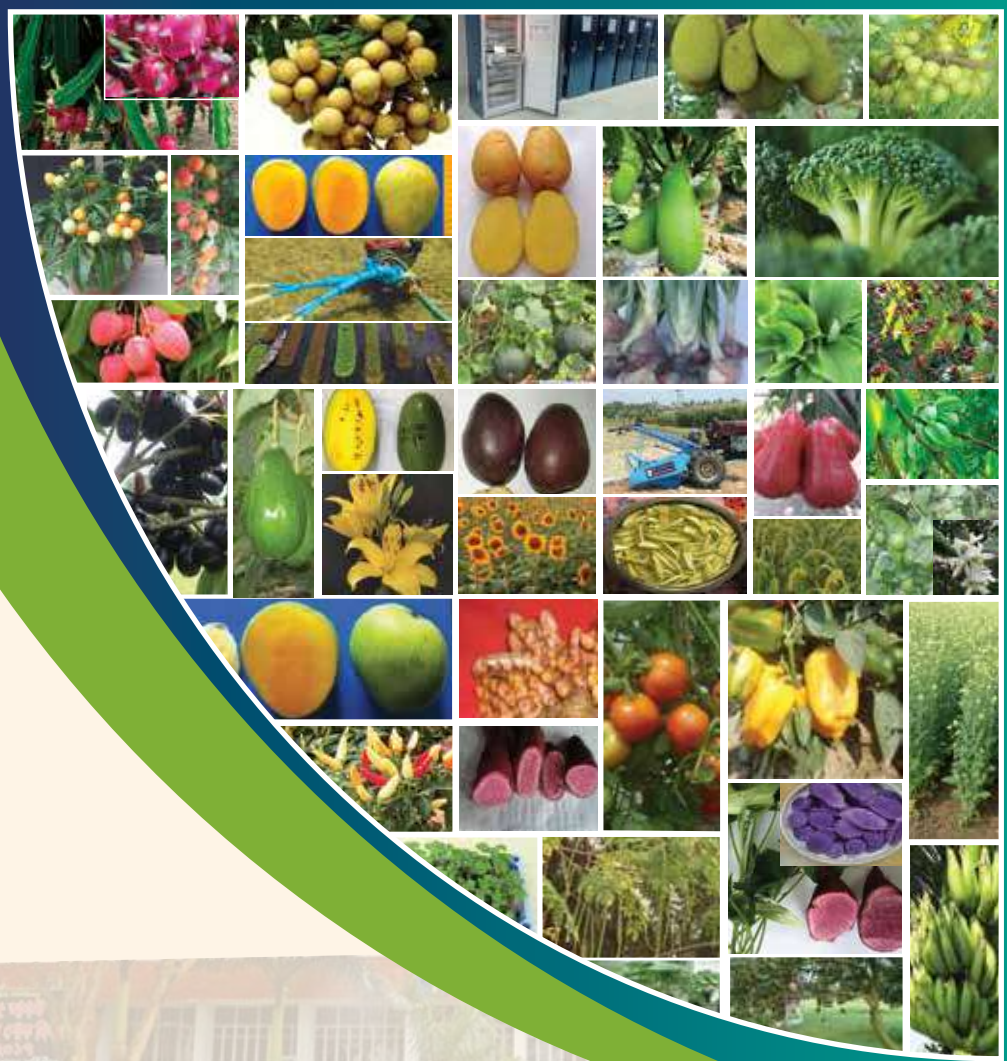
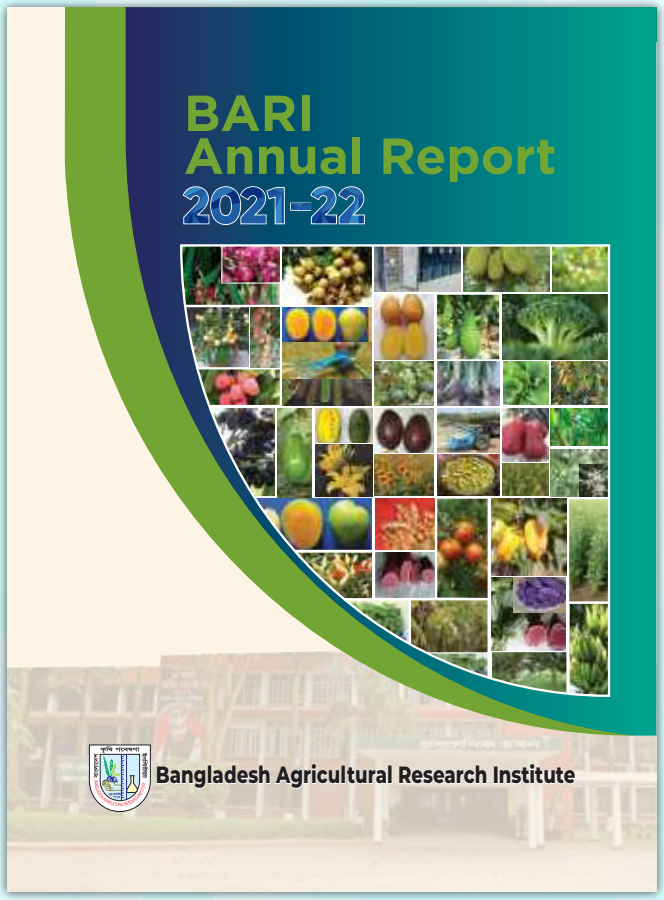
BARI Annual Report 2021-22



Bangladesh Agricultural Research Institute

BARI Annual Report 2021-22



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Foreword

BARI Annual report is an abridged but comprehensive form of compilation of research and related activities of the Institute conducted and achieved in the preceding year. It is written on a yearly basis which gathers almost all research findings and highlights of the developed technologies showing the overall performance, also indicates the future research thrust taking the NAP, plan of action, SDG Agenda, Delta Plan, 4IR and Vision 2041 in mind. In particular, this annual report includes the major findings of the experiments conducted by the scientists of different Crop Research Centers and Research Divisions, RARS and ARS of BARI during the year 2021-2022.

The major research areas of BARI 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.). Apart from Plant Breeding Program, BARI also undertakes many dimensions of crop management research such as improvement of cropping systems, agronomic manipulation, soil health and fertilizer management, crop water requirement and irrigation scheduling, disease and insect pest management, agricultural mechanization, postharvest processing and value addition, information and communication technology, on-farm verification and technology transfer, production economics. In the recent years, attention has been given on adaptation and mitigation under changing climate, tissue culture and plant biotechnological intervention, strengthening of floriculture, hydroponic culture, floating bed agriculture, hill farming, and precision agriculture.

Although this annual report summarizes all the research activities of the previous fiscal year but it is really very hard to accommodate all the findings of such a gigantic research program of BARI in a single volume. Nevertheless, only the major findings have been incorporated in this report for a real overview. Readers those are interested in detailed study reports are suggested to follow the reports of the concerned crop research centers and divisions.

I convey my heartfelt thanks and appreciations to all the scientists, field and lab staff for their commendable contributions. Special thanks are also to the editors and associates who have compiled and edited this report working so hard and making it available to the readers in the form of comprehensive publication. I hope this report will be very useful to the scientists, teachers, students, policymakers and other stakeholders who are engaged in agricultural research, education and extension services for achieving the food and nutrition security in Bangladesh.

