml/L, Armada 35 SC @1ml/L, Campride 30 wp @1g/L, Amcozole Plus 25SC @0.5g/L and Conza Plus 10SC @0.5g/L against the powdery mildew disease of Pumpkin. All the fungicides had significant effect on reduction of disease incidence compared to control. The lowest disease incidence was found from Agistar 35 SC (8.00%) preceeded by Antivo 75 WDG (10.00%). The highest disease incidence (50 %) was found from control treatment followed by Campride 30WP (25.00%). In terms of disease reduction of powdery mildew, Agistar (84%), Antivo (80%), Select (76%) and Fungistar Top (70%) were found over control treatment.

Evaluation of new fungicides against anthracnose disease of mango

Dr. Md. Monirul Islam

Mango (*Mangifera indica*) is one of the most important and popular fruit in the tropical and subtropical countries including Bangladesh. Like other filed crops mango fruit suffers from many diseases. Among the diseases, Anthracnose is a major pre- and post- harvest disease of mango in tropical climate, causing direct yield loss and quality which affect market price. Although losses start to occur in the field, postharvest losses to this disease are most significant. Anthracnose presents great challenges domestic market and export of Bangladesh. So, it is necessary to identify efficient fungicide for effective control of anthracnose of mango. Therefore, the experiment was conducted at RHRS, Chapainawabgonj during 2020-2021 cropping season with 10 new fungicides viz. Asiazab 80wp @ 1g/L, Latex 75WG@0.5ml/L, Mansil 72wp@1g/L, EBAD 69@2g/L, Himani 8SC@2g/L, Suijin 72wp@2g/L, Clipper 77wp@2g/L, Arenastar 32.5SC@0.5ml/L, Safe plus 82 WDG@2g/L and Milestone 80wp@2g/L under natural condition in an established orchard. Among the 10 new fungicides, Latex 75WG, and

Safeplus 82WDG were showed best performance to control postharvest anthracnose as these two fungicides were able to reduce 84.55% of the disease. Although some other fungicides were also able to reduce more than 80% of the disease. The lowest disease reduction 58.70% was observed in Asiazab 80WP. Out of 10 fungicides Latex 75WG and Safe plus 82 WDG were showed the best performance to control postharvest anthracnose as these two fungicides were able to reduce 84.55% of the disease. So the fungicides that were able to reduce more than 80% of the disease may be considered for recommendation of the control of mango anthracnose.

Management of purple blotch disease of onion seed crop through fungicide

Dr. Md. Monirul Islam

Purple blotch of onion seed crop induced by *Alternaria porri* is the most serious disease prevalent all over the country. Under environmental conditions favourable to the disease, complete failure of the crop takes place and there is no bulb formation or seedset. Very little work has been done to manage this serious pathogen. There is no resistant varieties; the only alternative is to reduce the damage by using fungicides. Therefore, the experiment was conducted at Plant Pathology Field of Bangladesh Agricultural Research Institute, Gazipur during 2020-21 cropping season with nine fungicides viz. Sanageb 80 wp @ 2g/L, Nativo 75 wg @ 1g/L, Victor Plus 60 wdg @ 1.5 g/L, Kingcen @ 2g/L, Fluzole 20 Sc @ 1.5 ml/L, Synblast 5wg @ 0.5 ml/L, Rovral 50 wp @ 2g/L, Amister Top @ 1ml/L and Cardian Super 50 wp @ 2g/L against the purple blotch disease of onion seed crop. Among the fungicides, Rovral, Amister Top, Sanageb 80 wp, Victor Plus 60 wdg and Cardian Super 50 wp were effectively control the purple blotch disease of onion where Rovral and Amister Top were showed the best performance to control the purple blotch disease and to increase the yield of onion. Out of nine fungicides, Rovral and Amister Top were showed the best performance in controlling purple blotch disease of onion. So, these two fungicides may be recommended against the purple blotch disease of onion seed crop.

Validation of integrated management package against CMV of Chilli (*Capsicum annum* L.)

M.S. Rahman

A validation trial was conducted to find out the effectivity of selected integrated management against CMV of Chilli. BARI Marich-1 was planted at the research field of Plant Pathology Division, BARI Gazipur on January 2021 with three replications. Significant variation of disease incidence and severity was found in different management packages. Disease incidence and severity ranged from 12.0 to 35.50 % and 1.0 to 3.5 in different management packages. The lowest disease incidence and severity was found 12.00 and 1.0 respectively in treatment package T₁ (One spray of Imidacloprid 0.1% at 5 days before transplanting + Sticky yellow trap in the plot + 3 sprays of Imidacloprid 0.1% at 15 days interval starting after observing the vector population by yellow trap) followed by T₂ (One spray of Bio-Neem instead 0.2 % at 5 days before transplanting + Sticky yellow trap in the plot + 3 sprays of Bio-Neem 0.2% at 15 days interval starting after observing the vector population by yellow trap) where disease incidence and severity was 13.50 and 1.50 respectively. The highest yield (14.57 t/ha) was recorded from T₁ followed by T₂ (14.31 t/ha). The reduction of disease incidence was found 66.20 % and 61.98 % in treatment T₁ and T₂ respectively and maximum increase of yield 34.16 and 31.75 % was found in the same management packages. Both the packages T₁ and T₂ were considered as the best management option on the basis of minimum disease incidence, higher yield and Marginal benefit cost ratio (1: 3.96 & 1: 3.32), respectively. Marginal cost benefit analysis indicated that the two management packages (T₁ & T₂) were economically viable and cost effective. However, these management packages could be used as effective options for management of CMV infecting chilli in Bangladesh.

Evaluation of selected okra lines resistant to Okra yellow vein mosaic virus (OKYVMV)

M.S. Rahman

Okra (*Abelmoschus esculentus*) is an important commercial vegetable crop grown throughout the world. It is commonly known as lady finger. Okra

yellow vein mosaic virus (OYVMV) is a major and devastating pathogen of Okra, significantly lowers the yield up to 94%. Two resistant varieties/lines and one tolerant variety/line which was selected from the previous screening experiment of 2019-2020 were evaluated under field condition along with susceptible variety against OYVMV during the year of 2020-21. The selected resistant varieties/lines varieties/lines OK-01 (Shemoli) and OK-02 (Desh) showed moderately resistant response where OK-03 (Narsingdi lokal) showed tolerant against the virus. It was also found that the virus is not seed transmitted.

Screening of cucumber germplasm against cucumber mosaic virus (CMV)

M.S. Rahman

Cucumber (*Cucumis sativus*) is an important commercial vegetables crop having export potential. Mosaic disease caused by *Cucumber mosaic virus* (CMV) is considered as the most serious virus disease of cucumber and causes severe yield loss, up to 100%. Fifteen varieties/cultivars were evaluated against CMV in field condition during the year of 2020-21. Out of 15 varieties/cultivars, no variety/cultivar showed highly resistant response against the virus. Among the tested varieties/germplasm only two varieties Shahi-50 and Sufola showed mild mosaic symptom on few leaves having disease incidence 14.75 % and 16.50 % respectively were graded as resistant and varieties, Piash, Chottogram local, Boro shosa, Modhumoti showed similar symptoms having 23.20-27.35 % incidence were graded as moderately resistant. The varieties ACI Green, Bonus, Hi-grad, Japan and Green long showed vein clearing and mild mottling (35-38.25 % infection) were considered as moderately susceptible and Lal teer, ACI, Long king, Thailand showed severe mosaic and mottling (61.50-67.30 % infection), were considered as susceptible.

Efficacy of natural bioactive compounds in controlling post-harvest disease (*Botryodiplodia theobromae*) of guava

Zinnat Karim

To study the efficacy of four natural bioactive compounds viz. propolis, honey, turmeric and nigella oil, infected guava samples were collected

from two local markets where post-harvest infection of *Botryodiplodia theobromae* was observed to occur from 6-8% alone in fresh samples. To culture the pathogen, *B. theobromae* was isolated following standard procedure from those infected guava samples. To test the efficacy in vitro, those bioactive compounds were applied on PDA plates in poison food technique to compare the mycelial growth of those treatments along with control (no treatment). It was observed that the lowest growth was recorded in honey treatment (1.08cm) at 7th DAI (day after inoculation) whereas the highest of that was occurred in control (8.7 cm) which were statistically significant.

Efficacy of natural bioactive compounds in controlling post-harvest disease (*Colletotrichum gloeosporioides*) of mango

Zinnat Karim

To study the efficacy of four natural bioactive compounds viz. propolis, honey, turmeric and nigella oil, infected mango samples were collected from three local markets where post-harvest infection of *Colletotrichum gloeosporioides* was observed to occur from 10-14% alone in fresh samples. To culture the pathogen, *C. gloeosporioides* was isolated following standard procedure from those infected mango samples. To test the efficacy in vitro, those bioactive compounds were applied on PDA plates in poison food technique for comparing the mycelial growth of those treatments along with control (no treatment). It showed that significant lowest growth was recorded in honey treatment (2.48cm) at 7th DAI (day after inoculation) and in nigella oil treatment (3.28cm) at 14th DAI whereas significant highest of that was occurred in control (6.9 and 8.00cm respectively) in both the cases.

Efficacy of natural bioactive compounds as soil amendment against *ralstonia solanacearum* of potato

Z. Karim and M.I. Faruk

Three natural bioactive compounds viz. cow dung (@ 30 t/ha), bee propolis (@ 5 lit/ha) and turmeric powder (@ 30 kg/ha) were compared to control-T1 (no treatment) to understand the effectiveness of those compounds against soil-borne *Ralstonia solanacearum* in artificially inoculated field soil of

potato. Sun dried cow dung and, aqueous extraction of turmeric powder and propolis solution were prepared and applied by mixing with field soil (@ 2:1 ratio) as soil amendment in inoculated soil. Data on percent disease index (PDI), total cfu/ml and avirulent cfu/ml, soil pH and percent organic matter (% OM) of the amended soil were recorded and compared with those of control. Statistically significant difference was observed among the treatments and in total cfu/ml of per gram of soil, the lowest was occurred in propolis (8.2×10^7) which was statistically similar to those of cow dung (1.1×10^8) and the highest was occurred in control (2.7×10^8). Besides, each of the treatments showed significant difference in soil pH and percent organic matter (OM) over control.

Integrated management of grey leaf spot and bud rot diseases of coconut

Md. Mynul Islam

Experiment was conducted at Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to find out the effective management practices to control grey leaf spot and bud rot disease of coconut, the most prevalent diseases in Bangladesh. Six treatments were applied, however, integration of sanitation (Two times, one at May and another at October) and two times spray of Autostin (carbendazim) and Secure (fenamidone + mancozeb) @ 2 g/l water two times at 15 days interval (one after sanitation) significantly reduced grey leaf spot and bud rot disease. To get effective results, recommended doses of fertilizers and insect management should be done.

Integrated management of white mold disease of red salvia and marigold

Md. Mynul Islam

White mold of red salvia and marigold is a devastation disease causes 100% yield loss. As the primary inoculum survive in soil, it is difficult to control. The present study was undertaken to compare the integrated approach (treated) with regular cultivation practices (untreated). Tools for integrated management was designed to reduce primary inoculum (deep ploughing, sun drying, application of Trichoderma) and three consecutive spray of systemic fungicide Autostin (carbendazim) started before disease symptoms observed.

Resealed that integrated management significantly reduces disease incidence compared to untreated plants. Plant showed disease symptoms at vegetative stage and the highest disease incidence (39% in red salvia and 25% in marigold) was recorded at flowering stage.

Collection and isolation of endophytic bacteria to suppress bacterial wilt pathogens

The experiment was conducted in the laboratory of Plant Pathology Division in 2020-2021 cropping season at BARI, Gazipur. Plants derive several advantages from endophytic colonization, such as growth promoting factors and biocontrol of the phytopathogens. Plant disease control by endophytes is one of the useful properties because endophytes can support sustainable agriculture and they do not cause environmental pollution or harmful toxic effects unlike chemical pesticides. The objective of this study was to isolate endophytic bacteria from different healthy vegetable plants and to determine their antimicrobial properties against bacterial wilt pathogen. For the isolation of endophytic bacteria, healthy leaves, stems and roots of tomato, brinjal, potato and chilli were collected from randomly selected healthy plants from BARI, Gazipur. Samples were placed in clean plastic bags, brought to the laboratory. Surface sterilization is the initial and mandatory step for isolation of endophytes in order to kill all the surface microbes. In general, isolation and purification of endophytic bacteria from plant tissue consist of the following steps: i) Pre-treatment: The leaves, stems and roots of each plant were washed separately under tap water to remove the adhering soil particles and the majority of microbial surface epiphytes is a part of pre-treatment; ii) Surface sterilization: Freshly collected leaves, stems and roots were washed under slow running tap water for 10 minutes followed by the washing in 70% Ethanol for 1 minute, then 3% Sodium hypochlorite for 3 minutes and then again with 70% Ethanol for 30 seconds. Finally, all the plant parts were rinsed 3 times with SDW in the laminar air flow cabinet. After surface sterilization and air drying of the different plant parts, the tissues were macerated with 5 ml aqueous solution of 0.9% NaCl using sterilized mortar and pestles. Tissue macerations from different plant

parts were prepared for 10^5 to 10^6 serial dilution. Each dilution was placed on Nutrient Agar plate by pouring method and plates were replicated for 3 times. Plates with macerated plant tissues were incubated at $28 \pm 2^\circ\text{C}$ in order to recover the maximum possible colonies of bacterial endophytes. The observation was made for 48 hrs to 1 week. After 24 hours from the bacterial cultures, morphologically different bacterial colonies were selected and were repeatedly streaked in order to achieve bacterial isolates. All selected isolates were subcultured in nutrient agar plates and finally all the purified endophytes were maintained at 4°C till further used.

The plates were incubated at $28 \pm 2^\circ\text{C}$ for one to seven days or until growth was observed, upon which colony-forming unit (cfu) was counted and population density was estimated using the following formula: $\text{Cfu/ml} = (\text{No. of colonies} \times \text{dilution factor}) / \text{volume of culture plated}$. In this study, 58 different probable endophytic colonizing bacterial strains were isolated from four solanaceous vegetable crop species. Among them, 14 from different plant parts of tomato, 23 from brinjal, 15 from potato and 6 from chilli. The results showed that, in case of tomato plants cfu value of probable endophytic bacteria was higher in leaves (9.6×10^4) than root and stem parts. On the other hand, cfu value of probable endophytic bacteria in root for brinjal (3.7×10^5) was higher than stem and leaves. In case of potato (1.1×10^7) and chilli (6.3×10^6) similar trend was observed. Detailed investigations like phenotypic characteristics and antimicrobial activity of all the collected endophytic bacterial isolates will be determined by using standard procedures to prove its potential further.

Survey and collection of wilt and stem blight disease from the watermelon growing areas of Bangladesh

M.M. Alam (PPD), K. M. Alam (PPD) and M. Arifunahar (PPD)

Fusarium wilt and stem blight disease melon are major disease of watermelon. A field survey was conducted in different upazillas of 9 major watermelon growing districts viz. Bhola, Patuakhali, Chattagram, Noakhali, Gopalgongz,

Khulna, Panchagarh, Pabna and Sylhet. Disease incidence and other information were collected during survey from farmers' fields. In this year, we surveyed 126 farmers field in 9 districts. Among the 126 farmers' fields, 35 farmers field (27.78%) were infected with Fusarium wilt and 74 (58.73 %) with GSB. The maximum wilt infected field was recorded in a Patukhali (40.67%). The highest Gummy stem blight disease was recorded in Sylhet (50.67%) and the lowest in Panchagar (5.33%).

Characterization of the isolated pathogen of watermelon at morphological and molecular level

M.M.Alam (PPD), K.M. Alam (PPD) and M. Arifunahar (PPD)

Fusarium wilt and stem blight disease melon are major disease of watermelon caused by *Fusarium oxysporum* f.sp. *niveum* and *Didymella bryoniae* are the causal agent of this disease respectively. Morphological identification was carried out by noting colony features on full strength PDA. Molecular identification was carried out by DNA extraction, PCR analysis and nucleotide sequence analysis. Morphological traits of 50 fungus was evaluated based on five characters and found wide variation. Morphological characteristics of 31 *F. oxysporum* and 19 *D. bryoniae* were studied based on colony color, growth traits, conidial growth had wide variation. DNA extraction was done from those isolates and sequenced for molecular study. Two separate phylogenetic tree were made for *Fusarium* sp. and *D. bryoniae*. From phylogenetic study, three *Fusarium* species such as *F. oxysporum*, *F. solani* and *F. verticillioide*s were observed responsible for wilt causing disease. In the phylogenetic tree of *D. bryoniae*, most of the isolates except WSB Gazi remained in same tree.

Efficacy of fungicides in vitro and in vivo for management of wilt and stem blight disease of watermelon

M.M. Alam (PPD), K. M. Alam (PPD), M. Arifunahar (PPD) and M.R. Karim (RHRC, Patuakhali)

Fusarium wilt and stem blight disease melon are major disease of watermelon. An experiment was conducted to find out effective fungicides against wilt and stem blight disease of watermelon during

2020-2021. The lowest wilt and stem blight disease were obtained from Autostin (0.2%) and Provax (0.2%), respectively and the lowest wilt and stem blight disease were obtained from control in pot and field experiment. Plant growth character showed the similar trend. Similar observations were determined in-invitro and in-vivo test. In foliar spray five fungicides viz. Amister top (0.2%), Nativo (0.2%), Autostin (0.2%), Sunvit (0.1%), Companion (0.2%), Ridomil gold (0.2%) and one untreated control were used in this experiment. The lowest Fusarium wilt and the highest plant plant height and canopy diameter were obtained from Companion (16.67%) followed by Amister top (18.52%) and the highest stem blight, plant height and canopy diameter were obtained from Amister top. Thus, fungicides used for wilt and stem blight management could enhance plant height and canopy diameter in water melon.

Evaluation of bio-control agents in vitro and in vivo and cultural practice for the management of wilt and stem blight disease of watermelon

M.M. Alam (PPD), M. Arifunahar (PPD), K. M. Alam (PPD) and M.R. Karim (RHRC, Patuakhali)

Fusarium wilt and stem blight disease melon are major disease of watermelon. The present in-vitro study, pot house and field experiment aimed to evaluate the efficiency of Decoprima (commercial BCAs), BAU biopesticide (commercial *T. harzianum*), *Bacillus subtilis*, *Pseudomonas fluorescens*, Ridge bed covered with black plastic and Ridge bed covered with black plastic with bio-fumigation control of wilt and stem blight disease and promoting the growth of watermelon plants. Effect of formulated BCAs on disease reduction and the pathogen colonization frequency in plants were assessed. The tested BCAS species were able to inhibit the growth of the causal pathogen in vitro. Under pot house (inoculated) and sick field (natural) conditions, the highest reduction in wilt disease incidence and gummy stem blight severity was detected in watermelon plants treated with commercially formulated Decoprima (74.4%), followed by *T. harzianum*, *B. subtilis* PTB001 and *E. nigrum* ESJ002, while the lowest reduction occurred in watermelon seedlings treated with BAU pesiticide. The study confirmed that the use of the four fungal bacterial species as suspensions

or formulations could be applied as future eco-friendly alternatives to the synthetic fungicides for controlling the wilt and gummy stem blight of Watermelon caused by *F. oxysporum f.sp. niveum* and *D. bryoniae*.

Integrated management of bacterial wilt disease of Brinjal

M.M.Alam (PPD), K.M. Alam (PPD) and M. Arifunahar (PPD)

An attempt was taken for the management of wilt of brinjal caused by *Ralstonia solanacearum* by using different treatments at Bangladesh Agricultural Research Institute (BARI), Gazipur 2018-2021. Based on the preliminary laboratory and field evaluation from 2018-20, few treatments were selected for the control of bacterial wilt disease of brinjal in the field experiment as an integrated method. In the field trial, among the different treatments Krowsin spray in seedlings+*Trichoderma harzianum*/Bacillus subtilis/*Epicocum nigrum* in soil drenching, polythine covered ridge bed +bactrol spray was found to be superior in controlling the wilt of brinjal and also significantly increased the yield.

Identification of associate pathogens of imported vegetable seeds in Bangladesh

M. M. Karim, M. N. Islam, K. E. Jahan, M. I. Faruk, F. Khatun and M. M. Rahman

The experiment was conducted during the year 2020-21 in Plant Pathology Laboratory, BARI, Gazipur. Imported seeds of cauliflower, cabbage, broccoli, cucumber, radish and tomato were collected from Siddik Bazar, Dhaka. All the vegetable seeds were collected as two samples. One seed sample was imported from Japan and another seed sample was imported from India. For the detection of seed borne fungi the blotter incubation method (ISTA, 2001) was followed. Two hundred seeds from each sample was tested on moist blotter paper @ 25 seeds per plate and incubated for seven days at 24°C at 12 h alternate light and darkness. Seeds were then examined for fungal growth under a stereo microscope. Overall quality of imported vegetable seeds from Japan was better compared to seeds from India. No microorganism involvement was observed in all the seed samples imported from Japan while different microorganisms were

detected from all the seed samples imported from India except tomato. Though, the infection rate of microorganisms was very low in the seeds from India. From all the seed samples of India, identified microorganisms were- *Aspergillus flavus*, *Aspergillus niger*, *Cladosporium* sp., *Fusarium* sp. and *Penicillium* sp. Seeds imported from India showed lower germination rate compared to seeds imported from Japan except tomato.

Isolation and identification of causal organisms of chilli anthracnose

M. M. Karim, M. N. Islam, K. E. Jahan, M. I. Faruk, F. Khatun and M. M. Rahman

The experiment was conducted during the year 2020-21 in Plant Pathology Laboratory, BARI, Gazipur. Anthracnose disease is one of the major economic constraint to chilli production in Bangladesh. The disease is reported to affect almost all aerial parts of the plant. In this study, samples of chilli anthracnose were collected from six different upazilas of three different districts of Bangladesh. They were Titas, Homna and Comilla Sadar upazilas of Comilla; Melandaha upazila of Jamalpur; and Nakla and Sherpur Sadar upazilas of Sherpur. From all the six upazilas of three districts *Colletotrichum capsici* was identified as a causal organism of chilli anthracnose. Colonies of *C. capsici* on PDA at first white and becoming grayish with age. Acervuli dark brown to black, conspicuous for their dark setae. Conidia formed in white masses, one-celled, smooth walled, hyaline, falcate, tapering towards each end with acute apex and truncate base.

Efficacy of fungicides in controlling white mold disease of french bean

M. Arifunnahar, K.M.Alam, M.N. Islam, R.Momotaz, M.M.Alam, M.M.Islam and M.M.Rahman

French bean (*Phaseolus vulgaris* L.) is one of the major pulse crops cultivated in Bangladesh and around the world. It is a self-pollinated crop under the family Leguminosae, is commonly known as Forashi sheem or Jhar sheem in Bengali, belongs to the family Fabaceae is an annual, diploid ($2n=2x=22$) species. The average yield of French bean is very low in our country due to various reasons, where diseases are considered as one of

the important factors. White mold or Sclerotinia rot caused by *Sclerotinia sclerotiorum* is a growing threat to the French bean and is of great concern to producers and researchers in countries like Bangladesh. The pathogen can infect all the stages of crop and has become important in recent times and elsewhere with high incidence and severe yield losses. A experiment was conducted at Plant Pathology Division, BARI, Gazipur during Robi cropping season 2020-21 to evaluate the effectiveness of different groups of fungicides against white mold disease of French bean. Eleven different fungicides namely T₁=Carbendazim (Autostin), T₂=Propiconazole (Tilt 250EC), T₃=Tebuconazole (Folicur 250EC), T₄=Difenoconazole (Score 250EC), T₅=Mancozeb (Indophil M45), T₆=Hexaconazole (Contaf 5 EC), T₇=Asoxytrobin+Difenoconazole (Amister top 325 SC), T₈=Mancozeb+Carbendazim (Companion), T₉=Copper oxychloride (Sunvit 50WP), T₁₀=Iprodione (Rovral 50WP), T₁₁=Fenamidone+Mancozeb 600WG (Secure) along with T₁₂=Control treatment were applied with three replications from the first appearance of the disease at 10 days interval in field experiment. The crop was raised as per maintaining recommended agronomical practices. For the *in vitro* conditoin Tilt 250EC, Folicur 250EC, Companion and Rovral 50WP were controlled the radial growth of *Sclerotinia sclerotiorum* at 500 ppm which was followed by Score 250 EC and Contaf 5EC. In the experiment, all the chemical fungicides reduced the disease over the control. The lowest disease incidence (13.33%) was found in T₄ (Score 250EC) treated plots which was followed by T₂ (Tilt 250EC), T₃ (Folicur 250EC) and T₁₀ (Rovral 50WP) treatment. and highest (43.33%) was from control treatment. The range of disease reduction over control was from 23.08% to 69.23%. The highest disease reduction over control (69.23% was found in T₄ (Score 250EC) treated plot which was followed by T₂ (Tilt 250EC), T₃ (Folicur 250EC) and T₁₀ (Rovral 50WP) treatment. The maximum (9.30 t/ha) yield was obtained from T₄ (Score 250EC) treatment and minimum was 5.23 t/ha which was from control treatment (T₁₂). From the Laboratory and field experiment result it was found that Score 250EC, Tilt 250EC, Folicur 250EC

fungicides effectively reduced the white mold disease of French bean over the control.

Evaluation of new fungicides against early blight of tomato

M. Arifunnahar, K.M.Alam, M.N.Islam, R.Momotaz, M.M.Alam, M.M.Islam and M.M.Rahman

Tomato (*Lycopersicon esculentum* Mill.) is the second most important remunerable solanaceous vegetable crop after potato. Tomato is commonly consumed in our daily life and it is a good source of antioxidants. With high nutritional value, it provides a balance source of Vitamin A, C and E needed to maintain good human health. Varied climatic adaptability and high nutritive value made the tomato cultivation more popular in the recent years. Tomato crop is vulnerable to infect by bacterial, viral, nematode and fungal diseases. Among the fungal diseases, *Alternaria* leaf blight of tomato caused by *Alternaria solani* (Ellis and Martin, 1882) is a soil inhabiting air-borne pathogen responsible for leaf blight, collar and fruit rot of tomato disseminated by fungal spores. The pathogen causes infection on leaves, stem, petiole, twig and fruits as well as leads to the defoliation, drying of twigs and premature fruit drop which ultimately reduce the yield 30 to 65 % in various states. The efficacy of some fungicides like Propicarb 70 wp (Propineb 70 wp), Moen 80 wp (Mancozeb 80 wp), Cibalux 75WP (Mancozeb+Carbendazim 75%WP), Joybun 80 WDG (Mancozeb), Azob 80 WDG (Mancozeb80%), Amazan 32.5 WP (Azoxystrobin + Fenoxanil), SC Double Action 76WP (Propineb 70%+Cymoxanil 6%), Bicoraj 50 SP (Chloroisobromine Cyanuric acid 50%sp), Cocymil 72 wp (Mancozeb64%+ Cymoxanil 8%) along with commonly used fungicides viz., Rovral (Ipridione) were tested against early blight of tomato at Plant Pathology Division of Bangladesh Agricultural Research Institute (BARI) during 2020- 2021 cropping season. The seedlings of BARI tomato -14 were used. Spraying was started immediately after the onset of disease and a total of three sprays were applied at an interval of 12 days. All fungicide treatments reduced the disease intensity as compared to untreated control. The lowest disease incidence was observed in Cocymil

72 wp and Joybun 8WDG treated plot which was followed by Rovral and Propicarb 70wp sprayed plot and the highest disease incidence was found in Control treatment. The lowest percentage disease index (44.00) was recorded in Cocymil 72 wp sprayed plot followed by treatment T₁(Propicarb70wp) and T₇(SC Double Action 76WP). The highest PDI (86.66) was observed in Control treatment. Percent disease reduction ranges from 22.31% to 49.23% while the lowest disease reduction was recorded from T₈ (Bicoraj 50 SP) treatment and the highest disease reduction was found from T₁₀(Cocymil 72 wp) over Control which was followed by T₁(Propicarb70wp) and T₄(Joybun80WD). The highest yield (29.37 ton/ha) was obtained from T₁₀(Cocymil 72 wp) which was followed by T₄ (Joybun 80 WDG), Rovral treated plot and T₁ (Propicarb 70 wp) treatment where lowest was recorded from control treatment i.e., 23.90 ton/ha. From the experimental results, it was observed that Cocymil 72 wp, Rovral, Propicarb 70 wp, Joybun 80 WDG fungicides effectively reduced the early blight disease of tomato over the Control treatment.

Survey, isolation and identification of major diseases of flowers (gerbera, tuberose and gladiolus)

M. Arifunnahar, K. M. Alam, M. N.Islam, R. Momotaz, M. M. Alam, M. I. Faruk and M. M. Rahman

Gerbera is a genus of ornamental plants from the sunflower family (Asteraceae). It is cultivated throughout the world under a wide range of climate conditions, especially in temperate and mountainous regions. Gerbera, a perennial herb, is native to South Africa and Asia. Tuberose (*Polianthes tuberosa* L.) of family Agavaceae is a bulbous ornamental plant, native of Mexico. It is one of the most important bulbous ornamental of tropical and subtropical areas. On the other hand, Gladiolus (*Gladiolus grandiflorus* Ness) of family Iridaceae is considered to be the “queen of bulbous flowers”. Some important diseases are leaf spot caused by *Alternaria alternata*, the foot rot (*Pythium irregularae*, *Phytophthora cryptogea* and *Rhizoctonia solani*), wilt (*Fusarium oxysporum*), sclerotium rot (*Sclerotium rolfsii*), grey mold (*Botrytis cinerea*), powdery mildew (*Erysiphe*

cichoracearum), bacterial leaf spot (*Pseudomonas cichorii*) and mosaic for the flowers. So regular investigation of plant disease are essential to identify the disease, and to take immediate measure for controlling the disease. Keeping mind on this view point a short survey was carried out in Gazipur during November 2020 to January 2021 cropping season. Plant samples (viz. leaf, stem, flower and root) were collected and brought in the plant pathology laboratory for identification of the disease and pathogen following standard method. The isolated pathogen was identified based on morphological characteristics observed under a compound microscope comparing standard keys. Different fungi namely, *Alternaria alternata*, *Fusarium graminearum* and *Fusarium oxysporum*. were isolated from the infected plant parts of different flowers which were responsible for the Leaf blight, leaf spot, and wilt diseases, respectively.

Evaluation of different new fungicides in controlling anthracnose of chilli

M. Arifunnahar, K.M.Alam, M.N.Islam, R. Momotaz, M.M.Alam, M.M.Islam and M.M.Rahman

Chilli (*Capsicum annum*), an important spice crop in the world, is cultivated in Bangladesh both during winter and summer seasons. It is the fruit of the plants from the genus *Capsicum* belonging to the family Solanaceae. It is known to suffer from as many as 83 different diseases, of which more than 40 are caused by fungi. Among the fungal diseases, die-back/anthracnose caused by *Colletotrichum capsici* is very serious and it is one of the major problems of chilli cultivation in the country. It causes seedling mortality, leaf spots, die-back and ripe fruit rot losses varying from 10 to 60% (Bansal and Grover, 1969). It is obvious that proper disease control measures can substantially improve the quality of fruit and significantly increase the yield. So far various methods have been practiced and proposed to control this disease. Fungicides have been successfully used in controlling the disease. The efficacy of some fungicides like the code 88, 114, 119, 121, 142, 144, 145 with control used in set 1 and in set 2 the total 13 new fungicides with control were used namely with the code 162, 203, 206, 215, 224, 226, 227, 246, 247, 274, 283, 285,

510 were tested to reduce the anthracnose and increase the yield of chilli at Plant Pathology Division of Bangladesh Agricultural Research Institute (BARI) during 2020- 2021 cropping season. BARI morich 1 was used in the experiment. Fungicides with code 119 and 142 for set 1 and the fungicides with code 203, 224, 226, 227, 246, 247, 274 and 510 for set 2 effectively control the growth of *C. capsici* in the laboratory conditions over the Control treatment. Code 142, 114, 119 sprayed plot effectively control the disease (set 1). The highest yield (1.80 ton/ha and 1.67 ton/ha) was obtained from Code 142 and code 215 fungicides and where lowest was recorded from control treatment in case of both set experiment. So it was observed that fungicides with code 119 and 142 for set 1 and the fungicides with code 203, 224, 226, 227, 246, 247, 274 and 510 for set 2 effectively control the growth of *C. capsici* in the laboratory conditions over the Control treatment. In case field experiment, Code 142, 114, 119 sprayed plot effectively control the disease (set 1).

Identification and characterization of *alternaria* spp. Collected from different solanaceous and cruciferous crops of Gazipur

Ferdous-E-Elahi, M.M. Alam and M. Mynul Islam

From October 2020 to April 2021, some leaf spot infected cruciferous crops (cabbage, cauliflower, broccoli and turnip) leaves were collected from the experimental fields of Bangladesh Agricultural Research Institute (BARI), Gazipur. The fungus was successfully isolated on potato dextrose agar medium. These fungal isolates were proved by Koch's postulates to be the causal agent of leaf spot of cruciferous crops. The fungal culture morphology was identical to *Alternaria brassicicola* and the identification was confirmed by amplifying the internal transcribed spacer region of rDNA using the primer pair ITS1 and ITS4. Based on morphology and molecular characterization, the fungus was identified as *A. brassicicola*.

Studies on seed transmission of *xanthomonas campestris* PV. *Campestris* in cabbage

Ferdous-E-Elahi, M. Mynul Islam and K. M. Alam
Xanthomonas campestris pv. *campestris* (Xcc) is the causal agent of black rot of cabbage. It is a seed borne pathogen and worldwide distributed. In order

to evaluate the risk of seed transmission, the relationship between seed contamination and disease outbreak, this current study was carried out in October 2020 to April 2021. The causal agent of black rot of cabbage has not been investigated yet in Bangladesh. It is assumed that the disease is caused by the bacteria *Xanthomonas campestris* pv. *campestris* (Xcc). For this propose, this year the causal agent of black rot of cabbage was identified based on both morphological characteristics and molecular characterization. Bacteria were isolated in CKTM semi-selective medium and pure colonies were grown in YDC medium. Pure colonies were tested for some biochemical and physiological characteristics. The sequences of the isolates were analyzed using the BLASTN program. The sequences of two isolates of cabbage (MZ453012 and MZ453013) were 99% homologous with the previously submitted Genbank sequences of *Xanthomonas campestris* pv. *campestris* strains MT645261, MT645246 and KR708882.

Survey, isolation and identification of plant-parasitic nematodes of different fruits of Bangladesh

Ferdous-E-Elahi, M. I. Faruk, M. Mynul Islam and K. M. Alam

From December 2020 to February 2021, suspected nematode infected root samples of banana, strawberry and papayawith rhizospheric soil were collected from Gazipur, Sherpur and Sylhet districts. After the isolation of the nematodes through Baermann-funnel technique, based on the morphology of the nematodes, they were identified as *Hoplolaimus* sp., *Helicotylenchus* sp., *Meloidogyne* sp. and *Pratylenchus* sp.

Evaluation of antifungal activity of cinnamon powder *in vitro* and *in vivo* fruit test

M. M. H Tipu, F Khatun and M Mrahman

An experiment was conducted at Plant Pathology Division, BARI under laboratory condition during 2020-2021 to evaluate the antifungal activity of cinnamon powder. Cinnamon powder suspension with a concentration of 2.00% suppressed mycelial growth of *Aspergillus niger* at a substantial level (64.44%).

Effect of *trichoderma* sp. On survival of sclerotia of *sclerotinia sclerotiorum* in soil

M M H Tipu, F Khatun and M Mrahman

An experiment was conducted at Plant Pathology Division, BARI under laboratory condition during 2020-2021 to evaluate the antagonistic effect of *Trichoderma* sp. on survival of sclerotia of *Sclerotinia sclerotiorum* in soil. Three times application of *Trichoderma harzianum* effectively suppressed the growth of sclerotia of *Sclerotinia sclerotiorum* and damaged its viability.

Evaluation of new fungicides against late blight of potato

M M H Tipu, F Khatun and M Mrahman

Twenty two of different new fungicides were tested against late blight disease of potato along with control (water spray) at the experimental field of RARS, Jamalpur during Rabi season of 2020-21. No disease was observed in the experimental plot during this year.

Efficacy of new fungicides in controlling alternaria blight disease of mustard

M. M. H Tipu, F Khatun and M M. Rahman

An experiment was conducted at the field of Plant Pathology Division, BARI during 2020-2021 to find out effective chemical fungicide for controlling alternaria blight disease of mustard. Six different fungicides were tested along with control (water spray). All the fungicides showed excellent result to control the disease effectively.

Evaluation bio-fumigation with mustard to control bacterial wilt in tomato

M M H Tipu, F Khatun and M M. Rahman

An experiment was conducted at the pot-house of Plant Pathology Division, BARI during 2020-2021 to find out effectiveness mustard plant as biofumigant for controlling bacterial wilt of tomato. Bio-fumigation worked well in pot-house condition showing zero mortality and higher crop growth.

Evaluation of different fungicides against purple blotch disease of onion

M. N. Islam, M. M. Karim, M. I. Faruk M. Arifunnahar and M. M. Rahman

Two experiments were carried out in the research field of Plant Pathology Division of BARI, Gazipur using the seedlings of variety of BARI Piaz-4 during 2020-21 cropping season. Ten treatments (nine fungicides and one control) were arranged for both of the experiments in Randomized Complete Block Design with three replications for experiment no. 01 and 02 respectively. The selected fungicides were: T₁=Uposom 78 WP, T₂=Technovit 50 WP, T₃=Limizeb 80 WP, T₄=Raben 60 WG, T₅=Azox 50 WG, T₆=Hypoizim 50WP, T₇=Folicur 250 EC, T₈= Victor Plus 60 WDG, T₉=Acibin 28 SC, and T₁₀=Control for experiment 01 and T₁=Unique 20 SC, T₂=Demistratop 325 SC, T₃= Sean 75 WDG, T₄=Cycozeb Plus 72 WP, T₅=Proven 70 WP, T₆=Lomim M-45, T₇=Bagha 30 EC, T₈= Seednil 72 WP, T₉=Huglee 50 SC, and T₉=Control for experiment 02. Considering the disease severity, all the fungicides were found effective against purple blotch disease as compared to unsprayed control. Among the fungicides in experiment no. 01, T₁=Uposom 78 WP (11.85%), T₆=Hypoizim 50WP (12.99%) and T₉= Acibin 28 SC (13.4%) were found better in managing purple blotch disease over control treatment. The highest yield (26.4t/ha) was observed in T₁=Uposom treated plot followed by T₉= Acibin 28 SC (25.35 t/ha) and T₆=Hypoizim (25.19 t/ha) respectively. The control treatment showed highest disease severity (71.8%) and the lowest yield (19.46 t/ha) parameters. In experiment no. 02, T₃= Sean 75 WDG (10.73%) and T₂= Demistratop 325 SC (12.15%) performed highest disease reduction and observed highest yield (25.38 t/ha) and (24.04t/ha) respectively over control treatment which represent highest disease severity (70.76%) and the lowest yield (18.80 t/ha).

Survey, isolation and identification of dragon fruit diseases

M. N. Islam, M. M. Karim, M. Arifunnahar, M. I. Faruk and M. M. Rahman

A survey program was carried out in dragon fruit orchards of Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh, bali bazaar area of Domar, Nilphamari and 6 other orchards of Rangpur Division during 2020-2021 cropping season. Disease plant samples as well as fruits were collected and cultured for identification of the

pathogen in Plant Pathology laboratory, BARI, Gazipur following standard method. From the survey, two types of disease were identified from dragon fruit disease sample viz. i) Anthracnose caused by *Colletotrichum gloesporoides* and *C. truncatum* and ii) stem rot or soft rot caused by *Fusarium* spp. It was also found that around 40% dragon plant infected by anthracnose disease whereas 15% of total plants were attacked by stem rot or soft rot disease in all the growth stage of plant. No prominent disease symptoms as well as causal entity were isolated from fruit sample of dragon fruit plant. Through pathogenicity test it is confirmed that *Colletotrichum gloesporoides* and *C. truncatum* are causal agents of anthracnose disease of dragon fruit and *Fusarium* spp. is causal agent of stem rot or soft disease of dragon fruit respectively.

Selection of resistant guava seedlings against *nalanthamala psidii* wilt disease pathogen

K. M. Alam and M.M. Alam

Wilt disease caused by the *Nalanthamala psidii* is being a threat for guava production due to its devastating nature in our country. An experiment was carried out in the pot house, Plant Pathology Division, BARI to evaluate the seedlings of BARI payara 2 in artificially inoculated condition against wilt disease causing pathogen *Nalanthamala psidii*. isolate NPB 001. A total of 200 seeds were sown in cocodust containing pot where 197 seedlings were got from those seeds. After three month of artificial inoculation of pathogen, 195 seedlings were died and only two were survived.

Evaluation of microbial products for controlling fusarium and bacterial wilt of chickpea

K. M. Alam, M. M. Alam

Fusarium wilt diseases caused by soil-borne pathogens are very difficult to control by any chemical means. An experiment was carried out to mitigate wilt disease of chickpea by using microbial products during 2020-2012. BARI chola 5 was used for evaluation of four microbial products, namely Decoprime (*Trichoderma* sp. + *Geobacillus* + *Streptomyces*), Biofungicide (BAU), three biological agents *T. erinaceum*, *Acremonium cavaeaeum* and *Bacillus* sp. Significant difference was obtained among the microbial

products for disease incidence and yield. *Trichoderma erinaceum*, *Acremonium cavaeaeum* were the best microbial products for soil treatment to control fusarium wilt disease of checkpea.

Survey of aloe vera plant diseases

B. Akhter, M. R. Humauan and M. S. Hossain

A comprehensive survey was conducted in seven villages of sadar upazilla in Natore district to identify the incidence and severity of different diseases of Aloe vera and to know the existing management practices during Rabi season 2020-2021. Eighteen farmers were interviewed with a pre-designed structured questionnaire during this survey period. Three major diseases of Aloe vera were observed in the surveyed areas and were reported by the Aloe vera producing farmers as a major limiting factor of Aloe vera cultivation. From the survey it was found that leaf spot, leaf blight and wilt diseases of Aloe vera are predominant. Plant samples (leaf and root) were collected and observed in the plant pathology laboratory for identification of the diseases and pathogens following standard method. The isolated fungi were identified based on morphological characteristics observed under a compound microscope. *Alternaria spp* and *Fusarium proliferatum* were isolated from the infected leaves of Aloe vera which caused leaf spot and leaf blight diseases. On the other hand *Fusarium spp* was isolated from infected roots which caused wilt disease of Aloe vera.

Management of alternaria leaf spot and flower blight disease of marigold

B. Akhter, M. R. Humauan and M. S. Hossain

A field experiment was conducted at Regional agricultural Research Station Ishurdi, Pabna during Rabi season of 2020-2021 to find out the effective fungicides against *Alternaria* leaf spot and flower blight of marigold. Local variety of marigold was used in the study. Eight different fungicides viz. T₁= Tilt 250 EC @ 0.05% T₂= Autostin 50 WDG @ 0.2%, T₃= Rovral 50 WP @ 0.2% T₄= Contaf 5EC @ 0.1% T₅= Companion @ 0.2% T₆= Score 250 EC @ 0.2% T₇= Indofil M 45 @ 0.2% T₈= Secure 600wg @ 0.2% and one unsprayed Control were used in this experiment. Among the treatments the lowest

severity of leaf spot (2.67%) and flower blight (11.67%) were found in score 250 EC followed by rovril 50 WP. The highest severity of leaf spot (18.33%) and flower blight (38.33%) were found in control plots. In case of total fresh flower/ha the highest (1353840) was recorded from Rovral 50 WP treated plots followed by Score 250 EC (1105453) treated plots whereas, the lowest (281068) was recorded in control plots. The lowest infected flower (26.16%) was recorded in Score 250 EC treated plots, while the highest (83.52%) was found in control plots.

Effect of glyphosate and ammonium sulfate (NH₄)₂SO₄ for controlling orobanche of mustard

M. R. Humauan, B. Akhter and M. S. Hossain

The trial was conducted at Regional Agricultural Research Station Ishurdi, Pabna during Rabi season of 2020-21 to find out one / more effective management practices against *Orobanche* of mustard. Seven treatments viz. T₁= Glyphosate @ 60 ml and 120 ml/ha at 30 DAS and 55 DAS, T₂= 1% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS, T₃= 125% of recommended fertilizer (N & P) + Glyphosate @ 60ml and 120 ml/ha with 0.25% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS, T₄= 125% of recommended fertilizer (N & P) + Glyphosate @ 60ml and 120 ml/ha with 0.50% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS, T₅= 125% of recommended fertilizer (N & P) + Glyphosate @ 60ml and 120 ml/ha with 0.75% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS, T₆= 125% of recommended fertilizer (N & P) + Glyphosate @ 60ml and 120 ml/ha with 1% solution of (NH₄)₂SO₄ at 30 DAS and 55 DAS and T₇= Control were tested for their performance against the disease. All the treatments gave satisfactory reduction of orobanche and increased plant growth as well as yield of mustard. The number of orobanche/m² ranged from 3.44 – 34.06. The lowest (3.44/m²) was found in treatment T₆ while the highest (34.06/m²) was recorded in control plots. The highest reduction of number of *Orobanche* over control (89.90%) was found in T₆ and the lowest (33.62%) was in treatment T₂. The highest yield (1264 kg/ha) was recorded from treatment T₆, while the lowest (823 kg/ha) was found in control plots.