Dr. Debasish Sarker
Director General, BARI


Bangladesh Map
Central Station
Regional Station
Research Centre
Sub Station
SP. Crop Station
North
INDIA
INDIA
INDIA
MYANMAR
B A Y O F B E N G A L
PANCHAGARH
NILPHAMARI
LALMONIRHAT
THAKURGAON
DEBGANJ
BURIRHAT
NASHIPUR
KURIGRAM
DINAJPUR
RANGPUR
MAHIGANJ
GAIBANDHA
JOYPURHAT
SHERPUR
NAOGAON
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JAMALPUR
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NAWAB GANJ
BOGRA
MYMENSINGH
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MOULVIBAZAR
KISHOREGANJ
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AKBARPUR
JOYDEBPUR
PABNA
GAZIPUR
NARSINGDI
MEHERPUR
KUSHTIA
MANIKGANJ
DHAKA
N'GANJ
BRAHMANBARIA
CHUADANGA
RAJBARI
JHENAIDAH
FARIDPUR
MUNSHIGANJ
COMILLA
KHAGRACHARI (HILL TRACTS)
MAGURA
SARIATPUR
CHANDPUR
JESSORE
NARAIL
MADARIPUR
GOPALGANJ
LAXMIPUR
FENI
BARISAL
NOAKHALI
HATHAZARI
RANGAMATI (HILL TRACTS)
KHULNA
PEROJPUR
PAHARTALI
RAIKHALI
BAGERHAT
RAHAMATPUR
JHALAKATI
CHITTAGONG
PATUAKHALI
BHOLA
BARGUNA
BANDARBAN (HILL TRACTS)
COXS BAZAR
0 10 20 30 40 50 miles
0 20 40 60 80 km

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

CONTENTS

TUBER CROPS

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Tuber crops comprised of potato, sweet potato, aroids, yam and cassava, which are essential food crops in Bangladesh. 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, long term preservation 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 2021-2022 on varietal improvement, biotechnology approaches, disease and 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

B. C. Kundu, M. Rahman, S. Naznin, M. N. Uddin, M. M. Islam and S. Akhter

Potato is one of the most promising crops in Bangladesh due to its high productivity, short duration and wide adaptability. Potato research and development of HYV potato was started regularly in 1960, its varietal improvement has only been limited to introduction and selection until the year 2000 due to lack of facility. Potato plants do not flower under the short day conditions of Bangladesh. In the recent years, hybridization has been made possible at the TCRC after long lasting efforts on variety selection under extended photoperiod and use of flower induction techniques. Several treatments like extension of photoperiod, brick planting, stem girdling, grafting on tomato and use of hormones, alone or in combination, have been found effective in inducing flowers and berry setting in potato. Hybridization was done at Debigonj and Joydebpur using 154 and 139 clones/ varieties, respectively under 16 hours extended photoperiod to create variability, and to select superior genotypes in the subsequent generations. At Joydebpur, 162 out of 397 crosses and at Debigonj, 480 out of 1460 crosses produced berries. In total 365g hybrid seeds were produced of which 215g were at Debigonj and 150g at Joydebpur.

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

B. C. Kundu, M. Rahman, S. Naznin, M. M. Islam, M. N. Uddin 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 2021-22. After harvesting of all plantlets, 420 single plants and 678 single tubers of 825 crosses were selected. In total 485 kg seedling tubers were stored for next year.

Selection of potato hybrids in subsequent clonal generations (F_1C_1, F_1C_2 and F_1C_3)

M. Rahman, B. C. Kundu, S. Naznin, M. M. Islam, M. N. Uddin and S. Akhter

During the selection process all potato clones were examined critically. Each generation materials were planted separately. In three generations of single plant, plant row and single plot (F_1C_1, F_1C_2 and F_1C_3 generations), 529 potato clones weighing 2245 kg were selected and stored at BSPC, Debigonj for further evaluation.

Preliminary yield trial with clonal potato hybrids

S. Naznin, M. M. Islam, M. M. Rahman, B. C. Kundu and S. Akhter

Eleven hybrid clones of potato were evaluated along with four check varieties, namely BARI Alu-7

(Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady-Rosetta) at Debigonj and Gazipur. Combined analysis was done to see the genotype and location interactions. Significant influence was observed for different environmental factors of different locations on the expression of different characters of the potato hybrids. During final harvest, clone 18.117 gave the highest average yield (42.05 t/ha) followed by 18.19 (39.23 t/ha), 18.102 (38.4 t/ha), 18.8 (37.88 t/ha), 18.46 (35.50 t/ha) and 18.13 (35.02 t/ha). These six clones can be selected for their higher tuber yield potentialities. In case of dry matter, the clones 18.37 (22.37%), 18.11 (21.62%) and 18.102 (20.97%) were suitable for processing purpose. No early mature clone was found than the checks. Clone 18.8, 18.13 and 18.19 gave higher percentage of larger tuber size and weight which is important for processing and export purpose. Considering marketable tuber yield, dry matter, disease, insect and tuber characteristics (shape, size, colour, scoring) these eight clones (18.8, 18.11, 18.13, 18.19, 18.37, 18.46, 18.102 and 18.117) can be selected for SYT.

Secondary yield trial with clonal potato hybrids

S. Naznin, M. M. Islam, M. M. Rahman, M. S. Rahman, B. C. Kundu and S. Akhter

Eleven hybrid clones of potato were evaluated along with four check varieties *viz*., BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at Debigonj, Gazipur and Jamalpur. 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. Clone 17.19 (34.45 t/ha) and 17.5 (29.5 t/ha) can be selected from this study as early bulker. Clone 17.578 can be selected as early mature (74.67 days). The highest average yield (47.57 t/ha) was observed in clone 17.159 followed by clones 17.18 (45.04 t/ha), 17.167 (45.01 t/ha), 17.172 (43.31 t/ha) and 17.12a (43.17 t/ha). Clones 17.159, 17.18, 17.167, 17.172 and 17.12a can be selected for AYT due to their higher tuber yield potentialities. In case of dry matter check variety BARI Alu-28 (Lady Rosetta) gave the highest result. Therefore, no clone was selected for processing purpose. Clone 17.5 and 17.159 gave higher percentage of larger tuber size and weight which is important for processing and export purpose. Clones 17.578 and 17.159 performed better than checks regarding taste, appearance and texture of boiled potato. Considering the tuber yield, dry matter, organoleptic taste, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) these eight clones (17.5, 17.12a, 17.18, 17.19, 17.159, 17.167, 17.172 and 17.578) can be selected for next year AYT.

Advanced yield trial of clonal potato hybrids

S. Naznin, M. M. Islam, M. M. Rahman, M. S. Rahman, M. Z. H. Prodhan, B. C. Kundu and S. Akhter

Six clonal hybrids of potato were evaluated along with four check varieties, namely BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) at six locations during 2021-22 for seventh generation. Tuber yield at 65 DAP was recorded to identify the early bulker genotypes. Clone 16.9 was selected from this study. At final harvest, clone 16.9, 16.16 and 16.28 were selected for RYT due to their higher tuber yield (44.06 t/ha) (42.54 t/ha) and (42.45 t/ha), respectively. The average dry matter content of clone 16.16 (20.68%) and 16.62 (20.48%) were suitable for processing purpose. The clones 16.9 and 16.16 gave larger (>40mm dia) tubers size and weight, which had higher dormancy (70-75 days and 95-100 days). These three characters are important for export purpose as well as some cases of processing purpose. Clones 16.62 and 16.16 performed better regarding taste, appearance and texture of boiled potato. From AMMI stability analysis, clone 16.16 was found as more stable and higher yielder. Clones 16.9, 16.16, 16.28 and 16.62 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 of advanced clonal hybrids

S. Naznin, M. M. Islam, M. M. Rahman, M. S. Rahman, M. Z. H. Prodhan, B. C. Kundu and S. Akhter

Six 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 16.28 (42.54 t/ha) followed by 16.16 (40.69 t/ha) and lowest average yield was found in check variety BARI Alu-28 (Lady Rosetta) (25.79 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 of clonal hybrids of potato

S. Naznin, M. M. Islam, M. M. Rahman, M. S. Rahman, M. Z. H. Prodhan, B. C. Kundu and S. Akhter

Three clonal hybrids of potato, namely 15.112, 15.139 and 15.156 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 2021-22 cropping season. Clones 15.139 and 15.156 were selected as early bulker from this study. The highest average yield was found in clone 15.139 (50.10 t/ha) followed by the clone 15.156 (42.88 t/ha) and 15.112 (42.08 t/ha). These two clones can be recommended for release as commercial varieties. Average dry matter percentages of clone 15.112 (21.45) and 15.156 (20.77) were suitable for processing purpose. Clones 15.156 and 15.139 gave larger (>40mm dia) tubers size and weight and dormancy 70 and 100 days which is important for export purpose as well as some cases processing purpose. In case of organoleptic taste, the clones 15.156 performed better regarding taste, appearance and texture of boiled potato. From AMMI stability analysis, clone 15.156 was found as more stable and higher yielder. Considering tuber yield, organoleptic taste performance, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) these three clones (15.112, 15.139 and 15.156) can be recommended for release as commercial varieties.

Participatory variety selection of clonal hybrids

S. Naznin, M. M. Islam, M. M. Rahman, M. S. Rahman, M. Z. H. Prodhan, B. C. Kundu 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 15.156 (42.50t/ha) followed by 15.139 (36.11 t/ha) and lowest average yield was found in BARI Alu-28 (Lady Rosetta) (25.79 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 three clones (15.139 and 15.156) can be recommended for release as commercial varieties.

Preliminary yield trial of exotic potato varieties

M. M. Islam, S. Naznin, M. M. Rahman, B. C. Kundu and S. Akhter

Potato variety development through hybridization and selection is common and popular in potato growing countries. As, it is a crop of cooler region, long day condition is required for flowering. But, in Bangladesh such condition does not prevail in all locations. So, variety development through hybridization and selection is a tedious job and takes more time. In that case to release a variety within a short period through introduction is skillful. Three exotic potato varieties including four checks were evaluated at Gazipur and Debiganj for yield. The variety Zorba and Chenoa gave the highest average marketable yield at Gazipur and Debiganj, respectively. As the seed potato was collected from different countries, they might not expose their all characters completely in the first-year trial. Therefore, no selection was done this year. Seeds produced from this trial are kept for 2nd year trial for further confirmation.

Secondary yield trial of exotic potato varieties

M. M. Islam, S. Naznin and S. Akhter

Thirteen exotic varieties along with four check varieties *viz*., BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (L. Rosetta) were evaluated at Gazipur during 2021-22 for second generation trial. A significant influence was observed due to different germplasms on the expression of different characteristics of potato. Exotic variety 'Everest' gave the highest yield (53.34 t/ha) followed by 'Spectra' (46.14 t/ha). Dry matter percentage at harvest was the highest with check variety 'Lady Rosetta' (21.79). The check BARI Alu-28 (Lady Rosetta) again gave the statistically highest percentage of dry matter (22.58) and followed by 'Ranoni' (21.7). Seed tuber grade performance was satisfactory among the genotypes. No selection was done from this trial and all the germplasm are kept for the next year's trial.

Regional yield trial with exotic potato varieties

S. Naznin, M. M. Islam, M. M. Rahman, M. S. Rahman, M. Z. H. Prodhan, B. C. Kundu and S. Akhter

Three exotic potato varieties, namely 'Alcander', 'Hind' and 'Roslin' 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 2021-22 cropping season in RYT. The significant influence was observed of different environmental factors of different locations on the expression of different characters of potato. 'Hind' was selected as early bulker exotic variety from this study. Mean yield over the locations, 'Roslin' gave average highest yield (43.39 t/ha) which was statistically similar with 'Hind' (42.30 t/ha). Therefore, these two exotic varieties can be recommended for the release as commercial varieties due to their higher tuber yield potentialities. Among the tested exotic varieties 'Alcander' was early mature exotic variety and also produced acceptable average dry matter percent (20.12) for processing. 'Hind' and 'Roslin' gave more large (>40mm dia) tubers size and weight and dormancy 70 to 78 days which is important for export purpose as well as some cases for processing purpose. 'Roslin' performed best 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 two exotic varieties (Hind and Roslin) can be recommended for release as commercial varieties.

Participatory variety selection of exotic potato varieties

S. Naznin, M. M. Islam, M. M. Rahman, M. S. Rahman, M. Z. H. Prodhan, B. C. Kundu and S. Akhter

Three exotic potato varieties along with three check varieties were evaluated at farmers' field of six agro ecological environments during 2021-22. Yield varied significantly from location to location. The average highest tuber yield was recorded from 'Roslin' (37.62 t/ha) followed by 'Hind' (37.36 t/ha) and lowest average yield was found in check variety BARI Alu-28 (Lady Rosetta) (25.79 t/ha). Farmers were very much interested in all these new varieties but varied from location to location. Therefore, these two varieties (Hind and Roslin) can be recommended for the release as commercial varieties.

Regional yield trial of late blight tolerant exotic potato varieties

M. M. Islam, S. Naznin, M. M. Rahman, M. S. Rahman, M. Z. H. Prodhan, B. C. Kundu, A. K. Saha and S. Akhter

The experiment was conducted with three late blight tolerant promising exotic varieties, namely 'Dunstar', 'Twinner' and 'Twister' with three checks BARI Alu-7 (Diamant), BARI Alu-8 (Cardinal) and BARI Alu-77 (Sarpomira) at TCRC Gazipur, BSPC Debiganj, TCRSC, Bogura and RARS, Jamalpur during 2021-22. All the locations showed significant variations for tuber yield at 65 DAP and 95 DAP. At 65 DAP, the mean yield over the locations was the highest in Twister (26.59 t/ha). At 95 DAP, 'Twister' produced 38.85 t/ha potato and followed by 'Twinner' (34.09 t/ha). 'Twister' can be recommended for release as commercial variety because of the yield and late blight disease tolerant capability.

Participatory variety selection for late blight tolerant exotic potato variety

M. M. Islam, S. Naznin, M. S. Rahman, M. Z. H. Prodhan, A. K. Saha and S. Akhter

Three exotic potato varieties, namely 'Dunstar', 'Twinner' and 'Twister' with three checks *viz*., BARI Alu-7, BARI Alu-8 and BARI Alu-77 were evaluated at farmers' field of three different agro ecological environments/locations during 2021-22 cropping season. Yield of three tested new exotic varieties varied significantly from location to location. Farmer's perception was also varied, from location to location. 'Twister' can be recommended for release for its higher yield and high level of late blight disease resistant.

Observation trial with clonal hybrids and exotic varieties against natural high temperature stress for early planting

M. Rahman, B. C. Kundu, M. M. Rahman, S. Naznin, M. M. Islam, M. N. Uddin and S. Akhter

Potato production outside the regular growing season results in farmer's 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- November. Performance of twenty genotypes of potato along with four check varieties *viz*., BARI Alu-13 (Granola), BARI Alu-41, BARI Alu-29 (Courage) and BARI Alu-28 (Lady Rosseta) were evaluated at the breeder seed production center, Debiganj during *rabi* season 2021-22 following RCBD with 3 replications. The results revealed significant variations due to genotypes for all characters. Emergence, plant height, stem per hill, marketable tuber yield at 65 days, non-marketable yield at 65 days were recorded to identify the early bulker varieties. Finally clones 16.9, 16.7, 15.139, 15.156, BARI Alu-85, 'Prada', 'Innovator' and 'Roslin' can be selected for early material on the basis of field performance.