Stemphylium blight disease and yield of lentil as influenced by date of sowing, fungicide spray and variety

M. R. Humauan, B. Akhter, M. S. Hossain and D. Sarker

The experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during rabi season 2020-21 to find out the effect of date of sowing and fungicide (Folicure) spray on 9 BARI released variety viz. BARI Masur-1, BARI Masur-2, BARI Masur-3, BARI Masur-4, BARI Masur-5, BARI Masur-6, BARI Masur-7, BARI Masur-8 and BARI Masur-9. There were 4 date of sowing viz. 10 Nov. 20 Nov. 30 Nov. 10 Dec. In sprayed condition all the variety yielded higher than unsprayed condition. As the date of sowing was delayed yield of BARI Masur-9 increased. But in case of other varieties yield was decreased as the sowing date was delayed in sprayed and unsprayed condition. BARI Masur-8 yielded the highest in all treatment combination, while the yield of BARI Masur-9 was lowest than all other varieties in all combinations.

Yield loss assessment of lentil varieties due to stemphylium blight disease

M. R. Humauan, B. Akhter and M. S. Hossain

The experiment was conducted at RARS, Ishurdi, Pabna during Rabi season of 2020-21 to measure and quantify the loss of yield in lentil varieties due to Stemphylium blight disease. Two spray conditions viz. spray with Rovral (Iprodione) @ 0.2% and no spray and 9 BARI released variety viz. BARI Masur-1, BARI Masur-2, BARI Masur-3, BARI Masur-4, BARI Masur-5, BARI Masur-6, BARI Masur-7, BARI Masur-8 and BARI Masur-9 were used in this experiment. Yield loss ranged from 5.30% - 13.50%, while the highest loss was found in Masur-7 and lowest was in BARI Masur-9 compare to sprayed plots. The highest yield (2823 kg/ha) was found in sprayed plots of BARI Masur-8 while the lower (1191 kg/ha) was recorded in non sprayed plots of BARI Masur-9.

Germplasm evaluation against leaf curl virus of chili

M. R. Humauan, B. Akhter and M. S. Hossain

The experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during rabi season 2020-21 to find out resistant chili lines against leaf curl virus disease. A total of 46 entries were screened against leaf curl virus under natural field condition. All the lines were found highly susceptible against the disease.

Evaluation of new fungicides against early blight of tomato

M. R. Humauan, M. S. Hossain and B. Akhter

The experiment was conducted at RARS, Ishurdi, Pabna during rabi season 2020-21 to find out effective fungicides against early blight of tomato. Twelve new fungicides and control were used in this experiment. The disease reduction over control ranged from 8.69 to 34.78%. The highest disease reduction over control was recorded in fungicide 454 @ 2 gm/l with 34.78% and the lowest were recorded in fungicide 369 @ 1.50 gm/l with 8.69%.

Evaluation of new fungicides in controlling powdery mildew of pumpkin

M. R. Humauan, B. Akhter and M. S. Hossain

The experiment was conducted at RARS, Ishurdi, Pabna during rabi season 2020-21 to find out effective fungicides against powdery mildew of pumpkin. The experiment was carried out following Randomized Complete Block Design with three replications. The test variety was BARI Mistikumra-2. Seedlings were established in seedbed and transplanted in the main field on November 16, 2020. The unit plot size was 2m x 2m and spacing was 1m x 1m. Twelve new fungicides and control were tested for their performance against the disease. But no disease was observed in this experiment. So the experiment may be repeated in the next year.

Validation trial of bacillus species and their emos for controlling bacterial wilt in eggplant

Mohammad Tofajjal Hossain, M. Muktdir Alam and M.K.R. Bhuiyan

Bacterial wilting of eggplant is a serious threat over the world. Still there is no successful remedy for controlling the wilt in eggplant. However, from the last decade, probiotic *Bacillus* species and their formulated products have been used to the agriculture

with the many aspects over the world. This approach is rudimentary in our country. The activity of the EMOs (Effective Microbial Organisms) by using the endophytic novel *Bacillus oryzicola* YC7007 and *B. velezensis* GL6 to control bacterial wilt in eggplant is the first study in Bangladesh to our knowledge. The *in vitro* antagonistic activities by formulated product of EMOs and their inocula levels had been scrutinized against the bacterial pathogen *Ralstonia solanacearum* for controlling bacterial wilt. Strain YC7007 and GL6 did quorum having with the 2.0×10^7 CFU/ml or CFU/gm inocula that suppressed the wilt and promoted the plant growth compared with control. Bacterial wilt of the eggplant (very susceptible variety BARI Bt Begun 2) was successfully controlled *in vitro* and *in vivo* in RARS, Hathazari and other locations of Chattogram Division. EMOs were scrutinized by three times drenching and one time spraying that suppressed the bacterial wilt of eggplant. There was no diseases at 2-MAT (Months after transplanting) in the treated plot of individual location. Considering the all locations, EMOs (1×10^8 CFU/g) revealed significantly (Tukey HSD, $P < 0.05$) lower disease severity by 1.5 ± 0.3 , than the control 3.6 ± 0.4 in the BARI Bt begun 2 at 4-MAT. However, EMOs (1×10^8 CFU/g) revealed significantly (Tukey HSD, $P < 0.05$) lower disease severity by 1.6 ± 0.4 , than the control 4.16 ± 0.1 at BARI Bt Begun 2 at 5-MAT out of 0-5 disease rating scales over the Chattogram division including hilly districts. EMOs showed significantly consistent disease suppression 100-60 % in the BARI Bt Begun 2 at 2-MAT and 5-MAT respectively, to bacterial wilt compared to control. Individually, at the location of Cumilla and ARS, Raikhali, the treated plot indicated HR (Highly Resistance) disease reaction whereas the BARI Bt Begun 2 in the treated plot became R (resistant) disease reaction at the locations of Satkania, Chattogram, Kawkhali, Rangamati, Ghagra, Rangamati and Fatikchari, Chattogram, at 4-MAT. At the same time 4-MAT, the resistance to wilt of BARI Bt Begun 2 impaired and turned into HS (Highly susceptible) in the untreated plot almost in all locations. We concluded EMOs products that are key vital biological products to *Ralstonia solanacearum* for controlling bacterial wilt in eggplant.

Effect of bacterial fertilizer on yield in tomato

Mohammad Tofajjal Hossain and M. K. R. Bhuiyan

Rhizobacteria, bio-control agents, are the pivotal issues for promoting the plant growth and increasing the yield having with the eco-friendly manner. However, from the last decade, probiotic *Bacillus* species and their products have been used to the agriculture with the many aspects over the world. This approach is rudimentary in our country. The activity of the EMOs (Effective Microbial Organisms) by using the endophytic novel *Bacillus oryzicola* YC7007 and *B. velezensis* GL6 to increase yield in tomato is the first study in Bangladesh to our knowledge. The product of EMOs formulation in the liquid and granular shape and size had been conducted successfully at the Regional Agricultural Research Station, Hathazari, Chattogram *in vitro* and *in vivo* to optimize the inocula like fertilizer for the tomato plant. Strain YC7007 and GL6 did quorum having with the 2.0×10^7 CFU/ml or 2×10^7 CFU/gm inocula that increased yield of tomato compared with control. The concentration 1.0×10^7 CFU/gm by granular form of YC7007 and GL6 showed significantly yield compared to control. Granular EMOs (1×10^7 CFU/g) revealed significantly (Tukey HSD, $P < 0.05$) higher yield by 6.0 ± 0.3 kg/m², than the control 4.3 ± 0.2 kg/m² in the BARI Tomato 15 followed by liquid EMOs (1×10^7 CFU/g) by 5.67 ± 0.3 kg/m², than the control 4.3 ± 0.2 kg/m² in the BARI Tomato-15. EMOs products are key vital biological products for higher yielding.

Characterization of novel species for degradation of propiconazole fungicide in mango

Mohammad Tofajjal Hossain and M.K.R. Bhuiyan

Triazole fungicide like propiconazole group especially Tilt is very effective to control the stem end rot of mango. But, Triazole fungicide inhibits the demethylation that is serious harmful in human body. Therefore, the basic research has been conducted at Regional Agricultural Research Station, Hathazari, Chattogram to find out the eco-friendly antagonistic endophytic novel *Bacillus* species that might degrade the propiconazole properties. Out of ten (10) isolates, only one isolate BARI/HAT/GL6 could change the color of Tilt within 6 hr. It also showed 0.13 absorbance by 600 nm web length by deleting the absorbance of Tilt-250 EC. It seems strain BARI/HAT/GL6 has positive effect to degrade the propiconazole. The

newly isolated endophytic bacterium GL6 has strong antagonism against to devastating plant fungus *Lasiodiplodia theobromae* that causes the stem end rot of mango. A very clear and distinct inhibition zones were observed at *in vitro* cell bioassay. They are now subjected for sequencing preparation for novel species.

Determination of transmission mechanism of okra yellow vein clearing mosaic virus (OKYVCMV) of okra

M.G. Kibria, M.R. Islam, M. M. R. Talukder and M.R.Uddin

An experiment was conducted at RARS, HRC, BARI, Rahmatpur, Barishal. The first seeds sowing date was March 2021. Germination started after six days of seed sowing. Eighty five percent (85%) seeds were germinated. After fifteen days of germination, Virus symptoms were exhibited on seedlings. Virus symptom was dominated with the increasing of seedlings age. After fifteen days, some of the treatments exhibited virus symptoms. However, plant growth and virus symptoms were varied among the treatments

Survey of diseases of malta in southern region

M.G. Kibria, M.R. Islam, M.M.R.Talukder and M. R.Uddin

A Survey was conducted in Pirojpur, Jalakhathi (Binoikathi and Gava Ramchandrapur) and Barishal (Wazirpur, Babugonj and Banaripara) Districts. Respondents in different Upazilla recorded all the disease with the highest incidence being Greening (91%), followed by dieback (75%), Sooty mold (58%), Canker (44%) and Gummosis (36%).

Isolation and identification of causal organism of gummosis disease in wood apple

M.M.E. Rahman and A.K. Saha

Wood apple is a popular fruit based on its nutritive and medicinal value. Gummosis is one of major problems of wood apple faced in different places including RARS, Burirhat, Rangpur. The fungus as a causal agent was isolated initially from moist blotter and water agar plate and pure culture was prepared using PDA media following standard procedure. During morphological characterization, microscopic examination of fungal growth was

observed. Numerous microconidia with few falciform macroconidia were observed. Morphological characteristics were confirmed the fungus as *Fusarium solani*. Molecular characterization of the isolates is under process.

Multiplication, purification and maintenance of indigenous potato varieties

A.K. Saha and M.M.E. Rahman

Indigenous cultivars of potato are famous for taste, dry matter and preservation quality under natural condition. During 2020-2021 cropping year, quality seeds of nine indigenous variety viz. Ausha, Challisha, Dohazari, Indurkani, Lalpakri, Patnai, Sadaguti, Shilbilati and Sindurkota were produced under net house condition. There are 145 Kg seeds preserved in cold-storage of BSPC, Debiganj, Panchagarh for next year use.

Screening of potato varieties and germplasms against late blight

A.K. Saha and M.M.E. Rahman

Field experiment was conducted to evaluate the 10 (Ten) BARI released potato varieties, 03(Three) germplasm against late blight disease during 2020-21cropping season in the field of RARS, BARI, Burirhat, Rangpur. None of the variety/germplasm was found immune. The present study revealed that BARI Alu-90 (Alouette) and BARI Alu-91 (Carolus) were highly late blight resistant. The new germplasm Twinner and Twister were also highly resistant against late blight. At present, BARI alu-46 was resistant though earlier it was highly resistant. BARI Alu-53, BARI Alu-57 and BARI Alu-77 showed moderate resistant. Yield of BARI Alu-46, BARI Alu-57, BARI Alu-77, BARI Alu-90 (Alouette), BARI Alu-91 (Carolus), Twinner, Twister and Levante was 46.14, 30.57, 27.22, 48.45, 32.58, 37.98, 35.11 and 37.09 t ha⁻¹ respectively. In respect of resistance and tuber yield performance of BARI Alu-46, BARI Alu-90 (Alouette), BARI Alu-91 (Carolus) and germplasms Twinner, Twister and Levante weres far better than all others released late blight resistant varieties.

Efficacy of new fungicides in controlling late blight of potato

A.K. Saha and M.M.E. Rahman

The experiment was conducted at RARS, BARI, Burirhat, Rangpur during rabi season of 2020-21 to evaluate 15 (fifteen) new fungicides against late blight of potato under natural inoculum pressure. Coded 302 and 428 fungicides effectively managed late blight disease of potato and yielded more than 30 t/ha.

Effect of different chemicals in controlling common scab disease of potato

A.K. Saha and M.M.E. Rahman

There were 10 (ten) different chemicals were evaluated against common scab of potato as treatment and soil drenching (30,45 and 60 days after planting) at RARS, BARI, Burirhat, Rangpur in 2020-2021 cropping season. Used chemicals significantly reduced incidence and severity of common scab and potato tuber yield over control where no chemical was used against common scab. There was no incidence and severity was recorded on potato tuber where, Blitox (Copper Oxy-Chloride) and Timsen™ (n-alkyl dimethyl benzyl ammonium chloride 40% + Stabilized urea 60%) was used and tuber yield was 26.16 t ha⁻¹ and 25.45 t ha⁻¹ respectively while, 32.22 t ha⁻¹ tuber yield was in control plot.

Effect of different fungicidal combinations in controlling late blight of potato

A.K. Saha and M.M.E. Rahman

Effectiveness of thirteen different sole and combined fungicides were evaluated against late blight of potato at RARS, BARI, Burirhat, Rangpur in 2019-20 and 2020-2021 cropping season. Fungicides and fungicidal combinations significantly reduced late blight disease and increased tuber yield over control (where no fungicide was used). Zampro DM (Ametoctradin 30% + Dimethomorph 22.5%) was the best one for disease management (≥95% over control) and yield. The highest yield (42.30 t ha⁻¹ and 40.22 t ha⁻¹ in 2019-20 and 2020-21 cropping season, respectively) was harvested from Zampro DM sprayed plot.

Performance of different organic matter for disease free organic potato production

A.K. Saha and M.M.E. Rahman

There were five different organic matter like Tobacco dust (Barley) waste @ 5.0 t ha⁻¹, Tobacco dust (Local) waste @ 5.0 t ha⁻¹, Varmi compost (Annapurna) @ 3.0 t ha⁻¹, Mustard oil cake (MOC) @ 1.50 t ha⁻¹, Kazi Jaibo Sar (KJS) @ 5.0 t ha⁻¹, Tobacco dust @ 3.0 t ha⁻¹ + Sulphate of Potash (SoP) @ 0.25 t ha⁻¹, MOC @ 1.0 t ha⁻¹ + SoP @ 0.25 t ha⁻¹, KJS @ 3.0 t ha⁻¹ + SoP @ 0.25 t ha⁻¹ were used in cropping season 2019-2020 and 2020-21 to produce organic potato where TCRC, BARI developed recommended practice and control (no added organic matter) was also as a treatment. Potato yield > 24 to ≤ 25.00 t/ha was recorded in tobacco dust waste @ 5.0 t ha⁻¹ treatment and yield range of 04 different organic matter was 24.11 to 18.00 t/ha while 38.00 to 40.00 t/ha was in TCRC, BARI recommended fertilizer dose. Lower common scab disease incidence (<5%) and severity (<1.00) was in organic matter used for organic potato production

Effect of different organic matter for managing soil-borne diseases (common SCAB) and yield of potato

A.K. Saha and M.M.E. Rahman

Seven different organic matter and their combination along with recommended chemical fertilizers viz. Cow dung @ 5.0 t ha⁻¹, Ash @ 5.0 t ha⁻¹, Cow dung @ 2.50 t ha⁻¹ + Ash @ 2.50 t ha⁻¹, Kazi jaibo sar @ 1.0 t ha⁻¹, Annapurna jaibo sar @ 1.0 t ha⁻¹, Mustard oil cake @ 0.50 t ha⁻¹, Farah jaibo sar @ 1.0 t ha⁻¹ and Tobacco dust waste @ 0.85 t ha⁻¹ were tested for management of common scab disease and yield of potato during 2019-2020 and 2020-2021 cropping season at RARS, Burirhat, Rangpur. Annapurna jaibo sar, Mustard oil cake, Farah jaibo sar and Tobacco dust significantly lowered common scab disease incidence and severity. Tobacco dust waste used treatment was the best one for disease control (Incidence 10.20% and 6.44% and Severity i.e. PDI- 2.14 and 1.29 in 2019-2020 and 2020-2021 cropping season, respectively) as well as highest potato tuber yielder (Marketable fresh yield >28 mm dia: 40.75 t ha⁻¹ and 38.91 t ha⁻¹, and total yield- 48.42 t ha⁻¹ and 43.61 t ha⁻¹ in 2019-2020 and 2020-2021 cropping season, respectively).

Development of cost-effective integrated fertilizer management practice utilizing agricultural waste tobacco dust for disease free potato production

A.K. Saha and M.M.E. Rahman

Study of 2019-20 and 2020-21 cropping season at RARS, Burirhat, Rangpur revealed that use of tobacco dust waste (TDW) ($\geq 800 \text{ kg ha}^{-1}$) as organic fertilizer significantly increased total and marketable potato yield and decreased common scab disease (incidence and severity) over control (Only recommended chemical fertilizer dose i.e. RCFD used plot) and cow dung (5 t ha^{-1}) + recommended chemical fertilizer (RCFD) used plot. There was no significant difference among tobacco dust waste dose 2000, 25000 and 3000 kg ha^{-1} with recommended fertilizer dose (RCFD) for tuber yield (range from 40.77 to 47.48 t ha^{-1}), marketable sized fresh tuber ($>28 \text{ mm}$ diameter) yield (range from 37.49 to 42.73 t ha^{-1}). Common scab disease incidence and severity was decreased as the tobacco dust waste dose increased. There was no significant differences among TDW 3000 Kg ha^{-1} + RCFD, TDW 3000 Kg ha^{-1} + (-10%) recommended chemical fertilizer (RC) NPKS, TDW 3000 Kg ha^{-1} + (-20%) RC- NPKS, TDW 2500 Kg ha^{-1} + RCFD and TDW 2000 Kg ha^{-1} + RCFD for total tuber and fresh marketable tuber yield in both cropping years.

Evaluation of new fungicides against early blight of tomato

M. S. Ali, M. B. Anwar, M. Arifunnahar, Monirul Islam, K.M. Alam, R. Humauan, B. Akhter and F. Khatun

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi2020-21 to find out appropriate chemical fungicide to control early blight of tomato. Among the fungicides, the lowest disease severity (2.00) was recorded in T_8 (503) and T_9 (530) treated plot

and it was statistically similar with T_3 (444) and T_5 (454) treated plot. On the other hand, the highest disease severity (5.00) was found in T_{11} (control) plot. The highest yield (30.42 t/ha) was recorded in T_9 (530) treated plot followed by T_8 (503), T_3 (444), T_2 (423) and T_5 (454) treated plot and the lowest yield (10.62 t/ha) in T_{11} (control) plot.

Evaluation of new fungicides for controlling purple blotch disease of onion

M. S. Ali, M. B. Anwar, M.N. Islam, M.M.Karim, M.I.Faruk and F. Khatun

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi2020-21 to find out the effective chemical fungicides against purple blotch disease of onion. Among the fungicides, the lowest disease severity (2.00) was recorded in T_9 (374) and T_7 (337) treated plot, and it was statistically similar with T_3 (237), T_{11} (393), and T_2 (225) treated plot. On the other hand, the highest disease severity (5.00) was found in T_{12} (control) plot. The highest yield was recorded in (15.61 t/ha) T_9 (374) treated plot followed by T_7 (337), T_3 (237), T_{11} (393), and T_2 (225) treated plot, respectively and the lowest (7.38 t/ha) in T_{12} (control) plot.

Survey and identification of major diseases of vegetable crops in saline area

M. S. Ali and M.B. Anwar

A comprehensive survey was conducted in two upazilla of Satkhira District districts of the saline region to identify the incidence and severity of different vegetable diseases and existing management practices during Rabi 2020-21. About 20 farmers were interviewed with pre-designed structured questionnaire during this survey. Different vegetable diseases were reported by the farmers as major crop production issue. Moreover, existing disease management practices were also explored through the survey questionnaire.



Effect of high temperature stress at different growth periods of winter onion

F. Ahmed, I. M. Ahmed, A.F.M Shamim Ahsan, R. Ara (Src)

A pot experiment was conducted during rabi season of 2020-2021 to evaluate the effect of high temperature stress on physiological and biochemical changes at different growth periods of winter onion. Five treatments namely T_1 = open field (control), T_2 = Inside polythene chamber from transplanting to maturity, T_3 = Inside polythene chamber from 20 days after transplanting (DAT) to 35 DAT, T_4 = Inside polythene chamber from 20 DAT to maturity and T_5 = Inside polythene chamber from 35 DAT to maturity were used in the study. High temperature was imposed by polythene covered chamber where temperatures were 1 to 6 °C higher (depending on time of the day) than outside of the chamber. The experiment was laid out in randomized complete block design with 10 replications. Plastic pots (top dia: 25 cm, bottom dia: 18 cm and height 25 cm; 12 kg soil) were filled up with soil and cowdung (4:1). Ten seedlings (40 days old) of BARI Paj-1 were transplanted in plastic pots on 27 December 2020. Fertilizers were applied 90-45-120-30-3-1.4 kg ha⁻¹ of N P K S Zn B. Half of N and half of K along with full amount of other fertilizers were applied as basal. Remaining N and K was top dressed in 2 equal splits at 25 and 50 DAT. After 10 DAT, plants were thinned to five plants in each pot and kept up to maturity. Leaf chlorophyll content, leaf area, total dry matter production (TDM) and bulb yield was significantly reduced due to high temperature stress; however, there exists variability among the treatments. Significantly higher leaf area plant⁻¹ was observed in T_2 and T_5 treatments compared to other treatments. TDM was significantly reduced in

T_2 treatment compared to control and other treatments. Antioxidant activities (Catalase and Peroxidase) and Malondialdehyde (MDA) were found more in T_2 and T_5 treatments indicating that plants in these two treatments were affected more by temperature stress than others. Consequently, higher bulb yield reduction (19.69%) was found in T_2 treatment followed by T_5 and the lowest in T_4 (6.27%) treatment. Furthermore, it revealed that higher temperature as well as fluctuating temperatures are very much harmful for bulb development in onion.

Effects of exogenous salicylic acid on physio-biochemical activity, growth and yield of mustard under drought stress

F. Ahmed, I.M. Ahmed, S.N. Mahfuza, A.F.M.S. Ahsan, A.H.M.M. Talukder, B. Ahmed, M.N. Islam

A pot experiment on exogenous application of salicylic acid on mustard was conducted under drought stress during rabi season of 2020-21 to evaluate its effect on physio-biochemical activity, growth and yield. Five doses of salicylic acid namely 0, 50, 75 and 100 ppm were used on mustard under drought and well-watered conditions (control). The experiment was assigned in split plot design where soil moisture condition was assigned in main plot and the salicylic acid in sub-plot with 10 replications. Plastic pots (top dia: 25 cm, bottom dia: 18 cm and height 25 cm; 12 kg soil) were filled up with soil and cowdung (4:1). Seeds were sown in each pot on 11 November 2020. Fertilizers were applied @100-30-80-20-3-1 kg/ha NPKSZnB. Half of N and all other fertilizers were applied as basal and remaining N was applied at 20 days after sowing (DAS). Drought was imposed at 15 days after sowing by withholding of irrigation water. Foliar application of salicylic acid was done at 30

and 45 days after sowing. Salicylic acid showed significant positive impact on physiological parameters as well as antioxidant activities in both drought and control conditions. Leaf chlorophyll content and photosynthetic rate were greatly influenced by salicylic acid application. Photosynthetic rate increased with the increased dose of salicylic acid irrespective of water stress treatments. Catalase (CAT) and Peroxidase (POD) activities increased with the increased dose of salicylic acid which showed significant variability among the drought stress treatments. Malondialdehyde (MDA) content decreased with the increased dose of salicylic acid both in drought and control treatments. Salicylic acid showed positive impact on leaf area and total dry matter production in both drought and control conditions. Drought caused significant seed yield reduction but salicylic acid showed positive impact on seed yield. With the increased dose of salicylic acid seed yield also increased irrespective of drought and control treatments but there was no significant difference in seed yield among the treatments.

Difference in yield and physiological features in response to drought and heat combined stress during reproductive stage in wheat

I.M. Ahmed, F. Ahmed, A.F.M.S. Ahsan, N. Mokalroma, A.H.M.M.R. Talukder, S.N. Mahfuza, B. Ahmed, M.N. Islam

Drought and heat are the two most common and frequently co-occurring abiotic stresses constraining crop growth and productivity. Vinyl house pot experiment were conducted to investigate the tolerance potential and mechanisms of wheat genotypes (BWSN 31, drought/heat tolerant; BWSN 33, drought/heat sensitive) during reproductive stage compared with heat tolerant cv. BARI Gom-33 in response to separate and combined stresses (D+H) of drought (10% soil moisture, D) and heat (H) in Plant Physiology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh during the November, 2020 to March 2021. Ten seeds of each genotype were sown in each pot on 18 November 2020. Thinning of seedling was done by keeping five plants for each pot at 10 days after emergence. Drought and heat treatments were imposed during anthesis. This experiment included the following 4

treatments: (1) control (no drought), in which pots remained humid (at a 50-60% water holding capacity) throughout; (2) drought stress (D) treatment, in which 2 L water was added to each pot and the plants were then subjected to drought stress over 20 d by withholding irrigation until the soil moisture content (SMC) was reduced to 10%; (3) Heat stress i.e. elevated temperature (polythene chamber). The experiment was laid out in randomized complete block design with 9 replications. Then plastic pots (10 L, 30 cm height) were filled with the mixture of air-dried soil and cow dung in 4:1 volume ratio. Fertilizer at the rate of 120-30-90-15-6-2-1 kg/ha NPKSMgZnB in the form of Urea, Triple super phosphate, Muriate of potash, Gypsum, Zinc sulphate and Boric acid were incorporated in the soil as follow the pot method. Results revealed that, either drought or heat alone and in combination (D+H) stresses significantly decreased plant growth, chlorophyll content, net photosynthetic rate (Pn), maximal photochemical efficiency of PSII (Fv/Fm), with the largest suppression under combined stress, and BWSN 31 genotypes showing more tolerance than BWSN 33. Water use efficiency (WUE) increased significantly in BWSN 31 and BARI Gom-33 after D+H, but no significant change in BWSN 33. Moreover, larger increases in the level of reduced glutathione (GSH), ascorbate (ASA), and the activities of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPX), guaiacol peroxidase (POD) and glutathione reductase (GR) under D+H vs control were observed in BWSN 31 and BARI Gom-33 than BWSN 33, with less accumulation of H₂O₂ and malondialdehyde. We demonstrated that glycine-betaine and soluble sugars increased significantly in BWSN 31 and BARI Gom-33 under all stress conditions, along with increases in proline and soluble protein contents. Compared with control, all stress treatments significantly reduced grain yield and 1000-grain weight; however, BWSN 31 and BARI Gom-33 were less affected than BWSN 33. Our results suggest that high tolerance to D+H stress in BWSN 31 and BARI Gom-33 is closely related to the enhanced glycine-betaine and soluble protein and sugar contents, improved proline, and antioxidative capacity for scavenging reactive oxygen species during reproductive stage. These results may provide

novel insight into the potential responses associated with increasing D+H stress in wheat genotypes.

Screening of wheat for salinity stress at early stages of plant growth

I.M. Ahmed, F. Ahmed, N. Mokarroma, A.H.M.M R. Talukder, S.N. Mahfuza, A.F.M.S. Ahsan, B. Ahmed, M.N. Islam

Soil salinity is a major limiting factor for wheat production in Bangladesh. A comprehensive understanding of salt-tolerance mechanisms and the selection of reliable screening indices are crucial for breeding salt-tolerant wheat cultivars. A hydroponic experiment was conducted in a rooftop of Plant Physiology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh during the November, 2020 to March 2021. In this study, 10 wheat genotypes (obtained from last year selection of 150 wheat accessions) were chosen to investigate the existing screening methods and clarify the salinity tolerance mechanisms in wheat. Healthy seeds were surface sterilized by soaking in 2% H₂O₂ for 30 min, rinsed in tap water, and then germinated in moist filter paper in an incubator at 20 ± 1°C. At the first leaf stage (7 days old), uniformly healthy plants were selected and transplanted to 60L reservoir containers containing 50L basal nutrient solution (mg l⁻¹): KNO₃, 6.5 mM; Ca(NO₃)₂·4H₂O 4.0 mM as stock solution A, NH₄H₂PO₄ 100 µM, MgSO₄·7H₂O, 2.0 mM as stock solution B, MnCl₂·4H₂O, 0.5 µM; ZnSO₄·7H₂O, 0.2 µM; CuSO₄·5H₂O, 0.02 µM; H₃BO₃, 4.6 µM; (NH₄)₆Mo₇O₂₄·4H₂O, 0.1 µM. The container was covered with 40 small pots and placed in a net house. Seven-day-old seedlings were treated with 150 mM NaCl. Fourteen agronomic and physiological parameters were measured. The results indicated that the effects of salinity on the agronomic and physiological traits were significant. Salinity stress significantly decreased K⁺ content and K⁺/Na⁺ ratio in the whole plant, while the leaf K⁺/Na⁺ ratio was the strongest determinant of salinity tolerance and had a significantly positive correlation with salt tolerance. We concluded that Na⁺ exclusion rather than K⁺ retention contributed to an optimal leaf K⁺/Na⁺ ratio. Furthermore, the present exploration revealed that, under salt stress, tolerant accessions had higher shoot water content,

shoot dry weight. Taken together, the leaf K⁺/Na⁺ ratio can be used as reliable screening indices for salt tolerance in wheat at the seedling stage.

Phytochemicals accumulation in potato cultivar at variable harvesting date

I.M. Ahmed, F. Ahmed, N. Mokarroma, A.H.M.M R. Talukder, S.N. Mahfuza, A.F.M.S. Ahsan, B. Ahmed, M.N. Islam

Potato (*Solanum tuberosum* L.) synthesizes a variety of bioactive metabolites including phenolic compounds and glycoalkaloids. Glycoalkaloids (α -solanine and α -chaconine) are naturally occurring toxic compounds in potato tuber that cause acute intoxication in humans after their consumption. Phenolics provide valuable health promoting antioxidants, whereas glycoalkaloid concentrations exceeding the upper safety limit of 20 mg 100g⁻¹ fresh weight (Fwt) are potential neurotoxins. Therefore, efficient selection for tuber nutritional quality is dependent upon safe and reliable analytical methods. The aim of this study was to determine the changes in the concentration of glycoalkaloids and phenolic compounds during different growth stages in tubers of three selected early potato varieties. The selected potato varieties were grown under field conditions in rabi season (Nov-Feb) of 2020-21 at Plant Physiology Division, BARI, Joydebpur, Gazipur. The experiment was laid out in randomized complete block design with three replications. The treatments included three potato varieties viz, BARI Alu 13, BARI Alu 29 and BARI Alu 41 with four harvesting time i.e 55 DAP (days after planting), 65 DAP, 75 DAP and 90 DAP (at harvest). The unit plot size was 4m × 3m. Whole tubers were planted with a spacing of 60 cm × 25 cm on 23 November 2020. Well decomposed cowdung was applied @ 10 t ha⁻¹ before land preparation. Fertilizers were applied @ 150-45-125-20 kgha⁻¹ N, P, K, S in the form of urea, triple super phosphate (TSP), muriate of potash (MOP) and gypsum, respectively. Full amount of TSP, MoP, gypsum and 50% of urea were applied as basal during planting and the remaining amount of area was side dressed at 35 days after planting. Total glycoalkaloids (TGA) and phenolics were determined by UV spectrophotometry. Tuber TGA content ranged from 7.47 to 9.23 mg 100g⁻¹ Fw in vars. BARI

Alu-41 and BARI Alu-13, respectively, and were within the upper safety limit. Total phenolic concentration in the examined tuber extracts varied from 94.98 to 194.98 mg g⁻¹. Fwt. Glycoalkaloid and phenolic production were significantly reduced from time of initiation to maturity at 55 and 90 days, respectively, after planting (DAP). These results demonstrate that tuber phytochemicals were strongly influenced by variety and level of maturity. For nutritional safety and quality purposes, harvesting of mature potato tubers after 90 DAP is recommended.

Morpho-physiological responses of soybean varieties to salinity stress

S.N. Mahfuza, A.F.M.S. Ahsan, I. M. Ahmed, B. Ahmed, A.H.M. Rahman Talukder, F. Ahmed

Glycine max (L.) Merr. has a tremendous value in agriculture as a good source of high quality plant protein and vegetable oils in one hand and nitrogen fixing ability on the other, now a day largely growing in coastal salt marshes areas of Bangladesh. The aim of this study was to determine morphological and physiological responses of soybean varieties (Shohag, BARI soybean 6, BARI soybean 5 and BINA Soybean 4) when subjecting pot grown plants to different concentrations of salinity level i.e. control (0.3), 4, 8 and 12 dS m⁻¹ in vinyl house of Plant Physiology Division, BARI, Gazipur during rabi season of 2020-21. Salinity was imposed at 30 days after sowing (DAS) by adding NaCl solution. Salt solution was prepared by dissolving calculated amount of lab grade NaCl with pond water. Salt solution was applied with an increment of 4 dSm⁻¹ in every alternate day until desired salinity levels were attained. Salinity levels were maintained by monitoring and adding salt solution when require up to maturity. The experiment was laid out in randomized complete block design with 6 replications. Plastic pots (top dia: 25 cm, bottom dia: 18 cm and height 25 cm; 12 kg soil) was filled up with soil and cow dung (4:1). Seeds were sown in each pot on 29 November 2020. Fertilizers were applied @30-30-80-20-3-1 kg⁻¹ ha NPKSZnB (FGR, 2012) in the form of Urea, Triple super phosphate (TSP), Muriate of potash (MoP) Gypsum, Zinc sulphate and Boric acid respectively. Half of N and all other fertilizers were applied as basal and remaining N was applied

at 30 days after sowing (DAS). Irrespective of the variety, with the increase of salinity levels physiological parameters as well as seed yield were greatly affected. Salinity stress reduced total chlorophyll (Chl a+b) and total dry matter (TDM), which ultimately reduced seed yield irrespective of the genotypes. Sodium (Na⁺), calcium (Ca²⁺) and potassium (K⁺) ion content and the potassium sodium ratios (K⁺: Na⁺) in leaf tissue were significantly affected by salinity with significant variability in variety. Among the varieties, BARI soybean 6 showed higher K⁺: Na⁺ ratio in leaf, which indicates higher tolerance to salinity compared to others under every salinity levels. H₂O₂ and malondialdehyde (MDA) contents were comparatively lower in the respective variety. This variety also showed higher TDM production, pod plant⁻¹ and seed yield plant⁻¹ in all salinity levels compared to other varieties. Results revealed that, BARI soybean 6 showed relatively tolerant against salinity stress.

Morpho-physiological evaluation of selected tomato variety under drought condition

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Morpho-physiological evaluation of selected tomato variety under drought condition was done at the vinyl house of Plant Physiology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh during the December, 2020 to April 2021. Four selected tomato varieties (BARI Tomato17, BARI Tomato19, BARI Tomato20 and BARI Tomato21) were used in this experiment. Twenty-five days old seedlings were transplanted in each pot on 07 December 2020. The experiment was done in Randomized Complete Block design (RCBD) with six replications. The soil was air-dried and mixed daily until 8% water content was reached. Air-dried soil was sieved. Then plastic pots (10 L, 30 cm height) were filled with the mixture of air-dried soil and cow dung in 4:1 volume ratio. Fertilizer at the rate of 90-12-40-1-2-2-1 kg/ha NPKSMgZnB in the form of Urea, Triple super phosphate, Muriate of potash, Gypsum, Zinc sulphate and Boric acid were incorporated in the soil. Drought treatment was imposed during early flowering stage. This experiment included the following 4 treatments:

control, irrigation at 2 days interval, irrigation at 3 days interval and irrigation at 4 days interval, in which 2 L water was added to each pot and the plants were then subjected to drought stress to pre flowering stage by withholding watering and maintained up to maturity. Our results from the pot experiment showed that Biomass accumulation, Photosynthetic activity, Relative water content, malondialdehyde (MDA) content, Total chlorophyll content plant⁻¹ and yield contributing characters as indices of drought stress tolerance, it is clear that BARI Tomato 21 is more tolerant to drought stress, than BARI Tomato 17, BARI Tomato 19 and BARI Tomato 20.

Physiological mechanism of salinity tolerance in selected tomato lines

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An experiment with some selected newly developed tomato entries was conducted at the hydroponic site of Plant Physiology Division, BARI, Gazipur during 2020-2021 rabi season to find out the suitable salt tolerant entries. Eight selected tomato entries like 3 Parents (P1, P4 and P5), 4 Hybrids (P1×P2, P1×P5, P2×P5, P3×P4) and BARI Hybrid Tomato-10 (check) were evaluated to determine their tolerance levels against two salinity levels (0 and 15 dS/m) in the hydroponic culture during rabi season of 2020-21. Healthy and equal-sized seeds of each genotypes were selected and then surface sterilized with 70% ethanol solution for 3 minutes, followed by washing several times with sterile distilled water. The seeds were sown in cell trays (35cm×35cm×5.5cm; 36 cells/tray with drainage holes) with a potting mixture (2/3 parts of coconut peel, 1/6 unfilled rice seed and 1/6 vermicompost) and were kept in a growth shade with a moist cover. Seedling emergence took between seven days. After emergence, seedlings were thinned to five seedling in each cell of the tray, by choosing seedlings with even size and healthy appearance. After two week-old-seedlings (second-true leaf) were transplanted into cork sheet floating on ½ strength modified Hoagland solution culture in 160L wood container covered with 10 mm polythene for leaching loss. The nutrient solution pH was maintained at 6 ± 0.5 and buffered with 1 N sodium hydroxide (NaOH) and hydrochloric acid

(HCl). The containers were covered by cork sheet to avoid the effect of light on the roots and on nutrient solution. The roots were suspended in the nutrient solution, and the stem was wrapped with sponge plugs to hold the plants firmly in the cork sheet. Continuous aeration was maintained in the nursery through an aquarium bubble stone by a diaphragm pump (RESUN LP60 50W Flow rate 140L/min). Thirty days old homogenous seedlings (homogenous) were transplanted in three other hydroponic containers, containing ½ strength modified Hoagland solution. Salinity was initiated at the late vegetative stage and maintained up to the maturity stage. The results showed that the plants exposed to salt stress presented a significant decline in yield and yield contributing characters except for root parameters, but the reduction rate was significantly lower in P3×P4 which was identical with P2×P5 hybrid. Salinity stress significantly reduced the Chlorophyll content, relative water content (RWC), cell membrane stability index (CMSI), and K⁺ ion uptake in leaf tissues with the least reduction in P3×P4 and P2×P5 hybrids. Moreover, P3×P4 and P2×P5 hybrids showed lower accumulation of malondialdehyde (MDA), and Na⁺ ion in comparison with other tomato entries at salinity stress. These results suggested that P3×P4 and P2×P5 hybrids can be regarded as suitable materials for developing saline tolerant hybrid tomato varieties.

Biochemical and anatomical responses of waterlogging tolerance in sesame at vegetative stage

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Sesame is a highly susceptible to waterlogging stress which results in the reduced growth and yield along with oxidative stress. A pot experiment was conducted with three selected sesame genotypes (G3 and G7 relatively tolerant and G1 sensitive genotype to waterlogging stress) under three duration of waterlogging stress (0, 72 and 120 hours) to evaluate the biochemical and anatomical responses during the period of October to December, 2020 at the vinyl house of plant physiology division, BARI, Gazipur. Plastic pots (top dia: 40 cm, bottom dia: 30 cm and height 10 cm; 0.9 kg soil) were filled up with well mixed

sandy loam soil and de-compost cowdung (4:1). Fertilizers were applied 100-30-55-25-3-1 kg ha⁻¹ N-P-K-S-Zn-B. All fertilizers were applied as basal at sowing. Irrigation was done as and when required for maintaining adequate soil moisture. Fifteen seeds were sown in each pot on 15 October 2020. After emergence excess plants were thinned out and two plants pot⁻¹ were maintained. Thereafter, pots were divided into three groups. One group culture with natural condition up to 34 DAE as the control and the other groups were followed by waterlogging treatments. Waterlogging treatment was imposed at 28 DAE at the pots in a big plastic drum. Duration of waterlogging was 72 and 120 hours and water level was maintained about 3 cm above the soil surface of the pots. After the treatment period, water was drained out from the water drum and pots was allowed to grow for 3 days at normal condition. The experiment was laid out in Randomized Complete Block Design with 5 replications and two pots were considered as one replication. Results showed that G7 and G3 genotypes had not only the superior capacity to improve from the waterlogging damage with lower MG and O₂⁻ accumulation, but also had higher activities of antioxidant than sensitive G1 genotypes. However, G7 genotype showed the leading capability in detoxification of MG by glyoxalase enzymes activities than others. Moreover, waterlogging tolerance might be closely related to an increased capacity of the ADH and PDC including lower activity of LHD. These results suggest that the main pathway of NAD⁺ regeneration in waterlogging tolerance of genotypes is not lactate fermentation but alcohol fermentation. On the basis of above results it might be concluded that the relative waterlogging tolerance of G7 and G3 sesame genotype appears to depend on a combination of metabolic and morpho-anatomical responses.

Morphophysiological and yield response of tomato as influenced by different plant growth regulators

B. Ahmed, A.H.M. M. Rahman Talukder, And M. N. Islam

A field experiment was carried out at Plant Physiology Research Field of Bangladesh Agricultural Research Institute, Gazipur-1701,

Bangladesh, to assess the effect of different plant growth regulators on tomato during winter season 2020-21. Different plant growth regulators available in market (PGR) viz., PGR1 = Flora @ 20 ppm, PGR 2= Protozim @ 20 ppm, PGR3 = Vagimax and PGR4 = Miraculan@ 20 ppm and PGR0 = Control (No PGR) were used in the study. The experiment was laid out in Randomized Complete Block Design with three replications. Twenty four days old seedlings were transplanted at spacing of 60cm × 40cm in the experimental plot on November 24, 2019. Manures and chemical fertilizers were applied at the rate of cow dung 20 t/ha, Urea 250 kg/ha, Triple Superphosphate (TSP) 200 kg ha and Murate of Phosphate (MOP) 150 kg ha. Later the stock solution was diluted in distilled water to prepare the working solutions just before application. Spraying was performed early in the morning to avoid rapid drying of the spray solution, due to transpiration. The growth and yield contributing characters were significantly differed due to different plant growth regulators. The maximum number of fruits plant (65) was recorded from PGR treatment (application of Flora @20 ppm) while the minimum number of fruits plant(25) was recorded from PGR treatment (no application of plant growth regulators. Plant growth regulators had significant influence on growth and yield of tomato and gave the highest yield PGR1 = Flora @ 20 ppm than other plant growth regulators. So, among the four plant growth regulators (PGR), application of Flora @20 ppm gave the best response for tomato production.

Screening of sunflower genotypes against waterlog

B. Ahmed, A.H.M. M. Rahman Talukder, M. N. Islam

Screening of waterlogging tolerance of sunflower genotype may relieve from yielding constraints caused by heavy or long-lasting rainfall. So, to identify the waterlogged tolerance sunflower genotype, a study was conducted at research field of Plant Physiology Division under BARI, during rabi 2020-2021. Twenty one sunflower genotypes from Plant Genetic Resources Centre (PGRC) were evaluated under three waterlogged conditions viz. control (no waterlogged), 12h waterlogged, 24h waterlogged. The experiment was carried out in

RCB design with ten replications and single plant was considered a replication. The experimental plots were fertilized @ 92-40-7530-4-1 Kg/ha N-P-K-S-Zn-B in the form of urea, triple super phosphate, Muriate of potash, Zypsum and Zinc sulphate respectively. Half of Nitrogen and all of the fertilizers were applied at the time of final land preparation. Rest half of nitrogen was applied in two equal splits at 20-25 and 40-45 days after sowing (DAS). Morphological, yield and yield supporting parameters were reduced for all genotypes under waterlogged condition over control. Plant height of genotypes was notably reduced under 24h waterlogged over 12h. Genotypes BD-9363, BD-9361, BD-9368, BD-9373, BD-9401, BD-9850 were showed comparatively lower yield reductions under 24h waterlogged over control as well as yield supporting parameters.

Evaluation of selected grass pea genotypes against salinity stress

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The experiment was conducted in on-station of Agricultural Research Station (ARS), Benarpota, Satkhira during rabi season, 2020-2021. The objective of the study was to evaluate the salt tolerance of grass pea genotype(s) for expansion in saline area of Satkhira. Four genotypes viz. BD-4774, BD-5880, BD-4885, BD-5721 along with BARI Khesari-4 were taken as check variety in this experiment. The unit plot size was 3mx2m. The land was prepared by 2-3 ploughing to gain good tilth condition and fertilized with 16-12-23-8-2 kg/ha of N-P-K-S-B in the form of urea, TSP, MoP, gypsum and boric acid. All fertilizers were applied during final land preparation. Seeds were sown on 08 December, 2020 in joe condition. Before sowing seeds were treated with Provax-200 WP at the rate of 2.5 g/kg of seed and seeds sown continuously in line maintaining 40 cm row to row spacing. The highest seed yield was obtained from BD-4774 (1400 kg/ha) while BD-5880 gave the lowest yield (1102 kg/ha). During crop growing period soil salinity ranged from 2.20 to 7.37 dS/m.

Physiological response of garlic varieties to salinity stress

A.H.M. Motiur Rahman Talukder, M.N. Islam, F. Ahmed, I. M. Ahmed, N. Mokarroma

An aggravated salt concentration in soil restricts to intensify the crop productivity. So, the purpose of this study was to examine the genetic potentiality of *Allium sativum* varieties exposed to different salt stress level regarding physiological responses. In a salinity tolerance test, five contrasting *Allium sativum* variety viz. BARI Rashun-1, BARI Rashun-2, BARI Rashun-3, BARI Rashun-4 and Natore local were compared subjecting four level of NaCl viz. 0, 4, 8 and 12 dS m⁻¹ under pot culture system. This research was carried out in a Randomized Complete Block (RCB) design with six replications and a single pot was counted as one replication. Seven cloves of same varieties were planted in pots of 30 cm top breadth, 25 cm base breadth and 30 cm in height filled with soil and well decomposed farm yard manure at 4:1 volume ratio with a small five perforation system at the pots base for facilitating drainage in pots on 26 November, 2020. Each pot contained approximately 12 kg soil. Pots soil were nourished by fertilizer @ 114-48-90-30-3.0-3.0 kg ha⁻¹ of nitrogen, phosphorous, potassium, sulphur, zinc, boron in the form of urea, triple super phosphate, muriate of potash, sulphur and zinc sulphate and Boron respectively (Ahmed et al., 2018) at the time of planting. Urea and muriate of potash was also top dressed at the mentioned rate in to two equal installments during 25 & 60 days after planting (DAP).

Successively induced salt obviously depressed in total dry matter (TDM) (g) plant⁻¹, bulb yield and yield supporting parameters of all varieties. Meanwhile, across different salinity levels, varieties showed the non-linear patterns for the synthesis of biochemical and physiological activities like peroxidase (POD), catalase (CAT), Ascorbate peroxidase (APX); Proline, lipid peroxidation (MDA) activities, relative water content (RWC), photosynthetic pigment accumulation, K⁺, Na⁺ concentrations. Total dry matter (TDM) production, yield and yield supporting parameters were less degraded in BARI Rashun-4 and BARI Rashun-3 at 12 dSm⁻¹ salinity

and had a stronger ability to continue constant osmotic potential maintaining the peak K^+/Na^+ ratio, which indicates the tolerance to salinity. The variety BARI Rashun-1 & BARI Rashun-4 showed the less degradation rate of chlorophyll pigments at 12 dSm⁻¹ salinity than other varieties. The variety BARI Rashun-4 showed the higher activity of CAT, POD, APX, proline, RWC and less membrane damage in the apex (12 dSm⁻¹) salinity level which indicated the best Reactive Oxygen Species (ROS) defensive. Due to strong ROS defensive mechanism, ion homeostasis and less degradation of yield and yield components, BARI Rashun-3 and BARI Rashun-4 were considered as a relatively saline tolerant.

Growth reproductive efficiency and yield of mungbean as influenced by sink manipulation

A.H.M. Motiur Rahman Talukder, F. Ahmed, I.M. Ahmed

Pot experiment was conducted at the pot yard of Plant Physiology Division, BARI, Gazipur during Kharif I season, 2021 to observe sink manipulation impacts on growth reproductive efficiency and yield of Mungbean. This study was laid out in randomized complete block design (RCBD) with ten replications and each pot was considered as one replications. The Mungbean variety BARI Mug-8 was used as a tested variety and collected from Pulse research sub-station, BARI, Gazipur. The five levels of deflowering treatments were employed viz. i) Deflowering at 40 days after sowing (DAS), ii) Deflowering at 45 DAS, iii) Deflowering at 50 DAS; iv) Deflowering at 55 DAS; v) Control (no deflowering). However, in order to execute the treatment more conveniently, a total of 50 pots (26 cm top diameter, 20 cm base diameter, and 25 cm height) were organized in the pot house, with 10 pots placed in five replicate blocks. Soil and fully decomposed farm yard manure were appropriately blended in a 4:1 volume ratio and sieved through a 2 mm sieve. The sieved soil samples were weighed and placed in pots, each holding around 12 kg of soil. Fertilizers @ 18-18-24-12-2.0-1.2 kg ha⁻¹ of N-P-K-S-Zn-B were applied in the form of urea, triple super phosphate, muriate of potash, zypsum, zinc sulphate and Boron respectively (Ahmed *et al.*, 2018). Each pot received double rate of 1.5-2-1.44-1.08-1.0-1.0-1.25

g urea, triple super phosphate, muriate of potash, zypsum, zinc sulphate and Boron respectively as a basal dose with calculation of one hectare cultivated field contained 2×106 kg soil in root zone of crop. Results revealed that, with the termination of deflowering pod length, number of seeds pod⁻¹, seed weight of five pods, 100-seed weight were substantially reduced while number of pods plant⁻¹ were increased and there was a positive response on seed yield (g plant⁻¹). Deflowering at different reproductive phase after sowing resulted in a 10–41.9% reduction in seed yield compared with control plants and deflowering at 55 DAS decreased the minimum seed yield by 10% over control. From the economic point of view, 50 or 55 days onsets flower following sowing could be considered for obtaining the mungbean yield with the sacrificing minimum seed yield.

Stolon development and tuber formation pattern of potato varieties at different planting dates

A.H.M Motiur Rahman Talukder, F. Ahmed, I. M. Ahmed

A field experiment was conducted in Plant Physiology Division research field of BARI during winter (rabi) season of 2020-2021 to study the effect of planting dates on stolon development and tuber formation of potato varieties. Three potato varieties viz. BARI Alu-25, BARI Alu-56 and BARI Alu-79 were planted in four different dates viz. 26 November, 06 December, 16 December and 26 December respectively. Split-plot design with three replications was followed in this study allocating the planting dates and varieties in sub-plots main and plots respectively. Importantly, nematicide Furadan 5G @ 20 kg ha⁻¹ was used in furrows before earthing up for the treatment of root-knot disease of *Solanum tuberosum*. Fertilizers were applied as per the general recommendation of FRG (2018). Accordingly, the soil was fertilized @ 150-45-125-20 kg ha⁻¹ N-P-K-S respectively in the form of urea, tripple super phosphate, muriate of potash and gypsum. The full amount of tripple superphosphate, muriate of potash, gypsum and half urea were applied as a basal during final land preparation and remaining urea was applied at 30 days after planting (DAP) and earthing-up as required was done to prevent expose of tubers to direct sun light and for promoting tuber bulking

and for comfort of harvesting. The growth period, morphological index and change in yield and their relationships with temperature was investigated for each planting dates. Results indicated that crop growth with different planting dates experienced different weather conditions, which lead to show variation in growth duration, yield and yield contributing characters. The growth duration was shortened by on an average 3 days for every 10-day delay in planting. Differences in tuber yield were found among the three planting dates, potato planted on 26 November gave the highest tuber yield. Planting dates significantly decreased the total dry matter production in potato varieties with greatest suppression under December 26 planting. On the basis of growth parameters and tuber yield, the variety BARI Alu-79 can be planted up to mid-December allowing it to withstand higher temperatures.

Effect of plant growth regulators on the performance of lady's finger

The field experiment on lady's finger was conducted at the Plant Physiology Field of HRC, BARI, Gazipur during the summer season of 2020 to study the effect of plant growth regulators on growth and yield of the crop. The experiment was laid out in randomized complete block design in three replications. The experiment consisted of seven PGR treatments viz., two NAA concentrations (100 and 200 ppm), two GA₃ concentrations (100 and 200 ppm), two CCC concentrations (200 and 400 ppm) and tap water as control, and two okra varieties viz, 'BARI Dheros-2' and 'OK-1820'. Seeds of two okra varieties were dibbled at the rate of 2 seeds/ hill on 26 April 2021 maintaining 50 x 50 cm plant spacing. Prior to planting, seeds were soaked in tap water for 24 hours for uniform and better germination. After completion of the germination thinning was done leaving one healthy seedling in each hole. The harvesting of green fruits was done every alternate day.

All growth regulators performed well in respect of all characters studied over control. Among all foliar agents, the response of GA₃ was found better. The results revealed that plant height at harvest, fruit length, individual fruit weight and number of green fruits/plant, were found maximum from GA₃ 200

ppm followed by NAA 100 ppm and CCC 400 ppm. Maximum green fruit yield/plant was obtained from the application of GA₃ 200 ppm (717.5 g in 'BARI Dheros-2' and 746.2 g in 'OK-1820') followed by NAA 100 ppm (716.7 g in 'BARI Dheros-2' and 709.10 g in 'OK-1820'). The result indicated that the highest green fruit yield per hectare (21.62 t in 'BARI Dheros-2' and 22.51 g in 'OK-1820') was recorded with the application of GA₃ 200 ppm. It might be concluded that application of GA₃ @ 200 ppm in 3 equal sprays at 4 weeks after sowing, first flowering and 3 weeks after first flowering would be optimum for maximum yield of lady's finger.

Effect of gibberellic acid on growth, flowering and yield of lady's finger genotypes during off-season

The field experiment was conducted at the Plant Physiology Field of HRC, BARI, Gazipur during the period from October 2020 to February 2021 to study the effect of GA₃ on growth and yield of off-season lady's finger. The experiment was laid out in randomized in complete block design with three replications. The experiment consisted of four GA₃ concentrations viz., 0.0, 100, 200 and 300 ppm, and three okra varieties viz, 'BARI Dheros-2', 'OK-1820' and 'Ananda 777'. Seeds of three okra varieties were dibbled at the rate of 2 seeds/ hill on 27 October 2020 maintaining 50 x 50 cm plant spacing. Prior to planting, seeds were soaked in tap water for 24 hours for uniform and better germination. After completion of the germination thinning was done leaving one healthy seedling in each hole. The harvesting of green fruit was done every alternate day. The control plants were sprayed with tap water, whereas aqueous solutions of GA₃ were sprayed thrice on the plants i.e. 21, 30, 45 and 75 days after sowing. Trix was added in the solutions as surfactant for uniform spread of chemicals and moisture on leaves.

All growth regulators performed well in respect of all characters studied over control. The experiment was laid out in 3x4 factorial randomized complete block design with three replications. The variety 'OK-1820' and GA₃ @ 200 ppm independently produced maximum plant height at last harvest, fruit length, number of fruits/plant, weight of fruits/plant, % fruit set and green fruit yield/ha. The

variety 'Ok-1820' and GA₃ @ 200 ppm in combination also gave the highest plant height at last harvest, fruit length, weight of fruits/plant, plant dry weight and green fruit yield/ha. It might be concluded that application of GA₃ @ 200 ppm would be optimum for maximum fruit production of lady's finger genotypes, namely 'BARI Dheros-2' and '-1820' during off-season.

Effect of drought stress on growth and yield of BARI released tomato varieties under field condition

The experiment was conducted at the Plant Physiology field of HRC, BARI during November 2020 to March 2021 to study the responses of BARI released tomato varieties to drought stress. Tomato plants of eight varieties, namely BARI Tomato-2, BARI Tomato-14, BARI Tomato-16, BARI Tomato-17, BARI Tomato-18, BARI Tomato-19, BARI Tomato-20, BARI Tomato-21 were grown under two different conditions of water availability i.e. controlled and drought. The moisture percent of soil was monitored upto experimentation by Soil Moisture Meter (Model:PMS-714, Taiwan). The field capacity of soil was 29.5%. The study was evaluated under Randomized Complete Block Design (RCBD) with four replications. The unit plot area 2 m x 2m and plant spacing was 50 cm X 50 cm. Twenty-eight day-old seedling was transplanted in the field on 28 November 2020.

The parameters studied were plant height, (SPAD value, relative water content (RWC) (%), number of fruits/plant, individual fruit weight, fruit set% and yield/plant. All the parameters are negatively affected by drought due to less water availability. In respect of the parameters RWC and fruit yield/plant/ha, it might be concluded that BARI Tomato-18 and BARI Tomato-20 performed better at drought condition.

Evaluation of hyacinth bean varieties for drought tolerance through yield-based selection indices

Identification of drought-tolerant crop genotypes is fundamental to enhance productivity and for effective breeding and conservation. A field trial with 9 hyacinth bean varieties viz., BARI Shim-1, BARI Shim-2, BARI Shim-3, BARI Shim-4, BARI

Shim-6, BARI Shim-7, BARI Shim-8, BARI Shim-9, and BARI Shim-10 was conducted at the Research field of Plant Physiology section, HRC, BARI to determine drought tolerance of a set of hyacinth bean varieties and to identify promising drought tolerant varieties for direct production or breeding. The study was carried out using a 9 × 2 factorial experiment involving 9 hyacinth bean varieties under drought-stressed (DS) and non-stressed (NS) conditions. Significant differences were observed among hyacinth bean varieties with respect to pod yield under drought stress (DS) and non-stress (NS) conditions. The mean fruit yield under DS and NS conditions was 2.45 and 3.33 kg/plant, respectively. Drought stress reduced fruit yield by 23.71% on average. The three varieties BARI SHIM-6, BARI Shim-4 and BARI Shim-10 were identified as drought tolerant varieties for drought tolerance breeding.

Screening of brinjal genotypes against salinity at germination and early seedling growth stage

The impact of three levels of sodium salt (NaCl) (0.0, 8.0 and 12.0 dS/m) on 11 eggplant varieties (BARI Begun-1, BARI Begun-4, BARI Begun-5, BARI Begun-6, BARI Begun-7, BARI Begun-8, BARI Begun-10, BARI Bt Begun-1, V BARI Bt Begun-2, BARI Bt Begun-3 and BARI Bt Begun-4) was studied at the laboratory of Plant Physiology Section, HRC, BARI. Among 11 varieties, BARI Begun-6, BARI Begun-8 and Bari Begun-10 failed to germinate. Growth and germination parameters of brinjal varieties were investigated under salt stress. The seeds were collected from Horticulture Research Centre, BARI. The NaCl concentrations were measured by EC Meter. Required number of petri dishes each with a diameter of 9 cm were used in the experiment and arranged in a completely randomized design (CRD) moistened with respective treatment in three replications. Three layers of Kitchen (commercial) tissue paper were used in each petri dish for retaining required amount of water for imbibition of seeds. Twenty five and equal sized seeds of each variety were selected and placed on sterilized petri dish lined with filter paper. The petri dishes with seeds of the selected varieties of brinjal were kept in normal room temperature (25-32°C) for germination. The seeds were sterilized by soaking in a 5% solution of

sodium hypochlorite for 5 min and placed on the petri dish lined with filter paper. Salt solution was prepared by dissolving calculated amount of commercially available NaCl with tap water. The respective NaCl solution was poured into the petri dish. The germination count was taken after 72 hours of placing seeds. The 5 ml of distilled water (control) and 5 ml solution of salinity were added separately to the petri dishes. The petri dishes were covered to prevent the loss of moisture by evaporation. Number of seeds germinated was counted daily and data recording were continued up to 14 days. Results of this study showed a considerable decrease in growth criteria (seedling length, root length, seedling fresh weight and dry weight with the increase in salinity levels. In conclusion, eggplant genotypes showed variation in their response to salt tolerance and the three varieties BARI Bt begun-2, BARI Begun-1 and BARI Bt Beugun-3 performed better at 8 dS/m salinity level compared to other varieties.

Screening of bottle gourd genotypes against salinity at germination and early seedling growth stages

The impact of three levels of sodium salt (NaCl) (0.0, 8.0 and 12.0 dS/m) was tested on 28 bottle gourd genotypes/varieties at the laboratory of Plant Physiology Section, HRC, BARI from 24 December 2020 to 06 January 2021. The genotypes consisted of five BARI released varieties and 23 bottle gourd lines. The experiment was studied to find out the salt tolerant bottle gourd genotypes at germination and early seedling growth stage. Growth and germination parameters of bottle gourd genotypes/varieties were The seeds were collected from HRC, BARI. Required number of petri dishes each with a diameter of 9 cm were used in the experiment and arranged in a completely randomized design (CRD) moistened with respective treatment in three replications. Three layers of commercial tissue paper were used in each petri dish for retaining required amount of water for imbibition of seeds. Five healthy and equal sized seeds of each variety/genotype were selected and placed on sterilized petri dish lined with tissue paper. The petri dishes with seeds of the selected varieties/genotypes of bottle gourd were kept in normal room temperature (19.5-25.5°C) for

germination. The seeds were sterilized by soaking in a 5% solution of sodium hypochlorite for 5 min and placed on the petri dish lined with filter paper. Salt solution was prepared by dissolving calculated amount of lab grade NaCl with distilled water. The respective NaCl solution was poured into the petri dish. The germination count was taken after 72 hours of placing seeds. Results of this study showed a considerable decrease in growth criteria (shoot length) but increase in root length the increase in salinity levels. Among 28 lines two lines/genotypes LS206 and LS216 performed better in terms of germination percentage, germination index, germination rate index, coefficient of velocity of germination, shoot length, root length and seedling vigour index. In conclusion, bottle gourd genotypes showed variation in their response to salt tolerance and the two genotypes LS206 and LS216 performed better at 8 dS/m salinity level compared to other genotypes.

Effect of seed priming agents on germination and early seedling growth of tomato (var. BARI tomato-17)

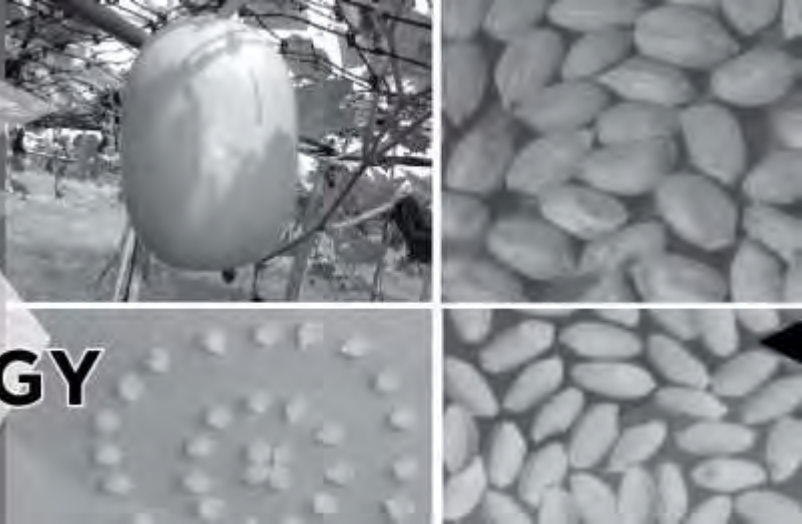
Seeds of tomato var. BARI Tomato-17 were primed with seven important priming agents viz. gibberellic acid (GA₃) (289.0 µM), distilled water, potassium chloride (KCl (134.0 mM), urea (167.0 mM), sodium chloride (NaCl (40.0 mM), diammonium phosphate (DAP) (70.0 mM), PEG-6000 (5%) with no priming as control. For each treatment seeds were soaked in priming chemicals for 24 hrs before putting for the germination test. Fifteen seeds in three replications were germinated on top of blotting paper in petri dish at 22±2°C in normal condition of laboratory for 14 days. Normally germinated seeds were counted which gave an estimation of germination percentage. Data was recorded on the Germination percentage, Germination Index, Germination Rate Index, Coefficient Velocity of Germination, shoot length, root length, seedling dry weight and seedling vigour index Most of the treatments had significant positive effect on all the quality parameters. PEG had showed adverse effect on the root length while other treatments were found to be significant role to improve the root length. Maximum seed germination (100%), Germination Index (133.0), Germination Rate Index (59.90), Coefficient

Velocity of Germination (57.80) was observed at 289.0 μM GA_3 and 40.0 mM NaCl. Highest shoot length (7.83 cm), root length (5.50 cm), seedling vigor index-I (31.1), seedling vigour index-II (1599.0) and seedling dry weight (120 mg) was found at 289.0 μM GA_3 . From this study it was suggested that GA_3 priming had important to enhance seed germination as well as seed vigour. Before sowing seed should be primed with GA_3 @ 289.0 μM for obtaining high % germination and vigorous seedling that survive under adverse condition.

Germination and growth of brinjal seedling as influenced by seed priming agents

The experiment was conducted in the laboratory of Plant Physiology Section of HRC, BARI during the period from 13 February 2021 to 26 February 2021 to investigate the effect of different priming agents on seed germination and seedling growth of brinjal. The experiment consisted of two brinjal varieties, namely BARI Begun-6 and BARI Begun-10 and

seven priming agents *viz.*, gibberellic acid (GA_3) (289 μM), distilled water, potassium chloride (KCl) (134 mM), urea (167 mM), sodium chloride (NaCl) (40 mM), diammonium phosphate (DAP) (70 mM), PEG-6000 (5%) with no priming as control. The experiment was laid out following CRD design where each treatment replicated three times. Germination percentage of seeds of two brinjal varieties treated with all priming agents was significantly higher over control. Seed germination, germination index, germination rate index and coefficient velocity of germination were enhanced significantly in both the varieties at 289 μM of GA_3 . Seedling growth (shoot length, root length and seedling dry weight) and seedling vigour index also increased at 289 μM of GA_3 . From this study it was suggested that GA_3 priming had important to enhance the seed germination as well as seedling vigour. Before sowing seed should be primed with GA_3 289 μM for obtaining maximum % germination and vigorous seedling that survive under adverse condition.



Effect of plant spacing and fertilizer dose on seed yield and quality of onion

Sarker, P. C., M. O. Kaisar, S. N. Mozumder, M. A. Hossain, R. Sen, and A. K. Choudhury

A field experiment was conducted at the research farm of Regional Agricultural Research Station (RARS), BARI, Cumilla, Bangladesh during 2020-2021 to identify a suitable plant spacing along with fertilizer dose for higher seed yield with better seed quality of onion. The experiment was carried out in a split-plot design where three plant spacing viz., 30 cm X 20 cm (S_1), 25 cm X 20 cm (S_2) and 20 cm X 20 cm (S_3) were assigned in main plots and four fertilizer doses viz., chemical fertilizer recommendation of FRG 2018 (F_1), IPNS based fertilizer (F_2), Soil test based fertilizer (F_3) and Farmer's practice (F_4) were assigned in sub-plots. Onion variety was BARI Pij-6. Plant spacing showed significant variation on number of plant population per square meter, number of seed per umbel, thousand seed weight, seed yield per plant and seed yield per hectare of onion. Fertilizer dose showed significant difference on number of umbel per plant, number of seed per umbel, seed yield per plant, and seed yield per hectare. But their interaction effect showed significant difference only on number of umbel per plant. Seed germination per cent, seedling length and seedling vigor index were found nonsignificant in case of individual as well as interaction effects. Though insignificant, plant spacing 20 cm X 20 cm along with IPNS based fertilizer dose may be suggested regarding highest seed yield (809 kg/ha), gross return (1213500 tk/ha) and gross margin (1091430 tk/ha) of onion (var. BARI Pij-6) for Cumilla region.

Effect of vermi-compost stimulated integrated nutrient management on seed yield and quality of onion

P. C. Sarker, M. S. Huda, M. R. Islam, M. S. Rahman, R. Sen and A. K. Choudhury

The study was undertaken at Agricultural Research Station, BARI, Dinajpur during October, 2020 to June, 2021 to find out a suitable vermicompost based integrated nutrient management system for quality seed production of onion. The experiment was laid out in a randomized complete block design with three replications. Six treatments viz. T_1 : Recommended dose of chemical fertilizer (FRG'2018), T_2 : T_1 + 1 Ton Vermicompost ha^{-1} , T_3 : T_1 + 2 t Vermicompost ha^{-1} , T_4 : T_1 + 3 Ton Vermicompost ha^{-1} , T_5 : T_1 + 4 Ton Vermicompost ha^{-1} , and T_6 : T_1 + 5 Ton Vermicompost ha^{-1} were tested. The results revealed that seed germination percentage and seedling vigor index were found insignificant. Vermicompost @ 4 ton/ha along with inorganic fertilizer (105-45-60-20-2-1.5 kg/ha of NPKSZnB, respectively) gave the highest seed yield (689 kg/ha) of onion (var. BARI Pij-4) which was 26.42% higher than sole inorganic fertilizer.

Effect of vermicompost leach on seed germination and seedling emergence of onion seeds against drought stress

P. C. Sarker, M. S. Rahman, I. M. Ahmed and A. K. Choudhury

A laboratory experiment was conducted at the Seed Technology Division, BARI, Gazipur, Bangladesh during 2020-2021 find out a suitable vermicompost treatment for better seed germination and seedling emergence under drought stress condition. The experiment was carried out in a 2-factorial

completely randomized design. The seeds of onion were imposed by five levels of priming viz., untreated control, 5% VCP, 10% VCP, 15% VCP, and hydropriming. After that two levels of drought viz., 10% PEG 6000 and 15% PEG 6000 were imposed on onion seeds. Onion variety was BARI Piaj-4. Seed priming with vermicompost leach had a positive impact enhancing seed germination and seedling emergence percentage under drought stress condition. Vermicompost leach @ 10% under 10% PEG drought stress condition showed better performance than any other treatment combination regarding seed germination (90%), seedling emergence percentage (81%), seedling vigor index (614), germination rate index (22.84), promptness index (123) and germination stress tolerance index (84.25%).

Effect of vermicompost leach on seed germination and seedling emergence of onion seeds against salt stress

P. C. Sarker, M. S. Rahman, R. Sen, I. M. Ahmed and A. K. Choudhury

A laboratory experiment was conducted at the Seed Technology Division, BARI, Gazipur, Bangladesh during 2020-2021 to find out a suitable vermicompost treatment for better seed germination and seedling emergence under salt stress condition. The experiment was carried out in a 2-factorial completely randomized design. Onion seeds (var. BARI Piaj-4) were imposed by five levels of priming viz., untreated control, 5% VCP, 10% VCP, 15% VCP, and hydropriming, and then salt stress was imposed @ 40 mM NaCl and 80 mM NaCl. Seed priming with vermicompost leach has a positive impact enhancing seed germination percentage, seedling emergence percentage, average seedling dry weight and seedling vigor index under salt stress condition. Seed priming with 10-15% vermicompost leach along with 40 mM NaCl showed better performance than any other treatment combination with respect to seed germination (84-86%), seedling emergence percentage (64-66%) and seedling vigor index (247-254). Therefore, these treatments showed better performance considering less reduction than any other treatment combination regarding seed germination percentage, seedling emergence

percentage, average seedling dry weight and seedling vigor index.

Growth and quality seed production of onion influence by plant growth regulator (GA₃)

S.A. Bagum and A. K. Choudhury

The experiment was carried out at the research field and laboratory of Seed Technology Division, BARI, Gazipur during *rabi* season of 2019-20 and 2020-21, to study the effect of different concentrations of application of GA₃ on growth, seed yield and quality seed production of onion and to find out the suitable GA₃ concentrations. The experiment was laid out in RCBD with four treatments combinations viz. T₁= Control (0.0 ppm GA₃), T₂= 100 ppm GA₃, T₃= 200 ppm GA₃, and T₄= 300 ppm GA₃. The bulbs were soaked in treatment wise concentrations of the GA₃ in tray for 48 hours then sowing directly in experimental filed plots. The earliness (10-12 days) of bolting and bolting period was found from treated onion bulbs with GA₃ at 300 ppm compared to the control. The maximum no. of leaves (37.5 and 38.0 during 2019-20 and 2020-21, respectively), no. of branch per plant (5.0 and 5.6 during 2019-20 and 2020-21, respectively), no. of umbel per plant (6.0 and 6.35 during 2019-20 and 2020-21, respectively), seed weight per umbel (1.90 g and 1.95g during 2019-20 and 2020-21, respectively) and yield (775.78 kg and 789 kg during 2019-20 and 2020-21, respectively) was obtained from onion bulbs soaked with 300 ppm concentrations of the GA₃ in tray for 48 hours before sowing in the field. So, it was concluded that onion bulb treated with 300 ppm GA₃ before 48 hours sowing for high quality seed production, growth and yield of onion seed of BARI Piaj-4.

Hybrid seed production of BARI hybrid Mistikumra-1

S.A. Bagum A. K. and Choudhury

The field experiment was carried out during 2020-21 *rabi* at Seed Technology Division, BARI, Gazipur-1701. to increase the quality hybrid seeds stock of BARI hybrid mistikumra-1 for demonstration and distribution. The seed of parental lines of BARI hybrid mistikumra-1 was obtained from the of Olericulture Division, Horticulture Research Center, BARI, Gazipur. The

seedlings were raised in controlled conditions and 30 days old seedlings were transplanted one seedling per hill at the spacing of 3.0 m x 1m. Planting ratio was 3:1 was applied i.e. 3 female and 1 male. During sowing time of male plant was sowed 10 days after females for synchronization of flowering. Finally, 3.0 kg quality hybrid mistikumra seed harvest and keep safe store for distribution.

Effect of fermentation duration on seed quality of Bt brinjal

A.N.Md. Anamul Karim, M. A. Hossain and A. K. Choudhury

The experiment was carried out at the laboratory of Seed Technology Division, BARI, Gazipur during 2021, to find out the proper fermentation duration on seed quality of Bt brinjal. The experiment was laid out in CRD with 10 treatment combination of five fermentation duration viz., F_1 =Control (0 hrs), F_2 = 8hrs, F_3 = 16hrs, F_4 =24 hrs and F_5 =48 hrs. and two Bt brinjal varieties i.e. V_1 = BARI Bt Begun-2 and V_2 = BARI Bt Begun-4. The results indicated that the 16 hrs. Fermentation duration of BARI Bt Begun-2 noticed significantly higher purity (93%), 1000 seeds weight (94.66 g), germination (94.66%), seedling length (13.70cm), seedling dry weight (1.73g) and seedling vigor index (165.0).

Effect of GA₃ on seed yield of garden pea

A.N.Md. Anamul Karim, M. A. Hossain and A. K. Choudhury

The experiment was carried out at the research field and laboratory of Seed Technology Division, BARI, Gazipur during 2020-2021 to find out the effect of appropriate concentration of GA₃ for better growth, seed yield and quality of garden pea. The plant growth regulator (GA₃) was applied as foliar application at 15, 30, 45 DAS. Looking to the result, it was noticed that the GA₃ (200 ppm) application as foliar spray gave significantly yield attributes and seed quality of BARI Motorshuti-3 such as plant height (51.62 cm), numbers of pods/plant (17.26), numbers of seeds/pod (17.26), 1000 seed weight (254.46 g), germination percent 97.04 (%), seedling dry weight (0.084g), vigor index (2.52) and protein content (26.26%). Therefore it may be concluded that foliar application of GA₃ at 200 ppm can be

recommended to BARI Motorshuti-3 for obtaining better yield attributes and seed quality.

Effect of GA₃ and time of application on seed yield and quality of soybean

M. A. Hossain, P.C Sarkar, S.A. Begum, A.N.M Karim, M. Islam, M. S. Rahman and A.K. Choudhury

The experiment was carried out at the research field and laboratory of Seed Technology Division, BARI, Gazipur during rabi season of 2020-21 to study the effect of plant growth regulator (GA₃) on seed yield and quality of Soybean at different stages of application. The factorial experiment was laid out in RCBD with 12 treatment combination of four different plant growth regulators viz., H_0 = Control (water), H_1 = GA₃ (50 ppm), H_2 = GA₃ (100 ppm), H_3 = GA₃ (150 ppm) and three different time of application i.e. S_1 = Vegetative stage, S_2 = Flower initiation stage, S_3 = Pod formation stage. Soybean variety was BARI Soybean-6. The results indicated that the application of growth regulators GA₃ 100 ppm (H_2) noticed significantly higher plant height (78.64 cm), number of seeds per pod (2.77) and seed yield (2.54 t/ha). Better seed quality parameter such as 100- seed weight (15.826 g), germination percentage (89.33 %) and vigor index (10884) were also noticed from GA₃ 100 ppm (H_2). Among the different time of application, pod formation stage (S_3) recorded significantly higher number of pods per plant (116.28) along with seed quality parameters viz., 100- seed weight (15.986 g), germination (88.00 %), and seedling vigor index (10883). So the treatment combination of GA₃ 100 ppm at pod formation stage (H_2S_3) was found suitable for seed yield and quality of Soybean crop.

Removal effect of lateral vines on seed yield and quality of bottle gourd

M. A. Hossain, P.C. Sarkar, S.A. Begum, A.N.M. Karim, M. Islam, M. S. Rahman and A. K. Choudhury

The experiment was carried out at the research field and laboratory of Seed Technology Division, BARI, Gazipur during rabi season of 2020-21 to investigate the removal of lateral vines for quality seed production of bottle gourd. The seed yield and quality parameters like length of fruits (cm), diameter of fruits (cm), individual fruit weight (kg),

seed yield (t/ha), 100 seed weight (gm), germination percentage, seedling dry weight and vigor index were influenced significantly due to removal effect of lateral vines on seed yield and quality of Bottle gourd. In Bottle gourd, the maximum length of fruits (58.43 cm), diameter of fruits (49.80 cm), Individual fruit weight (7.027 kg), and seed yield (1.210 t/ha) were observed in the treatment (T₄) removal of lateral vines up to 1.5 m. Among the treatments, (T₄) removal of lateral vines up to 1.5 m showed significantly better seed quality parameters such as 100 seed weight (27.11 g), germination percentage (96.00 %), seedling vigor index (11043) and seedling dry weight (113.93 mg).

Effect of pre-sowing invigoration seed treatment with micronutrients on mother bulb yield of onion

M.S. Rahman, S. Biswas, P.C. Sarker, M. A. Hossain and A. K. Choudhury

The quality of the onion seed is an important factor in their growth and development and yield under field conditions. Therefore, the methods for improving their vigor through priming especially with micronutrients enhancing germination to increase yield. The objective of the present study was to examine the effect of seed priming with different concentrations (0, 0.5, 1.0, 1.5, and 2.0%) of micronutrients (Zn, and B) on the growth and yield characteristics of mother bulb of onion. It was found that seeds primed with 1.0, 1.5, and 2.0% Zn significantly increased germination. Their priming with 2.0% Zn resulted in the highest bulb diameter with lowest bulb neck diameter and TSS. The highest total bulb yield was obtained under the priming with 0.5% Boron but the highest mother bulb yield was obtained from priming with 2.0% Zn. It is recommended to prime onion seed with 2.0% Zn as pre-sowing invigoration nutrimpriming for better emergence (15% better over untreated) and mother bulb yield (17% higher over untreated) with higher storability.

Improving field emergence performance of soybean by sand matrix priming

M. S. Rahman, U. Kulsum, A. Hossain, M. Islam, A. K. Choudhury

A priming method called sand priming was developed using sand as a priming solid matrix. The effect of sand priming on improving the field emergence performance of soybean was investigated. The ratio of water volume: seed volume: sand volume was 1:2:2. Seeds were uniformly embedded in the wet sand and incubated at 25°C for 24h, 48h, 72h, and 96h in darkness. Sand matrix priming for 24h improves the emergence and yield of soybean. The relative possibility of emergence and yield was increased by 123% and 112%, respectively.

Seed quality of bottle gourd as affected by fruit size and seed position

M. Islam, M. A. Hossain and A.K. Choudhury

An experiment was conducted in the experimental field and laboratory of seed technology division, BARI, Gazipur during rabi season 2020-21 to find out the effect of fruit size and seed position on seed quality of bottle gourd. Seeds were collected from three parts viz proximal, middle and distal portion of large, medium and small size fruit. Maximum number of seeds/fruit (394) were collected from distal portion of large size fruit that showed higher seed yield (107.15g), superiority in germination (100%) and higher germination speed.

Impact of foliar boron sprays on seed yield and seed quality of capsicum

M. Islam, M. S. Rahman and A.K. Choudhury

An experiment was conducted under pot culture and laboratory of Seed Technology Division, BARI, Gazipur during rabi season 2020-21 to find out the effect of foliar application of Boron on plant growth, seed yield and quality of capsicum. The doses of Boron were 0ppm (control), 150ppm, 200ppm, 250ppm, 300ppm and 350ppm. Boron was applied as Boric acid (17.5% B) according to treatments spraying at pre-flowering and flowering stage in capsicum plant. Maximum number of fruits per plant (4.50), fresh weight of fruit (80.25g), seeds per fruit (161), number of seeds per plant (727.25), % germination (78.25%), root length (2.75cm) of seedling, shoot length (2.94cm) of seedling, vigor index(1.833) were found when plants were supposed to foliar spraying of Boron @250ppm. The tallest plant was found from 150ppm spray. Seed quality parameters was found

in the treatment of 200 ppm Boron in case of root length, shoot length and seedling length and vigor index of seedling. Maximum fruit length (7.70cm) with average fresh weight of fruit (75.25g) was obtained from 350ppm spray of Boron in capsicum.

Assessment of seed quality of groundnut through accelerated aging method

S.A. Bagum and A. K. Choudhury

Seedling growth depends on consequence of seed deterioration. An experiment was conducted to evaluate the effects of duration of seed aging on groundnut seeds quality characteristics on groundnut varieties. Experiment conducted as completely randomized design with 3 replications. Seeds were subjected to accelerated aging treatment for, 24, 48 72 and 96 hours at $45 \pm 1^\circ\text{C}$ and 100% relative humidity. These artificially aged seeds were compared to control (Unaged seeds) for evaluation of seed quality parameters. The percentage of groundnut seeds that germinated was significantly affected by accelerated aging of up to four days. Accelerated aging reduced seedling length, seed vigor index, germination speed index, and shoot, root fresh and dry weight, in addition to lowering germination percentage. BARI badam-10 showed high quality seed and long-time storability in storage. Finally, the findings demonstrated that rapid aging reduced the viability of groundnut seeds.

Influence of chemicals and crude plant materials as pre-storage treatment on seed quality of onion

M. S. Rahman, I. Ahmed, M. M. H. Tipu and A. K. Choudhury

Fresh onion seeds dried to 7.0% seed moisture content were stored with crude plant materials (red chili powder@10g/kg of seed; neem leaf powder@20g/kg of seed, lemon leaf powder @20g/kg seed), and chemicals (common bleaching powder and mancozeb @2g/kg of seed). The germination potential of onion seeds was found satisfactory in treated seeds. Water uptake during imbibition was maximum in lemon leaf treated seed which indicates better germination as the imbibition of water is an essential part of germination. A high correlation between EC measurements and germination was found; which

indicates that conductivity readings have the potential to provide a rapid assessment of standard laboratory germination. In terms of seed-associated pathogens during storage, chemicals have shown better results in suppressing pathogens.

Effect of different packaging materials and storage condition on quality of sesame seed during storage

M. Islam, M. S. Rahman, M. A. Hossain and A.K. Choudhury

An experiment was conducted in the laboratory of Seed Technology Division, BARI, Gazipur during October 2020 to June 2021 find out the effect of packaging materials and storage condition on seed quality of sesame. The packaging materials were polyethylene bag of 0.06mm thickness, polyethylene bag of 0.03mm thickness, plastic container and earthen pot. Seed were stored for a period of 8 months in two types of storage environments : dry cold room ($15-18^\circ\text{C}$ and 55% RH) and ambient condition. Seed stored in plastic container showed maximum germination (78.667%), germination speed (16.569), seedling vigor index I and seedling vigor index II (532.58) either kept in ambient storage or cold storage. Maximum mean seedling length (7.256cm) was found in 0.03mm thick polythene bag and similar result was found in case of 0.06 mm thick polythene bag and plastic pot. Earthen pot showed maximum electrical conductivity and seedling dry weight. Initial germination%, germination speed, seedling length, seedling vigor index I and seedling vigor index II

Of indigenous storage practices of pulse seed

M. S. Rahman, M. Sh. Rahman, P. C. Sarker and A. K. Choudhury

The present study was undertaken for documentation of indigenous storage system practices of pulse seed of bangladesh. The data were collected from 180 farmers of Madaripur, Faridpur, Jashore, Pabna, Barishal and Patuakhali district. Purposive sampling technique was used to select the pulse crop producers. production of pulse crop has steadily increased due to advances in technology, but post-harvest loss is constant at 10%. Losses during storage, accounts for around 6% of the total losses. Storage plays an important

role in preventing losses which are caused mainly by insect pests, pathogens and rodents. Even though chemical control of stored product pest is predominant, traditional pest control practices are still continued especially in rural areas. It is estimated that 60-70% of pulse produced in Bangladesh is stored at household level in indigenous storage structures. Hence, a study was

undertaken to collect and document traditional storage practices of pulse crop followed by the farmers of mentioned district. Data were collected from various farmers by personnel contact. Six storage system and ten seed treating materials were followed by the respondents. Of them 52% farmers prefer plastic drum for seed storage and 52% farmers prefers neem leaf for seed treatment.

VERTEBRATE PEST



Evaluation of some plant oils as repellent against rodents

A T M Hasanuzzaman and M S Alam

Three plant oil viz. eucalyptus, neem and karanj were evaluated as rodent repellent. Three outdoor rodent enclosures, were considered as three observations were used for each plan oil. A twig of cotton was put in a metallic food cup that was placed at one corner of enclosure. One drop of plant oil was provided on the cotton twig which was considered as repellent odor source. Four more food cups were placed at 1 cm, 50 cm, 1 m and 6 m distances from the odor source. All plant oils showed the similar repellence against rat feeding where those can repel rat up to 3 days from their food. Rat consumed significantly lower amount of food from within 1m distance (0-2.63 g/rat/day) of oil source compared to 6 m distance (5.76-12.09 g/rat/day). At up to 1m distance of eucalyptus oil source, rat consumed 1.26-2.25 g food per day where as it was 1.32-1.58 g for neem oil and 1.47-2.63g for karanja oil.

Modification and evaluation of indigenous trap for controlling field rat

A T M Hasanuzzaman and M S Alam

Two types of test viz. enclosure test and field test was conducted for this experiment. In enclosure test, five rats were released into the enclosure. Five newly designed snap traps and five local kill traps and five live trap were set inside the enclosure. Bread was used as bait material for all types of traps. Traps were randomly set inside the enclosure. All the traps were set in every evening and the data were recorded in the following morning. This test was conducted up to 5 days. Percent trap success for different traps were calculated. In Field test, one trap was set near the active burrow openings of each burrow system. Bread was used as bait

material for all types of trap. Traps were randomly set near the burrow opening. All the traps were set in every evening and the data were recorded in the following morning. This test was conducted up to 5 days. Per cent trap success for different traps were calculated.

The efficacy of newly designed snap trap and commonly used live and snap trap were statistically similar in both enclosure and field-test. In enclosure test, the average success of newly designed snap trap and commonly used live trap was 40.00% whereas commonly used kill trap showed only 24.00% success. In field, the average success of newly designed snap trap and live trap was 44.09% and 43.90% respectively whereas commonly used kill trap showed 37.71% success.

Evaluation of some wrapping materials for poison baiting inside the burrow

A T M Hasanuzzaman and M S Alam

Four wrapping materials viz. wax paper, parafilm, tree leaf (banana leaf) and paper were used for poison baiting inside the burrow where paper was used as a control treatment. Twenty-five to thirty wet burrows that placed in the drain side were used for each treatment. Before applying treatments all the active burrows were identified properly. The burrows with rats inside and having fresh soil at the opening including some symptoms of new activities were identified and marked as the "active burrows". Only active burrows were used for applying the treatments. The pre and post-treatments rodent population index was taken by using tracking tiles. Highest success was observed with paper (61.33%) wrapped poison baiting which was statistically similar with wax paper wrapping (48%). Lowest success was found in case of banana leaf (31.33%) that was similar with parafilm (35.67%) and wax paper.