Screening of the potato variety for export potential

B. C. Kundu, M. M. Islam, M. N. Uddin, S. Naznin, M. Sultana, K. U. Ahammad, M. Sultana, M. R. Karim, M. M. Rahman, R. Akter, M. Z. Ferdous, M. A. H. Talukder, M. I .A. Hawlader, M. A. Khan, M. K. Alam, M. Z. H. Prodhan, M. M. Uddin, M. H. Rashid and S. Akhter

The present consumption of potato estimates 7.0 million tons, seed requirement 0.8-1.00 million tons and processing factory use 0.1 million tons. The rest >1.5 million tons was surplus. Farmers sometimes face serious losses due to glut in the market. So, they get discouraged in potato cultivation, which can't be entertained in a food nutrition deficit country like Bangladesh. Therefore, we need to export this surplus potato to foreign country. Some of the exporters claimed that we have no sufficient technology for production of exportable potato. Suitable Variety is one of them. The requirement of export potato variety as well as production technology is different in our traditional table potato production. So, the present study was therefore undertaken to identify the suitable potato varieties for export with a view to sustainable potato production in the country. Fifty four released potato varieties and some advanced lines/varieties were evaluated at ten agro-ecological locations during the 2021-22 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-68 (Atlantic), BARI Alu-73, BARI Alu-92, Labela, BARI Alu- 98 (Arizona), BARI Alu-12 (Dheera), BARI Alu-21 (Provento), BARI Alu-50 (7.86), BARI Alu-66 (Pamela), BARI Alu-71 (Dolly), BARI Alu-72, BARI Alu-81, BARI Alu-83 (Cimega), Messi, BARI Alu-100 (Ottawa) can be selected for exportable potato variety.

Secondary yield trial of CIP biofortified potato clones

M. M. Islam, S. Naznin, M. M. Rahman, B. C. Kundu, M. A. Ali, E. H. M. S. Rahaman, D. Chanda and S. Akhter

Potato is the third most important food crop in Bangladesh. In our country, about 9.65 million tons of potato were produced from about 0.468 million hectares of land with an average yield of 20.61 t ha-1 (BBS, 2019). Due to the development of suitable variety as well as different production package and also regular supply of inputs potato production increases day by day. The present consumption of potato estimates 7.0 million tons, seed requirement 0.8-1.00 million tons and processing factory use 0.1 million tons. The rest >1.5 million tons was surplus. To fulfill SDG goals we need to ensure food as well as nutritional security. Biofortification is a feasible and cost-effective means of delivering micronutrients to populations that may have limited access to diverse diets and other micronutrient interventions (H.E. Bouis, A. Saltzman, 2017). The ultimate goal of bio fortification is producing nutritious and safe foods, sufficiently and sustainability. Micronutrient malnutrition is one of the major problems in many developing countries like Bangladesh. This study was under taken by TCRC in collaboration with the CIP to reduce malnutrition of Bangladeshi people through the use of biofortified potatoes. Fourty four CIP bio-fortified clones with four checks variety *viz*., BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (L.Rosetta) were tested at BSPC, Debiganj, Panchagarh. The highest yield was observed in CIP-430 (54.96 t/ha)

which was followed by CIP-445 (53.95 t/ha), CIP-432 (53.19 t/ha). Most of the genotypes (Around 30) produced higher yield and contained high zinc and iron alone or together over the check varieties. So, those clones will be used for the next year trial (AYT).

Secondary yield trial of CIP late blight tolerant potato germplasm

M. M. Islam, S. Naznin, M. M. Rahman, B. C. Kundu, M. A. Ali, E. H. M. S. Rahaman, D. Chanda and S. Akhter

Late blight (LD) of potato, caused by *Phytophthora infestans* is one of the most important diseases of potato in Bangladesh. The experiment was conducted under natural inoculum pressure in the isolated field of BSPC, BARI, Debiganj, Panchagarh to evaluate 10 CIP potato germplasm along with LB resistant BARI Alu-46, BARI alu-53, BARI Alu-90, BARI alu-91and susceptible BARI Alu-25 against late blight disease during 2021-22 cropping season. None of the variety/germplasm was found immune. BARI Alu-46, BARI alu-53, BARI Alu-90, BARI alu-91 and germplasm CIP-402, CIP-444, CIP-445 and CIP-449 were found highly resistant. In respect of yield BARI Alu-46 gave higher yield (52.15 t/ha) followed by (43.36 t/ha), BARI Alu-90 (41.19 t/ha), BARI Alu-53 (40.46 t/ha), CIP-445 (36.80 t/ha), and CIP-444 (35.41 t/ha). In respect of resistance and tuber yield performance. The germplasm CIP-449, CIP-445, CIP-402 and CIP-444 can be selected as a late blight resistant variety.

Preliminary yield trial of CIP heat tolerant potato germplasm

M. M. Islam, S. Naznin, M. M. Rahman, B. C. Kundu, M. A. Ali, E. H. M. S. Rahaman, D. Chanda and S. Akhter

International Potato Center (CIP) bred potato genotypes produce various yields under heat stress conditions due to being sown late. To explore options for achieving this, a replicated experiment was conducted at the field of TCRC, BARI, Gazipur, Bangladesh and Breeder seed production centre, Debiganj to evaluate the performance of eight CIP-bred potato genotypes with four controls. There was a great yield variation among the germplasm and all the material will be used in the next year trial to see the complete performance in a heat stress and non-heat stress condition.

Secondary yield trial of coloured flesh potato varieties

M. M. Islam, S. Naznin, M. S. Rahman, M. Z. H. Prodhan and S. Akhter

Two germplasm of potato from different source were evaluated along with four check varieties, namely BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28(Lady-Rosetta) at six locations during 2021-22. At final harvest, the germplasm 33.33 was selected for AYT due to its higher tuber yield (51.36 t/ha) and the germplasm 33.32 was also selected for the second highest yield (33.17 t/ha). β-carotene content of 33.32 and 33.33 were 5.39 and 7.43 mg/100g, respectively. Therefore, the germplasm 33.32 and 33.33 can be selected for next year AYT Trial due to their performance regarding tuber yield, β-carotene content, disease and insect infestation and tuber characteristics specially for their flesh color.

Regional yield trial of anthocyanin rich potato germplasm

S. Islam, M. M. H. Molla, F. Akhter, M. M. Islam, S. Naznin, M. M. Rahman, S. Ahmed, M. S. Rahman, M. Sultana, M. M. H. Bhuiyan, M. Salim, B. C. Kundu, M. Z. H. Prodhan, M. K. Alam, M. O. Kaisar, M. M. Kadir, M. A. Siddiky and S. Akhter

Two exotic potato varieties, namely MSZ109-10PP and Red Marker#2 along with three check varieties BARI Alu-7 (Diamant), BARI Alu-25 (Asterix) and 'Lalpakri' were evaluated at five different agro ecological environment/locations during 2021-22 cropping season in RYT. The significant influence of different environmental factors of different locations was observed on the expression of different characters of potato. Red Marker#2 and MSZ109-10PP were selected as early bulker exotic variety from this study. MSZ109-10PP gave the statistically highest tuber yield (50.83 t/ha) at Bogura during final harvest. MSZ109-10PP was the highest yielder at Bogura (50.83 t/ha), Cumilla (43.84 t/ha), Gazipur (46.79 t/ha) and Jamalpur (45.23 t/ha) and highest anthocyanine content (91.84 mg/100g). Only Red Marker#2 was the highest tuber producer at Debiganj (40.30 t/ha). Dry matter percentage at harvest was the highest in MSZ109-10PP (19.29%) followed by Red Marker#2 (19%). MSZ109-10 (83.16% in number basis) produced highest seed grade tubers followed

by BARI Alu-25 (78.99%). MSZ109-10PP produced highest over size tubers in weight basis (16.84%) and number basis (5.01%) which made great contribution towards percentage of tuber number and tuber weight. MSZ109-10PP is round purple skin and flesh potato. Red Marker#2 is red skin, round shape tuber with white flesh tuber. From the results of organoleptic taste, MSZ109-10PP and Red Marker#2 were found good at taste, appearance and texture of boiled potato. Diseases and insect data were collected by Regional technical team and found less infection both in disease and insects. Considering tuber yield, organoleptic taste performance, disease, insect infestation and tuber characteristics (shape, size, colour, scoring) these two potato germplasm, MSZ109-10PP and Red Marker#2 has already been proposed for release.