Comparative efficacy of different traps (live, kill and gopher) for controlling rodents

M S Alam and A T M Hasanuzzaman

Three types of traps such as live trap, kill trap, and Gopher trap were used at different tomato and potatoes fields for comparative efficacy. The experiment was conducted in potato and tomato fields for seven trap nights. In each wheat field 5 live traps, 5 kill traps, and 5 Gopher traps were set. Each active burrow was treated with one trap per night. Therefore, total 180 trap nights were used for this study. So, each type of trap was used for 60 trap nights. Live traps and kill traps were set near the burrow opening while Gopher traps were set inside the burrow opening. All traps were set in every evening and the data were recorded in the following morning. From this experiment, it was revealed that success rate of live traps was higher than the kill traps and Gopher traps. Average success rate of live trap was 51.49% whereas success rate of kill/snap trap was 39.75% and 41.63% in case of gopher trap.

Survey on squirrel damage in different fruits and vegetables in selected areas of Bangladesh

M S Alam and A T M Hasanuzzaman

The study was conducted in the squirrel infested area of Rajbari and Cox's Bazar regions during 2020-21. One upazillas of Rajbari and one upazilla of Cox's Bazar district were selected for this study. Questionnaire survey on squirrel damage in fruit and vegetables was conducted amongst fruit and vegetables growing farmers. The study was conducted among randomly selected 30 farmers from each upazilla of Rajbari and Cox's Bazar district. Scientists of Vertebrate Pest Division took the framers interview with a prescribed questionnaire sheet. It included different questions such as on species composition, crops damaged by the squirrels, intensity of damage, amount of loss, breeding season, number of parturitions per year, control method used by the farmers etc. Both of the Rajbari and Cox's Bazar district farmers reported two types of squirrels which were brown and striped whereas striped squirrel was pre dominant in Rajbari and Brown squirrel was pre dominant in Cox's Bazar. Most affected vegetable crops were bottle gourd (60%) followed by pumpkin (46.67%), cole crop (40%) and carrot (21.67%). Among the fruit crops maximum damage was found in Guava (46.7%) followed by coconut (35%), litchi (33.3%),

Jamun, jackfruit and mango (33.3%) and ber (26.6%). Farmers reported that average Tk. 500-1000 per family per year was lost in case of vegetables damaged by squirrel while it was more than Tk. 1000 in case of fruits. Maximum damage was occurred at full grown stage (51.67%) followed by ripening stage (43.33%) of the crop in all the season. Farmers were unknown about the breeding frequency, breeding season and number of young per parturition. Most popular control method used by the farmers was cage Trapping (50%) followed by snap trapping (21.6%) poison (11.6%).

Efficacy of netting against pest bird's management and bird diversity in sunflower

M S Alam and A T M Hasanuzzaman

The experiment was conducted at BARI central research field, Gazipur during rabi season in 2020-21 to find out the efficacy of different combination of netting on sunflower against pest birds. Six treatments viz., One side netting, two side netting, Four side netting, Whole crop cover by net, Only top of the crop cover by net and Untreated control (without netting) were used in this experiment. The number and types of birds were also recorded. Bird survey data were attained using the point count and direct observations methods which is count from a fixed location for a fixed time period at flowering to maturity of the sunflower crop. Bird counts were started early in the morning from 6 am to 6 pm. Bird counts were divided into three recorded time of the days viz., Morning (6 am 11 am), Noon (11 am – 2 pm) and Afternoon (2 pm to 6 pm). From the study, it was revealed that significantly maximum damage of sunflower caused by the pest birds were in the control plots compared to netting treated plots. In control plots maximum 36.06% head damage and 49.58% plant were affected by the birds whereas the lowest damage was happened in treatment where whole plot covered by net (0%) treated plots and two side netting treated plot (2.5%). Seventeen birds species were recorded in sunflower belonging to 15 families and 7 orders during the study periods from dawn to dusk. Passeroformes was the most dominant order (53%) represented 8 families and 9 species followed by order Collumbiformes (2 families 2 species) and order Coraciiformes (2 families 2 species). However, the species richness and Diversity of bird species were obtained higher in morning (17) and afternoon (9) than noon (7).

Controlling of bird pests in sunflower crop using different repellent tools at coastal areas of Bangladesh

KN Islam, M S Alam and A T M Hasanuzzaman

The experiment was conducted under farmer's field condition at Patuakhali sadar, Patuakhali and Amtoli, Borguna during robi season of 2020-21. Five management techniques (MT) viz., Hanging red ribbon, making scarecrow, Plastic bottle windmill, Bird repellent mechanical device and Control were evaluated. BARI Surjomukhi-2 was used as test crop and the unit plot size was 33 decimal for each site.

Among the different repellent tools the maximum seed yield of sunflower was obtained from (1.91 t ha⁻¹) Plastic bottle windmill as repellent tool which was followed by (1.90 t ha⁻¹) Bird repellent mechanical device, (1.82 t ha⁻¹) Hanging red ribbon and (1.80 t ha⁻¹) Making scarecrow while the minimum was in (1.50 t ha⁻¹) control. Similarly different repellent tools showed increase in yield of sunflower over control. Over the using different repellent tools, the maximum BCR was obtained from (1.50) Plastic bottle windmill used plot followed by (1.46) Hanging red ribbon, (1.40) Bird repellent mechanical device, (1.40) Making scarecrow while the minimum (1.23) was in control.

Local people perception and knowledge about owls and their conservation implications in three districts of Bangladesh

M S Alam and A T M Hasanuzzaman

The survey was conducted during July -December, 2018 in the village of Gazipur, Rajshahi and Jessore districts. The study used an interview-administered questionnaire. The questionnaire was designed to evaluate the knowledge and perceptions of local people about Owl. Education and demographic information, including gender and age, were obtained from each respondent. Data were grouped and summed by response category. Most of farmers (77.22 %) replied that they had seen only one species whereas 23.33% farmers reported on two species, 3.33% farmers reported on three species. Half of the farmers (50%) mentioned available owl species as Vutum pecha whereas 43.33% farmers mentioned it as Hutum pecha and only 32.22% farmers mentioned it as Laxmi pecha i.e. Burn owl. Most of the farmers (71.11%) respond that they liked owl as bird but 28.89%

farmers did not like owl. Majority of the farmers (87.77%) thought that owl had no harmful effect on human and the environment. Most of the farmers (81.11%) thought that owl had no scary effect on human being as well as the environment. Only 18.89% farmer mentioned that it is a dangerous thing. About 85% farmers replied that owl has a beneficial effect on the nature. Only 14.44% farmers thought it has not affected on nature. Majority of the farmers (85.55%) treated owl as a rat feeder whereas 11.11% farmers considered it as environmental protector.

Relative abundance and documentation of available owl species in Bangladesh

M S Alam and A T M Hasanuzzaman

The study was a list of owl species that are usually found in those areas Gazipur, Rajshahi and Barishal and documentation and it was carried out during June, 2018 to July, 2020, once in a month. Owls were counted by line transect, point counting and look and see methods by using cameras and were identified with the help of taxonomic book. Other owl species documentations were recorded by the help of some facebook group such as Birds Bangladesh, Birds and Wildlife of Bangladesh etc. Observations were made by standing and sitting from a hiding place and recorded along with their abundance. Surveys were conducted in the morning hours (6.30 a.m. to 9.30 a.m.) and evening hours (3.30 p.m. to 7.30 p.m.) by a single observer. Species diversity and richness were also calculated.

During the study period 14 species of owl have been recorded and documented. Among them Barn owl, spotted owlet, Brown Hawk owl, Brown fish owl, Collard scops owl etc were the most abundant species in different zone. All other owl species also presented in different but their density was comparatively lower than others owl species.

Diet of barn owl, *Tyto alba* and spotted owlet, *Athene brama* regurgitated pellets at locations of Gazipur and Rajshahi

M S Alam and A T M Hasanuzzaman

The study was conducted at BARI Head quarter central farm, Gazipur and Shampur, Rajshahi. Diets of barn owl and spotted owlet were determined by pellet analysis. Pellets were collected from BARI research field, Gazipur and Rajshahi. Total 40 pellets of barn owl, *Tyto alba* and 25 pellets of spotted owlet, *Athene brama* were collected from

Gazipur and 20 pellets of barn owl and 15 pellets of spotted owl were collected from the roosting site of Rajshahi district. Regurgitated pellets found at all the sites were collected in polythene bags and brought to the laboratory. In the laboratory, pellets were kept at 60°C in a hot air oven for 24hr to kill the associated insects and any other infectious agent. These pellets were then used for analysis. All the pellets were first weighed on electronic balance and then their morphometric measurements, i.e., length (mm), breadth (mm) and thickness (mm) were recorded. To record the diet composition of the Spotted Owl and Barn owl, each pellet was first soaked in 8% sodium hydroxide solution for about 8 hours. This solution assisted in easy separation of the osseous remains (skulls and other bones) and chitinous contents from other contents like hair, debris etc. The contents were then sieved to separate all the prey remains from the dust and soil particles.

Regurgitated pellets collected from two locations in Bangladesh determined barn owl and spotted owl average weight, length, breadth and thickness to be 5.82g, 47.95 mm, 30.43 mm and 20.29 mm, and 2.33g, 26.14 mm, 15.66 mm and 11.94 mm respectively. The diet of barn owl mainly comprised small mammals such as rat, (47.85%), Shrew (27.27%) and insect coleoptera (4.88%), crab (1.73%). Spotted owl pellets contained small mammals only mice (32.29%), followed by insect (38.72%) of them coleoptera (23.92%), Orthoptera (9.29), Hemiptera (3.28%), Odonata (2.23%), snail (2.14%) and crab (6.75%) and unidentified (15.74%). The remains of insect and crab in the pellets comprised of wing, legs, heads, shell etc.

Assessment of rat damage surrounding the watch tower areas and nest box occupation by owl

M S Alam and A T M Hasanuzzaman

A study was carried out to assess the rat damage around the watching tower and the effectiveness of nest box for owl occupation at Rajshahi and Gazipur district. watch towers were set at the field and nest box were installed in different tree above 12-15 feet from the ground level in both the location. Wheat, Barley, Potato, Sweet potato and Groundnut crop damaged by rat were assessed at 0-25, 26-50 and 51-75 meters apart around the watch tower areas. Nest box occupancy was also recorded for nesting and roosting by owl.

Percent rat damage in different growth stage of wheat and barley differed significantly in active burrow count methods and cut uncut methods around the owl watching tower areas. Significantly the lowest number of active burrow (0.6) was recorded in 0-25-meter distance around the watching tower followed by 25-50m distance and the highest number of active burrows was observed in 50-75 m distance from watching tower both in Rajshahi and Gazipur. Rat damaged and number of active burrows were higher as increase the distance from the watch tower areas. In Rajshahi 55 % nest boxes were occupied by owl whereas 50 % nest boxes were occupied by owl. In Gazipur maximum nest box were occupied by spotted owl (*Athene brama*) and in Rajshahi most of the nest box occupied by barn owl (*Tyto alba*).

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Effects of frying temperature and time on physicochemical changes and shelf life of vacuum fried jackfruit chips

M.G.F. Chowdhury, M.H.H. Khan, M. M. Molla, A.A. Sabuz, M. Alam

The aim of the study was to optimize the vacuum fried jackfruit chips processing to produce quality jackfruit chips at suitable frying temperature and time. Jackfruit chips were prepared from matured khaja type jackfruit. The harvested matured jackfruit was cut into halves and separated the bulbs. The seed was removed and bulb was sliced into about 5 mm thickness and then packaged in high density polyethylene (HDPE) packet (~60 micron) and frozen at -18°C for 24-48 hours. Then the frozen slices were fried instantly using BARI Vacuum Frying Machine at 100, 110 and 120°C for 5, 10, 15, 20 and 25 minutes, respectively. The fried chips were de-oiled using BARI De-oiling Machine at 1400 rpm for 3 minutes. Finally the de-oiled chips were packaged in metalex foil (~50 micron) packet without nitrogen gas and sealed for storage at ambient temperature ($26 \pm 2^{\circ}\text{C}$ & $75 \pm 5\% \text{RH}$). Then the changes of physicochemical properties with different frying temperature and time at one month interval upto six months and consumer preference test was evaluated by expert sensory panelists. According to the sensory panelist, the best frying temperature and time combination was found 110°C for 25 minutes, where sensory parameters scored 8.12. The study will generate the information to the food processors and product development sectors to find out proper ways and means of processing and production of good quality vacuum fried jackfruit chips and thus mitigate the postharvest losses by extending the shelf life and marketability.

Optimization of processing parameter for producing quality vacuum fried banana chips

M.G.F. Chowdhury, M.H.H. Khan, M. M. Molla, A.A. Sabuz, M. Alam, M. A. Haque

The aim of the study was to optimize the vacuum fried banana chips processing parameters to produce quality banana chips using BARI developed vacuum fryer at suitable frying temperature and time. Uniform size of BARI Kola-1 was collected from farmer's field and then peeled and thinly sliced by the slicer. To prevent turning into grayish black discoloration of banana during slicing due to catalase enzymatic action, 1% lemon extracted juice solution and 5% turmeric powder mixed water were prepared. Banana slices were soaked into mixed solutions for 3 hrs. to develop attractive natural color as well as to use as natural preservative. Enhancing spicy flavor and palatability spices combination comprising of salt powder (41.67%), sugar powder (47.67%), red chili powder (8.33%) and garlic powder (8.33%) were added to the banana chips after frying. The effects on physicochemical changes and quality attributes of three different frying temperature (110, 120 and 130°C) and frying time (8, 10 and 12 minutes) combination were evaluated. The banana chips were de-oiled by centrifugation at 1400 rpm for 2 minutes and packaged in high density polyethylene (HDPE). Then the shelf life study at 1 month interval upto 6 months and consumer preference test were evaluated by expert sensory panelists. According to the sensory panelist's opinion, the best frying temperature and time combination was found at 120°C for 12 minutes ranked higher sensory score (8.20) among the treatments. The study will generate the information to the food processors and product development sectors to find out proper ways and means of processing and

production of good quality vacuum fried banana chips and thus will mitigate the postharvest losses by value addition and will extend the shelf life and marketability all the year round.

Effect of sugar concentration on physicochemical properties, bioactive compounds and shelf life of osmotically dehydrated mango slices

M.G.F. Chowdhury, M.H.H. Khan, M. M. Molla, A.A. Sabuz, M.M. Kamal

The objective of this study is to investigate the effects of different sugar concentration on the physicochemical properties, bioactive compounds and shelf-stability of osmotically dehydrated mango slices. Fresh and semi-ripe mango of Himsagor cultivar was collected from the farmers' orchard and peeled with stainless steel knife. For this, three different concentration of sugar solution (50, 60 and 70° Brix) were used for osmotic dehydration followed by mechanical drying at 60°C. Results revealed that sugar concentration significantly affect the physicochemical parameters and bioactive compounds during storage. The moisture content of osmotically dehydrated mango slices increased from the initial 8.63-9.66% to final 11.22-12.98% after 6th month of storage, while the ash content was recorded as 2.72-3.22% and 2.36-2.53% on the beginning and the end of the storage period, respectively. Results also showed that the acidity was increased throughout the storage period in all treatments. The total sugar content was decreased throughout the storage period while reducing sugar was increased in all treatments. All the dehydrated mango slices retained considerable amounts of different bioactive compounds such as ascorbic acid, total carotenoids and total phenolic compounds and showed significant antioxidant properties after 6th month of storage. However, 50°Brix sugar concentration showed higher nutritional quality, retained maximum bioactive compounds and showed better antioxidant properties after 6th month of storage at ambient temperature (27±2°C, 75±5%RH). Therefore, it can be concluded that it is possible to prepare dehydrated mango slices from semi-ripe mango commercially using 50°Brix sugar solution and can be preserved more than 6th month at normal temperature without appreciable nutrient loss.

Physicochemical properties and shelf life of osmotically dehydrated jackfruit slices

M.G.F. Chowdhury, M.H.H. Khan, M. M. Molla, A.A. Sabuz, M.M. Kamal

The present study was carried out to preserve the jackfruit slices through osmotic dehydration techniques. Fully ripe jackfruit of khaja cultivar was collected from the farmer's orchard of Gazipur and then peeled and cut longitudinally to separate the bulb. For this study five different concentration of sugar solution (30, 40, 50, 60 and 70°Brix) were used to squeeze out water from the jackfruit slices followed by drying in mechanical dryer. Results revealed that moisture content of osmotically dehydrated jackfruit slices increased slightly from the initial 5.87-7.42% to final 8.06-9.44% after 6th month of storage. The ash content was recorded by dehydrated jackfruit slices prepared using 30°Brix (1.28%) sugar solution. Results also showed that the acidity was increased throughout the storage period in all samples. The total sugar content was decreased throughout the storage period while reducing sugar was increased in all the samples. All the dehydrated jackfruit slices contained significant amount of energy value (450.98 to 538.10 KCal/100g) after 6th month of storage; however, jackfruit slices prepared using 70°Brix sugar showed the maximum calorific value. All the samples retained considerable amounts of different bioactive compounds such as ascorbic acid, total carotenoids, total phenols and showed significant antioxidant properties after 6th month of storage. The sensory evaluation revealed acceptable overall sensory qualities of dehydrated jackfruit, however, 60°Brix sugar concentration showed higher acceptability than the other samples. Conclusively, the dehydrated jackfruit slice can be prepared commercially and preserved more than 6th month in high density polypropylene (HDPE packet) at ambient condition (26±2°C, 75±5%RH) without appreciable nutrient loss.

Effect of drying on physicochemical properties, bioactive compounds and microstructure of jackfruit seed flour

M.G.F. Chowdhury, M.H.H. Khan, M. M. Molla, A.A. Sabuz, M.M. Kamal, Md. Mynul Islam

Jackfruit seed, a by-product of the fruit industry, is a potential raw material for the production of a

number of valued-added products. In this study, physicochemical composition, minerals, bioactive compounds, antioxidant activity and functional properties of jackfruit seed flour were evaluated as a function of drying methods (hot air cabinet drying at 50-80°C, freeze drying at -56°C and sun drying). Results revealed that the drying methods significantly influenced the analyzed parameters, such as moisture (11.10~13.62%), protein (14.22~19.07%), fat (0.28~0.96%), carbohydrate (77.64~83.02%), starch (56.59~74.14%) and energy (470~490 KCal/100g) except ash (2.25~2.40%). Jackfruit seed flour was found to have significant amounts of different mineral constituents including sodium, potassium, calcium, magnesium, iron, phosphorus, zinc, sulphur. The antioxidant properties of jackfruit seed flour were reflected by its content of total carotenoids (31.86~72.20 mg/100g), ascorbic acid (42.41~65.05 mg/kg) and total phenolic content (704~1009 mg GAE/100g), which was evaluated by the DPPH radical scavenging activity (69.03~75.60%). Conclusively, it is expected that the jackfruit seed flour produced by different drying methods could be useful in formulating diverse food products including bakery in replace/adjunct to wheat flour.

Effect of cooking methods and oil on physicochemical, nutritional, minerals and bioactive compounds of leafy vegetables

M. M. Molla, A. A. Sabuz, M.H.H. Khan, M.G.F. Chowdhury, M. Alam

Bioactive compounds especially ascorbic acid is changed soon after harvest particularly drastically changed by thermal process. The research explored to determine the nutritional, physicochemical, minerals and phytochemical compounds of the leaf of BARI cultivar Radish-2, locally called BARI Mula-2. Its green leaf is mainly consumed as frying by soybean oil in traditional cooking process. Recently extra virgin olive oil is recommended by the dietician because it provides various health benefits. But the information is insufficient regarding the proximate and nutritional composition, minerals and phytochemical constituents using extra virgin olive oil and soybean oil. Results indicate that BARI radish-2 is the rich source of ascorbic acid, anthocyanin, total

carotenoid, total phenolic, β - carotene and energy content. It does contain amusing amount of Ca (1.25 ± 0.02 %), K (3.31 ± 0.01 %), Fe (286.33 ± 0.23 ppm) and Zn (49.23 ± 0.02 ppm), which is essential for adults (especially women) and child. Most of the minerals and bioactive compounds enriched after cooking and steam blanching by extra virgin olive oil as compared to soybean oil. The highest β -carotene (84.54 ± 0.09 $\mu\text{g}/100\text{gm}$) and energy content (7486.29 ± 0.28 cal/gm) possessed by the steam blanching using extra virgin olive oil whereas the control sample contained 29.08 ± 0.07 $\mu\text{g}/100\text{gm}$ β -carotene and 4528.72 ± 0.48 cal/gm of energy content. Moreover, the leafy vegetables blanched by steam blancher using extra virgin olive oil is the superior source of minerals and bioactive compounds and lower source of carbohydrate and crude fat content. Hence, the steam blanching process and extra virgin olive oil may be helpful for the dietary people to reduce their overweight by intake of low fat and carbohydrate food through fat adaptation and metabolism process.

Effect of pineapple pomace on the development of peanut bar and their physicochemical and nutritional properties

M.M.Molla, A.A.Sabuz, M.H.H.Khan, M.G.F. Chowdhury, M.Alam

The study was conducted to maximum utilize the pineapple pomace for formulation of peanut bar using jaggery (cane sugar). The study was laid out in complete randomized design (CRD) with 3 replications. Developed pineapple pomace peanut bar were stored in PET boxes for 2 months for observation. The market sample was collected from the local market of the Gazipur city to compare with our nut bar. Then the collected sample was stored and analyzed for its color, texture, sensory attributes, nutritional and physicochemical properties. Results revealed that our developed nut bar is the rich source of crude fiber ($6.48 \pm 0.48\%$), crude protein ($13.06 \pm 0.05\%$), vitamin-C (23.28 ± 0.21 mg/100g) and β -carotene (16.32 ± 0.03 $\mu\text{g}/100$ g) than market sample. Nutritional and physicochemical properties of our nut bar and the market sample (Badam topi) gradually decreased with the advancement of storage periods. An increasing trend of water activity (a_w) found in our developed and market samples with increasing

storage periods. The maximum hardness was found in market sample as compared to our developed nut bar. Statistically insignificant sensory score was obtained for all the formulated and market samples. The storage studies confirmed that the marketability of our nut bar T₃ could be extended 2 months more using without any excessive quality deterioration. These findings may be applied for the manufacturing of pineapple pomace peanut bar as health beneficial. These peanut bars can be practically used for the school nutrition programs to uplift the nutritional status of the school going children.

Effect of orange peel concentration on the development of sapota marmalade in terms of proximate and nutritional composition

M.H.H.Khan, M.M.Molla, A.A.Sabuz, M.G.F. Chowdhury, M.Alam, A.K.Choudhury, P.C.Sarker

The study explored to find out the possible strategy for processing of sapota into its value added shelf stable products. Therefore, an attempt was made to develop marmalade with different concentrations of orange peel viz. 0%, 5%, 10%, 15% and 20% respectively. Sensory evaluation, proximate and nutritional composition performed on the day of preparation and after storage. Marmalade treated with orange peel and without orange peel was rich source of proximate and nutritional composition. Final TSS of the developed marmalade maintained $65.30 \pm 0.02^\circ\text{B}$. β -carotene (12.21 ± 0.01 and 11.93 ± 0.03 $\mu\text{g}/100$ g), pH (5.05 ± 0.04 and 4.90 ± 0.01), total sugar (21.15 ± 0.04 % and 22.28 ± 0.03 %) and reducing sugar (9.70 ± 0.01 % and 10.15 ± 0.05 %) was superior on the day of storage and after storage in without orange peel treated marmalade (T₁). On the day of storage and after storage, highest total carotenoid and vitamin-C content of the orange peel treated marmalade ranged from 31.92 ± 0.02 to 49.21 ± 0.51 mg/100 g and 23.26 ± 0.02 to 43.39 ± 0.05 mg/100 g, 4.68 ± 0.02 to 5.84 ± 0.03 mg/100g and 2.36 ± 0.01 to 3.62 ± 0.06 mg/100 g respectively. According to the expert panel judges, the highest overall acceptability score was secured by the combination of T₂ followed by others in terms of color, aroma, mouth feel and high spreadable capacity. The marketable life of the developed marmalade could be extended 6 months more without any excessive

quality deterioration. This technology could be utilized to fulfill the off-season nutritional requirement and increase the income of the farmers to enhance their productivity.

Effect of steam blanching and cooking oils on physicochemical, nutritional, minerals and bioactive compounds of mixed vegetables

M.M.Molla, M.H.H. Khan., A.A.Sabuz, M.G.F. Chowdhury, M.Alam

Cooking is a crucial part of our daily life. Several cooking methods and oil exert their effects on nutritional, physicochemical, minerals and phytochemical compounds. Most of them are directly or indirectly include with human health merits and demerits. Hence, the present study was conducted to find out the effect of extra virgin olive and soybean oil on the nutritional, physicochemical, minerals and phytochemical compounds under different cooking conditions. Results revealed that steam blanching mixed vegetables minimized more nutrient loss than the traditional one. The mixed vegetables cooked using soybean oil by traditional cooking process exhibited higher amount of crude fat content (31.09 ± 0.08 %) whereas the fat content is below 1.00% (0.15 ± 0.00 to 0.39 ± 0.00 %) by the extra virgin olive oil in steam blanching process. The lower carbohydrate (6.01 ± 0.01 %) and higher energy value (6293.29 ± 0.15 cal/g) had also predominant in the steam blanching process using extra virgin olive oil followed by the traditionally cooked vegetables using soybean oil (12.33 ± 0.02 % and 5869.81 ± 0.24 cal/g), our staple food rice (81.58 ± 0.42 % and 3439.33 ± 0.15 cal/g), wheat bread (79.32 ± 0.95 % and 3486.66 ± 3.55 cal/g) and oats (68.91 ± 0.48 % and 4020 ± 1.00 cal/g). Most of the minerals especially human body essential Ca, Mg, Fe, Cu and Zn found notable in steam blanched vegetables using extra virgin olive oil than the traditional one. The leading phytochemical compounds β -carotene, anthocyanin, total carotenoid and total phenolic content of the steam blanched mixed vegetables using extra virgin olive oil was noticed as 26.24 ± 0.24 $\mu\text{g}/100$ g, 42.87 ± 0.13 mg/100g, 4.52 ± 0.48 mg/100 g and 20.09 ± 0.09 mg GAE/g whereas the less amount of this phytochemicals were present in traditional cooking process using soybean oil. The findings

obtained from this study may be helpful for the consumer to change their eating behavior and dietary lifestyle as well as fat adaptation and minimizing overweight and obesity.

Kinetics of dehydration and appreciation of the physicochemical properties of osmo-dehydrated plum

S. Pervin, M.G. Aziz and M. Miaruddin

The experiment was conducted to evaluate the dehydration kinetics and quantify its effect on the various physicochemical properties of the osmo-dehydrated plum during storage at an ambient condition. The six treatments with a combination of three different sucrose-sodium chloride concentrations and two peeling conditions were selected in the experiment. Among the treatments, peeled plum dipped into 5 percent NaCl solution exhibited a faster drying rate. Concerning the rehydration properties of the osmo-dehydrated plum, the whole plum immersed into 50°B sucrose solution showed the highest reconstitution behavior and the lowest moisture content (wb). The highest values of water activity of 0.514 and the lowest values of texture 1.79 N-mm² were investigated in 50°B sucrose treated whole plum. The peeled plum obtained the highest lightness, redness (a*) and yellowness (b*) compared to the unpeeled plum. Osmo-dehydrated plum with high sugar solution contained more sugar and less total phenolic content nevertheless using only 5 percent NaCl resulted in less sugar and more total phenolic content after the treatment. The osmo-dehydrated whole plums prepared in 50°B sucrose scored the highest overall acceptability (8.0 e.g. like very much) followed by the 50°B sucrose with peeled plum envisaged the sensory evaluation analysis. In conclusion, the osmo-dehydrated plum treated in 50°B sucrose and unpeeled condition performed better with a view to the overall plum quality, color, and acceptability judged by the expert panelists even after 12 months of storage at room temperature.

Study on physico-chemical characteristics of plum during preservation at different concentrations of sodium chloride

S. Pervin, M.G. Aziz and M. Miaruddin

The study was undertaken to find out the effect of sodium chloride concentration on plum to

investigate the shelf life of plum in an ambient condition. There were five treatments using various sodium chloride solutions for the experiments. The stored plum firmness, color parameters, pH, acidity, β -carotene, vitamin C and TSS data were analyzed up to six month; it was noticed that in an ambient condition the plum firmness, pH, β -carotene and vitamin C content were decreased as compared to an initial as well as fresh plum but the acidity and TSS of plum was increased during storage. The color parameters of lightness was decreased at prolonged storage and the color coordinates a* and b* values was responsible for the plum color during storage. However, using 8 percentage sodium chloride concentrations in plum; the less decreased and increased was found for each quality parameters of stored plum than that of the other concentrations in an ambient condition.

Effect of various combinations of sodium chloride and sucrose concentrations on the quality of plum pickle during storage

S. Pervin, M.G. Aziz and M. Miaruddin

The study was undertaken to standardize the processing conditions of plum pickles to enhance the diversified use of the plums. There were six treatments with a combination of three different sodium chloride and sucrose concentrations. The research was conducted to examine the quality parameters such as pH, acidity, product color and microbial growth and organoleptic test at various treatments. After twelve months of storage, the pH was slightly decreased and acidity was increased. In the case of color of the pickle, the highest lightness was found in a sample containing 3% sodium chloride plus 12 percent sucrose and the lowest lightness was investigated in the 5% sodium chloride plus 12 percent sucrose treated plum pickle. For color co-ordinates a*; initially, it was seen light red color but slowly increased during storage. Regarding the color co-ordinates b*, it turned into light yellow to yellow color during 12 months of storage. The microbial growths of the plum pickle were detected at the end of storage and the load was found to vary between 7×10^{-2} and 32×10^{-1} . Regarding the comparative sensory evaluation of the plum pickles, the overall acceptability was remained as the highest attribute for the combination of 4 to 5% NaCl plus 12%

sucrose treated plum pickle and the score was 9.0 (i.e., like extremely). Therefore, the plum pickle treated in 4 to 5% NaCl plus 12% sucrose performed better with a view to the overall pickle quality, color, and acceptability until 12 months of storage at room temperature.

Effects of various sucrose concentrations on the quality of plum chutney during storage

S. Pervin, M.G. Aziz and M. Miaruddin

The study was undertaken to optimize the processing of plum chutney to extend the variegated use of the plum. There were five treatments using various sucrose percentages were used for the experiments. The chutney was stored for six month. The pH was slightly increased where acidity was decreased. The intensity of light yellow color of the chutney was gradually increased and turn into light red color during storage. No microbial growths of the plum chutney were seen in all the treatments up to five but in six month seen acceptable microbial count. Comparative sensory evaluation of different quality attributes of the plum chutney is judged and found the treatments T₃ (using 40 percent sucrose in plum) scored highest overall acceptance (8.5 e.g. like very much to like extremely) followed by treatment T₂ (using 30 percent sugar in plum) scored of 7.5 (e.g. like moderately to like very much).

Effect of pretreatments and storage temperatures on the physico-chemical parameters and quality of plum

S. Pervin, M.G. Aziz and M. Miaruddin

The study was undertaken to compare physico-chemical parameters and quality of the plum at different pretreatments and storage temperatures for long time use of fresh plum. There were nine treatments using various pretreatments and temperatures for the experiments. For analyzed stored plum firmness, pH, vitamin C and TSS data; it was noticed that in an ambient condition after 7 days stored plum was spoilage but in cold room when the storage temperature was (10±1)⁰C, the stored plum was good in condition upto 42 days; whereas the stored plum was also good in condition upto 70 days if the storage temperature was (5±1)⁰C and the plum was wash with clean water as well as it washed with 150 ppm NaOCL solution.

Effect of different fruit juice on the physicochemical properties, bioactive compounds and shelf life of jackfruit leather

A.A. Sabuz, M.G.F. Chowdhury, M.H.H. Khan, M. M. Molla, M.M. Kamal

Fruit leathers are nutritious products that are made by dehydrating a thin layer of fruit puree or juice under specific conditions to obtain a chewy snack. The aim of this study was to prepare jackfruit leather using lemon and tamarind juice to reduce the strong jackfruit flavor. Fully ripe Gala jackfruit cultivar was collected from the farmer's orchard and peeled and then cut longitudinally to separate the bulb. The bulb was blended and extracted the pulp. Tamarind and lemon were collected to prepare the juice. For this 10% of lemon and tamarind juice were added into jackfruit pulp to prepare jackfruit leather and jackfruit leather without fruit lemon or tamarind juice was used as the control treatment. Results revealed that after 4 months of storage, the moisture content ranged from 10.29 to 15.76% and the ash content varied from 2.00 to 3.10%. The acidity and reducing sugar increased with the storage period while total sugar decreased. All the jackfruit leather contained significant amount of energy value (394 to 542 KCal/100g). The color of jackfruit leather was bright yellow to dark yellow. Results also showed that prepared jackfruit leather contained satisfactory amounts of different bioactive compounds and exhibited antioxidant properties during 120 days of storage at ambient temperature (27±2⁰C & 75±5%RH). The overall sensory qualities of jackfruit leather were acceptable; however, lemon juice added leather showed higher acceptability than the other treatments. Therefore, it can be concluded that use of fruit juice in jackfruit leather would improve the nutritional quality of jackfruit leather with consumer acceptability.

Baseline survey on existing hazardous agents in fresh cut fruits and salad vegetables used in street vendor, hotels and restaurant at selected locations in Bangladesh

A.A. Sabuz, M.H.H. Khan, M.G.F. Chowdhury, M. M. Molla, T.Karim

The baseline survey was conducted with a view to generate information on existing status of

hazardous agents in fresh-cut fruits and salad vegetables used for customer's consumption in hotels, restaurants, street vendor etc. at selected locations of Bangladesh. The baseline information was collected from three selected districts namely Dhaka, Gazipur and Bogura by an interview using pre-tested questionnaire. Fifteen respondents were randomly selected to collect the information from each location both from producer to consumer. The findings were that most of the hawkers of Dhaka were 21-40 years old (75%) followed by similar aged person of Bogura (62.5%). The result also showed that eighty percent people were above 20 years old engaged in fresh-cut fruits and salad vegetables processing and direct selling. 30% vendors of Bogura and 16.67% vendors of Dhaka use hand gloves during processing time, respectively. Most of the vendors did not have much knowledge regarding the hazards (physical, chemical, microbiological and cross contamination) and hygienic practices which exists in environment in different ways. Most of the street and mobile vendors sell their food in consumable plate or normal poly bag. Almost 100% vendors don't use any sanitizer to wash the produce or clean the processing place. Most of the vendors serve immediately after cutting fresh-cut fruits and salad vegetables to the customers.

Determination of hazards in fresh-cut fruits and salad vegetables used in street food vendor, hotels and restaurant at selected locations in Bangladesh

A.A. Sabuz, M.H.H. Khan, M.G.F. Chowdhury, M.M. Molla, T.Karim, M.M.Islam

This study was conducted to identify and quantify the hazardous agents (microbial load) in fresh-cut fruits and salad vegetables collected at different selected locations of Bangladesh. Different fresh-cut fruits and salad vegetables such as guava, pineapple, cucumber and carrot were collected from various restaurants to street vendor. All samples were analyzed to detect the existing different microbial agents such as *Salmonella* spp., *Escherichia coli* (*E. coli*), *Staphylococcus aureus*, *Listeria monocytogenes* total plate count (cfu/g), etc. The aims were to find out the microbial agents

of fresh-cut fruits and salad vegetables to analyze the fresh-cut fruits/salad vegetables qualities of the restaurants, hotel and street food vendor and also to compare it with different standards to assess the health risk of people. Results indicated that most of the samples were significantly positive to colony forming unit cfu/gm. Most of the sample contaminated by *Escherichia coli* (*E. coli*) and *Staphylococcus aureus*. On the other hand *Salmonella* spp. was not found in all the samples. Our recommendations are therefore, restaurant owners, hotel owners and street vendor should take necessary steps for the maintenance of microbial quality of water and microbial assessments should be done very often to leading a hygienic practice.

Effect of different sanitizer on physicochemical, microbiological load and shelf life of spinach

A. A. Sabuz, M.H.H. Khan, M.G.F. Chowdhury, M. M. Molla, T.Karim, L.Bari

The present study was conducted to evaluate the efficacy of selected sanitizers such as, acetic acid (0.5%), trisodium phosphate (1%) and calcinated calcium (0.01%) on physicochemical, microbiological load and shelf life of fresh vegetables spinach. Spinach was collected and dipped into the selected sanitizer solution and stored at refrigerator condition ($4 \pm 0.1^\circ\text{C}$). Different physicochemical properties including physiological weight, chlorophyll, total acidity (%) and ascorbic acid (mg/100g) were evaluated in addition with the microbial load (cfu/g). Results indicated that most of the studied parameters were significantly differed during the storage period. On the other hand, microbial study revealed that control sample contained the highest number of viable bacteria (cfu/g) while 0.01% calcinated calcium treated sample had reduced a significant number of microorganisms throughout the storage period. From this study, it can be concluded that spinach can be stored upto 6 days with considerable retention of nutrients. However, in terms of microbial load, spinach treated with calcinated calcium was acceptable upto 4 days of storage beside control sample tremendously increased microorganism initially after harvest exhibited at unsatisfactory level.

20 BIOTECHNOLOGY

Micropropagation and Regeneration Protocol Development

Standardization of micropropagation protocol for enhancing large-scale production of BARI released strawberry varieties

M. M. Khatun and M. A. Y. Akhond

Shoot tip and node explants of BARI Strawberry-3 were cultured on MS medium supplemented with different concentrations and combinations of BAP, Kn and GA₃. Combination of 1.0 mg/l BAP + 0.5 mg/l Kn + 1.5 mg/l GA₃ was found most suitable for shoot elongation. Two days required for shoot initiation in the same concentration using node explants. Half MS medium without hormone produced maximum root than full MS medium. For *ex vitro* establishment, 100 percent plantlets were survived in potting media comprised of soil and coco-dust mixture.

Large-scale production of BARI released banana varieties through tissue culture

S. C. Halder, M. M. Khatun and M. A. Y. Akhond

Tissue cultured banana plantlets have good demand among the farmers. Micropropagation is an excellent method to produce large-scale banana plantlets within a short period of time. So, for setting the experiment, sword suckers of different banana varieties developed by BARI were collected from the farm field of Pomology Division, HRC and Hill Agriculture Research Station, Raikhali. Shoot tips were separated from those suckers and cultured on different shooting and rooting medium for *in vitro* production. One hundred suckers of different varieties were cultured. This year, 546 different plantlets of banana varieties were distributed among banana growers.

Development of *in vitro* propagation protocol for gerbera

M. M. Khatun, N. Bilkish and M. A. Y. Akhond

An attempt has been made to develop a micropropagation protocol of gerbera. Capitulum and flower stalk explant of pink, red, white and magenta cultivars were cultured on MS medium supplemented with four different concentrations and combinations of BAP, NAA and IAA. Early shoot initiation (40 days) and maximum shoot (139) was observed in red cultivar on MS medium supplemented with 2.0 mg/l BAP + 0.5 mg/l IAA. The maximum root number (7) was obtained from ½ MS medium supplemented with IBA (1.5 mg/l).

***In vitro* regeneration of papaya (*Carica papaya* L.)**

M. M. Khatun, A. Saha, K. Nahar and M. A. Y. Akhond

The aim of this study was to develop an efficient regeneration protocol of papaya from immature embryos. Different concentrations of 2, 4-D were used for callus formation. The highest percentage of explant produced callus (46%) in 12 mg/l 2, 4-D concentration. In regeneration, the highest shoot number (135), highest shoot length (6.36 cm), higher leaf number (8), higher root number (6) and maximum root length (3.16 cm) was observed in 0.08 mg/l both BAP and NAA and 3.5 mg/l GA₃. For *ex vitro* establishment, all together 66% plantlets were survived. They were well established in the field and produced fruit.

Development of an efficient *in vitro* regeneration protocol for BARI Mungbean varieties

M. M. Khatun, M. K. Hasan and M. A. Y. Akhond

A study was undertaken to develop an efficient regeneration protocol for BARI Mungbean

varieties. BARI Mung-7 was used and double cotyledonary nodes were used as explants source. There were four different treatments which consist of different concentrations of BAP and NAA for shoot regeneration. Shoot bud initiation started at 11 days after inoculation of explant in 1.0 mg/l BAP and 0.0186 mg/l NAA. Eighty eight percent explants produced shoots and maximum length of shoot (1.44 cm) was measured from the same treatment. The highest number of shoots were produced number (2.2) were produced from the same treatment.

***In vitro* regeneration of soybean**

M. K. Hasan, S. C. Halder, M. M. Khatun and M.A.Y. Akhond

Cotyledon explant of Soybean variety 'Sohag', BARI Soybean-5 and BARI Soybean-6 were cultured on MS medium supplemented with different concentrations and combinations of growth regulators. Among the different treatments, 2.50 mg/l BAP + 1.25 mg/l GA₃ showed better response for the formation of shoot and 1.0 mg/l IBA for root development in all the varieties. Rooted plantlets were acclimatized under controlled conditions with 73-78% success and produced viable seeds.

Micropropagation of date palm (*Phoenix dactylifera* L.)

S. C. Halder, M. M. Khatun and M. K. Hasan

The aim of this study was to develop an efficient micropropagation protocol of date palm. Offshoots and inflorescence were used as explant source. Different concentrations of IAA, NAA and 2,4-D were used for initial culture establishment. Calli were noticed after 2 months of culture. In offshoot explant, some explant produced direct root at the base of the swelled portion, some produced both callus and root. In inflorescence explant, some florets swelled, enlarged in size and produced callus. Calli were then transferred to differentiation medium. In both explant types, root formation was noticed without any shoot development.

Rescue of Amritsagar banana from extinction through Biotechnological approaches

S. C. Halder, S. Islam and M. A. Y. Akhond

Several clones of Amritsagar banana was collected from different location of the country and a mother

orchard has been established at research field of Biotechnology division, BARI, Joydebpur, Gazipur. Amritsagar banana collected from Gafargaon and Kapashia were found to be better than other varieties and were compared with each other by following the standard Descriptor for Banana (*Musa* spp.). Shoot tips of Amritsagar banana (Gafargaon & Kapashia) were cultured on MS medium supplemented with BAP (5.0 mg/l). Well-developed shoots were transferred onto half MS medium supplemented with IBA (0.5 mg/l) for root induction. The plantlets were transferred into the polybags containing a mixture of soil and cowdung.

Molecular Genetics and Genetic Engineering

PCR-based detection and characterization of papaya viruses in Bangladesh

M. A.Y. Akhond, K. Nahar, N. Bilkish and S. Ahmed

Papaya (*Carica papaya*, Caricaceae) is a major horticultural crop in Bangladesh. The tree is often infected by various pests and diseases. Papaya ringspot virus (PRSV) is the cause of one of the most important diseases of the plant which is transmitted by aphids. A total of 40 papaya leaf samples from 12 districts of Bangladesh were collected from papaya plants showing various types of symptoms consistent with virus infection. Total RNA was extracted from all of those and 36 of the samples were analysed by Reverse Transcription Polymerase Chain Reaction (RT-PCR) method. Thirty one samples were found to be RT-PCR positive for Papaya ringspot virus (PRSV). Complete coat protein (CP) gene sequence was obtained so far from 20 of the samples. Phylogenetic analysis of the 20 isolates based on the CP gene showed two major clusters having high polymorphism among the virus isolates within the clusters.

Study on relative bacterial wilt tolerance of Bt eggplant varieties and their non-Bt parents

A. Saha, K. Nahar and M.A.Y. Akhond

Bacterial wilt is one of the most important diseases of eggplant caused by *Ralstonia solanacearum*. In

this study artificial inoculation of *R. solanacearum* was carried in BARI Bt varieties and their non Bt parent lines to find out the susceptibility of the varieties. Previously collected and identified sample of *R. solanacearum* was used as inoculum source. Leaf clip inoculation technique was followed to inoculate the bacteria in seedlings of eggplant. BARI Bt varieties and their non-Bt parent lines were found to be susceptible to infection by *Ralstonia solanacearum*. All the BARI Bt varieties and their non-Bt parent lines show similar susceptibility to artificial inoculation of *R. solanacearum*.

Collection and identification of germplasm of cultivated crops and wild species for drought and salinity stress tolerance

K. Nahar, F. Ahmed and M.A.Y. Akhond

Identifying drought tolerant germplasm at the vegetative stage is a meaningful effort at reducing cost and time of screening large number of genotypes for drought tolerance. The current study has been undertaken to evaluate the performance of sorghum genotypes against drought stress. Evaluation of sorghum genotypes was made against 7 different parameters related to early growth stages. Results were analyzed by using balanced two factor factorial analysis of variance, principal component analysis and biplot analysis for selection of tolerant genotypes. Highly significant differences among accessions for all the characters were found under water stress condition. First two principal factors showed more than one eigen value under water stress condition. First two factors contributed 60.96% and 77.05% cumulative variability in stress condition. G1, G3, G4, G11 and G12 were better performer under drought stress.

Transformation of tomato for broad spectrum resistance against leaf curl viruses

M.A.Y. Akhond, K. Nahar, S. Ahmed and M.R. Kabir

Several experiments were conducted with a view to genetically transform tomato plants for broad-spectrum resistance against leaf curl viruses. Two binary vectors harbouring different promoter-terminator combinations having GUS and GFP reporter genes have been constructed for optimisation of transformation protocol. Based on the genome sequence of various ToLCV strains,

DNA fragments from three diverse ToLCV species along with two tomato introns were amplified and cloned. Both the virus and intron sequences were assembled into sense/antisense configurations into *Escherichia coli* using standard protocols. In-house made vectors were tentatively named pBPA-BARI followed by a number. All the plasmid vectors were mobilised into electro-competent *Agrobacterium* cells prepared in-house and their presence in the *Agrobacterium* was confirmed by PCR analyses. Transformations carried out using the confirmed *Agrobacterium* clones resulted in plant regeneration. Regenerated plants are yet to be tested for the presence of the transgenes.

Exploring the development of gametophyte – mediated genetic transformation systems in crop plants

M.A.Y. Akhond, K. Nahar, N. Bilkish and Roland Schafleitner

Genetic transformation is a powerful tool for plant improvement programmes. Most of the transformation methods developed are based on *Agrobacterium*-mediated transformation and biolistic bombardment which are time- and labour-intensive. Therefore, it is desirable to develop alternate simple and rapid transformation protocols for development of transgenic plants without a prolonged tissue culture and regeneration process. Although it has been shown that plant gametophytes could be a potential target for transformation as an alternative to produce transgenic plants, a reproducible method is still lacking in most of the crop plants. To fulfill the objectives of the experiment, stages of flower buds of eggplant and mustard harbouring male gametophytes at late uninucleate stage have been identified. Two pollen-specific promoters have also been cloned. Results obtained in this experiment could lead the way for an optimized system for gametophyte-mediated transformation for crop plants in future.

Validation/On-Farm Trials

Validation trial of tissue cultured BARI strawberry-2 plantlets under field condition

M. M. Khatun, S.C. Halder and M.A.Y. Akhond

The experiment was conducted at the Biotechnology Division research field of BARI,

Gazipur during November, 2020 to April, 2021. BARI Strawberry-2 was used as tissue cultured plantlets in this study. Higher fruits/plant (35), single fruit weight (17.48 g) and fruit yield/plant (603.49 g) were observed than the results of BARI released Strawberry-2. Probably, because of tissue cultured plantlets were clean, healthy and disease free. Results suggested that the higher yield could be obtained using tissue cultured plantlets as planting material for commercial strawberry cultivation.

FtFBP Research Activities

Sustaining Bt eggplant in Bangladesh by implementing effective stewardship

M.K. Hasan, A.K.M. Quamruzzaman, M.S. Alam, and M.A.Y. Akhond

Stewardship is the responsible and ethical way to manage crop protection products from their discovery and development, to their use. The overall aim of the stewardship approach is to maximize the benefits, and minimize any risk, and make the technology durable. To sustain the first GE crop, Bt eggplant in the long run some activities like maintenance and purification of the varieties/lines, monitoring, Bt trait assessment and expression, attempts to develop new varieties etc. were carried out during 2020-21 with the support of Feed the Future South Asia Eggplant Improvement Partnership project.

Contained trial of late blight resistant transgenic 3R-gene potato

M.M. Khatun, S.C. Halder, M.M. Begum, P. Wharton, K. Hokanson, M.A.Y. Akhond (PI) and D. Douches (PD)

A contained trial of late blight resistant 3R- gene potato was conducted in the greenhouse of

Biotechnology Division, BARI, Gazipur in April 12, 2021. Minitubers of GM (genetically modified) potato event 1(DIA-MSU-UB015), event 2 (DIA-MSU-UB255) and Non-GM potato variety Diamant were used in the trial. A comparison of agronomic characteristics, including phenotype and efficacy against late blight pathogen in Bangladesh using detached leaf bioassay of GM potato event1 and GM potato event2 compared to Non-GM potato variety Diamant was investigated. Plant started to emerge 7.7 days after planting. After 15 days, 100 percent plant was emerged from all 3 lines. Result revealed that in all the parameter studied, phenotypically there was no significant difference between the two events compared to Non-GM Diamant. These results indicate that there are no unanticipated differences between GM and Non-GM Diamant. The intended modification is late blight resistance, and the GM Diamant events show strong resistance compared to Non-GM Diamant in detached leaf bioassay using the Bangladesh isolates of the pathogen for infection. In molecular identity check, DNA of DIA-MSU-UB015 plants gave expected band at 600 bp and DIA-MSU-UB255 gave band at 1500 bp which is unique to each event.



Physical Aspect of Soil Management

Determination of crop coefficient values of sweet pepper and estimation of leaching loss of nutrients by drainage lysimeter

A.T.M.A.I. Mondol, M.J. Alam and H.M. Naser

A study on sweet pepper (cv. BARI Misti morich-1) was conducted in the drainage Lysimeter located in the Central Research Farm, BARI, Gazipur during rabi 2020-2021. The objective of the study was to find out the location specific crop coefficient (Kc) values for garlic and to estimate leaching loss of nutrients. Four regimes of irrigation water were applied on the basis of depletion over field capacity (FC) at predetermined intervals such as T₁: Irrigation up to FC at 5 days interval, T₂: Irrigation up to FC at 10 days interval, T₃: Irrigation up to FC at 15 days interval and T₄: Irrigation up to FC at 20 days interval. As such, 11, 8, 6 and 4 irrigations were needed for T₁, T₂, T₃ and T₄, respectively. The experiment was conducted in completely randomized design with 3 replications. The highest sweet pepper yield (16.5 t ha⁻¹) was obtained from T₂, which was statistically identical to T₁ and but significantly higher over T₄. Therefore, Kc values were calculated from the best performed treatment, T₂. The estimated Kc values for garlic during rabi season found to be 0.41, 0.81, 94.0 and 0.86 for initial, crop development, midseason and late season stages, respectively. The Kc values derived from this experiment may be more accurate and better suited under Bangladesh contexts and alike agro-climatic conditions. Thus, the values determined from the present study may be recommended for Bangladesh and similar climate elsewhere to estimate crop water requirement for sweet pepper. Due to covid-19 pandemic, the leachate from the lysimeter tanks from each treatment not analysed.

Synchronization of different aged compost to crop demand, nutrient release and their contribution to the yield of spinach

A.T.M.A.I. Mondol, M.J. Alam and H.M. Naser

This study was conducted at the research field of Soil Science Division, Bangladesh Agricultural Research Institute (BARI), Gazipur under AEZ-28 during rabi season of 2019-2020 and 2020-2021 to understand the release of nutrients for crops and their contribution to growth and yield. Spinach cv. BARI Palongshak-2 was used for this experiment. Four different organic amendments of different ages were studied in comparison with only chemical fertilizer application. The amendment treatments were T₁: 30 days aged compost T₂: 45 days aged compost, T₃: 60 days aged compost, T₄: 75 days aged compost. The experiment is laid out in a Randomized Complete Block Design (RCBD), where each treatment was replicated thrice. Data on growth and yield attributes of spinach were collected during the crop growing season and after harvesting. Necessary soil data were also collected periodically to determine available nitrogen (N) status as well as the microbial-respiration of soil during the experimental period and soil was collected for physical, chemical and microbiological properties. Yield and its component of spinach were significantly affected by the different aged compost. The organic amended performed in the sequence: 45 DOC > 60 DOC > 30 DOC > 75 DOC. The increases of yield in 45 DOC, 60 DOC, 30 DOC and 75 DOC were 114, 98.0, 87.2 and 61.8 % higher than yield obtained with only chemical fertilizer. A significant increase in yield, fresh weight plant⁻¹ plant height and number of leaves plant⁻¹ of spinach was obtained with organic amended treatments relative to only chemical fertilizer application. The hetero-tropic respiration (CO₂ emission) was found higher in

soils under 30 DOC which might be due the rapid decomposition of the semi-composted materials applied in the treatments. But the available N recorded in 45 DOC treatment was more synchronised with the crop demand which resulted in increased yield of spinach in the same treatment. Overall, compost of 45 days old was found to be the best aged compost to apply for obtaining the best yield of crops like spinach.

Effect of organic and synthetic mulches on soil temperature, nutrient availability and yield of squash

A.T.M.A.I. Mondol, M.J. Alam and H.M. Naser

The field experiment was conducted on squash cv. Bulam house at Central Research Farm, BARI, Gazipur under AEZ-28 during rabi season of 2019-2020 and 2020-2021 to study the effect of organic and synthetic mulches on soil temperature, nutrient availability and yield of squash. The treatments were T₁: control, T₂: black polyethylene mulch, T₃: white polyethylene mulch and T₄: rice straw mulch. The experiment is laid out in a Randomized Complete Block Design (RCBD), where each treatment was replicated thrice. Data on growth and yield attributes of squash were collected during the crop growing season and after harvesting. Soil temperatures were differentially affected by the type of polyethylene mulch, with temperatures generally following the order: white polyethylene mulch > rice straw mulch > black polyethylene mulch. All plant growth characters, yield and yield contributing characters were superior with white polyethylene relative to grown without mulch (control). Treatment T₃ (white polyethylene mulch) resulted in increased single fruit weight (kg) of squash than control. Fruit yield was also increased when grown in soils under white polyethylene mulch which was 37.6 t ha⁻¹. White polyethylene mulch had 282 % increase in yield per ha over control. The higher yield was associated with higher soil temperature in white polythene mulch compared to other mulches during crop growing period.

Effect of conservation tillage and forms of urea on soil physico-chemical properties and performances of crops under garden pea-aroid-monsoon rice

M.J. Alam, A.T.M.A.I. Mondol and H.M. Naser

A field experiment on Garden pea-Aroid-Monsoon rice cropping system was conducted in Grey

Terrace soils under Madhupur Tract agroecological zone (AEZ-28) during 2018-2019, 2019-2020 and 2020-2021 to observe the effect of conservation tillage practice (strip tillage) and forms of urea on soil properties and crop yields, to explore the optimum combination of tillage practice and forms of urea in terms of yield and nutrient use. The effects of conservation tillage were compared with conventional crop establishment practice. In addition, performance of prilled urea in contrast with urea super granule were also evaluated under the crop establishment practices, laid out in a split plot design with 4 treatments and 3 replications. The yield contributing characters of garden pea (plant height, number of pods plant⁻¹, number of seeds pod⁻¹) were influenced by tillage practices. The yield of crops (green pod yield) was found higher in soils under strip planting practices than conventional practices. The increased yields in strip planting practices might be associated with higher availability of N during important stages of the crop. The effects of tillage practices on uptake and uptake input proportion were significantly higher in strip planting practices than those in conventional practices. The soil properties (i.e., soil moisture, bulk density) were not changed due to tillage practices after one season of conservation tillage cropping.

Effect of crop establishment practices, residue and starter n dose on performance of vegetable based cropping system and n mineralization and soil health

A.T.M.A.I. Mondol, M.J. Alam and H.M. Naser

A field experiments on Broccoli-Amaranth-T. aman rice cropping pattern were conducted in Grey Terrace soil of Joydebpur under AEZ-28 during rabi season 2019-2020 and 2020-2021 to find out the performance of crops in vegetable based cropping system, to study on N mineralization under starter dose of N and to find out the best combination of crop establishment practice, residue and starter N dose for vegetable-based cropping system and soil health (Kader *et al.*, 2016). There were 2 types of tillage such as Strip tillage (ST) and conventional tillage (CT) and two residue retention practices under which 2 starter N doses (with and without N-starter dose) will be tested. The treatments will be replicated for four

times. According to the principal research question of the experiment, the effect of tillage for both T.aman and broccoli was not significant either. However, starter dose and residue have significant effect on yield and yield parameters for both T. aman and broccoli. Soil moisture and field capacity was increased but bulk density and penetration resistance compared to initial soil for all treatment combinations. OM, N, Zn was increased, pH, B remain same and K and S decreased compared to initial soil status. The 5th crop amaranth was damaged due to frequent heavy rainfall at vegetative stage. Land preparation is going for for T. aman transplanting during report writing.

Effect of conservation tillage and phosphorus on the productivity of gardenpea-maize-t.aman rice cropping pattern and soil physico-chemical properties

J. Alam, A.T.M.A.I. Mondol and H.M. Naser

A field experiments on Garden pea- Maize-T.aman rice cropping pattern were conducted in Grey Terrace soil of Joydebpur under AEZ-28 during rabi 2018-2019, 2019-2020 and 2020-2021 to observe the effect of tillage practices and phosphorus on soil properties and to increase the productivity of cropping system. There were 2 types of tillage such as Strip tillage (ST) and conventional tillage (CT). In addition, 3 type application of phosphorus such as granular dose (basal) (P_1), powder doses (P_2) and granular doses (split) (P_3) in a split plot RCB design with 6 treatments and 3 replications. Strip tillage (ST) gave more yield than conventional tillage (CT) for gardenpea ($p \leq 0.05$) and vice-versa for T. aman rice ($p \geq 0.05$) due to residual nutrient uptake factor for subsequent crop. Powder dose (basal) significantly performed the best than other phosphorus doses for both and T. aman ($p \leq 0.05$). Strip tillage with phosphorus combinations comparatively gave more moisture and field capacity than conventional tillage with phosphorus combinations and vice-versa for bulk density and penetration resistance. OM, N, S, Zn and B increased but pH, P and K content more or less remain same compare to initial soil. The 8th crop maize was harvested during report writing.

Effect of crop establishment practices and IPNS based nutrient management on vegetable based cropping system and soil physical health

M.J. Alam, A.T.M.A.I. Mondol and H.M. Naser

A field experiments on Cabbage-Indian spinach-T.aman rice cropping pattern were conducted in Grey Terrace soil of Joydebpur under AEZ-28 during rabi 2019-2020 and 2020-2021 to investigate the performance of crops in vegetable based triple crops cropping system under the crop establishment and organic fertilizer application practices and to study the soil health under crop establishment and organic dominant IPNS in the cropping system. There were 2 types of tillage such as Strip tillage (ST) and conventional tillage (CT). In addition, 3 nutrient management practices such as 100% organic matter, IPNS and 100% chemical fertilizers in a split plot design with 6 treatments and 3 replications. Strip tillage gave better yield for cabbage and vice-versa for T.aman due to residual nutrient of subsequent crop. IPNS package gave significant yield for broccoli where 100% chemical fertilizer gave significant yield for T.aman under Cabbage- Indian spinach-T. aman cropping pattern. Conventional tillage emitted more CO_2 than strip tillage during crop growing period and IPNS package emitted less CO_2 during crop growing period. Strip tillage gave more or less same bulk density, moisture, more field capacity and penetration resistance. Organic based nutrient package gave more moisture and field capacity, less bulk density and penetration resistance than chemical fertilizer. Positive change was occurred for pH, N, P, Zn and B but remain more or less for K and S. The second crop indian spinach was harvested during report writing.

Requirement of potassic fertilizer under conservation agriculture practice in the intensive wheat-mungbean-t. aman cropping system

N. Salahin, N. U. Mahmud, M. K. Alam, M. J. Alam and K. U. Ahammad

An experiment was conducted at Regional Agricultural Research Station (RARS), Jashore during 2019-2020 and 2020-2021 to determine the optimum rate of potassium fertilizer under conservation agriculture (CA) practice and to

evaluate the effects of K fertilizer on soil properties and cropping system productivity. Two crop establishment methods, such as, T₁: conventional method (excessive tillage + residue removal) and T₂: conservation agriculture (minimum tillage + residue retention) were assigned in main plots whereas four K fertilizer rates were applied as K₁: 75% of recommended rate of K (RDK), K₂: 100% of RDK, K₃: 125% of RDK and K₄: 150% of RDK were allotted in sub-plots. Potassium fertilizer rates showed significant performance in the yield and yield attributes of wheat regardless of crop establishment methods. The longest spike, highest number of spikelets and filled grains spike⁻¹ of wheat was obtained from plots receiving 150% and 125% of RDK. Consequently, significantly the highest grain yield (4.47 t ha⁻¹) of wheat obtained from the plots receiving 150% and 125% of RDK and differed from 100 and 75% of RDK. In case of T. Aman, crop establishment methods showed significant variations on the panicle length and number of filled grains spike⁻¹ whereas effective tillers hill⁻¹, panicle length, number of filled grains spike⁻¹ and 1000-grain wt. of T. Aman increased with increasing K rates. As a result, higher grain yield (4.79 t ha⁻¹) was obtained from the conventionally crop establishment method compared to conservation agriculture practice (4.42 t ha⁻¹). Highest grain yield (5.11 t ha⁻¹) of T. Aman was obtained from plots receiving 150% of RDK which were different from other K rates. There was no variation in mungbean performance due to crop establishment methods and K fertilizer rate. In addition, higher K doses (150% and 125% of RDK) gave the higher REY than those of lower RDK. Soil organic matter and available K content significantly improved due to CA practice.

Effect of seed priming and planting method on soil salinity amelioration and yield of sunflower in south-western Bangladesh

O. A. Fakir and M. M. Hossain

An experiment was conducted at Agricultural Research Station (ARS), BARI, Benarpota, Satkhira during rabi season of 2020-2021 to study the combined effect of seed priming and planting method on soil salinity and yield of sunflower. There were seven treatment combinations in two factorial RCBD approach where factor was seed

priming considering 4 levels viz. no priming, hydro-priming for 24 hours, hydro-priming for 48 hours and halo-priming for 48 hours (1% NaCl solution). On the other hand, factor was planting method and depth considering 3 levels viz. dibbling (1-5 cm), reduce tillage (6-10 cm), conventional tillage (12-15 cm). From the result it is evident that among different treatment combinations RT along with HP for 24H produced the highest seed yield (1.37 t ha⁻¹). Although the RT along with HP for 48H gave statistically similar yield followed by RT+NP and RT+HP 48H (1% NaCl). Yield obtained from Dibbling methods were statistically identical also. The lowest seed yield (0.34t ha⁻¹) was recorded in Dibbling+HP 48H. The lowest level of soil salinity over the growing period was recorded in sowing time (2.08 dS/m) and the average salinity was observed as the lowest (5.09 dS/m) for reduced tillage along with no priming (RT+NP). And the highest level of salinity (6.81 dS/m) was recorded in harvesting stage while the maximum salinity was observed for dibbling and conventional tillage.

Chemical Aspect of Soil Management

Nutrient management for sustaining soil fertility and yield of wheat-mungbean-t.aman cropping pattern

N. U. Mahmud, N. Salahin, R. Sen, S. Akhter and H. M. Naser

A long term field experiment on Wheat-Mungbean-T.aman cropping pattern has been carried out in High Ganges Floodplain Soils (AEZ-11) of RARS, Jashore from 2000-2020. The objectives were to find out sustainable fertilizer recommendations, monitor soil health, estimate uptake of different nutrient for the cropping pattern and to make a balance sheet for each of the nutrient. There were six treatments viz. 125% recommended dose (RD), 100% RD, 75% RD, 50% RD, Farmers' practice and native nutrient. The design was RCB with three replications. Results showed consistently highest yield from each of the crops of the pattern obtained with 125% RD treatment and which were statistically similar to 100% RD treatment. Highest total rice (system) yield of 13.12 t ha⁻¹yr⁻¹ was obtained from T₁ treatment (125% RD). Lowest total rice (system) yield of 7.03 t ha⁻¹yr⁻¹ was

obtained from control i.e. native fertility treatment (T_6). Highest gross margin of 121570 Tk⁻¹ ha⁻¹ yr⁻¹ was also obtained from T_1 treatment (125% RD). The highest benefit cost ratio of 1.86 was found in T_1 (125% RD) treatment.

Nutrient management for sustaining soil fertility and yield of mustard-mungbean-t.aman cropping pattern

N. U. Mahmud, N. Salahin, R. Sen, S. Akhter and H. M. Naser

A long term field trial on Mustard-Mungbean-T.aman cropping pattern has been conducted from 2000-2020 in High Ganges Floodplain Soils (AEZ-11) of Jashore. The objectives were to find out sustainable fertilizer doses for the pattern, monitor soil health, estimate uptake of different nutrients and make a balance sheet for each of the nutrient. There were three levels each of N (80, 120 and 160 kg ha⁻¹), P (18, 36 and 54 kg ha⁻¹) and K (35, 70 and 105 kg ha⁻¹) in the treatment combinations. The design was RCB replicated thrice. The combined effect of 120-54-70-40-3-1 kg ha⁻¹ of NPKSZnB (T_5) produced the highest seed yield (1.52 t ha⁻¹) of mustard. The residual effect of 120-54-70-40-3-1 kg ha⁻¹ of NPKSZnB (T_5) gave the highest yield of both grain and straw yield of mungbean and T.aman rice. Highest total rice (system) yield of 14.40 t ha⁻¹yr⁻¹ was obtained from T_5 treatment. Lowest total rice (system) yield of 8.30 t ha⁻¹yr⁻¹ was obtained from control i.e. native fertility treatment (T_8). Highest gross margin of 127237Tk⁻¹ha⁻¹yr⁻¹ and BCR of 1.79 obtained from T_5 treatment. It was observed that a total amount of 1345.9, 285.3, 1242, 210.7 and 10.6 kg ha⁻¹ of NPKS and Zn were removed from the soil by fourteen cropping cycles while 1300, 540, 700, 250, and 15 kg ha⁻¹ of NPKS and Zn were added in the soil as nutrients. N and K removal were found to be higher than the amount added. About 129, 71 and 7 kg ha⁻¹ of P, S and Zn were added in soil system when about 90 t ha⁻¹ of green biomass of mungbean from fourteen cropping cycles were ploughed down after grain harvest.

Effect of poultry litter biochar on maize in acidic soil

M. M. Masud, R. Sen, M. Sultana, A. Barman, I. S. M. Farhad, S. Akhter and H. M. Naser

The study was conducted at Central research field, Gazipur under Grey Terrace Soil (AEZ 28) to investigate the combined use of chemical fertilizer and poultry litter biochar (PLB) in acidic soil during 2018-2019, 2019-2020 and 2020-2021, hypothesized that biochar could increase soil C and improve soil fertility compare to its raw material. This study aimed to test i) effectiveness of poultry litter and its derivate biochar on ameliorating acid soil, and ii) quantify and maintain high yield of Khoibhutta and enhance SOC and if so, which organic materials should be implemented. In this contest, a filed trial was investigated with three rates of poultry litter (PL) and Poultry litter biochar (PLB) (3, 6, and 9 t ha⁻¹), compare to dolomite @ 1 t ha⁻¹ and no amending materials with recommended dose chemical fertilizer (RDCF). Composite soil samples were collected to the depth of 0-15 cm and analyzed for bulk density, total porosity, pH, soil organic carbon, total nitrogen, available phosphorus and potassium using standard procedures before and after biochar application. The results showed significantly reduced soil bulk density and exchangeable acidity with the application of biochar when compared with a control ($p < 0.05$). Moreover, the total soil porosity, soil pH, total nitrogen, soil organic carbon, available phosphorus and potassium were significantly increased in the soil. Compare to PL, PLB exhibited a higher soil pH and organic carbon with the magnitude of the increase dependent on the amount of biochar incorporated to the soil. Three years average yield of the Khoibhutta using RDCF weighed 3.21 t ha⁻¹ but, PLB increased the grain yield from 4.12 t ha⁻¹ to 5.28 t ha⁻¹, where highest yield found by addition of 9 t ha⁻¹ PLB, respectively. Compared with the unamended control, yield increase up to 48% at 9 t ha⁻¹ of biochar treated soil, whereas yield increases 1% at 1 t ha⁻¹ of dolomite treated soil. The highest total organic carbon was obtained where higher dose of biochar applied, which leads to an increase in soil organic carbon. The overall result indicated that RDCF with 9 t ha⁻¹ PLB is more effective for Khoibutta yield and improve soil fertility. Further study needed to stability of carbon in their respective field.

Effect of biochar on yield and nutrient uptake of cabbage

M.M. Masud, R. Sen, A. Barman, I.S.M. Farhad, R. Khatun, S. Akhter and H. M. Naser

Field study was conducted at BARI research field under Grey Terrace Soil (AEZ 28) during rabi season of 2020-2021 to investigate the effects of rice husk biochar (RHB) on soil fertility, carbon sequestration and increase yield and nutrient uptake of cabbage. The experiment consisted of randomized complete block design with eight treatments i.e. control, 100% recommendation dose of chemical fertilizer (RDCF) and three rate of rice husk biochar (i.e. 1.5, 3.0 and 4.5 t ha⁻¹) with 100% or 80% RDCF. The application of RHB improved soil pH and concentrations of organic matter, N, P, K, Ca and Mg, root length, yield and yield components of cabbage ($p < 0.05$). Soil fertilized with chemical fertilizers had lower soil pH (5.38) than all other treatments but 0.13 unit increased by 4.5 t ha⁻¹ RHB with 80% RDCF treated soil. The increase in RHB decreased bulk density of soil and increased soil organic carbon (SOC) stock. Irrespective of treatments, the highest carbon accumulation was recorded in soil amended with 4.5 t ha⁻¹ of RHB. Compare to control, more than 221% average yield increase by using 100% RDCF in soil. In addition, 100% RDCF with different dose of RHB yield increased varied 269 to 359% and 247 to 334% average yield increased by reduction of 20% RDCF. Compare to 100% RDCF with different dose of RHB yield increased varied 47 to 137% and 26 to 113% yield increased by reduction of 20% RDCF. The correlation coefficient between SOC and marketable yield were 0.9458. The highest gross margin was obtained from T₅ treatment with a BCR 3.99 but immediate lowest 3.83 was found in T₈ treatment where 20% RDCF were reduced from T₅ treatment. Our results demonstrate that application of more stable component such as biochar instead of easily degraded organic amendments seems to be a promising option to supply enough nutrients for the healthy growth and yield of cabbage Grey Terrace Soil (AEZ 28). For more confirmation, the trial need to continue in a same plot without any destroys.

Effect of co-composting biochar on cabbage-Indian spinach-t.aman productivity

M.M. Masud, R. Sen, M. Sultana, I.S.M. Farhad, R. Khatun, S. Akhter and H. M. Naser

A field study was conducted at BARI research field under Grey Terrace Soil (AEZ 28) during rabi season of 2020-21 to investigate the effects of Co-Composting biochar (COMBI) on soil fertility, carbon sequestration and increase yield and nutrient uptake of Cabbage- Indian spinach- T.aman cropping pattern. The experiment consisted of randomized complete block design with six treatments i.e. 100% recommendation dose of chemical fertilizer (RDCF), 80% RDCF with 5 t ha⁻¹ compost, 80% RDCF with 5 t ha⁻¹ RHB, 80% RDCF with 5 t ha⁻¹ COMBI or 3 t ha⁻¹ COMBI and control. Only two crops harvested in the first year and found that, yield was increased by amending organic compound. The greater yield was found in T₄ treatment (80% RDCF with 5 t ha⁻¹ COMBI). Compare to control, more than 108% cabbage and 136% Indian spinach yield increase by using 80% RDCF with 5 t ha⁻¹ COMBI. Compare to single doses of Compost and Biochar and two doses of COMBI the increment varied from 6.09 to 13.81 percent for cabbage and 10 to 30 percent for Indian spinach. In addition, 13% cabbage and 30% Indian spinach yield was increase over 100% RDCF treatment. Compare to 100% RDCF with different dose of RHB yield increased varied 17 to 43% and 9 to 37% yield increased by reduction of 20% RDCF. The highest gross margin was obtained from T₁ treatment with a BCR 9.01 but immediate lowest 6.14 was found in T₅ treatment where 20% RDCF were reduced from T₁ treatment. Our results demonstrate that application of more stable component such as COMBI instead of easily degraded organic amendments seems to be a promising option to supply enough nutrients for the healthy growth and yield of cabbage Grey Terrace Soil (AEZ 28). For more confirmation, the trial need to continue in a same plot without any destroys.

Development of fertilizer recommendation for cauliflower maize intercropping system

R. Sen, M. M. Masud, S. Akhter and H. M. Naser

An experiment was conducted at BARI Central Research Station, Gazipur during the rabi season of

2020-2021. The experiment was set up with nine treatments viz. T₁ (100% RDCF of Maize + 0% RDCF of Cauliflower), T₂ (100% RDCF of Maize + 10% RDCF of Cauliflower), T₃ (100% RDCF of Maize + 20% RDCF of Cauliflower), T₄ (100% RDCF of Maize + 30% RDCF of Cauliflower), T₅ (100% RDCF of Maize + 40% RDCF of Cauliflower), T₆ (100% RDCF of Maize + 50% RDCF of Cauliflower), T₇ (100% RDCF of Maize + 60% RDCF of Cauliflower), T₈ [Sole Maize (100% RDCF of Maize with recommended spacing)] and T₉ [Sole Cauliflower (100% RDCF of Cauliflower with recommended spacing)]. Both maize and cauliflower significantly influenced by different treatments. Average highest total system (maize) yield of 32.68 t ha⁻¹ was obtained from T₇ treatment (100% RDCF of Maize + 60% RDCF of Cauliflower). Cost and return analysis revealed that highest BCR of 5.33 was obtained from T₆ treatment (100% RDCF of Maize + 50% RDCF of Cauliflower). BCR in sole maize and sole cauliflower were 2.80 and 5.22, respectively. Nitrogen, potassium and sulphur balance were found negative where as phosphorus balance was found positive in all the treatments.

Efficacy of different form of urea on nitrogen availability and yield of maize

R. Sen, M.M. Masud, A. Barman, S. Akhter and H. M. Naser

The experiment was conducted at BARI, Gazipur during rabi season of 2020-2021 with the objectives: i) to find out use efficiency of different form of urea, ii) to find out the yield and yield components of maize as influenced by different form of urea and iii) to analyze cost and return of maize produced from different form of urea. There were four treatments viz. T₁: N-control, T₂: RD of nitrogen (225 kg ha⁻¹) in the form of Prilled urea, T₃: Application of 200 kg nitrogen ha⁻¹ in the form of urea super granule (USG), T₄: Application of 205 kg nitrogen ha⁻¹ in the form of neem coated urea. P, K, S, Zn & B were applied @ 60, 110, 40, 4 & 1.4 kg ha⁻¹. The experiment was laid out in RCB design with four replications. The highest yield (10.45 t ha⁻¹) of maize was obtained from T₃ treatment (200 kg N as USG) which was very close to T₄ treatment (10.40 t ha⁻¹). The lowest yield (6.26 t ha⁻¹) of maize was noted in N-control

treatment (T₁). The actual nitrogen add (130 kg ha⁻¹), nitrogen uptake (199 kg ha⁻¹) and nitrogen balance (-69 kg ha⁻¹) by maize was highest in T₃ the treatment. If 1 kg extra nitrogen applied, 20.95 kg extra maize grain yield over N-control was observed in T₃ treatment. If 1 kg extra nitrogen applied, 0.38 kg extra nitrogen uptake by maize over N-control was observed in T₃ treatment. Cost and return analysis revealed that highest gross margin (86841 Tk. ha⁻¹) as well as BCR of 2.25 was obtained from T₄ treatment (Neem coated urea applied maize plot). BCR in prilled urea and USG applied maize were 2.15 and 2.19, respectively.

Nutrient management for a rooftop garden

A. Barman, I. S. M. Farhad, M. Sultana, R. Khatun, R. Sen, S. Akhter and H. M. Naser

The study has been conducted at Gazipur (rooftop of Soil Science Division) during the year of 2019-2020 and 2020-2021. Two types of research work have been conducted in this study. One is organic and inorganic fertilizer combination based research which have 8 treatments viz. T₁ = 100% STB, T₂ = T₁ + 1 kg kitchen waste (decomposed) 6 kg⁻¹ soil, T₃ = 80% of T₁ + 2 kg kitchen waste (decomposed) 6 kg⁻¹ soil, T₄ = T₁ + 1 kg cowdung 6 kg⁻¹ soil, T₅ = 80% of T₁ + 2 kg cowdung 6 kg⁻¹ soil, T₆ = T₁ + 1 kg vermicompost 6 kg⁻¹ soil, T₇ = 80% of T₁ + 2 kg vermicompost 6 kg⁻¹ soil & T₈ = absolute control; and another is towards soil to organic materials ratio based research for safe food production in the rooftop garden consisting of 6 treatments viz. T₁ = 1 kg kitchen waste for 1 kg soil, T₂ = 1 kg kitchen waste for 2 kg soil, T₃ = 1 kg cowdung for 1 kg soil, T₄ = 1 kg cowdung for 2 kg soil, T₅ = 1 kg vermicompost for 1 kg soil and T₆ = 1 kg vermicompost for 2 kg soil. The experimental activities include fertilizer management of some vegetables, fruits and flower; and influence of different ratio of soil and organic materials on the yield and yield components of vegetable, fruit and flower for rooftop garden. Prior to setting the experiments initial soil samples as well as organic fertilizers were analyzed and nutrient statuses were determined. In case of 1st experiment, T₇ treatment (80% of T₁ + 2 kg vermicompost 6 kg⁻¹ soil) showed best performance followed by T₃ treatment (80% of T₁ + 2 kg kitchen waste 6 kg⁻¹ soil) for maximizing the yield of vegetables, fruits and

flower grown on the rooftop garden. In case of 2nd experiment, T₅ treatment (1 kg vermicompost for 1 kg soil) performed better in compared to others in the experiments related to influence of different ratio of soil and organic materials on the yield and yield components of vegetable, fruit and flower for rooftop garden. The lowest yield was recorded from the T₄ treatment (1 kg cowdung for 2 kg soil).

Development of fertilizer recommendation for mustard-mungbean-jute-t. aman

A. Barman, N. Salahin, N. U. Mahmud, F. Shikha, M. Yesmin, S. Akhter and H. M. Naser

A field experiment on Mustard-Mungbean-Jute-T.Aman cropping pattern was conducted at Jashore (AEZ-11) and Jamalpur (AEZ-9) during 2019-2020 and 2020-2021 with the objectives to find out suitable fertilizer combination for sustainable yield of the pattern, monitoring soil health as affected by chemical fertilizers and to make a balanced sheet of each nutrient. There were eight different treatments viz. T₁: 100% NPKSZnB (STB), T₂: T₁+ 25% N, T₃: T₁+ 25% NP, T₄: T₁+ 25% NK, T₅: T₁+ 25% PK, T₆: T₁+ 25% NPK, T₇: 75% of T₁, T₈: Native fertility. The experiment was laid out in RCB design with three replications. Data revealed that the grain yield of Mustard (BARI Sarisa-14), Mungbean (BARI Mung-6), Jute (O-9897) and T. Aman (BRRI dhan57) were significantly influenced by the fertilizer treatments. The highest yield was obtained from the T₆ treatment where 25% additional NPK was added over the 100% STB rate in both locations.

Effect of integrated nutrient management on the yield and nutrient uptake of foxtail millet

I. S. M. Farhad, F. S. Shikha, S. Akhter, R. Sen, M.A. Rahman and H. M. Naser

A field experiment was conducted at Central Research Farm, BARI, Gazipur and Regional Agricultural Research Station (RARS), Jamalpur during Rabi season of 2020-2021 to evaluate the effect of integrated nutrient management for better yield of foxtail millet; and to increase soil fertility and sustain crop productivity. Six treatment combinations viz. T₁ = Soil test based fertilizer dose for HYG, T₂= IPNS with 5.0 t ha⁻¹ cowdung, T₃ = IPNS with 5.0 t ha⁻¹ compost, T₄ = IPNS with 1.5 t ha⁻¹ vermicompost, T₅ = IPNS with 3.0 t ha⁻¹

poultry manure and T₆ = Absolute control were tested. The experiment was laid out in a randomized complete block design with 3 replications and BARI Kaon-2 was used as the test crop. The IPNS treatment combinations are significantly different from rest of the treatments in terms of yield and economic return. Application of treatment IPNS with 1.5 t ha⁻¹ vermicompost significantly increased all of the parameters such as the plant height, number of tillers plant⁻¹, panicle length, 1000 grain weight, grain yield and straw yield. The significantly highest grain yield (2.30 t ha⁻¹ and 2.41 t ha⁻¹ at Gazipur and Jamalpur, respectively) was recorded in IPNS with 1.5 t ha⁻¹ vermicompost treated plot (T₄) while the lowest grain yield (1.24 and 1.26 t ha⁻¹ at Gazipur and Jamalpur, respectively) was observed in absolute control treatment (T₆). The uptake of nutrients by foxtail millet was highest in the treatment T₄ receiving IPNS with 1.5 t ha⁻¹ vermicompost which was followed by T₅ (IPNS with 3.0 t ha⁻¹ poultry manure) in both the locations. The highest gross return (128140 Tk. ha⁻¹ and 133580 Tk. ha⁻¹ at Gazipur and Jamalpur, respectively), net return (69830 Tk. ha⁻¹ and 76065 Tk. ha⁻¹ at Gazipur and Jamalpur, respectively) as well as BCR (2.19 and 2.32 at Gazipur and Jamalpur, respectively) were obtained from T₄ treatment (IPNS with 1.5 t ha⁻¹ vermicompost) whereas the lowest gross return (70600 Tk. ha⁻¹ and 72020 Tk. ha⁻¹ at Gazipur and Jamalpur, respectively), net return (27500 Tk. ha⁻¹ and 29720 Tk. ha⁻¹ at Gazipur and Jamalpur, respectively) and BCR (1.63 and 1.70 at Gazipur and Jamalpur, respectively) were obtained from control (T₆) treatment. The overall results indicated that IPNS with 1.5 t ha⁻¹ vermicompost is more effective than other fertilizer management packages in respect of yield as well as economic return for foxtail millet cultivation at Gazipur and Jamalpur.

Development of fertilizer recommendation for chilli onion intercropping system

I.S.M. Farhad, R. Sen, S. Akhter and H. M. Naser

An experiment was conducted at Central Research Farm, BARI, Gazipur during Rabi season of 2020-21 to develop a fertilizer recommendation for chilli with onion intercropping system. Six treatment combinations viz. T₁= 100% RDCF of chilli + 0% RDCF of onion, T₂= 100% RDCF of chilli +10%

RDCF of onion, $T_3 = 100\%$ RDCF of chilli + 20% RDCF of onion, $T_4 = 100\%$ RDCF of chilli + 30% RDCF of onion, $T_5 = 100\%$ RDCF of chilli + 40% RDCF of onion and $T_6 = 100\%$ RDCF of chilli + 50% RDCF of onion were tested. The experiment was laid out in randomized complete block design with 3 replications. Both chilli and onion significantly influenced by different treatment combinations. Significantly highest yield of chilli (12.18 t ha^{-1}) and onion (8.13 t ha^{-1}) were obtained from T_6 treatment (100% RDCF of chilli + 50% RDCF of onion) which was statistically similar with T_5 treatment (100% RDCF of chilli + 40% RDCF of onion). Chilli equivalent yield progressively increases with the increase of inorganic fertilizers. The results showed that T_6 provided the highest CEY (21.93 t ha^{-1}) followed by T_5 (21.88 t ha^{-1}). The highest net return ($430005 \text{ Tk. ha}^{-1}$) as well as BCR (4.67) were obtained from T_5 treatment (100% RDCF of chilli + 40% RDCF of onion) whereas the lowest net return ($364411 \text{ Tk. ha}^{-1}$) as well as BCR (4.28) were observed in T_1 treatment (100% RDCF of chilli + 0% RDCF of onion). Though T_6 treatment gave higher yield over all the treatments yet it showed lower BCR compared to T_5 treatment due to higher cost involvement for inorganic fertilizer.

Effect of kitchen waste compost on broccoli yield and carbon accumulation in soil

I. S. M. Farhad, S. Akhter and H. M. Naser

A field experiment was conducted at Central Research Farm, BARI, Gazipur during Rabi season of 2020-2021 to evaluate the effect of kitchen waste compost for better yield of broccoli; and to increase soil fertility and improve the stock of organic carbon in the soil. Six treatment combinations viz. $T_1 = 100\%$ RDCF, $T_2 = 100\%$ RDCF + Kitchen waste compost @ 2.5 t ha^{-1} , $T_3 = 100\%$ RDCF + Kitchen waste compost @ 5.0 t ha^{-1} , $T_4 = 80\%$ RDCF + Kitchen waste compost @ 2.5 t ha^{-1} , $T_5 = 80\%$ RDCF + Kitchen waste compost @ 5.0 t ha^{-1} and $T_6 = \text{Native fertility}$ were tested. The experiment was laid out in a randomized complete block design with 3 replications. Application of treatment 100% RDCF + Kitchen waste compost @ 5.0 t ha^{-1} significantly increased all of the parameters such as the plant height, curd length, curd circumference, marketable weight of single

curd, sprout yield and curd yield. The significantly highest curd yield (16.31 t ha^{-1}) was recorded in T_3 treatment (100% RDCF + Kitchen waste compost @ 5.0 t ha^{-1}) whereas the lowest curd yield (5.92 t ha^{-1}) was observed from absolute control treatment (T_6). The uptake of nutrients by broccoli was highest in the treatment T_3 receiving 100% RDCF + Kitchen waste compost @ 5.0 t ha^{-1} which was followed by T_5 (80% RDCF + Kitchen waste compost @ 5.0 t ha^{-1}) treatment. The highest gross return ($489300 \text{ Tk. ha}^{-1}$), net return ($318502 \text{ Tk. ha}^{-1}$) as well as BCR (2.86) were obtained from T_3 treatment (100% RDCF + Kitchen waste compost @ 5.0 t ha^{-1}) whereas the lowest gross return ($177600 \text{ Tk. ha}^{-1}$), net return ($42000 \text{ Tk. ha}^{-1}$) and BCR (1.30) were obtained from control (T_6) treatment. Application of kitchen waste compost along with chemical fertilizers slightly increased total N, available P, exchangeable K, available S and available Zn & B contents in post-harvest soil. It also slightly increased OC content, carbon stock & carbon accumulation in soil. The overall results indicated that 100% RDCF + Kitchen waste compost @ 5.0 t ha^{-1} is more effective than other fertilizer management packages in respect of yield as well as economic return for broccoli cultivation at Gazipur district of Bangladesh.

Influence of organic fertilizers on the yield and nutrient uptake of carrot

M. Sultana, I. S. M. Farhad, M. R. Khatun, M. M. Masud, S. Akhter and H. M. Naser

A field experiment was conducted on Carrot (var. Beauty queen) in Grey Terrace Soil of Bangladesh Agricultural Research Institute (BARI), Gazipur (AEZ-28) ($24^{\circ}00' \text{ N}$, $90^{\circ}25' \text{ E}$ and 8.4 m) during the rabi season of 2020-2021. The objective of the experiment is to assess the effect of different organic fertilizers on yield and nutrient uptake of carrot. The experiment was laid out in a randomized complete block design with three replications. Ten rates of organic fertilizers were: $T_1 = \text{Compost @ } 2.5 \text{ t ha}^{-1} + 100\% \text{ RD}$, $T_2 = \text{Compost @ } 3.75 \text{ t ha}^{-1} + 100\% \text{ RD}$, $T_3 = \text{Compost @ } 5.0 \text{ t ha}^{-1} + 100\% \text{ RD}$, $T_4 = \text{Vermicompost @ } 2.5 \text{ t ha}^{-1} + 100\% \text{ RD}$, $T_5 = \text{Vermicompost @ } 3.75 \text{ t ha}^{-1} + 100\% \text{ RD}$, $T_6 = \text{Vermicompost @ } 5 \text{ t ha}^{-1} + 100\% \text{ RD}$, $T_7 = \text{Trichocompost @ } 2.5 \text{ t ha}^{-1} + 100\% \text{ RD}$, $T_8 = \text{Trichocompost @ } 3.75 \text{ t ha}^{-1} + 100\% \text{ RD}$, $T_9 =$

Trichocompost @ 5 t ha⁻¹ + 100% RD, T₁₀= Native fertility (no fertilizer). Results revealed that the T₉ (Trichocompost @ 5 t ha⁻¹ + 100% RD) produced the highest yield (29.44 t ha⁻¹) and Beta carotene (36.56 ppm) and the lowest yield (11.74 t ha⁻¹) with Beta carotene (21.92 ppm) was in native fertility (T₁₀) treatment. Highest gross margin (1,18,496 Tk ha⁻¹) was obtained from T₉ treatment. Highest BCR (1.74) was obtained from T₇ treatment (Trichocompost @ 2.5 t ha⁻¹ + 100% RD).