Participatory variety selection of RYT anthocyanin rich potato germplasm

S. Islam, M. M. Molla, F. Akhter, S. Naznin, M. M. Islam, M. M. Rahman, B. C. Kundu, M. Z. H. Prodhan, M. Selim, M. K. Alom, M. S. Rahman, M. M Kadir, S. Sultana, M. M. H. Bhuiyan, M. O. Kaisar and S. Akhter

Two anthocyanin rich potato varieties 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 average tuber yield was recorded in 'Blackberry' (41.89 t/ha) followed by 'Spartan Red' (29.46 t/ha). Considering tuber yield, tuber size, shape and colour, farmers of all locations showed their keen interest to 'Blackberry' and 'Spartan Red'. Therefore, these two-potato germplasm have been already proposed for release.

Morphological characterization of advanced breeding lines and exotic potato varieties

S. Naznin, M. M. Islam, M. M. Rahman, B. C. Kundu and S. Akhter

Morphological characterization is essential for recognizing, distinguishing and describing a variety. In recent years a number of newly developed advanced breeding lines of potatohave been added to the germplasm collection. No information regarding the extent of genetic divergence in these newly acquired potato lines, is available under this condition. In view of the above,the present study has been undertaken to collect information on genetic divergence in the newly acquired genotypes so that useful parental materials for the breeding program could be selected. Nine advanced clones of potato developed by TCRC and six exotic varieties were characterized at TCRC, Gazipur during 2021-22 following the DUS descriptor. There were lots of variations in morphological characteristics in addition to agro-morphic characters. Large variation was found among the genotypes and distinct characters were recorded which could help to find out the respective clones as well. Furthermore, a lot of information were identified which could provide important information to the breeders.

Screening of parental lines for TPS production under extended photoperiod

S. Naznin, M. M. Islam, B. C. Kundu and S. Akhter

A study with 139 genotypes was carried out in the research field of TCRC, BARI, Gazipur for screening of some parental lines delivering good performance in different angles. The germplasm were planted in different dates *viz*., 8th, 15th and 27th November, 2021 for the conveience of crossing. Among 139 genotypes, 79 flashed with flowering where 397 crosses were made and 162 crosses produced 506 berries. Finally, In this case, the genotype BARI Alu-72 were superior pursued by BARI Alu -52 (Labadia), BARI Alu -53, BARI Alu -56, BARI Alu -75 (Montecarlo), BARI Alu -78, BARI Alu -83 (Cimega), BARI Alu -86, TPS-67 and TS-15 respectively (Table 2). In this study, some genotypes showed good performance as a male parent named as BARI Alu -32 (Quincy), BARI Alu -53, BARI Alu- 56, BARI Alu -75 (Montecarlo), BARI Alu -78, BARI Alu -83 (Cimega) and BARI Alu- 86. In addition, good growth and excellent bearing was noticed in some studied materials visually BARI Alu-12 (Dheera), BARI Alu-25 (Asterix), BARI Alu-32 (Quincy), BARI Alu-47, BARI Alu-48, BARI Alu-72 and BARI Alu-73 and BARI Alu -100 (Ottawa).

Selfing in diploid potato germplasm

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

Diploid potato breeding can replace tetraploid potato with a seed-propagated diploid potato inbred

line (ShelleyJanskey, 2016). Once a highly genetic homozygous inbred line would produce, inbred line can replace tetraploid variety and could be used as highly homogenous TPS production. In addition, diploid potato breeding can help to transfer disease resistance genes to tetraploid potato and take full advantages of modern genetics. In considering the use of pure lines for the development of genetically uniform clonal or TPS varieties, self-fertile, seed-propagated lines are highly desirable. For these circumstances, this experiment has been taken. Selected 10 diploid lines were planted at TCRC and BSPC. 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-incompatible. Only the genotype A-15 produced around 55 seeds which will be used in the next generation for selfing.

Production of seedling tubers of the selfed populations (F_1S_0)

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

The produced TPS of diploid parents were planted at BSPC in 2021-22. Total planted TPS were 85 at BSPC. Most of them did not germinate at all. Some of them produced tubers. From them 40 tubers of 15 progenies of A-56 were produced and stored at BSPC for next year trial.

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

B. C. Kundu, M. Rahman, S. Naznin, M. M. Rahman, M. M. Islam and S. Akhter

Maintenance breeding is the routine work of TCRC for future use of valuable materials. Potato needs to grow every year and stored in cold storage in our climatic conditions. Each and every year all the germplasm grown under net house in BSPC, BARI, Debigonj and after harvest stored in cold storage. This year also the same experiment was conducted for this same purpose. A total of 28823 kg seeds of potato was preserved in Breeder Seed Production Center cold storage, Debiganj, Panchagarh collected from 4413 potato variety/germplasm/ hybrid clone during 2021-2022. The preserved materials will be used in future for variety development program.

Multiplication, purification and maintenance of indigenous potato varieties

A. K. Saha, M. M. E. Rahman, S. Naznin, M. M. Islam and S. Akhter

Indigenous potato variety (IPV) contains higher proportion of amylopectin than exotic potato variety (EPV) which makes them sticky and testier. In spite of low yields, the IPV are popular among the growers and consumers mainly for containing higher percentage of dry matter and as such exhibit good keeping quality under ordinary temperature. Besides, IPV gives reasonable yield under low input condition and because of that, it fits well into the production system of small and marginal farmers. Due to farmers and consumers acceptability particular attention should be given to the maintenance and improvement of IPV. That's why these materials should be maintained and purified through clonal selection over the year. After purification each year yield performance should also checked for how much progress of yield compared to previous year. These were the objectives for this trial. During 2021-22 cropping year, quality seeds of nine indigenous cultivar *viz*., 'Ausha', 'Challisha', 'Dohazari', 'Indurkani', 'Lalpakri', 'Patnai', 'Sadaguti', 'Shilbilati' and 'Sindurkota' were produced under net house condition. 390 Kg seeds were 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. Ali, M. M. Islam and S. Akhter

To exploit heterozygosity among sweet potato genotypes polycross method is generally used to generate half-sib sweet potato hybrid seeds with great variability regarding yield potentiality, dry flesh, earliness, carotene content, disease tolerance and good taste. In reality, there is only one breeding objective- a better variety. The experiment was conducted during 2021-22 at Gazipur. Seven (07) F_1 seeds were collected from controlled cross between BARI Mistialu-12 and BARI Mistialu-17. In natural cross, a total of 79 numbers of F_1 seeds were collected from five parents (Table 1). The highest number of F_1 seeds was collected from

BARI Mistialu-2 (36) followed by BARI Mistialu-12 (30) and the lowest number of F_1 seeds from H 9.6/09 (1). These F_1 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. Ali, M. M. Islam and S. Akhter

Thirteen vial of sweet potato germplasm were imported from CIP, Peru. TCRC, BARI, Gazipur is maintaining three germplasm in the field and others are in tissue culture laboratory. Using those germplasms, experiment will be taken in next year.

Observational trial of orange fleshed CIP sweet potato germplasm

Z. Alam, M. A. Ali, M. A. H. Khan, M. S. Alam, E. H. M. S. Rahaman, D. Chandra, M. Islam and S. Akter

An experiment was conducted at two locations (Gazipur and Bogura) with two sets where Set-1 was early bulking type harvesting at 90 days and Set-2 was regular bulking type harvesting was 120 days. In this experiment, 176 & 366 OFSP germplasm were evaluated including four checks in Set-1 & Set-2, respectively. The experimental design was augmented with fully randomized and evaluated regarding their phenotypic, yield and yield contributing characters. There was a huge variability present among these lines. Especially wide variation present in marketable tuber weight which varied from 815 g/plant to 0.00 g/plant and 1354 g/plant to 0.00 g/plant in Set-1 & Set-2, respectively. Considering all the characters that was taken in this experiment, 27 genotypes from Set-1 and 20 genotypes from Set-2 were selected.