Effect of kitchen waste compost on soil carbon accumulation and tomato yield

M.Yasmin, F.S.Shikha, M.A Rahman, R.Sen, S.Akhter and H. M. Naser

The experiment was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2020-2021. The objectives were composting of kitchen solid waste for waste to fertilizer conversion and its use in tomato production and soil fertility restoration. There were seven treatments comprising T₁ = 100 % RDCF (control), T₂=100 % RDCF + Kitchen Waste Compost @ 2.5 t ha⁻¹, T₃ = 100 % RDCF + Kitchen Waste Compost @ 5 t ha⁻¹, T₄ = 85% RDCF + Kitchen Waste Compost @ 2.5 t ha⁻¹, T₅ = 85% RDCF + Kitchen Waste Compost @ 5 t ha⁻¹, T₆ = 70% RDCF + Kitchen Waste Compost @ 2.5 t ha⁻¹ and T₇ = 70% RDCF + Kitchen Waste Compost @ 5 t ha⁻¹. Data revealed that, combined application of kitchen waste compost and chemical fertilizer increased tomato production as compared to that obtained from sole application of chemical fertilizers at the recommended dose. The highest tomato fruit yield (77.66 t ha⁻¹) was found in T₃ treatment (100 % RDCF + Kitchen Waste Compost @ 5 t ha⁻¹). T₁ treatment (100% RDCF) produced tomato yield of 63.37 t ha⁻¹ which indicated that sole application of chemical fertilizer could not supply enough nutrients to plants. On the other hand, tomato yield was gradually decreased with decreasing chemical fertilizers. The lowest tomato yield of 59.15 t ha⁻¹ was recorded in the T₆ (70% RD + compost @ 2.5 t ha⁻¹) treatment. So, application of Kitchen Waste Compost @ 5 t ha⁻¹ with 100% recommended dose of chemical fertilizer can be practiced for achieving higher tomato yield and keeps the soil and environment free from pollution.

Effect of vermicompost on groundnut yield and soil fertility in charland

M.Yasmin, F.S.Shikha, M.A Rahman, R.Sen, S.Akhter and H. M. Naser

The experiment was conducted at farmers' field of Nouvanger char, Jamalpur Sadar, Jamalpur during the period of 2020-2021. The objectives was to find out the effect of vermicompost with chemical fertilizer on groundnut yield and to increase soil fertility by vermicompost application. There were seven treatments comprising, T₁ = 100 % RDCF (control), T₂ = 100 % RDCF + vermicompost @ 1 t ha⁻¹, T₃ = 100 % RDCF + vermicompost @ 3 t ha⁻¹, T₄ = 85% RDCF + vermicompost @ 1 t ha⁻¹, T₅ = 85% RDCF + vermicompost @ 3 t ha⁻¹, T₆ = 70% RDCF + vermicompost @ 1 t ha⁻¹ and T₇ = 70% RDCF + vermicompost @ 3 t ha⁻¹. Data revealed that, application of vermicompost with chemical fertilizer increased the yield attributes and yields of groundnut. Treatment T₅ (85% RDCF + VC @ 3 t ha⁻¹) produced the highest nut yield (2.17 t ha⁻¹) which was 16.66 % higher over 100% RDCF dose. The treatments T₂ (100 % RDCF + vermicompost @ 1 t ha⁻¹), T₃ (100 % RDCF + vermicompost @ 3 t ha⁻¹) and T₄ (85 % RDCF + vermicompost @ 1 t ha⁻¹) were recorded statistically identical nut yield. Therefore, 15% recommended dose of chemical fertilizer could be saved when integrated use of chemical fertilizer with vermicompost was used. Considering the overall performance, farmers may be advised to cultivate groundnut in charland applying 85 % chemical fertilizer with vermicompost @ 3 t ha⁻¹ application. This combination would enable farmers to increase productivity of groundnut so as to enhance farmers' income and livelihoods.

Application of vermiwash on yield and quality of brinjal

M.Yasmin, F.S.Shikha, M.A Rahman, R.Sen, S.Akhter and H. M. Naser

The experiment was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2019-2020 and 2020-2021 to investigate the effect of vermiwash on yield and quality of brinjal and to find out suitable foliar dose of vermiwash for optimizing the yield of brinjal. There were five treatments comprising T₁=Foliar

spray of distilled water (control), T₂=Foliar spray of 10% vermiwash, T₃ =Foliar spray of 20% vermiwash, T₄=Foliar spray of 30% vermiwash and T₅=Foliar spray of 40% vermiwash. Recommended dose of chemical fertilizer were used as a blanket dose in all treatment. Results revealed that, vermiwash treated brinjal plants showed better yield than the control plants. The highest average brinjal fruit yield (29.99 t ha⁻¹) was found in T₃ treatment i.e., foliar spray of 20% concentration of vermiwash and the lowest (26.35 t ha⁻¹) came from control. On the other hand, nutritional quality (moisture content, TSS, β carotene and nutrient content) were seen to be higher in vermiwash treated treatment compared to control treatment. The study suggests that, 20% vermiwash could be used as effective foliar spray for eco-friendly and higher yield of brinjal.

Nutrient management through organic manuring and biofertilizers on the yield of onion

F. S. Shikha, M. Yasmin, M. A. Rahman and H. M. Naser

A field trial was conducted during the period of 2020-2021 at Regional Agricultural Research Station (RARS), Jamalpur to increase yield of onion using tricho compost and arbuscular mycorrhizal fungi to obtain a good economic return with good soil health for the onion. There were six treatments comprising T₁ = 100% NPKSZnB (STB), T₂ = Tricho compost (5 t ha⁻¹) + IPNS basis NPKSZnB, T₃ = Tricho compost (5 t ha⁻¹) + IPNS basis NPKSZnB +AM, T₄ = 100% NPKSZnB (STB) + AM, T₅ = Tricho compost (5 t ha⁻¹) + AM, T₆ = Native fertility. The highest bulb yield (22.82 t ha⁻¹) of onion was obtained from T₃ (Tricho compost (5 t ha⁻¹) + IPNS basis NPKSZnB +AM) treatment which was followed by T₂ (17.52 t ha⁻¹) (Tricho compost (5 t ha⁻¹) + IPNS basis NPKSZnB) treatment. The lowest bulb yield (9.93 t ha⁻¹) obviously recorded from control (T₆) treatment. The highest bulb wt. (61.73 g) was obtained T₃ (Tricho compost (5 t ha⁻¹) + IPNS basis NPKSZnB +AM) treatment which was followed by T₂ = Tricho compost (5 t ha⁻¹) + IPNS basis NPKSZnB which produced bulb wt. (57.24 g) and lowest (48.03 g) was obtained from T₆ (native fertility) treatment. From the trial, it can be concluded that tricho compost and AMF inoculant along with

IPNS based chemical fertilizers is the best treatment.

Nutrient management through tricho compost on the yield of garlic

F.S.Shikha, M.Yasmin, M.A. Rahman, S. Akhter and H. M. Naser

A field trial was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2020-2021 to develop an optimum and economic tricho compost dose for maximizing the yield of garlic. There were five treatments comprising T₁ = 100% NPKSZnB (STB), T₂ = Cowdung (3 t ha⁻¹) + IPNS basis NPKSZnB, T₃ = Tricho compost (3 t ha⁻¹) + IPNS basis NPKSZnB, T₄ = Tricho compost (6 t ha⁻¹) and T₅ = Native fertility. Significantly the highest yield (7.7 t ha⁻¹) was obtained from T₃ [Tricho compost (3 t ha⁻¹) + IPNS basis NPKSZnB] treatment which was followed by T₂ [Cowdung (3 t ha⁻¹) + IPNS basis NPKSZnB] treatment and the lowest (2.6 t ha⁻¹) from T₅ (Native fertility) treatment. The highest individual bulb wt. (21.67 g) was obtained from the T₃ [Tricho compost (3 t ha⁻¹) + IPNS basis NPKSZnB] treatment which was statistically identical with T₂ [Cowdung (3 t ha⁻¹) + IPNS basis NPKSZnB] and T₁ [100% NPKSZnB (STB)] treatment. The lowest individual bulb wt. (8.6 g) was obtained from T₅ (Native fertility) treatment. From the trial, it can be concluded that tricho compost along with IPNS based chemical fertilizers is the best treatment.

Micronutrient Aspect of Soil Management

Dynamics of soil and foliar applied boron and zinc to improve yield and quality of strawberry

H. M. Naser, S. Sultana, M. Akter and M. B. Banu

A field experiment was carried out to study the effectiveness of soil and foliar application of micronutrients on the yield of strawberry (*Fragaria ananassa*) at Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, located at 23°59'26" N and 90°24'52" E. The micronutrients zinc (Zn) in the form of zinc sulphate (ZnSO₄.7H₂O) as zinc source at the rate of 0.05 % and boron (B) in the form of boric acid (H₃BO₃) at the rate of 0.03% were applied as foliar spray at

four different stages of plant growth i.e (i) at 15 days after planting; (ii) before flower initiation; (iii) after fruit set when it becomes approximately green pea sized; and (iv) at 15 days interval of second spray. The strawberry yield and its contributing yield traits were significantly affected by foliar fertilizer treatments as against soil application of B and Zn fertilizers. Among various treatments, foliar application of Zn (0.05 %) + B (0.03%) produced maximum fruit yield (7.35 t ha⁻¹) while the control no use of Zn (0.0) and B (0.0) produced 3.53 t ha⁻¹ and it was statistically differed with soil application of B and Zn @ 2 and 4 kg ha⁻¹ (T₅), respectively. The increment of yield was 34.6 to 108% and 36.3% respectively, over control and soil application. The integrated use of foliar application of micronutrients and soil application of macronutrients recommended enhancing strawberry yield. This paper also suggests that foliar application of micronutrients; particularly of Zn and B is an effective technology for increasing the yield of strawberry.

Effect of boron on yield and quality of bitter gourd

M. B. Banu, M. Akter, S. Sultana and H. M. Naser

A field experiment was carried out to study the effect of boron on yield and quality of bitter gourd at Soil Science Division, BARI, Joydebpur, Gazipur. Design of the experiment was RCB with 3 (three) replications. The micronutrient boron (B) in the form of boric acid (H₃BO₃) having 18% boron were applied. The treatment combinations were T₁: Control, T₂: RDF (STB), T₃: 1.0 Kg B ha⁻¹ +NPKSZn (STB), T₄: 1.5 Kg B ha⁻¹ +NPKSZn (STB) and T₅: 2.0 Kg B ha⁻¹ +NPKSZn (STB). The yield and yield contributing character of bitter gourd were significantly affected by boron application. All parameters showed higher tendency in T₄ treatment accept flower seedlings. The highest yield (14.74 t ha⁻¹) was observed in T₄ (1.5 kg B ha⁻¹) treatment and it was significantly higher than control plants. Highest flower shedding decreased (49.62%) was also observed in T₄ (1.5 kg B ha⁻¹) treatment and it was higher than control plants. Application of boron is effective on flower, yield and quality of bitter gourd.

Foliar application of boron on reproductive growth of sunflower

M. B. Banu, M. Akter, S. Sultana, and H. M. Naser

Foliar application may be used to supply boron (B) to a crop when B demands are higher than can be supplied via the soil. A field experiment was carried out to study foliar application of boron on reproductive growth of sunflower at Soil Science Division, BARI, Joydebpur, Gazipur. Design of the experiment was RCB with 3 (three) replications. The micronutrient boron (B) in the form of boric acid (H₃BO₃) having 18% boron were applied at 20-25 and 40-45 days after sowing (DAS). The treatment combinations of foliar spray of boron were T₁: control (spray with distilled water), T₂: 50 mg L⁻¹ B, T₃: 100 mg L⁻¹ B and T₄: 150 mg L⁻¹ B. The yield and yield contributing character of sunflower were significantly affected by foliar application of boron. All parameters showed higher tendency in T₄ treatment. The highest seed yield (2.27 t/ha) was observed in T₄ (150 mg L⁻¹) and it was significantly higher compared with untreated plants. Foliar application of boron is effective on reproductive growth of sunflower.

Effect of seed priming on yield and nutrient uptake of cauliflower

S. Sultana, H. M. Naser, M. Akhter and M. B. Banu

A field experiment on effect of seed priming on yield and nutrient uptake of cauliflower was conducted in Grey Terrace Soil (AEZ-28) of Gazipur during the year of 2020-2021 to determine concentration of seed priming on growth, yield and quality of cauliflower. There are six treatments viz. T₁: Control (without priming), T₂: Hydropriming (soaked with distilled water), T₃: Seed soaked with 0.5% zinc, T₄: Seed soaked with 0.01% boron, T₅: Seed soaked with 0.05% zinc and 0.01% boron and T₆: Seed soaked with sand matrix. The experiment was RCB design with three replications. The combined use of micronutrients seed priming gave the highest yield (59.2 t ha⁻¹). The same trend was observed in the yield contributing characters of cauliflower. The untreated treatment produced the lowest yield (38.2 t ha⁻¹). The highest zinc and boron uptake was found in T₅ treatment (seed soaked with zinc and boron). Quality characters like TSS, ascorbic acid and β carotene content also

found high in combine use of seed priming treatments.

Effect of boron on yield and nutrient uptake of mungbean

M. Akter, S. Sultana, M. B. Banu and H. M. Naser

A field experiment was carried out in Tista Meander Floodplain Soil (AEZ-3) at On Farm Research Division, Rangpur during Kharif 1 season of 2020- 2021. Boron deficiency has appeared as a serious threat to mungbean production in the northern part of Bangladesh. Supply of required amount of boron fertilizer is therefore needed to increase mungbean yield. The objectives were to study the effect of boron on yield and nutrient uptake of mungbean (BARI Mung 8), estimate optimum dose of boron for higher yield of mungbean (BARI Mung 8) and find out the boron use efficiency of mungbean (BARI Mung 8). The experiment was designed in Randomized Complete Block Design (RCBD) with three replications. BARI Mung 8 with five levels of boron along with a blanket dose $N_{18}P_{18}K_{24}S_{12}Zn_2Mo_{0.8}$ was used in the study. BARI Mung 8 was performed better with application of 1.5 kg B ha^{-1} (1.45 t ha^{-1}) as compared to the other treatment. The lowest yield was found in B_0 treatment where no boron was applied.

Effect of boron fertilization on lentil in Barishal region

M.R. Islam and M. R. Uddin

A field experiment was conducted at Regional Agricultural Research Station, Rahmatpur, Barishal during November 2020 to March 2021 to develop micronutrient management practice for lentil in Barishal region of Bangladesh. The crop variety was BARI MASUR-8. There were five treatments viz. T_0 : 0.0 kg B/ha , T_1 : 1.0 kg B ha^{-1} , T_2 : 1.5 kg B ha^{-1} , T_3 : 2.0 kg B ha^{-1} , and T_4 : 2.5 kg B/ha which were replicated for four times. Boron had influence on plant height (cm), number of branches, no of pods plant⁻¹, pods weight plant⁻¹, pod yield plant⁻¹, strover yield of BARI Masur-8. The highest seed yield of 1.96 t ha^{-1} was observed in T_3 ($B_{1.5}$) treatment which was statistically identical to all other treatments in Barishal region, (Non-calcareous Grey Floodplain Soils under AEZ 13).

Microbiological Aspect of Soil Management

Study on micropobial population status in rhizosphere soils of different crops of some AEZs of Bangladesh

M.E. Ali, M.F.A. Anik, F. Alam, M. Rahman and H.M. Naser

Soil microbes play a major role in legumes to supply nutrient to plants as well as decomposition of organic materials and cycling of nutrients. Sixteen rhizosphere soil samples were collected from selected locations of different AEZs of Bangladesh to know the total bacteria, Rhizobium, Freelifving bacteria, Phosphate Solubilizing bacteria (PSB), Actinomycetes and Fungal population at different AEZs of Bangladesh. Rhizobium was grown in YMA media and Rhizobium colonies were counted. The highest total bacacteria ($3.1 \times 10^8 \text{ g}^{-1} \text{ soil}$) was recorded in the rhizosphere soils of orange in AEZ 29 and the lowest number of total bacterial colony ($1.7 \times 10^6 \text{ g}^{-1} \text{ soil}$) was observed in the the rhizosphere soils of Tobacco in AEZ 29. The highest Rhizobium ($8.0 \times 10^6 \text{ g}^{-1} \text{ soil}$) was found in the rhizosphere soils of Maize in AEZ 28 and the lowest population ($1.9 \times 10^5 \text{ g}^{-1} \text{ soil}$) was observed in the rhizosphere soils of Tobacco in AEZ 29. Free living bacteria was grown in N free media and colonies were counted. The highest free-living bacterial population ($2.0 \times 10^8 \text{ g}^{-1} \text{ soil}$) was found in the rhizosphere soils of Onion in AEZ 28 and the lowest population ($1.8 \times 10^5 \text{ g}^{-1} \text{ soil}$) was observed in the rhizosphere soils of Cauliflower at Matiranga, Khagrachori region (AEZ-29). Phosphate solubilizing bacteria was grown in Pikovskaya's media and PSB colonies were counted. The highest PSB population ($8.0 \times 10^6 \text{ g}^{-1} \text{ soil}$) was found in the rhizosphere soils of Orange at HARS, Khagrachori region (AEZ-29) and the lowest population ($1.0 \times 10^5 \text{ g}^{-1} \text{ soil}$) was observed in the rhizosphere soils of Litchi at Ramgor, Khagrachori region (AEZ-29). Actinomycetes was grown in Actinimycetes agar media and colonies were counted. The highest Actinomycetes population ($2.0 \times 10^6 \text{ g}^{-1} \text{ soil}$) was found in the rhizosphere soils of Orange at HARS, Khagrachori region (AEZ-29) and the lowest population ($1.0 \times 10^4 \text{ g}^{-1} \text{ soil}$) was observed in the rhizosphere soils of

Bushbean at Dighinala, Khagrachori region (AEZ-29). Fungus was grown in PDA media and colonies were counted. The highest fungal colonies (3.6×10^6 g⁻¹ soil) was found in the rhizosphere soils of Onion at Joydebpur region (AEZ-28) and the lowest population (5.0×10^3 g⁻¹ soil) was observed in the rhizosphere soils of Maize at Dighinala, Khagrachori region (AEZ-29).

Effect of azotobacter on growth and yield of onion

M.E. Ali, M.F.A. Anik, M. Rahman, F. Alam and H.M. Naser

The experiment was carried out during Rabi season of 2020-2021 in the research field of Soil Science Division, BARI, Joydebpur, Gazipur to find out the effect of Azotobacter inoculum along with different doses of N fertilizer on growth and yield of Onion. The experiment was designed in RCBD with 6 treatments and 4 replications. Onion (BARI piya-4) was used as a test crop. Liquid azotobacter inoculum was used in this experiment. The population density of used inoculum was more than 10^8 cell ml⁻¹ liquid inoculant. There were six treatments viz. T₁: 100% N of Recommended Dose, T₂: 90% N + Azotobacter inoculum, T₃: 80% N + Azotobacter inoculum, T₄: 70% N + Azotobacter inoculum, T₅: Azotobacter inoculum and T₆: Control. Results of the experiment revealed that the highest bulb yield of onion (22.60 t ha⁻¹) was found in T₃ treatments which was statistically identical with T₁ (21.80 t ha⁻¹) and T₂ (21.18 t ha⁻¹) treatments. This result suggested that use of azotobacter inoculum in combination with reduced dose of N fertilizer was beneficial for onion in the Grey Terrace soils of Gazipur (AEZ 28) and we could reduce 20% of nitrogenous fertilizer. The experiment should be continued for conforming the findings.

Effect of arbuscular mycorrhizal fungi and phosphorus on cauliflower

F. Alam, M.F.A. Anik, M. Rahman, M.E. Ali and H.M. Naser

A field experiment was conducted at Central Farm, Soil Science Division, Bangladesh Agricultural Research Institute, during rabi season of 2020-2021 with the objectives to study the effect of combined use of arbuscular mycorrhizal fungi and

phosphorus on growth and yield of cauliflower, and to reduce to use of P-fertilizer under field condition. The experiment was designed in factorial RCBD with six treatments and four replications. The cauliflower variety was snow white as test crop. Soil based arbuscular mycorrhizal (AM) inoculum and infected root pieces of the host plant were used at the rate of 1 kg soil m⁻² in seedbed for producing cauliflower seedlings. The treatment combinations were: T₁P₁U: 0% P × without AM, T₂P₂U: 50% P × without AM, T₃P₃U: 100% P × without AM, T₄P₁AM: 0% P × with AM, T₅P₂AM: 50% P × with AM, T₆P₃AM: 100% P × with AM. Mycorrhizal inoculation significantly increased root length (cm), root colonization (%), spore population (100 g⁻¹ soil) and curd yield (t ha⁻¹). Collar diameter, Plant height (cm), Plant weight (kg), unfolded leaf (plant⁻¹), curd height (cm) and curd circumference (cm) were non-significant. The plant that received AM in nursery bed produced higher curd yield than without AM in all phosphorus levels of cauliflower. The highest cauliflower curd yield (43.2 t ha⁻¹ in 2020 and 51.9 t ha⁻¹ in 2021) was recorded in 50% P with AM (AM was used in nursery bed) in Madhupur Tract soil (AEZ 28). The result indicates that inoculation of AM used in nursery bed can save 50% P in the field. The plant which did not receive AM in nursery bed produced lower yield in all phosphorus levels in the field.

Isolation of salt tolerant *rhizobium* and their characterization, plant growth promoting and symbiotic performance on oilseed legume

F. Alam, M.F.A. Anik, M. Rahman, M.E. Ali and H.M. Naser

A study was conducted at Soil Science Division, Bangladesh Agricultural Research Institute, during 2019-2021 with the objectives to isolate of salt-tolerant rhizobia species from coastal saline area of Bangladesh, characterize, plant growth promoting and symbiotic performance of those effective salt tolerant bacteria on oil seed legumes. For isolating of salt tolerant Rhizobium bacteria, 20 nodule samples were collected from soybean and groundnut root from different fields of saline stress soils (Noakhali, Lakhimpur, Cox's Bazar, Bhola, Patuakhali) of Bangladesh using global positioning system (GPS) record along with crop history.

Nodules were collected aseptically, purified strains and preserved at 4°C for short time preservation and kept in -20°C, for long time preservation. The characters of 20 bacterial isolates (10 isolates from soybean and 10 isolates from groundnut) were studied following the standard microbiological and biochemical methods. The cells of *Rhizobium* isolates were examined under microscope and found that the cells were rod shape, motile and gram-negative bacteria. The biochemical characters such as Congo red, Gram staining, salt tolerance was investigated. The isolates were observed to lack the ability to absorb Congo red from YEMA medium. The salt tolerance study was carried out on YEM agar plate with each modified by NaCl at 0, 2, 4, 8, 16 and 32 dSm⁻¹. All isolated bacteria were tested by growing on plate up to (>32 dS m⁻¹) level. Seedlings were grown in glass tube to check the infection ability of *Rhizobium* (strain SR11 to SR20 for soybean and strain GR11 to GR20 for groundnut) and found nodule formation in seedling roots within 30-50 days after inoculation.

DNA isolation, molecular characterization and gene sequences of salt tolerant rhizobial strains and their symbiotic effect on groundnut at different salinity level under pot culture

F. Alam, M. Rahman, M.F.A. Anik, M.E. Ali, S. Akhter and H.M. Naser

A pot experiment was carried out at the net house of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur (24.00° N latitude, 90.25° E longitude and 8.4 m elevation) during rabi season of 2020-21 with the objective to symbiotic and molecular characterize of salt tolerant rhizobial strains and to evaluate the performance of salt tolerant bacterial trails on growth and yield of groundnut at different salinity level under pot culture. The pot soil belongs to the Chiata series of Grey Terrace Soil. The experiment was laid out in Complete Randomized Design (CRD) with three replications. There were 12 treatments viz. T₁: *Rhizobium* GR1, T₂: *Rhizobium* GR2, T₃: *Rhizobium* GR3, T₄: *Rhizobium* GR4, T₅: *Rhizobium* GR5, T₆: *Rhizobium* GR6, T₇: *Rhizobium* GR7, T₈: *Rhizobium* GR8, T₉: *Rhizobium* GR9, T₁₀: *Rhizobium* GR10, T₁₁: *Rhizobium* BARI RAH 801, T₁₂: Control. The pot soils were modified with 0, 4, 8, 12, 16 dS m⁻¹

salinity level by adding NaCl on to the pot. The tested crop was groundnut (cv. BARI Chinabadam-8). Seeds were shown on 27 December 2020. Peat based rhizobial inoculum containing 10⁸ cells g⁻¹ inoculum was used at the rate of 1.5 kg ha⁻¹. Seeds were mixed thoroughly with inoculum (20:1 ratio) before sowing. Ten seeds were sown in each pot 1 cm soil depth. Seeds were used at the rate of 75 kg ha⁻¹. Application of salt tolerance *Rhizobium* biofertilizer on groundnut, the inoculated plants exhibited better performance in nodule numbers, nodule weights, aboveground biomass, root biomass, and plant height than non-inoculated plants, indicating that all *Rhizobium* sp. effectively enhanced nodulation and growth parameters on groundnut plant than non-inoculated plants in all salinity levels. In pot trials, plants inoculated with *Rhizobium* sp. showed higher pod yield, stover yield and seed yield than non-inoculated plants, revealing the positive impact of *Rhizobium* sp. on yield parameters of groundnut. Groundnut plants inoculated with *Rhizobium* sp. showed better performance comparatively with *Rhizobium* sp. GR9 and *Rhizobium* sp. GR4 considering average nut yield of groundnut at different salinity levels than non-inoculated plants. Therefore, *Rhizobium* sp. established an effective symbiotic association with groundnut and was responsible for increased growth and biomass, and improved yield characteristics of groundnut at different salinity levels. *Rhizobium* sp. GR4 and *Rhizobium* sp. GR9 bacterial sequence were found, and phylogenetic analysis were revealed that all *Rhizobium* strains were belonging to bacteria kingdom, proteobacteria phylum, alpha proteobacteria class, rhizobiales order, rhizobiaceae family, and genus *Rhizobium*.

Salt tolerant bacterial performance on groundnut in saline stress coastal region of Bangladesh

F. Alam, M.F.A. Anik, M. Rahman, M.E. Ali and H.M. Naser

A field experiment was carried out at On Farm Research Division, Bangladesh Agricultural Research Institute, Cox's Bazar during rabi season of 2019-2020 and 2020-2021 with the objective to study on nodulation capacity of salt tolerant rhizobial strains and their performance on growth and yield of groundnut under field condition. Seeds

were shown on 23 December 2019 and 13 December 2020 in Cox's Bazar, respectively. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. There were 12 treatments viz. T₁: Rhizobium GR1, T₂: Rhizobium GR2, T₃: Rhizobium GR3, T₄: Rhizobium GR4, T₅: Rhizobium GR5, T₆: Rhizobium GR6, T₇: Rhizobium GR7, T₈: Rhizobium GR8, T₉: Rhizobium GR9, T₁₀: Rhizobium GR10, T₁₁: Rhizobium BARI RAh 801 and T₁₂: Control. The tested crop was groundnut (cv. BARI Chinabadam-8). Peat based rhizobial inoculum containing 10^8 cells g⁻¹ and inoculum was used at the rate of 1.5 kg ha⁻¹. Seeds were mixed thoroughly with inoculum (20:1 ratio) before sowing. Seeds were used at the rate of 75 kg ha⁻¹. Application of salt tolerance Rhizobium biofertilizer on groundnut, the inoculated plants exhibited better performance in nodule numbers, nodule weights, aboveground biomass, root biomass, and plant height than non-inoculated plants, indicating that all Rhizobium sp. effectively enhanced nodulation and growth parameters on groundnut plant than non-inoculated plants. In field trials, plants inoculated with Rhizobium sp. showed higher pod yield, stover yield and seed yield than non-inoculated plants, revealing the positive impact of Rhizobium sp. on yield parameters of groundnut in saline area. Groundnut plants inoculated with Rhizobium sp. GR9 showed highest nut yield of 2.82 t ha⁻¹ in 2019-20 and 2.90 t ha⁻¹ in 2020-21 at Cox's Bazar of Chattogram Coastal Plain AEZ's than other strains inoculated and non-inoculated plants.

Salt tolerant bacterial performance on soybean in saline stress coastal region of Bangladesh

F. Alam, M.F.A. Anik, M. Rahman, M.E. Ali and H.M. Naser

A field experiment was carried out at On Farm Research Division, Bangladesh Agricultural Research Institute, Noakhali during rabi season of 2019-20 and 2020-21 with the objective to study on nodulation capacity of salt tolerant rhizobial strains and their performance on growth and yield of soybean under field condition. Seeds were shown on 23 January 2020 and 12 January 2021 in Noakhali, respectively. The experiment was laid out in Randomized Complete Block Design

(RCBD) with three replications. There were 12 treatments viz. T₁: Rhizobium SR1, T₂: Rhizobium SR2, T₃: Rhizobium SR3, T₄: Rhizobium SR4, T₅: Rhizobium SR5, T₆: Rhizobium SR6, T₇: Rhizobium SR7, T₈: Rhizobium SR8, T₉: Rhizobium SR7, T₁₀: Rhizobium SR10, T₁₁: Rhizobium BARI RAh 801 and T₁₂: Control. The tested crop was soybean (cv. BARI Soybean-5). Peat based rhizobial inoculum containing 10^8 cells g⁻¹ and inoculum was used at the rate of 1.5 kg ha⁻¹. Seeds were mixed thoroughly with inoculum (20:1 ratio) before sowing. Seeds were used at the rate of 75 kg ha⁻¹. Application of salt tolerance Rhizobium biofertilizer on soybean, the inoculated plants exhibited better performance in nodule numbers, nodule weights, aboveground biomass, root biomass, and plant height than non-inoculated plants, indicating that all Rhizobium sp. effectively enhanced nodulation and growth parameters on soybean plant than non-inoculated plants. In field trials, plants inoculated with Rhizobium sp. showed higher pod yield, stover yield and seed yield than non-inoculated plants, revealing the positive impact of Rhizobium sp. on yield parameters of soybean in saline area. Soybean plants inoculated with Rhizobium sp. SR7 showed highest seed yield of 2.08 t ha⁻¹ in 2019-20 and 2.04 t ha⁻¹ in 2020-21 at Noakhali of Chattogram Coastal Plain AEZ's than other strains inoculated and non-inoculated plants.

Biocontrol of foot and root rot disease of groundnut (*Arachis hypogaea*) by dual inoculation with *rhizobium* and arbuscular mycorrhiza

M. Rahman, F. Alam, M.N. Islam, M.F.A. Anik, M.E. Ali and H.M. Naser

The present study was carried out to investigate the potential of AM (Arbuscular mycorrhiza) fungi alone and in combination with bioinoculants i.e. Rhizobium to find out the best combination on dry biomass, nodulation, colonization and yield, along with their biocontrol against groundnut foot and root rot caused by *Sclerotium rolfsii*. The study was carried out under pot culture condition in the net house of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur in 2020 and 2021. The experiment was designed in RCBD with eight treatments and four replications. Peat based rhizobial inoculum (BARI RAh-801)

was used in this experiment. Soil based AM inoculum containing about approximate 252 spores and infected root pieces of the host plant was used pot⁻¹. The treatments were Arbuscular mycorrhiza (AM), Rhizobium, AM+Rhizobium, Sclerotium rolfsii, Sclerotium rolfsii+AM, Sclerotium rolfsii+Rhizobium, Sclerotium rolfsii+AM+Rhizobium and Control. Dual inoculation (AM+Rhizobium) significantly increased dry biomass, nodulation, colonization, yield and yield attributes of groundnut compared to single inoculation or any other treatments. The result showed that dual inoculation (AMF+Rhizobium) increased nut yield (59.61% in 2020 and 26.32% in 2021) and stover yield (23.21% in 2020 and 33.74% in 2021) compared to control. On the contrary, Sclerotium rolfsii+AMF+Rhizobium increased nut yield (65.50% in 2020 and 52.94% in 2021) and stover yield (36.45% in 2020 and 99.35% in 2021) compared to only Sclerotium rolfsii treatment. Therefore, AMF species and its combination with rhizobial inoculum were not only significant in the formation and effectiveness of AM symbiosis but also increased yield and reduced the incidence of foot and root rot disease in groundnut plants.

Effect of arbuscular mycorrhizal inoculation on groundnut at different salinity levels

M. Rahman, M.E. Ali, M.F.A. Anik, F. Alam and H.M. Naser

Arbuscular mycorrhizal (AM) fungi increase the tolerance of host plants to different level of salinity. A pot experiment was carried out in the net house of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during 2019-2020 and 2020-2021. The objectives of the study were to evaluate the potentiality of arbuscular mycorrhizal inoculation on the nodulation, colonization, fresh and dry biomass, and yield of groundnut treated with different salinity levels. The experiment was designed in factorial randomized completely block design with four replications. Five salinity treatments (0, 2, 4, 6 and 8 dSm⁻¹) possessed salinity levels as the first factor and the second factor consists of mycorrhizal and non-mycorrhizal treatments. Soil based mixed arbuscular mycorrhizal (AM) inoculum containing about approximate 252 ± 20 spores and infected

root pieces of the host plant was used pot⁻¹. With increasing salinity concentration nodulation, colonization, biomass, plant height, nut yield and stover yield decreased significantly. It was observed that 0 dSm⁻¹ + AM treatment produced the highest nut yield (16.93 g plant⁻¹ in 2020 and 19.55 g plant⁻¹ in 2021) and stover yield (19.17 g plant⁻¹ in 2020 and 32.66 g plant⁻¹ in 2021) of groundnut. In contrast, 8 dSm⁻¹ treatments produced the lowest nut yield (12.52 g plant⁻¹ in 2020 and 14.19 g plant⁻¹ in 2021) and stover yield (14.47 g plant⁻¹ in 2020 and 18.69 g plant⁻¹ in 2021) of groundnut. The study clearly indicates that mycorrhizal inoculation could reduce the harmful effects of salinity to the host plants, thus increase plant survival allowing the plants growth under extreme condition.

Effect of arbuscular mycorrhizal fungi, biochar and vermicompost on soybean (*Glycine max*) in saline soil

M. Rahman, M.E. Ali, F. Alam, M.F.A. Anik, M.M. Masud and H.M. Naser

The present study was carried out to evaluate the effect of indigenous Arbuscular Mycorrhizal Fungi (AMF), biochar and vermicompost on nodulation, colonization and yield character of soybean in 8 dS m⁻¹ saline soil. The experiment was carried out under pot culture condition in the nethouse of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur through 2019 to 2021. The experiment was designed in CRD with eight treatments and four replications. The ten treatments were T₁ : Control, T₂ : Arbuscular mycorrhiza (AM), T₃ : Biochar @10 t ha⁻¹, T₄ : Vermicompost @ 3 t ha⁻¹, T₅ : AM + Biochar @ 5 t ha⁻¹, T₆ : AM + Biochar @ 10 t ha⁻¹, T₇ : AM + Vermicompost @ 3 t ha⁻¹, T₈ : AM + Vermicompost @ 6 t ha⁻¹, T₉ : Biochar @ 5 t ha⁻¹ + Vermicompost @ 3 t ha⁻¹ and T₁₀ : AM + Biochar @ 5 t ha⁻¹ + Vermicompost @ 3 t ha⁻¹. The result showed that AM + Biochar @ 5 t ha⁻¹ + Vermicompost @ 3 t ha⁻¹ treatment produced the highest nodulation, colonization and yield character of soybean in 8 dS m⁻¹ saline soil and control treatment produced lower nodulation, colonization and yield character of soybean in saline soil. AM + Biochar @ 5 t ha⁻¹ + Vermicompost @ 3 t ha⁻¹ treatment (T₁₀) produced 3.03%, 25.65%, 16.30%

and 164% seed yield in 2019, 10.00%, 16.38%, 5.90% and 35.86% seed yield in 2020 and 0.40%, 9.50%, 0.53% and 99.21% seed yield in 2021 compared to T₉ (Biochar @ 5 t ha⁻¹ + Vermicompost @ 3 t ha⁻¹), T₇ (AM + Vermicompost @ 3 t ha⁻¹), T₅ (AM + Biochar @ 5 t ha⁻¹) and T₁ (Control) treatment. On the other hand, T₁₀ treatment produced 1.52%, 18.73%, 10.87% and 66.90% stover yield in 2019, 7.49%, 14.86%, 12.29% and 48.89% stover yield in 2020 and 2.54%, 25.55%, 19.07% and 100% stover yield in 2021 compared to T₉, T₇, T₅ and T₁ treatment. The above-mentioned combination could sustain soil health, ensure better growth and productivity in a saline environment.

Effect of biofertilizer, biochar and chemical fertilizers on yield and qualitative properties of groundnut

M. Rahman, F. Alam, M.E. Ali, M.F.A. Anik, M.M. Masud and H.M. Naser

A field experiment was conducted at BARI Central Farm, Joydebpur, Gazipur to evaluate the effect of biofertilizer, biochar and chemical fertilizers on yield and qualitative properties of groundnut during the rabi season of 2020-2021. The crop variety was BARI Chinabadam-8 and Rhizobium strain was BARI RAh-803. There were nine treatments viz. T₁: Control (non-inoculated and non-fertilized), T₂: Biochar @ 5 t ha⁻¹, T₃: Biochar @ 10 t ha⁻¹, T₄: Biochar @ 5 t ha⁻¹ + IPNS based NPKS, T₅: Biochar @ 10 t ha⁻¹ + IPNS based NPKS, T₆: Biochar @ 5 t ha⁻¹ + Rhizobium + IPNS based PKS, T₇: Biochar @ 10 t ha⁻¹ + Rhizobium + IPNS based PKS, T₈: 100% NPKS, T₉: Rhizobium inoculant + 100% PKS which were replicated three times. Peat based rhizobial inoculum was used at the rate of 1.5 kg ha⁻¹ as seed inoculant. The result showed that the highest nut yield (1.64 t ha⁻¹) and stover yield (6.20 t ha⁻¹) were observed in T₇ (Biochar @ 10 t ha⁻¹ + Rhizobium + IPNS based PKS) treatment which was identical with the T₆ (Biochar @ 5 t ha⁻¹ + Rhizobium + IPNS based PKS) treatment having nut yield and stover yield 1.55 t ha⁻¹ and 5.80 t ha⁻¹, respectively. So, we can able to reduce biochar and inorganic fertilizer without affecting the quality and productivity of groundnut. From the trial, it can be concluded that Biochar @ 5 t ha⁻¹ + Rhizobium + IPNS based PKS may be

recommended for groundnut cultivation in Grey Terrace Soil of Joydebpur (AEZ-28).

Effect of biofertilizer and chemical fertilizers on soil microbial population status, nodulation pattern, nodule initiation date and yield of chickpea varieties

M.F.A. Anik., M.E. Ali., F. Alam, M. Rahman and H.M. Naser

A field experiment was conducted at central farm of Bangladesh Agricultural Research Institute (AEZ-28) during rabi season 2020-2021 to evaluate the effects of biofertilizer and chemical fertilizer on soil microbial population status, nodulation pattern, nodule initiation date and yield of chickpea varieties. The experiment was designed in randomized complete block (RCBD) with 2 factors (fertilizer doses and varieties) having 3 replications in each treatment. Three fertilizer doses were 100% PKS₂ZnB, Rhizobium + 100% PKS₂ZnB, 100% NPKS₂ZnB and three varieties were BARI chola-5, BARI chola-9 and BARI chola-10. Unit plot size was 3 m x 2 m. There were 9 treatment combinations. Basic doses of fertilizers were 50-22-42-20-5-1 kg N-P-K-S-Zn-B ha⁻¹. All the fertilizers except N were applied as basal at final land preparation. N was applied in three equal splits at 10, 20 and 30 days after sowing. Peat based rhizobial inoculum (BARI RCa-259) @ 1.5 kg ha⁻¹ was used for seed inoculation. Peat based rhizobial inoculum was used containing about 10⁸ cells g⁻¹ inoculum. BARI chola-9 has the greater ability to produce maximum number of nodule than all other varieties. In this experiment we found that chickpea varieties required 21 days for their first nodulation. The nodulation pattern trend was BARI chola-9 > BARI chola-10 > BARI chola-5 in Gazipur during 2020-2021. In three varieties, nodule initiation was increased during the pre-flowering stages but decreases when it turns into reproductive stages. The better nodulation was observed after 63 days of chickpea seeds sowing specially at BARI chola-9 varieties. 100% NPKS₂ZnB and Rhizobium + 100% PKS₂ZnB treated plot performed better than 100% PKS₂ZnB treated plot. In respect of variety, BARI chola-10 gave better results than others. Combined effects of fertilizer doses and varieties, Rhizobium + 100% PKS₂ZnB with BARI chola-10 and 100% NPKS₂ZnB with BARI chola-10 significantly gave

the highest straw yield and seed yield in Gazipur. In case of microbial population status, Rhizobium + 100%PKSZnB treated plot showed the maximum number of populations in Gazipur during 2020-2021. Rhizobium + 100% PKSZnB and 100% NPKSZnB with BARI chola-9 showed the maximum nutrient uptake from soil. All the nutrients during chickpea production exhibited the negative apparent nutrient balances in Gazipur during 2020-2021.

Isolation of phosphate solubilizing bacteria (PSB) and their efficacy on the growth of barley

M.F.A. Anik., M.E. Ali., F. Alam., M. Rahman, S. Akhter and H.M. Naser

A pot experiment was conducted during rabi season 2020-2021 at the net house of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to isolate the phosphate solubilizing bacteria (PSB) and their performance on the growth of barley laid out in RCBD with three replications. There were five treatments viz. T₁= Control, T₂= PSB isolate I (AEZ-29), T₃= PSB isolate II (AEZ-03), T₄= PSB isolate III (AEZ-11) and T₅= PSB isolate IV (AEZ-09). The four isolated PSB strains containing about 10⁸cells g⁻¹ inoculum. Among five different

treatment combinations, T₄ (PSB isolate III, AEZ-11) performed better than others. The germination percentage (97.3%) and seedling vigor index (3573) exhibited the better results significantly in T₄ treatment. In different growth parameters of barley like plant height (74.6 cm), root length (21.5 cm), root weight (399 mg), no. of tiller per hill (2.33), no. of spikes per hill (2.10), no. of kernel per spike (46.2), spike length (15.3 cm) and no. of filled kernel per spike (41.0) also showed the superior results in the same treatment. The PSB isolate III, AEZ-11 (T₄) revealed the maximum 1000-kernel weight (35.3 gm), seed yield per 10 plants (16.0 gm) and straw yield per 10 plants (24.6 gm), respectively. In respect of nutrient content, the seed and straw of barley showed the maximum amount of N (2.42 and 1.42%), P (0.70 and 0.51%), K (0.90 and 2.50%) content in the T₄ treatment. The better performing PSB isolate (PSB isolate III) increased the P availability in the soil than rest of the three isolates. The enormous amount of PSB population (3.0 x 10⁵ per gm soil) was also produced in the T₄ treatment. The worst performance was recorded in the T₁ (Control) treatment in case of all parameters of barley production.



Integrated pest management

Field evaluation of some new bio-pesticides against fall armyworm attacking maize

Field experiment was conducted in the research field of Entomology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur during December 2020 – May 2021. The experiment was laid out in Randomized Complete Block Design (RCBD) having 3 replications and 6 treatments including control. The treatments were assigned as follows: T₁: *Celastrus angulatus* 1% EW (Bio-Chamak) @ 2.5 ml/ litre of water; T₂: *Bacillus thuringiensis* var. Kurstaki (Bio-Bt-K) @ 1 g/litre of water; T₃: *Metarhizium anisopliae* (Lycamax) @ 1 g/litre of water; T₄: Azadirachtin 0.03% (Nimbicidine) @ 4 ml/litre of water; T₅: Bt+Spinosad (Minchu Plus) @ 2 ml/ litre of water, and T₆: Untreated control. The treatments were applied 5 times during whole cropping season. The first three sprays were given at seedling and vegetative stages at 15 days intervals starting from the initiation of plant infestation (plants with small fresh window panes). The last two sprays were done at 7 days interval starting from initiation of cob infestation (cobs with characteristic signs of FAW damage). Two new biopesticides, Bt+Spinosad (Minchu plus) and *Bacillus thuringiensis* var. Kurstaki (Bio-Bt-K) showed higher effectiveness in reducing plant and cob infestation compared to other biopesticides. Significantly the highest grain yield 9.75 t/ha was obtained from Bt+Spinosad treated plots followed by *Bacillus thuringiensis* var. Kurstaki (9.37 t/ha).

Evaluation of some integrated management packages against flower thrips and pod borers of mungbean

Several management packages were evaluated against flower thrips and pod borers of mungbean

at BARI, Gazipur during kharif I 2021. The experiment was laid out in randomized complete block design with three dispersed replications. The treatments were: T₁ = IPM Package-1: Installing blue sticky trap + two spraying of Biotrin (Matrine 0.5% AS) @ 1.4 ml/litre of water, first spray at 100% flowering stage and second spray after 7 days of first spray + third spraying with spinosad (Success 2.5 SC) @ 1.2 ml/litre of water after 7 days of second spray, T₂ = IPM Package-2: Installing blue sticky trap + two spraying of Bio-chamak (*Celastrus angulatus* 1% EW) @ 2.5 ml/litre of water, first spray at 100% flowering stage and second spray after 7 days of first spray + third spraying with spinosad (Success 2.5 SC) @ 1.2 ml/litre of water after 7 days of second spray, T₃ = IPM package-3: Installing blue sticky trap + two spraying of chlorfenapyr (Intrepid 10 SC) @ 1 ml/litre of water, first spray at 100% flowering stage and second spray after 7 days of first spray + third spraying with Emamectin benzoate (Proclaim 5 SG) @ 1 g/litre of water after 7 days of second spray, T₄= Recommended package: Three spraying of imidacloprid (Imitaf 20 SL) @ 0.5 ml/l of water; first spray at 100% flowering stage, second spray after 7 days of first spray and third spray after 7 days of second spray, and T₅= Untreated control. Recommended package appeared as the best followed by IPM Package 3, i.e. installing blue sticky trap + two sprays of chlorfenapyr + third spraying with emamectin benzoate. The highest Marginal Benefit Cost Ratio (MBCR) (5.64) was obtained from recommended package followed by in IPM package 3 (2.52).

Evaluation of several management packages against pod borer, *helicoverpa armigera* infesting chickpea

The experiment was conducted at BARI, Gazipur, during rabi 2020-21 to evaluate different IPM

packages against pod borer infesting chickpea. The packages were: T₁ = Pheromone mass trapping + Spraying of spinosad 2.5 SC (1.2ml/ litre of water); T₂ = Pheromone mass trapping + Spraying of Minchu plus (Bt-Kurstaki + spinosad) @ 2.0 ml/litre of water; T₃ = Pheromone mass trapping + Spraying of Bio-chamak 1% EW (*Celastrus angulatus*) @ 2.5ml/ litre of water; T₄ = Farmers' practice: Spraying of Nitro 505 EC (cypermethrin + chlorpyrifos) @ 2 ml/litre of water, and T₅= Untreated control. The experiment was laid out in a randomized complete block design with three replications (dispersed). Results indicated that the lowest pod damage (3.01%) and the highest yield (1.48 t/ha) was recorded from sex pheromone mass trapping + spraying of Minchu plus @ 2.0 ml/litre of water followed by sex pheromone mass trapping + spraying of Bio-chamak 1% EW @ 2.5ml/ litre of water.

Evaluation of new dimensional management options against sucking pests of brinjal

Field experiments were conducted at BARI, Gazipur during 2020-21 cropping season. The experiment was laid out in RCBD having three dispersed replications and 10 treatments including control. The treatments were: T₁ = *Verticillium lecani* (Bio Catch 1.15% WP) @ 6.0 g/L of water; T₂ = *Metarhizium anisopliae* (Bio Magic 1.15% WP) @ 6.0 g/L of water; T₃ = *Beauveria bassiana* (Bio Power) @ 6.0g/L of water; T₄ = *Bacillus thuringiensis* var. Kurstaki (Bio Fighter) @ 2.5g/ L of water; T₅ = *Bacillus thuringiensis* var. Kurstaki (Biocure) @ 1.0g/L of water; T₆ = *Metarhizium anisopliae* (Lycamax 2.0% WP) @ 1.0 gl/L of water; T₇ = *Beauveria bassiana* from Russle IPM @ 1.0 g/L of water; T₈ = Afidopyropen 5% (Sefina 5 DC) @ 2ml/l of water; T₉= Farmers' practice: spraying with thiamethoxam (Actara 25 WG @ 0.2g/L of water) & T₁₀=Untreated control. The bio-pesticides were sprayed thrice starting from the first sight of pest infestation at 07 days intervals. Afidopyropen (Sefina 5 DC) @ 2ml/l of water proved to be best approach reducing 83.53%, 83.46% and 88.77% aphid, jassid and whitefly population, respectively over control. *Bacillus thuringiensis* var. Kurstaki (Biocure) sprayed at @ 1.0g/L of water was also found promising considering relatively less attack of sucking pests.

Afidopyropen (Sefina 5 DC) provided highest yield (16.45 t/ha) followed by *Bacillus thuringiensis* var. Kurstaki (Biocure) (13.97 t/ha).

Evaluation of some bio-pesticides and a chemical insecticide against sucking insect pests of yard long bean

The experiment was conducted at the research field of BARI, Gazipur during 2021. Yard long bean seeds of Toki (Hybrid) variety were transplanted in plots of size 4.8m x 2.5m. The experiment was laid out in RCBD having 3 replications. Four biopesticides and a chemical insecticide were evaluated in this study, so there were 6 treatments including control. The treatments were: T₁= Spraying Bio-chamak 1% EW (*Celastrus angulatus*) @ 2.5 ml/litre of water; T₂= Spraying Biomax M 1.2 EC (Abamectin) @ 1 ml/ litre of water ;T₃= Spraying Fizimite (10% Sodium lauryl ether sulfate) @1 ml/ litre of water;T₄= Spraying Bioclean (D- limonene) @ 1 ml/ litre of water;T₅= Spraying Imitaf 20 SL (Imidacloprid) @ 0.5 ml/ litre of water;T₆= Control (Water spray only). Treatment applications were started as soon as the infestation of sucking insects were noticed and continued at weekly interval upto last harvest of the crop. The biopesticide, Biomax M 1.2 EC (Abamectin) performed best considering reduced infestation of the target pests and the higher yield. The chemical insecticide Imitaf 20 SL offered second best performance, while the other bio-pesticides offered intermediate level of performance. The biopesticide, Biomax M 1.2 EC provided the highest yield increase (34.39%) over control.

Management approach against pod borer, *eucrysops cnejus* F. Attacking yard long bean

The experiment was conducted in the research field of Entomology Division, BARI, Gazipur during Kharif 1, 2021. Yard long bean seeds of Toki (Hybrid) variety were transplanted in a plot of 4.8m x 2.5m. The experiment was laid out in RCBD having 3 replications and 6 treatments including control. The treatments were: T₁= Package (1): Sanitation i.e. hand picking of infested flowers and pods with larvae + 4 sprays of Bio-chamak 1% EW (*Celastrus angulatus*) @ 2.5 ml/litre of water;T₂= Package (2): Sanitation + 4 sprays of bio-pesticide

Antario (Bt+ Abamectin) @ 1g/ litre of water at fortnightly interval; T₃= Package (3): Sanitation + 4 sprays of bio-pesticide Biocure (*Bacillus thuringiensis*) @ 1g/ litre of water at fortnightly interval; T₄= Package (4): Sanitation + 4 sprays of bio-pesticide Biotrin (Matrine) @ 1.5 ml/ litre of water at fortnightly interval; T₅= Package (5): Farmers practice- spraying of Proclaim 5 SG (Emamectin benzoate) @ 1g/litre of water; altogether 8 sprays were done starting from the initiation of the pest attack at weekly interval; T₆= Untreated control. Treatment applications were started as soon as the infestation of pod borer was noticed. The management package 2 (sanitation + spraying bio-pesticide Antario) performed best in reducing flower and pod damage by pod borer which was followed by package 3 (Sanitation + spraying bio-pesticide Biocure). The management package 2 appeared best as it provided the highest yield (14.55 t/ha) and marginal benefit cost ratio (8.18).

Management of fruit borer, *deudorix isocrates* attacking wood apple

Field experiments were conducted for developing management approach against fruit borer, *Deudorix isocrates* attacking wood apple at experimental field Horticulture Fruit Research Station, BARI, Gazipur, and Breeder Seed Production Centre, Debiganj, Panchgarh during 2020-21. The experiments was laid out in RCBD design with three replications. There were six treatments including control. With some exceptions the same methodology was followed in both the locations. The treatments were: T₁= Sanitation+ polythene bagging when the fruits were at marble stage, T₂= Sanitation + bio-pesticide Minchu plus (Bt+Spinosad) @ 2 ml/ litre of water, T₃= Sanitation +spraying of Spinosad (Success 2.5SC) @ 1.2 ml/L of water, T₄= Sanitation +spraying of Azadirachtin (Fytomax 3 EC) @ 1.0 ml/litre of water, T₅= Spraying of Emamectin benzoate (Proclaim 5SG) @ 1.0 g/litre of water, T₆= Untreated control. Sanitation +Spraying of Spinosad (Success 2.5SC) @ 1.2 ml/L of water was found most effective which reduced 75.4 % and 81.8% fruit infestation over control at Gazipur and Panchgarh, respectively.

Population dynamics and bio-rational management of whitefly complex infesting guava

The present investigation was carried out at Entomology Research Field-2, BARI, Gazipur during January- June 2021 to document the population fluctuation of whitefly as well as to develop a suitable management option against newly introduced invasive pest Rugose Spiraling Whitefly (RSW). There were eight treatments including control. Treatments were: T₁= Spraying of Bioclean @1.0 ml/L of water; T₂= Spraying of Fizimite @ 1.0 ml/L of water; T₃= Spraying of Biotrin @ 1.5 ml/L of water; T₄= Spraying of Fytoclean 7.5 ml/L of water; T₅= Spraying of Bio-chamak @ 2.5 ml/L of water; T₆= Spraying of Fytomax @ 1 ml/L of water; T₇= Spraying of Confidor 70 WG @ 0.2 g/L of water; T₈= Untreated control. The peak period of RSW infestation was during January to March (about 54.11% to 58.79% leaf infestation and 7.58 to 13.14 adult/leaf were noticed at that time). Spraying of Bio-chamak @ 2.5 ml/L of water offered the highest reduction (81.19%) of adult whitefly population over control.

Biological control

Survey on the abundance of natural enemies of fall armyworm, *spodoptera frugiperda* attacking maize crop in Bangladesh

Field surveys were conducted in Saturia Upazila of Manikganj and Gazipur from April 2020 to April 2021 to identify and assess the abundance of natural enemies of Fall Armyworm, *Spodoptera frugiperda* attacking maize crop. Fall Armyworm (FAW) life stages (egg masses, larvae and pupae) were collected fortnightly from 10 (ten) randomly selected farmers' maize fields of the studied locations. In each field, FAW samples were collected from the randomly selected 25 m² area at two spots during the afternoon. Fall Armyworm egg masses, larvae and pupae were isolated in rearing containers for completion of development or emergence of parasitoids. The parasitoids that emerged from the eggs or larvae were recorded every 24 h until pupation. Parasitoids were preserved individually in 70% alcohol. A total of six species of parasitoids which parasitized FAW and one species of predatory bug (Spined soldier

bug) were found in the studied areas. Among them, two were egg parasitoids and identified as *Telenomus remus* and *Trichogramma pretiosum*, and three were larval parasitoid (*Cotesia* sp., *Campoletis* sp. and *Netelia* sp. another one was egg-larval parasitoid (*Chelonus* sp.). Egg mass parasitism by *Telenomus remus* was common at Manikgonj and Gazipur.

Efficacy of *Trichogramma pretiosum* and *Telenomus remus* for parasitizing the eggs of fall armyworm (FAW) in laboratory

A study was conducted on parasitization efficiency of *Telenomus remus* and *Trichogramma pretiosum* on eggs of *Spodoptera frugiperda* in IPM laboratory at Entomology division, BARI, Gazipur during February - April 2021. Experiments were conducted in the laboratory in a no-choice test using test tube as study areas with fresh eggs of host (FAW). Fall Armyworm eggs were collected from mass culture of FAW at IPM laboratory. Eggs of up to 24 h of age were used. The egg mass were glued to white paper (10 × 1.5 cm) with gum acacia diluted in distilled water. Female wasps used in the experiments were up to 24-h-old which were allowed to parasitize the FAW eggs for 48 h with replication 6. Parasitism efficiency of tested *Telenomus remus* wasps was recorded 95.91%. Adult emergence rate from the parasitized eggs was 86.75% with 80.11% female. Egg-to-adult period of *T. remus* in fall armyworm eggs was 14.69 days and adult female survive up to 9.00 days whereas the parasitism efficiency of tested *Trichogramma pretiosum* wasps was recorded 84.12%. Adult emergence rate from the parasitized eggs was 73.31% with 81.67% female. Egg-to-adult period of *Trichogramma pretiosum* in fall armyworm eggs was 10.0 days and adult female survived up to 8.67 days.

Pesticide toxicology

Study on residue degradation of newly registered along with some commonly used insecticides in selected vegetables under supervised field trial

The study was carried out to detect and quantify the residue of chlorpyrifos + cypermethrin in hyacinth bean, deltamethrin and cypermethrin in cauliflower

and lettuce and comparison between the detected residue levels with Maximum Residue Limit (MRL) set by European Union. Five supervised field trials were undertaken sprayed with chlorpyrifos + cypermethrin @ 1ml/L of water in hyacinth bean, deltamethrin and cypermethrin @ 1ml/L of water in cauliflower and lettuce. Samples were collected at 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11 days after spray (DAS). The residues of chlorpyrifos + cypermethrin were detected up to 9 DAS. All of the quantities of residue were above the EU-MRL up to 9 DAS (5.216 -0.019 mg/kg) in hyacinth bean. Although cypermethrin residue detected up to 7 DAS and the quantities were above EU-MRL up to 4 DAS (2.684-0.712 mg/kg) but the chlorpyrifos degrade slowly than cypermethrin. The residue of deltamethrin was above EU-MRL up to 4 DAS in lettuce; 8 DAS in cauliflower. In case of cypermethrin, the residue was above EU-MRL up to 3 DAS in lettuce; 4 DAS in cauliflower. Therefore, lettuce and cauliflower can be harvested safely at 4 DAS and at 5 DAS for cypermethrin. In case of deltamethrin lettuce can be harvested safely at 5 DAS and cauliflower at 9 DAS and for chlorpyrifos + cypermethrin hyacinth bean can be harvested safely at 10 DAS.

Quantification of pesticide residue load in major vegetables collected from different regions of Bangladesh

The study was conducted to detect and quantify the left over residue of four commonly used pesticides (lambda cyhalothrin, fenvalerate, cypermethrin and deltamethrin) in three vegetables like cauliflower, hyacinth bean and brinjal collected from local market of five different locations viz. Rangpur, Jamalpur, Cumilla, Dhaka and Gazipur comparison between the detected residue level with maximum residue limit (MRL) set by European Union (EU). A total of 150 samples of brinjal, cauliflower and hyacinth bean were collected from Rangpur, Jamalpur, Cumilla, Dhaka and Gazipur and were analyzed for the quantification of pesticide residues. Out of 150, 19 samples (about 12.66%) were contaminated with the residues of fenvalerate, cypermethrin, deltamethrin and lambda cyhalothrin. Out of 19 contaminated samples, 12 samples (about 8% of the total number of samples) of brinjal, cauliflower and hyacinth bean contained

residue which were above respective MRL. Among 50 analyzed samples of brinjal, 3 samples (about 6% of the total number of samples) were contaminated with fenvalerate (0.086-0.291 mg/kg) residues which were above MRL. A total of 50 analyzed samples of cauliflower, 6 samples (about 12% of the total number of samples) were of above MRL with fenvalerate (0.094-0.338 mg/kg), lambda cyhalothrin (0.201 mg/kg) and deltamethrin (0.149 mg/kg) residues which were above MRL. In case of 50 analyzed samples of hyacinth bean, 3 samples (about 6% of the total number of samples) contained fenvalerate (0.504 mg/kg), deltamethrin (0.232 mg/kg) and lambda cyhalothrin (0.438 mg/kg) residues, which were above MRL. Samples of cauliflower had more pesticide than other two vegetables (hyacinth bean, brinjal). Cauliflower samples collected from Cumilla and Jamalpur had about 17 times (0.338 mg/kg) and 10 times (0.205 mg/kg) higher residue of fenvalerate than the respective MRL value. Sample of hyacinth bean had 5 times higher residue of fenvalerate (0.504 mg/kg) than MRL value which was collected from Cumilla.

Monitoring of multiple pesticide residues in major fruits collected from different regions of Bangladesh

The study was conducted to analyze multiple pesticide residues in mango, litchi, guava, dragon fruit, hog plum and ber collected from different locations of Bangladesh. A simple and efficient multiple pesticide residue analytical method using Quick, Easy, Cheap, Effective, Rugged and Safe (QuEChERS) extraction technique and Gas Chromatography (GC) coupled with Electron Capture Detector (ECD) were used for the determination of pesticide residues in 40 samples of mango, 30 samples of litchi, 30 samples of guava, 30 samples of ber, 6 samples of hog plum and 6 samples of dragon fruit. A total of 142 fruit samples were analyzed. Among the 40 analyzed samples of mango, 4 were contaminated with cypermethrin and lambda-cyhalothrin residues. Out of 4 contaminated samples, 3 had cypermethrin residues (0.03 mg/kg, 0.045 mg/kg, and 0.07 mg/kg) at a level being below the EU-MRLs and the level of detected lambda-cyhalothrin residue (0.05 mg/kg) was also below the EU-MRLs; out of 30 analyzed samples of litchi, 2 had cypermethrin

residue (0.06 mg/kg and 0.085 mg/kg), which were below EU-MRLs; among the 30 analyzed samples of guava, 2 contained acetamiprid residues (0.015 mg/kg, and 0.028 mg/kg), both of them were above EU-MRL; out of 30 analyzed samples of ber, 4 were contaminated with pesticide residues. One had acetamiprid residue (0.015 mg/kg) and 3 had cypermethrin residues (0.035 mg/kg, 0.048 mg/kg and 0.105 mg/kg). All the contaminated samples of ber contained residues below EU-MRLs. Among the 6 analyzed dragon fruit samples, none of the samples contained residues of the tested pesticides. Out of 6 analyzed hog plum samples, none of the samples contained residues of the tested pesticides.

Monitoring of multiple pesticide residues in betel leaf collected from different regions of Bangladesh

In this study, a Quick, Easy, Cheap, Effective, Rugged and Safe (QuEChERS) extraction technique and Gas Chromatography (GC) coupled with Electron Capture Detector (ECD) were used for the determination of 4 synthetic pyrethroid insecticides, 1 neonicotinoid insecticide and 2 fungicide residues in the samples of betel leaf collected from different locations of Bangladesh. A total of 40 samples were analyzed. Among the analyzed samples of betel leaf, 4 contained detectable residues of the sought pesticides. Out of 4 contaminated samples, 2 were contaminated with cypermethrin residues (0.107 mg/kg, and 0.970 mg/kg) with a level above EU-MRLs, 1 was contaminated with acetamiprid residue (0.150 mg/kg) with a level above EU-MRLs and 1 was contaminated with difenoconazole residue (0.360 mg/kg) with a level being below the EU-MRLs.

Determination of pre harvest interval for neonicotinoid insecticide in selected vegetables under supervised field trial

The study was undertaken to determine pre harvest interval (PHI) for acetamiprid in hyacinth bean and cauliflower based on Maximum Residue Limit (MRL) set by European Union (EU-MRLs). Two supervised field trials were conducted and the selected neonicotinoid insecticide (acetamiprid) was sprayed with the recommended dose (1 g/L of water). Samples were collected at 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15 days after spray

(DAS). The collected samples were extracted and cleaned up using modified Quick, Easy, Cheap, Effective, Rugged and Safe (QuEChERS) extraction technique and the residues were determined by Gas Chromatography (GC) coupled with Electron Capture Detector (ECD). The level of residues of acetamiprid was above MRL up to 12 Days After Spray (DAS) (0.89 mg/kg) in hyacinth bean, and 11 DAS (0.72 mg/kg) in cauliflower. Therefore, the PHI of acetamiprid was determined at 13 DAS for hyacinth bean, and 12 DAS for cauliflower.

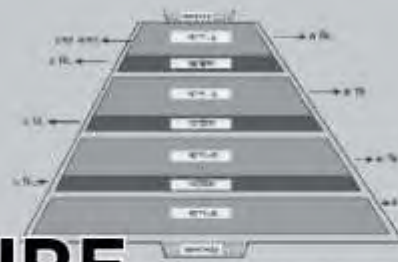
Detection and quantification of different pesticides residue in dry fish collected from different locations

In this study, Gas chromatography with Flame Thermionic Detector (GC-FTD) and Electron Captured Detector (GC-ECD) were performed to monitor seven organophosphorus and nineteen organochlorine pesticide residues in dry fish. The extraction and cleaned up was done with QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) method. A total of 48 (forty eight) dry fish samples of six different dry fish were collected from Dhaka and Gazipur for the quantification of pesticide residue. Among 48 analyzed samples, around 42% samples were contaminated with the residues of dimethoate, fenitrothion, chlorpyrifos and diazinon. The level of residues ranged from 0.02 to 2.4 mg kg⁻¹, where

around 14% of the analyzed samples were found in above MRL. Samples of chingri followed by mola and loitta were found contaminated most. The frequently found pesticide was dimethoate followed by fenitrothion.

Purity analysis of different brands of marketed pesticides

The study was undertaken to determine the purity of available marketed brands of eleven selected pesticides collected from local markets of four different locations of Bangladesh. In this study, Gas Chromatography coupled with Flame Ionization Detector (FID) and Electron Captured Detector (ECD) were used to determine the purity of acephate, diazinon, dimethoate, chlorpyrifos, quinalphos, malathion, cypermethrin, fenvelarate and fenitrothion and High Performance Liquid Chromatography (HPLC 20A Prominence) coupled with Photo Diode Array (PDA) detector was also used in this study to determine the purity of carbofuran and carbosulfan. Results indicated that 36% of tested pesticides have lower Active Ingredient (AI) than stated on the label of container. A total of 63 brands were tested. Out of 63 tested brands, 40 were found 100% pure in terms of AI presence, 15 tested brands contained <100% ≥ 90% AI, 4 tested brands had < 90% AI, one brands contained 65% AI, one brands contained only 5% AI while two brands found without any AI.



Research report on fruit crops

Performance of BARI developed mango varieties in Chattogram hill tracts

M. Islam, M.E. Hoque And M. A. Hossain

An experiment was conducted with five BARI developed mango varieties such as BARI Aam-1, BARI Aam-2, BARI Aam-3, BARI Aam-4 and BARI Aam-8 at hill valley of Hill Agricultural Research Station at Raikhali, Rangamati Hill District during 2020-21 on the existing twelve years old mango orchard with an objective to verify their performance. The maximum plant height (815 cm), highest fruits per plant (240) and yield (21.9 t/ha) was observed in BARI Aam-8. The highest fruit weight (370g), highest fruit Breadth (9.2 cm) and fruit thickness (7.3cm) and maximum TSS (23.0%) were found in BARI Aam-4. The minimum TSS (17.5%) and highest edible portion (80.5%) were recorded in BARI Aam-2. The lowest number of fruits per plant (120), edible portion (65.2%) and fruit yield (5.5t/ha) were found in BARI Aam-1.

Evaluation of mango germplasm for green consumption at hill valley in Chattogram hill tracts

M. Islam, M.E. Hoque And M. A. Hossain

An experiment was conducted at hill valley of Hill Agricultural Research Station of Raikhali, Rangamati Hill District during 2020-21 to find out the best green mango germplasm. The highest number of fruits per plant (129) was found in MIRai008 and the lowest number of fruits per plant (49) was in MIRai006. The heaviest individual fruit weight (251 g) and highest edible portion (80.5%) were recorded in MIR008 on the other hand lowest fruit weight (109 g) was found in MIR007. The maximum TSS (11%) was found in germplasm

MIR008. Germplasm MIR008 was found excellent in organoleptic test.

Evaluation of phalsa in hilly area of Rangamati

M. Islam, M.E. Hoque And M. A. Hossain

An experiment on the evaluation of phalsa in hill valley was conducted at the established minor fruits orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21. Maximum yield per plant (9.8 kg), fruit length (9.25 mm), highest TSS (25.5 %) and fruit yield (4.1 t/ha) was found in the genotype GARai002 on the other hand highest 100 fruit weight (60.2 g) was measured in the genotype GARai003.

Evaluation of pummelo in hilly region of Rangamati

M. Islam, M.E. Hoque And M. A. Hossain

An experiment with thirteen germplasms of pummelo was conducted at the existing twelve years old orchard of pummelo plants collected from different parts of Chittagong Hill Tracts at hill valley of Hill Agricultural Research Station of Raikhali in Rangamati Hill District during the period of 2020-21 for the evaluation of superior pummelo genotypes in hilly region. The maximum number of fruits per plant (67) was observed in CGRai052 followed by CGRai008 (63) and CGRai047 (63), whereas the minimum (19) in CGRai011. The earliest flowering (mid-February) was recorded in CGRai006 and the latest (mid-March) in CGRai047. The highest weight of individual fruit (1450g) was recorded in CGRai010 followed by CGRai011 (1400g). Highest edible portion (66%) also found in CGRai010. Maximum TSS (12.1%) was recorded in CGRai014. The genotypes CGRai007, CGRai009, CGRai014, CGRai030 and CGRai047 were found promising.

Evaluation of dragon fruit germplasm in Rangamati hilly area

M. Islam, M.E. Hoque And M. A. Hossain

An experiment with two germplasm of dragon fruits collected from different parts of the country were conducted at five years old dragon fruit orchard of Hill Agricultural Research Station, Raikhali, Rangamati. The maximum individual fruit weight (470 g) was recorded from HURai001 followed by HURa002 (415 g) but the minimum (272 g) in the check variety BARI dragon fruit-1. The highest number of fruits per pillar (64) was observed in the check variety BARI dragon fruit-1 followed by HURai002 (60) against the lowest in HURai001 (56). The maximum TSS (12.1%) was found in both HURai001 and HURai002 while the lowest (9.1%) in the check variety BARI dragon fruit-1. The germplasm HURai002 was white fleshed fruit but others were red fleshed.

Evaluation of dwarf coconut in hilly area of Rangamati

M. Islam, M.E. Hoque And M. A. Hossain

An experiment on the evaluation of dwarf coconut in hill valley was conducted at the fruits orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21. The average plant height was recorded 554.6 cm and 649.4 cm in Vietnam Xiem Blue and Kerala hybrid respectively after four year of plantation. The vegetative growth rate higher in Kerala hybrid coconut than Vietnam Xiem Blue coconut but only Xiem Blue coconut started to produce fruits after four year of plantation.

Collection and evaluation of custard apple germplasm

M. Islam, M.E. Hoque And M. A. Hossain

An experiment on the evaluation of Custard apple in hill valley was conducted at the fruits orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21. The maximum plant height (225 cm) was recorded in ARRai006 and ARRai008 germplasm, base girth (22 cm) in ARRai006 germplasm and canopy (250 × 277 cm²) was found in ARRai008 germplasm. Only one genotype (ARRai004) among eight genotypes produced fruits this year.

Evaluation of newly collected mango germplasm

M. Islam, M.E. Hoque And M. A. Hossain

An experiment on the evaluation of mango germplasm in hill valley was conducted at the fruits orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21. The maximum plant height (211 cm) was recorded in MIRai023 germplasm, highest base girth (20 cm) and canopy (195 × 190 cm²) was found in MIRai025 germplasm. Maximum number (21) of fruits were recorded in MIRai025 germplasm.

Collection and evaluation of coffee germplasm

M. Islam, M.E. Hoque And M. A. Hossain

An experiment on the evaluation of coffee in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21. The maximum plant height (133.3 cm) was recorded in *Coffea robusta* germplasm. Highest base girth (11.5 cm), canopy (115.8 × 113.7 cm²), leaf length (15.5 cm) and leaf breadth (7.9 cm) were found in *Coffea robusta* germplasm. On the other hand, *Coffea arabica* showed inferior performance regarding all the growth parameters.

Collection and evaluation of cashew germplasm

M. Islam, M.E. Hoque And M. A. Hossain

An experiment on the evaluation of phalsa in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21. The exotic germplasms showed the superiority over local germplasms among all the growth parameters. Only three local germplasm (AORai041, AORai042 and AORai043) among six produced fruits this year. On the other hand, all the exotic germplasm produced fruits this year

Collection and evaluation of avocado germplasm

M. Islam, M.E. Hoque And M. A. Hossain

An experiment on the evaluation of avocado in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21. The maximum plant height (240 cm) was recorded in PARai004 germplasm, base girth (22 cm) in PARai003 germplasm and canopy (246 × 250 cm²) was found in PARai004 germplasm. Time of flowering was same for all the genotypes

and it was the month of February but no fruit set was occurred.

Research report on vegetable corps

Evaluation of pumpkin lines

M. Islam, M.E. Hoque And M. A. Hossain

The experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21 to find out the suitable pumpkin lines to develop as a variety. Experimental lines varied significantly for their response to days to 1st flowering (DFF), node order of first female flower (NFF), fruit length (FL), fruit width (FW), flesh thickness (FT), individual fruit weight (IFW), yield and TSS (%). Of these, DFF ranged from 70-79, NFF 18-22, FL 10.1-17, FW 11.5-23.9, FT 2.3-5, yield (t/ha) 15-27 and TSS (%) 8.3-13.2. Minimum node order of first female flower (18) was observed in CMRai020. The highest yield (27 t/ha) was found in CMRai0017 followed by CMRai016 (25.5 t/ha) and lowest (15 t/ha) was found in CMRai004 and CMRai013.

Evaluation of year-round muskmelon (Lalmui) germplasm

M. Islam, M.E. Hoque And M. A. Hossain

The experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21 with five germplasms to find out the suitable year-round muskmelon lines to develop as a variety. Experimental lines varied for their response to days to 1st female flowering (DFF), node order of first female flower (NFF), fruits per plant (FPP), fruit length (FL), fruit girth (FG), flesh thickness (FT), average fruit weight (AFW), yield per plot and TSS (%). Of these, DFF ranged from 31-38.3, NFF 8.8-11.4, FPP 2.5-4.8, FL 24.5-44.2, FG 11.2-16.3, FT 2.24-2.54, AFW(kg) 1.9-6.2, yield per plant (kg) 7.9-15.5, yield(t/ha) 35.1-68.9 and TSS (%) ranged from 2.1-4. Minimum node order of first female flower (8.8) was observed in CMRai015. The highest yield (68.9 t/ha) was found in CMRai018 followed by CMRai015 (56.4 t/ha) and lowest (35.1 t/ha) was found in CMRai013 treatment.

Regional yield trial of french bean lines

M. Islam, M.E. Hoque And M. A. Hossain

An experiment for regional yield trial on French bean lines was conducted at Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21 to find out the suitable French bean lines in order to release as a variety. BARI Jharsheem-2 was used as check variety. Of these, 50% flowering ranged from 40-49, Plant height 47-162, Pod length 112.7-18.7, Pod weight 0.75-1.51, Green pod per plant 1116.7-3263, pod yield (t/ha) 10.5-17.4. The highest individual pod weight (12 g) was found in PVRai001 followed by PVRai004 (8 g) and lowest (6 g) was found in BARI Jharsheem-2 (check variety).

Evaluation of exotic cherry tomatogermplasm

M. Islam, M.E. Hoque And M. A. Hossain

The experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2020-21 with three cherry tomato germplasms to find out the suitable cherry tomato lines to develop as a variety. Experimental lines varied for their response to days to 1st flowering (DFF), Days to 1st harvest (DFH), fruits per plant (FPP), fruit length (FL), fruit width (FW), average fruit weight (AFW), yield per plant and TSS (%). Of these, DFF ranged from 51-60, DFH 76-82, FPP 149-167.7, FL 2.9-3.3, FW 1.8-2.7, AFW(g) 8-12.3, yield per plant (g) 1258.3-2035.0, yield (t/ha) 30.8-62.6 and TSS (%) ranged from 7-9. Maximum TSS (9.0%) was observed in SLRai-002 whereas minimum was recorded in SLRai-002. The highest yield (62.6 t/ha) was found in SLRai-002 and lowest (30.8 t/ha) was found in SLRai-001 treatment.

Evaluation of indian dillenia germplasm in hilly region

M. A. SALAM AND S. M. FAISAL

A field trial was conducted at the Hill Tracts Agricultural Research Station, Ramgarh during the year 2019-20 and 2020-21 evaluated with three Indian dillenia germplasm. These were DI RAM 002, DI RAM 003 and DI RAM 005. There was a lot of variability in respect to plant height, number of branch, spread of plant, fruit size, single fruit weight and edible portion (%). The line DI RAM 003 produced the maximum number of fruits

(542/plant in 2019-20 and 552 in 2020-21) while heavier fruit (742.3 g/fruit in 2019-20 and 680.5 g/fruit in 2020-21, respectively). It was produced lowest from the line DI RAM 0052 in both the year. The maximum fruit yield was recorded from the line DI RAM 005 followed by DI RAM 003. Edible portion (%) was almost similar in all germplasm. The maximum fruit yield (385.1 kg/plant in 2019-20 and 310.6 kg/plant during 2020-21) was obtained from the line DI RAM 005 and the lowest yield was recorded from DI RAM 002 in both the year. Minimum edible portion was calculated from DI RAM 005 during both the year. Therefore, among three germplasm, DI RAM 005 was superior considering yield and yield contributing characters than the other lines. So, the germplasm of Indian dillenia DI RAM 005 may be suitable for hilly region of Bangladesh.

Evaluation of golden apple germplasm in the hilly region

M. A. Salam And S. M. Faisal

Four Golden apple germplasm were evaluated at the Hill Tracts Agricultural Research Station, Ramgarh during the year 2019-20 and 2020-21 to evaluated with golden apple germplasm in hilly region. These were SD RAM 001, SD RAM 002, SD RAM 003 and SD RAM 004. There was a lot of variability found in respect to plant height, number of branch, spread of plant, fruit size, single fruit weight and edible portion (%). The line SD RAM 001 produced the maximum number of fruits (4416/plant in 2019 and 4984/plant in 2020) followed by SD RAM 002. The line SD RAM 001 produced the maximum number of fruits due higher yield contributing characters and heavier fruit produced by the line SD RAM 001 during both the year. The maximum fruit yield (446.1 kg/plant in 2019 and 550.8 kg/plant in 2020) recorded from the line SD RAM 001 followed by SD RAM 002. Number of fruits and single fruit wt. were higher in SD RAM 001. Therefore, it has been concluded that among three germplasm SD RAM 110 was superior considering yield and yield contributing characters than the other lines. So, Line of golden apple SD RAM 001 may be suitable for hilly region of Bangladesh.

Evaluation of china mandarin germplasm in hilly region

M. A. Salam And S. M. Faisal

Germplasm of China Mandarin were evaluated at Hill Tracts Agricultural Research Station, Ramgarh during the year 2019-20 and 2020-21. Average of two years, plant height, base girth, number of main branch/plant, plant spread (N-S), plant spread (E-W) and number of fruit/plant range were 1.94-4.5 m, 13.0-19.0 cm, 1.0-5.0, 1.10-1.80 m, 0.92-2.0 m and 15-105 respectively. Maximum number of fruit/plant was calculated and it ranges from 15-105 in 2019 and 14-109 in 2021, respectively. Mean plant height, base girth, number of main branch/plant, plant spread and number of fruits per plant was higher during 2020-2021. This might be due to higher yield contributing characters. Therefore, the experiment exhibited that China mandarin may be suitable for hilly region of Bangladesh.

Evaluation of jaboticaba germplasm in hilly region

M. A. Salam And S. M. Faisal

A field trial was conducted at to Hill Tracts Agricultural Research Station, Ramgarh during the year 2019-20 and 2020-21 evaluated with five germplasm of Jaboticaba. These were EC RAM 001, EC RAM 002, EC RAM 003, EC RAM 004 and EC RAM 005. There was a lot of variability in respect to plant height, number of branch, spread of plant, fruit size, single fruit weight and edible portion (%). The maximum number of fruits (770/plant in 2019-2020 and 782/plant) was found from EC RAM 002 and weight of fruits was calculated from the same germplasm during two years. The TSS (%) was the highest 11.92% from EC RAM 004 in 2019-20 and 12.08% from EC RAM 001 in 2020-21). Maximum number of fruits (542/plant in 2019-20 and 552 in 2020-21) while heavier fruit 742.3 g/fruit in 2019-20 and 680.5 g/fruit in 2020-21, was found from EC RAM 002. It was produced lowest from the line EC RAM 002 in both the year. The maximum fruit yield recorded from the line EC RAM 002 followed by EC RAM 003. Edible portion (%) was almost similar in all germplasm. The maximum fruit yield (385.1 kg/plant in 2019-20 and 310.6 kg/plant during 2020-

21) was obtained from the line EC RAM 002 and the lowest yield was recorded in EC RAM 005 in both the year. Therefore, it has been concluded that among germplasm EC RAM 002 was superior considering yield and yield contributing characters than the other lines. So germplasm of Jaboticaba EC RAM 002 may be suitable for hilly region of Bangladesh.

Evaluation of promising cashewnut germplasm in hill tract

M. A. Salam And S. M. Faisal

Ten promising cashewnut germplasm were evaluated at Hill Tracts Agricultural Research Station, Ramgarh during the year 2020-'21. The line AO RAM 001 produced the maximum number of fruits (1910/plant) while bigger nut (5.6 g) was obtained from the line AO RAM 009. The maximum nut yield (9.3 kg/plant) obtained from the line AORAM 001 and the maximum edible portion of nut (36.8 %) was recorded from AO RAM 010.

Evaluation of colour fleshed jackfruit germplasm in hilly region

S.M. Faisal And M. A. Salam

Abstract

Three colour fleshed jackfruit germplasm have evaluated at HTARS, Ramgarh during the year 2020-'21. The highest (175.00 cm) base girth, main branches/plant (4) and the highest plant height (7.95 cm) were observed in AH RAM 001 (Table 1) followed by AH RAM 002 (153.00 cm, 3 and 7.80 cm, respectively). Individual fruit weight was maximum in AH RAM 003 (8.86 kg) followed by AH RAM 001 (7.50kg) and minimum was in AH RAM 002 (7.36kg). The highest yield per plant (240kg) was observed in AH RAM 001 followed by AH RAM 002 (191.36kg) and the lowest yield recorded from AH RAM 003 (159.48kg). Maximum TSS was obtained from AH RAM 001 (20.62%) followed by AH RAM 003 (20.53%).



Research and Services

Agricultural Statistics and Information & Communication Technology (ASICT) Division has been conducting research works along with service activities for BARI personnel and different stakeholders of the agricultural system. Research activities have been conducting through the BARI annual research program. This division has been conducting different support service activities along with research with its scientific manpower. Besides ASICT Division has been working to implement “National ICT policy 2018” and “Digital Bangladesh 2021”.

Research Activities

Characterizing dry season’s agricultural land use in northwest Bangladesh: spatial dynamics and water use

M Golam Mahboob, AFM Tariqul Islam, Kowshik Kumer Saha, Khondaker Faisal Ibn Murad, Akbar Hossain and Jorge Penna Arancibia

The northwest region of Bangladesh has experienced changes in cropping patterns, increase in irrigated areas and associated water demand. Tracking historical changes in irrigated crops and their associated water use at the local-scale can only be practically achieved using remote sensing technologies. Bangladesh Agricultural Research Institute (BARI) and Commonwealth Scientific and Industrial Research Organization (CSIRO) have developed methods to map dry season crops including wet season Aman rice and estimating their water use from freely accessible satellite data supported by ground sampling, expert knowledge, machine learning image processing algorithms, and high-performance computing system. In this study,

the implementation/development and evaluation of two models for land cover and cropping system analysis was underpinned by remote sensing data. The models provide information on crop types and water use, as well as other land covers relevant to environmental monitoring in northwest Bangladesh. This is instrumental to assess changes in water use and crop areal extent that may lead to groundwater level declines as a result of a combination of factors including rainfall declines and over-use, particularly in the Barind tract of northwest Bangladesh. Both models developed here relied on freely-available remote sensing reflectance data archives via Google Earth Engine (GEE). Much of the pre-processing was performed in the GEE, thus facilitating the implementation of the models in this large geographical domain. The data underpinning both models were the Enhanced Vegetation Index (EVI) and the Global Vegetation Moisture Index (GVMI). First, a monthly actual evapotranspiration (ET_a) model based on the CMRSET (CSIRO MODIS ReScaled EvapoTranspiration) model, driven by MODIS reflectance data (500 m), was implemented from 2000 to 2016. CMRSET only requires multi-temporal EVI and GVMI to derive a crop factor and meteorological data for its implementation. The model provides the first long-term (>15 years) consistent ET_a time-series for the entire northwest Bangladesh region, at spatial (500 m) and temporal resolutions (monthly) that are useful to assess ET_a changes. The ET_a estimates were evaluated against a crop factor model driven by areal crop data aggregated at the district scale (second administrative tier). Both models were similar both in terms of seasonality and magnitude, and the largest difference between models in any month assessed was around 5%. The models’ estimates being similar while having different rationales

provide a level of confidence for them to be used as inputs to other hydrological models. Second, a machine learning supervised Random Forest (RF) model, driven by Landsat reflectance data (30 m) was developed. The RF model can predict the two main rice types in northwest Bangladesh, wet season Aman rice and dry season Boro rice, and other land covers of interest using both EVI and GVMi from 1989 to 2016. The model relied heavily on local expert knowledge and field data to understand the phenological stages of the main rice types. The process followed a semi-supervised approach that used unsupervised K-means clustering to obtain a representative training dataset to train a supervised RF learner. The training data captured the geographical and temporal characteristics of rice types and other land cover dynamics. Using covariates other than the monthly EVI and GVMi, the RF evaluation rendered accuracies generally >90%. The RF Boro and Aman maps were compared against areal statistics from agricultural surveys and the error was generally <20%. These maps are the first maps to capture the large areal increase in irrigated Boro rice in the northwest since the 1980s. The spatial ET_a estimates revealed that there are parts of the landscape where significant ET_a increases (>20 mm/yr per year) during the assessment period, coincide with areas where large groundwater declines have occurred in the last few decades. This is noticeable in the Barind tract in the Naogaon, Rajshahi and Chapainawabganj districts. Other areas had significant ET_a decreases (>5 mm/yr per year), this was noticeable in the Chalan wetland (or Beel), where there are reports of a decreased wetland area. On the other hand, the maps showed that a large areal expansion of Boro rice occurred within districts overlying the Barind tract like Chapainawabganj, Naogaon, Natore and Rajshahi, districts where the groundwater level is significantly decreasing. The use of the historical data for Boro and Aman, and historical standing water data, alongside other datasets such as groundwater levels, rainfall and actual ET_a can be used to underpin more detailed statistical, groundwater and landscape modelling to assess the role of these in declining groundwater levels in northwest Bangladesh.

Assessment of cropping patterns for sustainable intensification in drought prone ecosystem using remote sensing and geospatial modeling

M Golam Mahboob, AFM Tariqul Islam, Kowshik Kumer Saha and M Moniruzzaman

Bangladesh Government has given high priority to sustain groundwater use for irrigation. It is therefore, important to conduct agricultural land use and cropping patterns analysis and their implication to foster sustainable intensification (SI) strategies in the drought-prone regions of Bangladesh. Remote sensing and geospatial modelling can play a vital role to assess cropping patterns and availability of natural resources on the ground and allocate them judiciously for SI in agriculture. Hence, in order to facilitate sustainable cropping intensification in the problem agro-environments of Bangladesh, the current research project has been initiated to carry out in the drought-prone agro-ecosystems prevailing in the Barind Tract region of Bangladesh. During the reporting period (July 2020-June 2021), necessary ground data were collected from the study area to train satellite images for crop type mapping. A crop inventory for the entire Barind Tract region was prepared according to the methodological framework. Six major crop types namely: maize, lentil, mustard, potato, Boro rice, and wheat, predominant in the area, were chosen for delineation from satellite image classification. Total 28 cloud-free Sentinel 2A (MSS, level-1C) satellite imagery (10m spatial 10 days and temporal resolution) were downloaded (<https://scihub.copernicus.eu/>) of the year 2019-2020 for dry season (October-March). An algorithm was developed to delineate dry season crops using Sentinel-2 imageries in a pilot area (Godagari upazila). The maximum likelihood classification (MLC) technique was employed to classify the NDVI composite image and final classified image including six crops. However, during the reporting period July 2020-June 2021, an enormous fieldwork was conducted to collect reference data for the same crops to improve the crop type mapping. The results show that Boro rice and lentil occupied most of the area with 8,543.12 ha (17.35% of the total upazila) and 8381.55 ha (17.02%), respectively. Wheat, mustard, maize and potato area were 2,087.89 (4.24%), 1,731.55

(3.52%), 798.76 (1.62%) and 658.58 ha (1.34%), respectively during 2019-2020 Rabi season. Other areas (water bodies, other crops, orchards, settlement, etc.) shared the maximum area coverage with 27,052.42 ha (54.92%). The overall accuracy of the classified map was found 75% while comparing with the ground truth data, which indicates satisfactory results. Besides, a set of agro-environmental resources geo-database from image analysis were developed such as the digital elevation model, slope map, aspect map, soil map, top soil texture, soil reaction, waterbody, soil consistency and land type of the Godagari Upazila to be used as input data in further analysis towards achieving final objective location-specific cropping pattern modeling in GIS environment. Moreover, digitized land use land cover map (1:1000) of the study area is under development. In spite of the emergence of the COVID-19 pandemic, the objectives of this research project are expected to achieve within the project period.