Observational trial of purple fleshed CIP sweet potato germplasm

Z. Alam, M. A. Ali, M. A. H. Khan, M. S. Alam, E. H. M. S. Rahaman, D. Chanda, M. M. Islam and S. Akter

Sweet potatoes are playing a supplementary role in mitigating food with nutritional values as well as this can be playing a vital role in our economy. Purple flesh and orange flesh sweet potatoes play a vital role in the nutritional aspect. TCRC, BARI received 5000 true seeds of purple flesh sweet potatoes from CIP. These true seeds were germinated at TCRC, BARI through standard protocol provided by CIP in 2019. 1467 seeds were germinated (around 29% germination) and 1353 seedlings were transplanted into a 6-inch pot. These seedlings were again transferred to soil for vine multiplication. After being transferred to soil, around 884 germplasm survived, and the remaining were damaged. In season 2021-22, TCRC-CIP set up an experiment on accelerated breeding and genetic gain of purple flesh sweet potatoes utilizing these germplasms. The experiment was 1.5 partially replicated row-column design and laid out in two locations, one was Gazipur, and another was Debiganj. In this experiment, 884 germplasms were used as treatment with 9 checks. Here 50% germplasm was repeated in the Gazipur location and another 50% was repeated in the Debiganj location but checks were repeated eight times in both locations. In this experiment, all treatments and checks were fully randomized 52 rows and 28 columns were present, the field was managed properly as well as data were collected on time. Here, 3 vines were planted in each plot and the number of plots in this experiment was 1456. In this experiment, 322 germplasm produced storage roots (tuber) out of 884 germplasm in Debiganj & Gazipur. The highest root (tuber) number per plant 8.70, the highest marketable root (tuber) number per plant 5.07, the maximum root (tuber) weight per plant 614g, maximum marketable root (tuber) weight per plant 583.17g, were found combinedly in both locations. In the case of foliage yield per plant, 2231.89g was found highest. In these germplasms, thirty-one (31) genotypes were selected for the preliminary yield trial. All the selected purple flesh germplasm are being maintained in the germplasm nursery for the preliminary yield trial in next year.

Preliminary yield trial of hybrid clones of sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. M. Islam and S. Akhter

A total of sixty-two (62) genotypes were evaluated regarding their phenotypic characters. Experiment was conducted at Gazipur during 2021-22 cropping season. There is a huge diversity present among the genotypes. Wide variation present in yield which varied from 20 t/ha to 70 t/ha and flesh color from off white to purple. This information is useful for the optimal design of plant breeding programs, influencing the choice of genotypes to cross for the

development of new populations or for direct selection. Considering all the characters twenty-five (25) germplasm was selected.

Regional yield trial with CIP clones of sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. Sultana, M. Z. H. Prodhan, M. M. Rahman, M. S. Rahman, M. M. Quader, M. B. Anwar, K. U. Ahammad, M. M. Islam and S. Akhter

Two (2) sweet potato genotypes (Moz1.15 and Moz1.9), enriched in beta carotene and mineral content were provided by International Potato Centre (CIP). Two (2) high yielding Japanese varieties (SPM103 and SPO104) were collected from farmer's field. These four genotypes were evaluated with three check varieties *viz*. BARI Mistialu-12, BARI Mistialu -16 and BARI Mistialu-17 at Gazipur, Bogura, Jamalpur and Joshore in 2021-22 cropping season to get a variety comprising high marketable yield, tuber length, number of tuber/plant and weight of tuber/plant. SPO104 and Moz1.15 lines performed better.

Regional yield trial with hybrid clones of sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. Sultana, M. Z. H. Prodhan, M. M. Rahman, M. S. Rahman, M. M. Quader, M. B. Anwar, K. U. Ahammad, S. M. K. H. Chowdhury, A. S. M. H. Rashid, M. M. Islam 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 12 and BARI Mistialu 16 in five locations (Gazipur, Bogura, Jamalpur, Jashore and Pahartali) during 2021-22 season. All the six studied clones gave satisfactory yield. H16.ej/10 hybrid gave the highest yield in all locations except Jamalpur. For getting a conclusive result, the experiment will be repeated in next year.

Participatory variety selection trial with hybrid clones of sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. Sultana, M. Z. H. Prodhan, M. M. Rahman, M. S. Rahman, M. M. Quader, M. M. Islam and S. Akhter

A participatory variety selection trial at farmer's field 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 H9.48/11with two check variety BARI Mistialu-12 and BARI Mistialu-16 during the winter season of 2021-22. Farmers experienced very good mouth feel during testing BARI Mistialu-12. Overall, they choose H16.ej/10 in respect of their marketable yield and organoleptic test.

Participatory variety selection trial with CIP clones of sweet potato

Z. Alam, M. A. H. Khan, M. S. Alam, M. Sultana, M. Z. H. Prodhan, M. M. Rahman, M. S. Rahman, M. M. Quader, M. M. Islam and S. Akhter

A participatory variety selection trial at farmer's field of CIP (Moz1.9 and Moz1.15) and Japanese (SPM103 and SPO104) sweet potato clones was carried out with three check variety BARI Mistialu-12 and BARI Mistialu-16, BARI Mistialu-17 in Bogura, Gazipur and Jamalpur during the winter season of 2021-22. Farmers experienced very good mouth feel during testing SPO104, BARI Mistialu-12 and BARI Mistialu-17. All four lines showed high yield potentiality. Overall, they choose SPO104 in respect of their marketable yield and organoleptic test.

Aroids

Secondary yield trial of mukhikachu lines

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

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 secondary yield trial during April to November 2021 at TCRC research field, Gazipur. The growth parameters, yield components and yield were statistically significant. The highest yield (18.85 t/ha) was recorded in MK-182 closely followed by MK-190 (18.12 t/ha). Seven lines viz. MK-182, MK-190, MK-187, MK-180, MK-186, MK-177 and MK-185 were selected for further studies.

Regional yield trial of mukhikachu lines

M. S. Alam, F. Begum, M. Z. H. Prodhan, M. Sultana, M.R.H. Mondal, M. S. Rahman. M.M. Quader. B. Anwar, K. U. Ahammed and S. Akhter

Four genotypes of Mukhikachu (*Colocasia esculenta* var. *antiquorum*) *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 2021. The yield components and yield were statistically significant among the lines. The Mukhikachu line MK-176 produced the highest yield (28.24 t/ha) which was statistically similar with MK-129 (27.21 t/ha) at Bogura.

Regional yield trial of rhizome producing panikachu lines

M. S. Alam, F. Begum, M. Z. H. Prodhan, M. Sultana, M.R.H. Mondal, M. S. Rahman. M.M. Quader. B. Anwar, K. U. Ahammed and S. Akhter

Five lines of rhizome producing Panikachu (*Colocasia esculenta*) *viz.*, PK-179, PK-180 and PK-181, PK-182, PK-184 along with two released varieties 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 BARI Panikachu-6 at all the studied locations and it was the highest of 31.29 t/ha at Gazipur. The highest marketable rhizome yield (113.60 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.R.H. Mondal, M. S. Rahman. M.M.Quader. B. Anwar, K. U.Ahammed and S. Akhter

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 2021. 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 (30.30 t/ha) in Latiraj at Jamalpur closely followed by PK-134 (29.13 t/ha) at Gazipur. The marketable rhizome yield was the highest (72.22 t/ha) in BARI Panikachu-2 at Jamalpur.