Satellites and ICT based location and crop specific irrigation advisory system for growing more with less water

M. Golam Mahboob, AFM Tariqul Islam, Khandaker Faisal Ibne Murad, Sheikh Asim Ishtiaque, Md. Zannatul Ferdous, Md. Shakhawat Hossain, Jahan Al Mahmud and Faisal Hossain

Creative approaches can be devised to ensure optimal use of irrigation water in crop production through integrated satellite monitoring and ICT use for monitoring and forecasting of croplands, which will help in increasing crop production by applying less irrigation water. Such technology exists in the developed world. However, it is not directly usable in the context of our country. The University of Washington in the United States has successfully tested such an irrigation consultancy system called Provision for Advisory on Necessary Irrigation (PANI) in India and other Asian countries, which can be applied to Bangladesh with necessary modifications. The system analyze the demand for crop water and the amount of natural water supply (e.g., rainfall) using the existing satellite-based climate forecasting and forecasting model to determine the amount of irrigation water available in the land and provide irrigation advice to the farmers mobile. Using this integrated pilot project using integrated sensors, remote sensing (space and

ground) and ICT technology, a farmer can use this information on his mobile device to know when to irrigate and to produce more crops using less irrigation water by providing moderate irrigation to the croplands.

Assessment of water recession dynamics in selected haors for dry season cropping intensification using spatial data

AFM Tariqul Islam, Md. Golam Mahboob and Jatish Biswas

Monitoring Spatio-temporal dynamics of hydrology including land use land cover (LULC) changes and knowing the availability of agricultural land in limited time windows in haor region are important for local food security and livelihood improvement. In this context, the use of geospatial modeling can play important role in monitoring seasonal hydrology, LULC changes as well as locating and planning of the available land for agricultural intensification. This study aims to monitor long-term dynamics of seasonal water recession and land use patterns, to assess the impact of extreme flooding on dry-season crop production and to outline current fallow-lands along with its utilization strategies using geospatial modeling for dry season cropping intensification using satellite images. The preliminary results show that the most of the haor area goes underwater from May to October and becomes available again from December-January to April. Results also show that significant land of Sunamgonj district was retained fallow during the 2019 Rabi season. Monthly flooding and recession dynamics during 2000-2021 to know the availability of agricultural land along with its utilization strategies would be analyzed for the dry season cropping intensification during the next two years research period.

Spatio-temporal assessment of cultivable land in selected char-lands of the northern Bangladesh

AFM Tariqul Islam and Md. Golam Mahboob

The Ganges-Brahmaputra is characterized by its highly braided channel pattern, which has given rise to the number of river islands (chars) of various sizes and shapes. These chars have the potential for agriculture expansion in the non-flooding Rabi seasons, as the soil is fertile and productive. However, the dynamics of these Char-lands are important to understand properly in this case for better utilization in crop production. The study

aims to understand the spatio-temporal dynamics of the charlands in the northern Bangladesh for agriculture crop expansion using the decadal multispectral satellite data. During the first year study, MODIS satellite data have been downloaded and analyzed to assess the decadal extent (2000–2020) of river and char-lands along the Jamuna-Padma Rivers. Results show that the patterns of these meandering river systems are similar over the decades whereas the water and char-lands are very dynamic. The classified NDVI images of these river systems show that there are significant lands, which are undefined characters, i.e. they could have dry sand, moist sand, wetland or fallow lands. These lands would be classified along with agricultural utilization strategies during the next two years research period.

Non-destructive determination of mango maturity using hyperspectral remote sensing techniques

Suman Biswas, Md. Sorof Uddin, Taslima Ayesha Aktar Nasrin and Md. Golam Mahboob

The non-destructive on-plant assessment of fruit ripeness has received increasing interest as it provides several advantages compared with traditional destructive methods. Hyper-spectral remote sensing technology is a promising field of research for nondestructive quality assessment. The aim of this work was to evaluate the use of the hyper-spectral technique for detecting the maturity of mango (BARI Aam 4) based on its major physico-chemical parameters. Diffuse reflectance spectra in the region of 400–1075 nm were used to develop calibration models for firmness, total soluble solids, titratable acidity, sugar content and multifactor ripening index. Prior to estimating these calibration models, spectral data were pre-treated through different transformation techniques to improve the predictability of the models as these transformations can reduce the problems associated with noise, light scattering and external effects in raw spectral. One of the best linear methods termed partial least squares regression were employed to detect the effective wavelengths for determining the quality attributes of mangoes. Findings revealed that relationships between wavelengths and quality parameters could be assessed by using SNV pretreated spectra as variables, which yielded more than 80% accuracy. The effective number of wavelengths were selected for accurately predicting

the quality parameters as well as a multifactorial ripening index, which concludes that wavelengths could be used as a rapid, non-destructive method for measuring the mango maturity index.

Early detection of leaf physiological and chemical traits to salt stress in wheat using hyperspectral reflectance spectroscopy

Suman Biswas, Imrul Mosaddek Ahmad, AFM Tariqul Islam and Md. Golam Mahboob

Salt stress is the most widespread abiotic stress that limits plant growth, physiology and productivity mainly affecting the ionic balance and plant water relations. The maintenance of agricultural productivity implies better agricultural practices and a careful selection of resistant crops. Proper monitoring of the physiological status of plants can lead to better knowledge of plant nutritional requirements. Visible and near-infrared (VNIR) radiometry provides a non-destructive and quantitative method to monitor vegetation status by quantifying chemical properties using spectroscopic techniques. In this study, the capability of VNIR spectral measurements to detect salinity effects on wheat plants was tested. Wheat plants were cultivated at 60L reservoir containers containing 50L basal nutrient solution (mgL⁻¹). Spectral data of leaves were transformed into vegetation indices indicative of the physiological status of the plants. The results showed differences (decreasing tendency) for PH, K, KNaR, SDW, RDW, SFW and RFW ($p < 0.001$) due to salinity suggesting different degrees of salt stress on the plants. On the contrary, the Na leaf content showed a significant increasing trend with salinity. The capabilities of VNIR radiometry to assess the influence of soil salinity on wheat physiology using a non-destructive method were demonstrated. A normalized difference vegetation index $[(R_{800} - R_{680})/(R_{800} + R_{680})]$, and the salinity and water stress index $[(R_{803} - R_{681})/\text{root}(R_{905} - R_{972})]$ showed significant relationships ($p < 0.001$) with the salinity. Therefore, this method could be used for in-situ early detection of salinity stress effects.

Determinants of household food security in rural Bangladesh: An imperial analysis of farm level data

Kazi Saidur Rahman, Istiak Ahmed, Suman Biswas, Md Saiful Islam and Md. Kamrul Hasan

The world faces a tremendous challenge in providing food security to the increasing population. It is important therefore to increase food production in order to meet the growing demand for food emanating from population growth. Although there are significant achievements in food grain production, food insecurity both at the national and household level remain a matter of major concern in Bangladesh. The study endeavors to estimate the food security status and identify the determinants of food security among households in Hakimpur Upazila in Dinajpur, Aditmari Upazila in Lalmonirhat, Saghata Upazila in Gaibandha, Domer Upazila in Nilphamari and Sador Upazila in Bandarban district of Bangladesh. Primary data were collected from the field level through a questionnaire survey from the each upzila and secondary data were collected from various published sources e.g. BBS, FAO Stat, research reports, etc. Data were analyzed applying descriptive statistics and logistic regression analysis. Results shows that households of Hakimpur upazila, Aditmari Upazila, Saghata Upazila, Domer Upazila, Ramgarh Upazila, Bandarban Sador Upazila were food insecure during the period of the survey. A number of dependents the income of household head, age of household head and level of education were found to significantly influence household head food security in the study area positively. It is recommended that social security measures must ensure that the benefits of public efforts to improve food security and nutrition are universal. Human rights-based practices are preferable.

Data science and analytic technology in agricultural production of Bangladesh

Istiaq Ahmed, Suman Biswas, Kazi Saidur Rahman and Md. Saiful Islam

Data science can provide actionable insights bespoke to farmers' land and ownership patterns on what to plant when to plant, and what farm practices to deploy. Making well-informed decisions could save costs and enhance a farmer's profitability and income. Currently, the demand by consumption of agricultural products could be predicted quantitatively, however, the variation of harvest and production by the change of farm's cultivated area, weather change, disease and insect damage, etc. could not be predicted, so that the supply and demand of agricultural products

have not been controlled properly. This study presents the analysis of the agricultural production system for stabilizing the supply and demand of agricultural products. The results show that the Data analytic-based agricultural production system through correlation analysis between the crop statistical information and agricultural environment information has enhanced the ability of farmers, researchers, and government officials to analyze current conditions and predict the future harvest. There appears to be a very strong correlation between food production for some of the cereals and grains. This correlation appears to be positive implying that if we know that one crop had a bumper production, the correlated crop would have a bumper production as well. There also appears to be a moderate dependence on rainfall for food production. Additionally, agricultural products quality can be improved because farmers observe the whole cycle from seeding to selling using this Data science & analytics-based decision support system.

Genome-wide analysis of dcl, ago, and rdr gene families in brassica species (*Brassica rapa* L.) using integrated bioinformatic approaches

Zobaer Akond, Hafizur Rahaman, Monirul Hasan Tipu, ABM Khaldun Sohel, Sheikh Hasna Habib and Nurul Haque Mollah

RNA silencing is a conserved mechanism in eukaryotic organisms to regulate gene expression. It is controlled by the dicer-Like (DCL), argonaute (AGO), and RNA-dependent RNA polymerase (RDR) gene families also known as RNAi-related genes. These genes regulate gene expression against different biotic and abiotic stressors during plant growth and development. They also play roles at posttranscriptional and chromatin modification levels. A complete cycle of this technique occurs by the contribution of the members of these three gene families. However, these gene families have not been yet rigorously studied in the genome of the economically important oilseed crop *Brassica rapa*. Genome-wide identification, characterization, and diversity analysis revealed 4 BrDCL, 13 BrAGO, and 6 BrRDR genes from the *B. rapa* genome against the RNAi-related genes of *Arabidopsis thaliana* using BLASTp search. Phylogenetic analysis with *Arabidopsis* RNAi-related genes showed that BrDCL, BrAGO, and BrRDR proteins clustered into four, eight, and five

groups respectively. Domain composition analysis showed that the proteins conserved identical domain characteristics of their Arabidopsis homologs. The exon-intron structure of the genes was almost similar to their Arabidopsis counterparts. CREs showed that they are mostly hormone, light, and stress-responsive. In silico expression analysis showed that the maximum of 11 genes out of 23 were predicted to express in flowers/floral buds followed by leaf, root silique, and ovule but in B.napus genome the maximum protein were predicted to express in seed/seed coat followed by flower/flower buds. Overall results would therefore help oilseed molecular breeders and biotechnologists for more in-depth biological and molecular investigations about the important functionalities of B. rapa RNAi-related genes for oilseed crop improvement of BARI developed different varieties.

Service Activities of ASICT

Md. Saiful Islam and Suman Biswas

Web Information

BARI-developed technologies and related information are being publishing regularly through its own website (www.bari.gov.bd & বিএআরআই.বাংলা) and mobile apps. In addition to the technologies, some important issues like tender, circular, job circular, journal publication, annual report etc. are hoisted as and when necessary. Total 5438 information has been uploaded in the website and mobile apps during 2020-2021.

Query-Answer

BARI has started online e-agriculture services for the beneficiaries. Any stakeholder can ask question related to agriculture with the help of online facility

of BARI web site and Mobile web apps. BARI has been giving services on-line feedback through website (www.bari.gov.bd) and Mobile web apps (baritechnology.org/m) to end users. During 2020-2021, BARI (18 Centres/Divisions/Sections) has provided answers of all 425 questions received from different stakeholders.

Citizen Information Service Centre

BARI has started disseminating technological information to the citizen. Any citizen can come and obtain his/her required agricultural technological information/service directly from Citizen Information Service Centre and/or from respective crop centre/research division at BARI. During 2020-2021, 96 citizens of different professionals from 11 districts has visited BARI citizen services information centre and got services on 14 different areas.

Ensuring access to information of citizens through the Right to Information Act

BARI has appointed personnel to ensure citizen's access to the information in an easiest way. During 2020-21, BARI has provided information to the four citizens as citizen's access to information. BARI has also provided answers of all 425 questions received through website and mobile apps.

Online based service to the citizen

BARI has started providing online-based services to the citizens. Each year at least one online based service is being developed. During 2020-21, one service entitled Gene Bank has been developed. Any person from anywhere can get information of BARI collected germplasms through the link <http://pgrcbari.org/>.

Table 1. Online based service to the citizen

SN	Service	Link	Year
1.	Job application	https://bari.taletalk.com.bd	2016-17
2.	District wise cropping pattern	https://baritechnology.org/crpt	2017-18
3.	Online APA reporting	https://baripmis.org/apa	2018-19
4.	BARI Telephone Directory	https://play.google.com/store/apps/details?id=com.baridirectorey.iamsh.baridirectorey	2019-20
5.	Gene Bank	http://pgrcbari.org/	2020-21

Service simplification (SPS) to the citizen

BARI has started service simplification using ICT. Each year at least one service simplification would be developed. During 2020-21, one service simplification called ‘Online based Query-Answer’ has been developed for providing quick responses to the citizen’s queries regarding the BARI developed variety and technology.

Table 2. List of service simplification in BARI

SN	Type	Service	Year
1.	Information centre	Citizen information services	2017-18
2.	Collection of seed and seedling	Limited collection of BARI develop variety seeds and sapling.	2018-19
3.	Collection and preservation of personal information	Collection & preservation of the information of BARI scientists/officers/staff	2019-20
4.	Online based Query-Answer	Providing quick responses to the citizen’s queries regarding the BARI developed variety and technology	2020-21

ICT based innovation to the citizen

BARI has been started ICT based innovation to the citizen services. Each year at least one ICT based innovation is being developed. During 2020-21, a satellite-based irrigation advisory system called “Provision for Advisory on Necessary Irrigation (PANI)” has been developed.

Table 3. List of ICT based innovation to the citizen services in BARI.

SN	Type	Innovation	Year
1.	Apps	Krishi Projukti Vander	2016-17
2.	Online service	Faster analysis of soil samples	2017-18
3.	Apps	Mobile apps for mango yield estimation	2018-19
4.	Web Apps	GeoMango: Satellite-based mango orchard mapping	2019-20
5.	Web Apps	Provision for Advisory on Necessary Irrigation (PANI)	2020-21

Social Networking (Facebook)

BARI has been disseminating its regular activities among the public through social networking. Any person can ask and interact with BARI authority regarding technologies and/or other information through its official Facebook page (www.facebook.com/BD.GOV.BARI). At present BARI Facebook page is being followed by more than 9500 Facebook users. During 2020-21, a total of 367 posts or public Q/A were moderated/addressed through the BARI Facebook page.

Social Networking (YouTube)

BARI disseminates its regular activities among the public through YouTube channel. Any person know about BARI technologies through its official

YouTube channel titled Bangladesh Agricultural Research Institute (<https://www.youtube.com/c/BangladeshAgriculturalResearchInstitute>). At present BARI YouTube channel has 460 subscribers and 9 videos.

Web based mail services

BARI has its domain of email connectivity under the name “bari.gov.bd”. Up to date, a total of 695 webmail has been assigned under the BARI domain. It has been decided to assign the email address to all scientists under the BARI domain gradually.

Network and Antivirus maintenance

ASICT division has been giving services on LAN & Antivirus maintenance especially for the head quarter scientists and officers. Rendering 24 hours

internet services at BARI headquarters. At present more than 600 computers are connected with network and provided with a corporate version of antivirus.

Table 4. Network and Antivirus maintenance during 2019-20

SN	Subject	Number
1.	Trouble shooting for LAN & internet connectivity	400
2.	Trouble shooting for Antivirus	62
3.	New internet connectivity	47
4.	Network connection repair	26
Total		535

Wi-Fi connectivity

BARI has established Wi-Fi connectivity in different places. ASICT division was giving services on Wi-Fi & maintenance especially for the

head quarter scientists and officers. At present 528 devices are connected in Wi-Fi network.

Statistical analysis service

ASICT division has been giving services on statistical analysis through computer package software such as R and SPSS. Some important analysis of 25 experiments requested by the scientists from 12 different Centres/Divisions have been done by this division during 2020-2021.

E-Governance

(a) e-Filing system

Access to Information (a2i) has been established e-filing system in BARI Head Quarter (HQ), Crops Center and RARS. ASICT division has been assisted on e-filing system especially for the Head Quarter, Crops Center and RARS personnel. At present 177 personnel are connected in e-filing system.

Table 5a. List of file and letter issued in HQ through e-filing system during 2019-20

SN	Name of Wing/Centre/Division/Section	No. of file (2020-21)	No letter issued		
			2018-19	2019-20	2020-21
1.	DG Office	4	220	211	274
2.	Support and Service wing	2	3	0	4
3.	Research Wing	0	92	79	91
4.	Training & Communication Wing	102	8	21	297
5.	Planning and Evaluation Wing	12	32	113	41
6.	Horticulture Research Center	94	69	64	244
7.	Oilseed research center	16	297	118	154
8.	Tuber Crops Research Center	278	155	106	94
9.	Plant Genetic Research Center	10	50	43	71
10.	Agronomy Division	4	87	23	85
11.	Plant Breeding Division	19	190	108	168
12.	Entomology Division	82	100	27	77
13.	On-Farm Research Division	3	66	36	107
14.	Agricultural Economics Division	57	21	138	32
15.	FMPE Division	1	91	82	29
16.	IWM Division	20	126	25	136
17.	ASICT Division	9	33	111	200
18.	Postharvest Technology Division	70	3	19	1

SN	Name of Wing/Centre/Division/Section	No. of file (2020-21)	No letter issued		
			2018-19	2019-20	2020-21
19.	Biotechnology Division	1	81	117	85
20.	Seed Technology Division	0	7	28	2
21.	Vertebrate pest management Division	2	127	42	25
22.	Farm Division	7	2	5	5
23.	Plant Pathology Division	1	6	21	33
24.	Machinery Repair and Maintenance Section	0	74	27	76
25.	Regional Spice Research Center	3	5	86	3
26.	Pulse research sub station	3	30	30	53
27.	Administration Section	59	757	440	2078
28.	Finance and Accounts	183	-	-	191
29.	Transport Section	31	-	-	29

* Soil Science Division, Plant Physiology Division, Building & Ground Section, Procurement & Store section and Common Service did not issue any letter through e-filing system during 2020-21.

Table 5b. Letter issued in HQ, Crops Center and RARS through e-filing system during 2020-21

SN	Name of HQ/Crops Center/RARS	No. of the letter issued
1.	Head Quarters, Joydebpur, Gazipur	4685
2.	Pulse Research Center, Ishurdi, Pabna	204
3.	Spices Research Center, Bogura	12
4.	Regional Agricultural Research Station, Jamalpur	155
5.	Regional Agricultural Research Station, Jessore	160
6.	Regional Agricultural Research Station, Moulvibazar	0
7.	Regional Agricultural Research Station, Barisal	58
8.	Regional Agricultural Research Station, Hathazari	202
9.	Regional Agricultural Research Station, Burirhat	59
10.	Regional Agricultural Research Station, Cumilla	364

(b) e-Tendering system

Central Procurement Technical Unit (CPTU) has been established the e-tendering system at BARI. ASICT division has been assisted on the e-tendering system especially for the head quarter through two Procurement Entity (PE) offices like Building & Ground section and Procurement & Store section. During 2020-21, 145 E-tendering has been implemented through two PE offices.

Table 6. List of E-tendering during 2020-21

SN	Name of office	E-tendering
1.	Procurement & Store section	87
2.	Building & Ground section	58
Total		145

(c) Labour Management Software

BARI labour management automation is going on full swing. At present, 53 centres/divisions /sections and 1349 labour information are included

in this management software. This software is divided into three parts viz, Labour Information, Labour Salary and Labour Report. Each part can be operated solely and has an option to be integrated as per requirements.

(d) Salary System Software

BARI payroll management system has been developed for BARI personnel. This system is user friendly. Any person can be used own BARI ID number and prepare his/her salary statement. At present 500 scientist/officer/staff are using this system.

(e) Management Information System (MIS) Software

MIS software is divided into three separate modules viz. Personnel Management Information

System, Training Management Information System, Publications Management Information System. Each module can be operated solely and has an option to be integrated together as per requirements.

Human resource development

ASICT division has engaged human resources development through various type of training program related to ICT. ASICT division has trained 110 participants through four ICT-based training programs during 2020-21. Besides ASICT division has participated at Virtual Digital Fair 2020 as well as organized a field day on mobile apps at PTL, Gazipur during 2020-2021.

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Training & Communication Wing



Training & Communication

During 2020-21, due to COVID-19 pandemic situation only 1 (one) scientist was sent abroad for higher study) PhD) and for the same reason all the overseas training/ workshop/study tour/ visit/ meeting/ conference were suspended. In case of in country higher education not a single scientist was admitted in the university for higher study (MS/PhD) as the educational institutions were remain closed since March 2020 to June 2021. Total 217 scientists, officer and staff have been sent in 61 different training courses, 81 scientists attended 21 workshops and 67 scientists attended 6 seminars organized by various organizations in the country.

Seminar & Workshop

Communication Section of T&C arranges seminars and workshops in various fields of agricultural research. A total of 12 (twelve) seminars and 08 (eight) workshops were organized at BARI during the year 2020-21 on different aspect of agricultural Knowledge share to achieve the goal of Annual Performance Agreement (APA). A total of 1352 participants of BARI and other national research organization were actively participated in these seminars and workshops.

MoU signed

During the period 2020-21, BARI had signed MoU with 8 (eight) organizations. All of the organizations signed MoU with BARI were voluntary organization. The purpose of the MoU were to promote collaboration between agricultural research and development and also for promotion of technology transfer to the end users.

Publication

BARI regularly publishes journal, newsletters (Bengali and English), annual report, books and

booklets on the evolved technologies in order to disseminate information to the users including farmers. Brochure, manuals, and other literatures on BARI are also being published. During the year under report, 4 issues of newsletter, brochure of the institute, annual report, a few booklets and some other literatures have been compiled, edited and published. Further, more than hundred science articles revived from scientists of home and abroad has been processed for publication in the journal.

Library Section

Library section is responsible for the management of BARI central library. BARI central library was established to help and fulfill the purpose of the institute, as an adjunct of the researcher's tool and it's tends to play a significant role for providing appropriate information to the researchers at the right time. The mandates of the BARI central library is:

- Building up a balanced and comprehensive collection in the sphere of agriculture and its allied fields based on the scientists needs with a bit focus on the generalist's interests.
- Preparing and processing the procured materials to ensure users effectiveness.
- Making the research community aware of new information and technology collected in and organized technically.
- Participating inter-library loan and network system to serve the researchers effectively.
- Providing aid on the use of the library and help to find, locate and evaluate the information available in the library.
- Establishing Management Information System (MIS) i.e. digital library and library automation

system using library management software in the library.

- Adopting the technique of economic method to preserve and repair the collection to ensure its continued use.
- Developing the mini-libraries at the regional and sub-regional station to feed the scientists with their needed information.

Existing facilities: A total of 85,865 collections are exist till 2020-2021 from the establishment of the library information of resources materials collected so far have been properly catalogued, classified and organized. The Library now houses the information resource materials as furniture in Table 1.

Table 1. List of existing collection of BARI Central Library:

Items	Quantity
Books, Reports, Proceedings, etc.	46,484
Archival collection	2,670
Thesis	860
Periodicals (bound in book form)	4,247
Journal	24,459
Newsletter	641
Bulletin	144
Pamphlets & Booklets	944
Reprint	518
Leaflets	4,898

Table 2 a. List of information materials added during 2020-2021.

a. Books, Reports, Proceedings etc. and Thesis:

A total of 196 books, reports, thesis etc. were added to this library during 2020-2021. Out of 196, 140 were books, 44 were research report, project report etc. and 12 were thesis. Data's of the listed information resources are present in Table 2 a.

Items	Purchased	Exchange	Gift / Complimentary	Total
Books	52	0	88	140
Research reports, project reports & proceedings	-	20	24	44
Thesis (MS & Ph.D)	-	-	12	12

b. Serial Publications (printed form)

Journals, Newsletters, bulletins etc:

Ninety seven (97) no. of serial publication were added of which 58 were journal, 19 were newsletters and 20 were bulletins. All the details are show in Table 2 b.

Items	Purchase	Exchange	Gift / Complimentary	Total
Journals	-	7	51	58
Newsletters	-	10	9	19
Bulletins	-	-	20	20

Table 3. List of documentation service processed during 2020-2021.

A number of document is adding every year this library. Three hundred and sixteen (316) document was processed during 2020-2021.

SI No.	Procured material processed	No.
01	Document Accessioned	196
02	Catalogued & Classified and pasted with call numbers, book pockets and due slips	120
Total		316

Table 4. List of service provided to users during 2020-2021.

According to the mandate of this library it provide different type of services to the users. A total of 6049 number of services was provided to the users during 2020-2021.

Sl No.	Services provided to the Scientists	Number
1.	Documents Charged/Discharges	152
2.	Users Referenced	446
3.	Number of photocopies made	5,142
4.	Publication Distributed (Journal, Newsletter & Report) in Exchange & Complimentary)	224
5.	Correspondence made	85
Total		6,049

Online Browsing Facilities: BARI central library has online access to many of the world recognized report, journal publishers under library exchange program. Name of the publishers are listed below:

Subscribed Journals(Publisher's list)

01. American Institute of Physics
02. American Physical Society
03. American Society of Agricultural and Biological Engineers (ASABE)
04. American Society for Civil Engineers
05. Annual Reviews
06. British Institute of Radiography
07. Cambridge University Press (CPU)
08. Canadian Science Publishing (was NRC Press)
09. Cochrane Library
10. EBSCO Host including CMMC
11. Edinburgh University Pres
12. Geological Society
13. Mary Ann Liberty
14. Nature- Nature Research Journals (48 titles)
15. Nature- Palgrave Macmillan Journals

16. Nature- Academic Journals
17. Optical Society of America
18. Policy Press
19. Project MUSE Journals
20. Royal College of Physicians
21. Royal Society
22. Scientific American
23. SPIE Digital Library
24. Springer ALL (2000+ titles)
25. Springer- Adis Collection
26. Wiley Online Library- (access limit period 1997-2018)
27. Indian Online Journals

e-Book

28. Project MUSE books 2010-2017
Complete collection (17,000+ titles)
29. De Gruyter LIS books collection

Complementary Online Journal

(<https://www.research4life.org/>)

Access to Global Online Research in Agriculture (AGORA) is a program to provide free or low cost access to major scientific journals in agriculture and related biological environmental and social sciences to public institutions in developing countries.

Health Inter Network Access to Research Initiative (HINARI) is another program to provide free access to one of the world largest collections of biomedical and health literature.

BARI central library has access to both the program. Login link, ID and Password of both the program are given below:

AGORA

ID: ag-bgd026

Password: GQ34ACDX

HINARI

ID: BAN053

Password: 70555

BARI Digital Library: BARI library has launched “BARI Digital Library” which is associated with both digital and automated library system. Now this digital library is available for user access through internet from anywhere. The web address is www.barilibrary.org. Here SLiMS library software has used. In this page main icons are:

Icons	Document uploaded
BARI Publications	194
Bengali Books	624
Reference	3905
Booklet	62
Fiction	13
Center’s Publication	195
Divisional Publications	136
Newsletter	45
Report	33
Journal	11
Thesis – MS	334
Thesis –Ph.D	389
Leaflet	296
Personal Publications	85
Total	6322

BARI Digital Library user statistics

Year	2018	2019	2020	2021	Total
Total Hit	4,30,818	58,001	68,139	1,13,623	6,70,581

Annual Programme 2021-2022

- Take initiatives to lunch “e-Library”.
- Update “BARI Digital Library”.
- Procurement of Local and Foreign Books, Journals and other E-resource materials.
- Documentation works including Accessioning, Cataloguing, Classification etc.
- Strengthening Exchange and Complimentary Programme.
- Maintaining daily routine works like Processing, Circulation, Readers services, Corresponding, Photocopying etc.



Introduction

Planning is an organizational process as well as public policy body of an organization for creating and maintaining a plan; and the psychological process of thinking about the activities required to create a desired goal. This process is essential to the creation and refinement of a plan or integration of it with other plans. The term is also used to describe the formal procedures used in such an endeavor, such as the creation of documents to discuss the important issues to be addressed, the objectives to be met, and the strategy to be followed.

A plan serves three critical functions such as-

- Helps management to clarify, focus, and research their activities or project's development and prospects.
- Provides a considered and logical framework for research and activities which could develop and pursue research/activities for the fulfillment of the strategies.
- Offers a benchmark against which actual performance could be measured and reviewed.

Program evaluation is a systematic method for collecting, analyzing, and using information to answer questions about projects, policies and programs, particularly about their performance on effectiveness and efficiency.

As with most things in international development, there is no standard definition of a Monitoring and Evaluation (M&E) framework, or how it differs from an M&E plan. For many organizations, an M&E framework is a table that describes the indicators that are used to measure whether the program is a success.

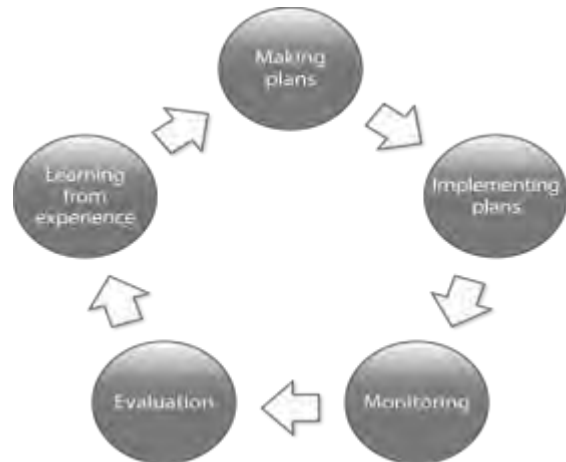


Figure: A Thematic Diagram of Planning & Evaluation Process

For community-engaged initiatives, formative and process evaluation can include evaluation of the process by which partnerships are created and maintained and ultimately succeed in functioning.

Program evaluations are successful if the following three conditions are met:

- Program objectives are well defined in terms of specific measures of program performance (Log Frame)
- Intended uses of evaluations are well-defined, and
- Monitoring and evaluation plans are developed.

Activities of Planning and Evaluation Wing

Planning and Evaluation Wing playing a pivotal role for BARI. Planning is a process of deciding in advance what we want to get (our goal) and how we

will get it. Evaluation enables us to assess how well we are doing and to learn from this. The activities of planning & evaluation wing of BARI are:

1. Preparation and processing of Project Proposal (DPP/RDPP/TAPP)
2. Preparation of new skim (Karmasuchi) under revenue budget.
3. Preparation of monthly report (IMED-05) and quarterly report (IMED 02 and 03)
4. Preparation of project director's profile (IMED-01)
5. Preparation of procurement plan (Works, goods & services), work plan of projects and their subsequent approval by the authority.
6. Monitoring and evaluation of development projects including procurement status (tender related activities).
7. Preparation of Project Completion Report (PCR).
8. Preparation of financial and physical progress report of the project and send to the Ministry of Agriculture
9. Co-ordination of Project Implementation Committee (PIC) meeting.
10. Co-ordination of planning and development co-ordination committee (P&DC) meetings of BARI
11. Liaison with IMED, planning commission and different ministries as and when necessary.
12. Performing other activities as directed by the Director General, BARI.
13. Participate in the monthly ADP review meeting in Ministry of Agriculture.
14. Prepare quarterly / half yearly report according to "Annual Performance Agreement"
15. Preparation of budget and report for "Sustainable Development Goals target, 2030".
16. Preparation of ADP and RADP for on-going & proposed development projects.
17. Preparation of monthly progress report on work plan for prime minister's office and Ministry of Agriculture.
18. Preparation of monthly progress report of "Implementation of Guidelines issued by Honorable Prime Minister"
19. Preparation of answers to the questions of Jatiya Sangshod (National Parliament).
20. Participation in Mid-term budget framework meeting.
21. Preparation of Five Year Plan (FYP).
22. Preparation of research activities according to Sustainable Development Goals (SDGs) which was instructed by cabinet division as well as collaborated with United Nations (UN) and Food and Agricultural Organization (FAO).
23. Preparation of Projects for Delta Plan-2100.

INFORMATION REPORT

(As per Information Commission Requirements)



Institutional information:

BARI (Bangladesh Agricultural research Institute) is the largest multi-crop research institute conducting research on a wide variety of crops such as cereals, tubers, pulses, oilseeds, vegetables, fruits, spices, flowers, etc. Besides variety development, this institute carries out research on such areas as soil and crop management, disease and insect management, water management and irrigation, development of farm machinery, improvement of cropping and farming system management, post-harvest handling and processing, and socio-economic studies related to production, processing, marketing and consumption. The institute functions with the Director General as the chief executive along with four directors of its four major wings such as Research Wing, Support Service Wing, Training & Communication Wing and Planning & Evaluation Wing. The research Wing executes and monitors all the research programs and other research activities through 6 special crop research centers, 16 research divisions, 8 regional agricultural research stations and 30 sub-stations. Support Service Wing provides all the logistics support for research and personnel management. This wing is also responsible for infrastructural development and general procurement of the institute. The Training & Communication Wing is responsible for human resource development through conducting short term, mid term as well as long term training and arranging scholarships for higher studies. Dissemination of information through print and electronic media, organizing seminars and symposia are also the important areas of activities of this wing. The Planning & Evaluation Wing is responsible for developing, executing, monitoring, evaluation of different projects.

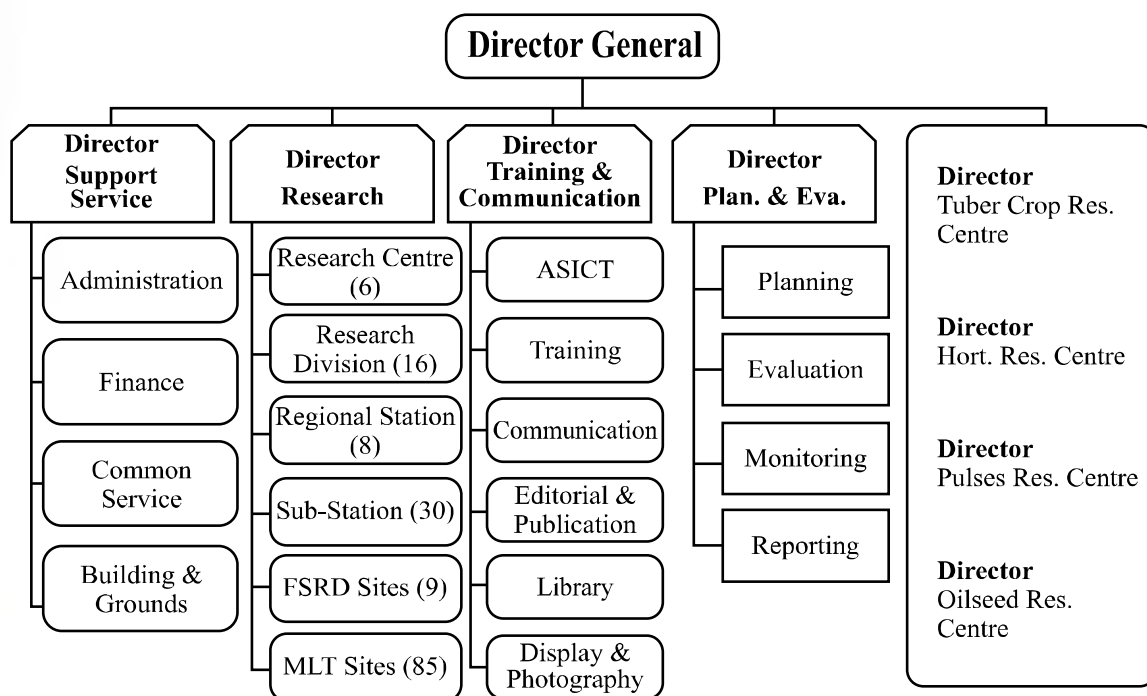
BARI has a long historical background of its own. The emergence of the Institute in its present status has occurred through a number of changes starting from simply a sub-ordinate status under the

Department of Land Records in the then Bengal. On the recommendation of the famine commission in 1880, the Bengal Department of Agriculture was established as a sub-ordinate part of the Department of Land Records in the then Bengal. In 1906, Lord Curzon, the then Vice Roy of India had granted separate status to the Bengal Department of Agriculture and in the same year, a Nuclear Agriculture Research Laboratory under this department was established at Tajgaon, Dhaka. In 1908, an experimental station what has become known as Dhaka Farm was established on an area of 161.20 hectares of land. This Dhaka Farm was the predecessor of BARI and some other research institutes. Establishment of Dhaka Farm offered a good scope for conducting research in the field level in 1947, Bengal Department of Agriculture was renamed as East Pakistan Department of Agricultural. The two constituent divisions of the department were Research and Extension. In 1962, there was a severe blow to agriculture research when the land of Dhaka Farm was acquired for establishing Second Capital (today called Sher-e-Bangla Nagar). In 1968 two separate directorates were established – one was Directorate of Agriculture (Extension and Management) and the other was Directorate of Agriculture (Research and Education). The Directorate of Agriculture (Research and Education) was mostly concerned with research. This directorate was also responsible for the management of Bangladesh Agriculture Institute (BAI) at Sher-e-Bangla Nagar, Dhaka. Later in 1980s and 1990s, two other agriculture colleges, one in Patuakhali and the other in Dinajpur, were established. These two agriculture colleges were also administered by BARI until these became universities, the former provincial organization took on national responsibilities. Like many other sectors, agricultural sector inherited poor manpower and insufficient administrative set ups as well. Therefore, it was rightly thought to have established a coordinated and comprehensive research and some major decisions were taken up

in 1973. Another important development in the year was the presidential Order No. XXXII that helps strengthen and reconstitute agricultural research organizations and system in the country. Upon subsequent developments of research institutions led to further restructuring in 1976, through the presidential Order No. LXII, the

Bangladesh Agricultural Research Institute (BARI) emerged as an autonomous and effective research organization following the dissolution of the Directorate of Agriculture (Research and Education) with sufficient operational flexibility, structural modification and improvement of regional and sub-stations.

Organizational Information:



Operational information:

Director General who is the Chief Executive of the institute has overall responsibility for administration, finance, development and execution of program related to research, manpower development, dissemination of information, transfer of technology and other extension activities. The Director General is assisted by four directors: Director (Research), Director (Support Service), Director (Training & Communication) and Director (Planning & Evaluation).

Director (Research) is responsible for program planning, monitoring and evaluation of the research activities as performed by the research centers, divisions and the regional and sub-stations.

Director (Support Service) is responsible for personal management, finance & accounts,

procurement, infrastructure development, security, transportation and repair & maintenance.

Director (Training & Communication), on the other hand, is responsible for the transfer of technologies to the users through trainings, seminars, workshop, print & electronic media. Human resource development through training and arrangement scholarships for higher studies at home and abroad also fall within his responsibilities.

Director (Planning & Evaluation) is responsible for developing, executing, monitoring, evaluation of different projects under development budgets and Programmes (Karmosuchi) under revenue budget of GoB with the help of crop centers, sub-centers, divisions, Regional Agricultural Research Station (RARS) and Agricultural Research Station (ARS). Also involves in financial management,

procurement activities, infrastructure development and arrange meetings like Project Implementation Committee (PIC), Project Evaluation Committee (PEC) of different projects and Planning & Development Committee (P&DC) meeting of the institute.

Each research division is headed by a Chief Scientific Officer (CSO) who is also designated as divisional head whereas a research center is headed by a Director/Project Director. Each divisional head

is assisted by the concerned scientist starting from Scientific Officer (SO) to Principal Scientific Officer (PSO). On the other hand, each research center is comprised of scientists from various disciplines in the rank of Scientific Officer (SO) to Chief Scientific Officer (CSO).

Regional Stations are headed by senior scientist equivalent to the status of CSO, while the sub-stations are headed by the scientists in the rank of either PSO or SSO.

Information on Right to Information: RTI of BARI

Designated Officer	
Officer's name	: Dr. Md. Saiful Islam ড. মো. সাইফুল ইসলাম
Designation	: Chief Scientific Officer (CSO)
Phone	: 49270129
Mobile	: 01552-388731
Email	: cso.asict@bari.gov.bd
Website	: www.bari.gov.bd
Office	: ASICT Division, Bangladesh Agricultural Research Institute (BARI), Gazipur-1701

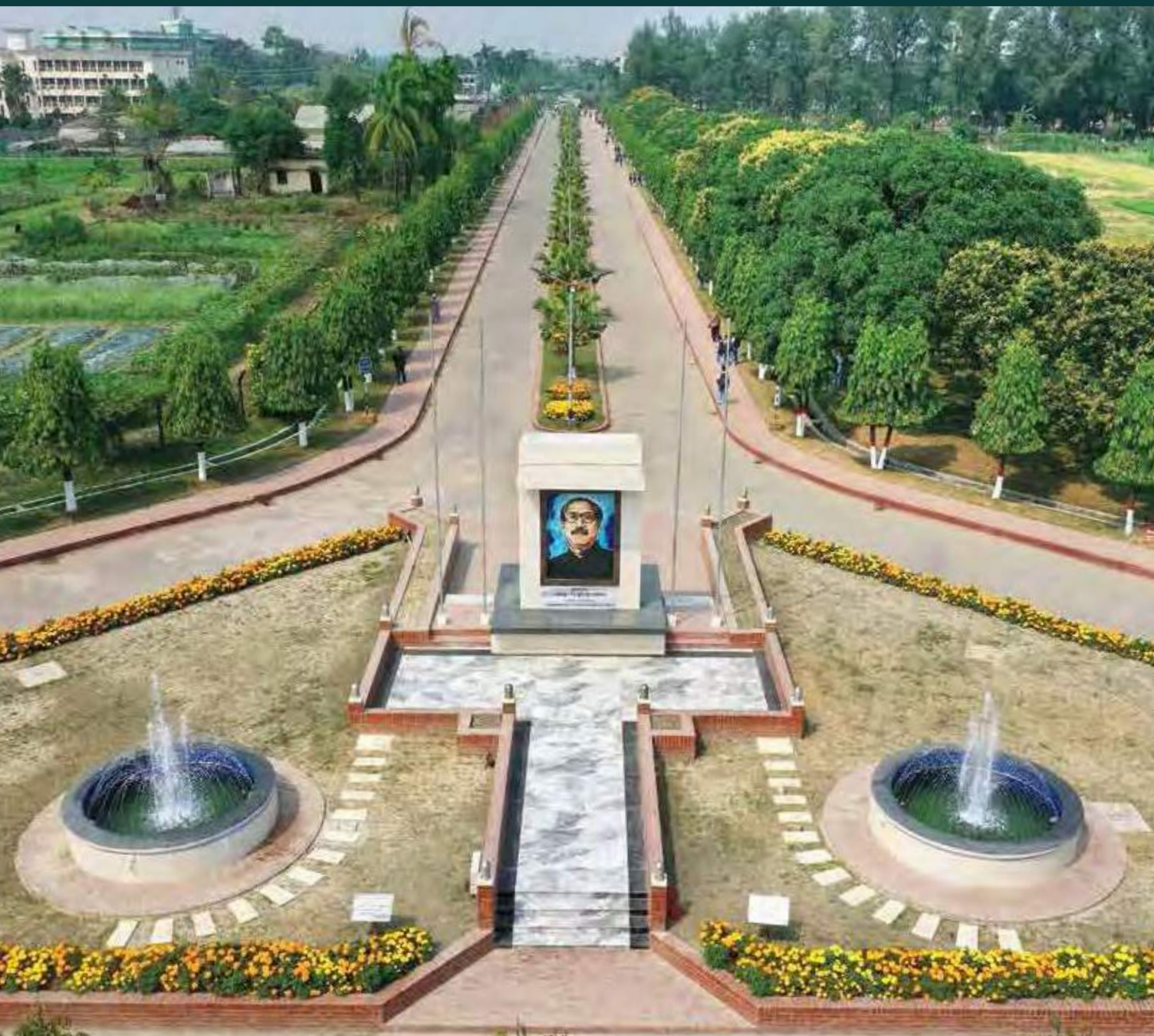
Designated Officer (Alternative)	
Officer's name	: Dr. Md. Shawquat Ali Khan ড. মো. শওকত আলী খান
Designation	: Senior Scientific Officer
Phone	: 49270198
Mobile	: 01552 353952
Email	: khanagro1997@gmail.com
Website	: www.bari.gov.bd
Office	: Training and Communication Wing, Bangladesh Agricultural Research Institute, Gazipur-1701

Designated Officer (Appeal)	
Officer's name	: Md. Mesbahul Islam মোঃ

List of Information delivery to the citizen during 2020-21

SN	Name of the Authority	No. of application received as of the format of Right to Information Act, 2009	N0. of application which has solved through providing information	No. of decisions for not providing requested information and the reason for that decision	No. of appeals against the decision of the officer in charge	No. settlement appeals	No. of disciplinary action taken by the authorities against the officer in charge	Amount received as the value of information as per rule 8 of Right (Regulation of Information) to Information Act, 2009	Details of different activities taken by the authorities
1	2	3	4	5	6	7	8	9	10
1	Bangladesh Agricultural Research Institute, Gazipur	2**	2**	-	-	-	-	-	-

** BARI has provided answers to all 425 questions received through the website and mobile apps.



Bangladesh Agricultural Research Institute

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