Preliminary yield trial of ghataman kachu in relation to spacing

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

Two spacings (60 cm × 60 cm and 70 cm × 70 cm) on Ghataman Kachu (*Alocasia* sp.) were evaluated during March to December 2021 at the field of TCRC, BARI, Gazipur. The vegetative growth parameter, yield contributing characters and yield were influenced significantly. 70 cm × 70 cm spacing was produced the highest (42.4 t/ha) yield than 60 cm × 60 cm spacing (35.4 t/ha).

Preliminary yield trial of panchamukhi kachu in relation to spacing

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

Two spacings like (60 cm × 60 cm and 70 cm × 70 cm) on Panchamukhi Kachu (*Colcasia esculenta*) were evaluated during March to December 2021 at the field of TCRC, BARI, Gazipur. Plant height and weight of individual corm was significantly influenced by spacing. Remaining parameters did not show any significant difference. The yield was not statistically significant. The corm yield was around 20 t/ha for both the spacing.

Maintenance of aroids germplasm

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

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

Cassava, Yam & Jicama

Yam (*Dioscorea spp.*) is the fourth most important tuber root crop in the world after potato, cassava and sweet potato. It is an ancient tuber-bearing and climbing type crop which is grown near at home or fence, on the tree and even the road side in all districts of Bangladesh. However, some farmers of different regions of the country like Jashore, Satkhira, Narsingdi, Kishoreganj along with Hill Tracts cultivate it commercially. It is important for its nutrients content and medicinal values though it is used as vegetable. BARI released two varieties of yam as BARI Mete Alu-1 and BARI Mete Alu-2. It has been proposed to release as varieties of mete alu, BARI Mete Alu-3 and BARI Mete Alu-4.

Cassava is considered as a primitive crop and cultivated in many countries of the world. It is used as an important staple food in many African countries. It is commonly known as 'Shimulalu' in Bangla and cultivated only in hilly areas of Bangladesh. Some tribal people in Sherpur, Netrakona, Mymensingh, Comilla, Sylhet and Chittagong regions of Bangladesh use cassava as food. Cassava is highly rich in starch and can also be used as biofuel, animal feed, laundry starch and various medicinal purposes. BARI has proposed two varieties as BARI Cassava-1 and BARI Cassava-2.

Jicama (bran potato, bran, branch potato, spinach potato, spinach, olive potato) is a type of tuber crop. Cold potatoes look a lot like conch shells in shape and color so this potato has been named Shankhaalu and Shakalu from there. The Chakmas call it Judo alu (Judo means cold) and the Marma community call it Roneu. In English it is called Mexican Yam or Mexican Turnip. Although it is shaped like a potato, it is eaten raw like a spinach fruit, on the other hand it is cooked and eaten like a vegetable. It is an expensive vegetable in the hills. Recently, British scientists believe that jicama has a role in preventing cancer. They say that jicama contains a rare chemical called crocetin which significantly reduces the amount of blood cholesterol and triglycerides in the human body.

Tuber Crops Research Center collected several germplasm from different locations of Bangladesh and evaluated those materials for growth habit, yield potentialities, pest vulnerabilities, diseases incidence, organoleptic test, morphological and physiological characteristics and chemical test. After few years trail, suitable lines will be released as variety (Non-notified crop) for Bangladesh.

Regional yield trial of yam (D*ioscorea* spp.)

M. H. Rashid, M. Sultana, M. Z. H. Prodhan, B. Anwar and S. Akhter

Ten yam germplasm, namely Bog-1, Bog-2, Bog-3, M. Man-2, KHG-1, Lal-1, M.man-1, HOM 7, HOM 20 and HOM 47 selected from last two consecutive years were evaluated at Joydebpur, Bogura and Jashore during 2021-22 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, Results of the present study clearly indicated among the germplasms, Bog-1, Bog-3, M.Man-2, KHG-1, HOM-7 and HOM-47 offered highest yielder. So, those could be advanced to release as variety considering the result.

Preliminary yield trial (PYT) of yam (D*ioscorea* spp.)

M. H. Rashid, B. Anwar and S. Akhter

Eight yam germplasm, namely Jas-1, Jas-2, Jas-3, Jas-4, Jas-5, Jas-6, Jas-7 and Jas-8 were evaluated at the research field, RARS, Jashore during 2021-22 cropping season under PYT. Results of the present study clearly indicated among the germplasms, Jas-8 (12.4 kg) offered highest yield followed by Jas-7 (8.9 kg). So, the genotype Jas-8 and Jas-7 can be released as variety.

Regional yield trial of some exotic cassava (M*anihot esculenta*) lines

M. H. Rashid, S. Sultana, F. Akhter, M. M. Molla, M. H. H. Khan and S. Akhter

Three exotic cassava germplasm, namely MEE-01, MEE-02 and MEE-03 were evaluated at the research field, TCRC, Gazipur and RARS, Cumilla during 2021-22 cropping season under RYT. Results of the present study clearly indicated MEE-1 offered highest yield (53.84 ton/ha) as well as possessed expectable starch content (33.59 %) with high dry matter content (42.52%) followed by MEE-2 (yield-45.30 ton/ha) and MEE-3 (starch content-31.04 %, dry matter content-44.97 %). Combined analysis for lines with locations and years it was a clear indication that, Cumilla was the suitable location than Gazipur for cassava cultivation and 2019-20 was the highest cassava roots production season among three seasons. So, these germplasm could be advanced to release as variety considering the result.

Regional yield trial of some local cassava (*Manihot esculenta*) lines

M. H. Rashid, S. Sultana, M. M. Molla, M. H. H. Khan and S. Akhter

Three local cassava germplasm, namely MEL-01, MEL-02 and MEL-03 were evaluated at research field, TCRC, Gazipur and RARS, Cumilla during 2021-22 cropping season under RYT. Results of the present study clearly indicated MEL-03 offered the highest yield (56.95 ton/ha) which was

followed by MEL-1(54.23 t/ha) and was statistically similar. Significantly poor performance (13.88 t/ha) was observed in MEL-2 but it possessed the highest starch content (32.04%) and was identical with MEL-1 (30.64%). Although MEL-3 gave statistically the lowest starch (26.73%), it was the highest dry matter containing germplasm (42.66%) which was on par with MEL-2 (42.50%) but statistically different with MEL-1 (36.01%). Combined analysis for lines with locations and years it was a clear indication that, Cumilla was the suitable location than Gazipur for cassava cultivation and 2019-20 was the highest cassava roots production season among three seasons. So, the lines could be advanced to release as variety considering the result.

Preliminary yield trial (PYT) of jicama (*pachyrhizus tuberosus*)

M. H. Rashid and S. Akhter

Five jicama germplasm namely, PTJ-1, PTB-1, PTB-2, PTI-1 and PTJ-2 were selected and evaluated at the research field, TCRC, Gazipur during 2021-22 cropping season in RCB design with three replications. Results of the present study clearly indicated among the germplasm, PTB-2 (23.02 ton/ha) offered the highest yield followed by PTB-1 (22.93 ton/ha) and PTJ-1 (19.86 ton/ha). So, these germplasm could be advanced to release as variety considering the result.

Production Technology

Effect of legume intercrop and conventional methods of weed suppression on tuber yield of potato

M. Salim and M. K. Alam

An experiment was conducted at the Tuber Crops Research Sub-Centre, Munshiganj during 2021-22 with seven treatments, namely T_1 = Control (No weeding), T_2 = Weeding with spade and hilling up (2 times) at 30 and 60 DAP, T_3 = Herbicide + Weeding with spade and hilling up (2 times) at 30 and 60 DAP, T_4 = Sowing mug, T_5 = Sowing Khesari, T_6 = Sowing chick pea and T_7 = Sowing pea with a view to select suitable weed control methods for quality potato production as well as improvement of soil health. Results showed that the best performance to suppress weed i.e. the lowest (0.062 gm) fresh biomass of weed accumulation was recorded from T_7 treatment which was followed by T_6 and T_5 treatment. The maximum potato equivalent yield (36.90 t/ha), gross return (Tk. 442800/ha), net return (Tk.254800/ha) and benefit cost ratio (2.35) were found in T_6 treatment which was followed by T_7 and T_5 treatment. Therefore, considering the fresh biomass of weed accumulation, yield and yield contributing characters, legumes intercrop with potato like khesari, chick pea and pea may be practiced to cultivate potato in our country to get maximum profit.

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 2021-22 with three types of mulch materials namely M_1 = Rice Straw, M_2= Water Hyacinth, M_3= Rice Straw + Water Hyacinth including M_0 = Control (No mulching) with three spacing like S_1 = 75 cm x 30 cm, S_2 = 60 cm x 25 cm and S_3 = 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 (39.72 t/ha) was obtained from treatment combination M_3S_2 i.e. M_3 = Rice Straw + Water Hyacinth with S_2 = 60 cm x 25 cm spacing. Therefore, considering the yield and yield contributing characters, mulch materials like mixtures of Rice Straw and Water Hyacinth with 60 cm x 25 cm spacing may be practiced to cultivate potato in our country to get maximum yield.

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

M. R. H. Mondol, M. Z. H. Prodhan, M. T. Rahman, M. A. Akther, M. M. sultana and S. Parvin

The experiment was conducted at TCRSC, Bogura during *rabi* 2021-22 to find out optimum seed tuber size and plant spacing for enhancing the productivity of BARI Alu-90. Three levels of tuber size *viz*., T_1= < 28 mm (small), T_2 = 28-55 mm (medium) and T_3 = > 55 mm (large) along with three levels of spacing *viz*., S_1= (60 cm × 25 cm), S_2= (50 cm × 25 cm) and S_3 = (40 cm × 25 cm) was included in the study. The results revealed that > 55 mm tuber size at 50 cm × 25 cm spacing showed better performance in terms of yield (56.01 t ha^{-1}).

The highest gross margin (Tk 611420/ha) and BCR (2.93) was found in 28-55 mm tuber size at 50 cm × 25 cm spacing.

Validation trial of newly developed red skin potato varieties in the farmers field

M. A. Akhter, M. Z. H. Prodhan, M. T. Rahman, M. R. H. Mondol and M. Sultana

Six BARI developed red skin potato varieties, namely BARI Alu-8, BARI Alu-25, BARI Alu-36, BARI Alu-41, BARI Alu-79, BARI Alu-90 along with BARI Alu-7 (check) and BARI Alu-73 (check) were evaluated in the farmer's field of Shibganj, Bogura during *rabi*, 2021-22 to select and disseminate suitable variety (s) in the farmers field condition. All red skin varieties produced satisfactory yield. Among them the highest yield was recorded from BARI Alu-90.

Performance of newly developed high yielding early potato varieties in the banana-potato intercropping system

M. A. Akhter, M. Z. H. Prodhan, M. T. Rahman, M. R. H. Mondol and M. Sultana

The experiment was conducted in the farmer's field of Shibganj during *rabi* 2021-22 to find out the performance of newly developed early potato varieties in the banana-potato intercropping system. Six varieties such as, BARI Alu-25, BARI Alu-54, BARI Alu-56, BARI Alu-84, BARI Alu-86 and BARI Alu-90 were evaluated in the study Among the tested varieties BARI Alu-86 and BARI Alu-84 produced higher yield.

Effects of seed tuber size on yield and quality performance of processing potato varieties under field condition

M. W. Rahman, M. M. Islam, M. Z. Masud, S. Parvin and B. C. Kundu

The experiment was conducted at Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh during the *rabi* season of 2021-2022 to study the effects of seed tuber size on yield and quality performance of processing potato varieties under field conditions. Three varieties *viz*., BARI Alu-25 (Asterix), BARI Alu-28 (Lady-Rosetta) and BARI Alu-29 (Courage) and four tuber size *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 (39.46ton/ha) was found in BARI Alu-25, which was statistically similar to BARI Alu-29.The lowest (33.49ton/ha) was recorded in BARI Alu-28. Maximum dry matter (23.98%) was recorded in BARI Alu-28, which was statistically similar to BARI Alu-29. Minimum dry matter (19.31%) was found in BARI Alu-25. Maximum medium (41 – 55 mm) and large size (>55 mm) tuber was found in BARI Alu-29. We know that tuber size and dry matter is very much important for processing varieties. For this reason BARI Alu-29 and BARI Alu-28 is suitable for tuber processing. The highest tuber yield (38.31ton/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 (34.60 ton/ha) was recorded in G_1 (28 – 35 mm). Dry matter 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 G_1 (28 – 35 mm), which was statistically similar to G_2 (36 – 45 mm). For getting maximum medium and large size of potato tuber for processing, tuber size G_1 (28 – 35 mm) was found superior over other tuber size of potato.

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

M. W. Rahman, M. M. Islam, M. Z. Masud, S. Parvin and B. C. Kundu

An experiment was conducted at the Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh during the *rabi* season of 2021-22 to study the effects of seed tuber size and spacing on yield and processing quality of potato. Four spacing *viz*., 50 cm x 25 cm, 60 cm x 25 cm, 70 cm x 25 cm and 70 cm x 20 cm and four tuber size *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 and 3 m x 2.8m. Significant variations were observed on tuber yield of potato by different level of spacing. The highest tuber yield (45.06 ton/ha) was recorded in S_1 (50 cm x 25 cm), which was statistically similar to S_2 (60 cm x 25 cm) and S_4 (70 cm x 20 cm).

Treatment S_3 (70 cm x 25 cm) was found superior over other spacing for getting maximum medium and large size of potato tuber for processing. 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 G_1 (28 – 35 mm) was found superior over other tuber.

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

M. R. H. Mondol, M. Z. H. Prodhan, M. T. Rahman, M. A. Akther, M. Sultana and S. Parvin

The experiment was conducted at TCRSC, Bogura during *rabi* 2021-22 to find out optimum seed tuber size and plant spacing for enhancing the productivity of BARI Alu-90. The trial was conducted with split-plot design with three replications. Three levels of tuber size *viz.* T_1= < 28 mm (small), T_2 = 28-55 mm (medium) and T_3 = > 55 mm (large) along with three levels of spacing viz. S_1= 60 cm ×25 cm, S_2= (50 cm × 25cm and S_3 = (40 cm × 25 cm was included in the study. The results revealed that in considering yield, > 55 mm tuber size at 50 cm × 25 cm spacing treatment combination showed better performance (56.01 t ha^{-1}). But according to economic analysis, the highest gross margin (Tk 611420/ha) and BCR (2.93) was estimated from 28-55 mm tuber size at 50cm × 25cm spacing treatment combination.

Effect of planting time and varieties on yield of mukhikachu in level barind tract (AEZ-25)

M. R. H. Mondol, M. Z. H. Prodhan, M. T. Rahman, M. A. Akther, M. Sultana and S. Parvin

The experiment was conducted at TCRSC, Bogura during *kharif*-1 2020-21 to find out suitable variety and optimum sowing date for enhancing the productivity of mukhikachu. Two varieties *viz.* V_1 = BARI Mukhikachu-1 and V_2 = BARI Mukhikachu-2 and five levels of sowing dates viz. D_1 = 10 February, D_2 = 20 February, D_3 = 2 March, D_4 = 12 March and D_5 = 22 March per hectare were included in the study. The experiment was laid out in factorial RCBD with three replications. The results revealed that in considering yield, BARI Mukhikachu-2 on 10 February sowing treatment combination showed better performance (37.19 t ha^{-1}) in respect of yield among all the treatment combination.

Effect of different types of mulching and plant spacing on weed control and yield of sweet potato at Munshiganj region

M. Salim and M. K. Alam

An experiment was conducted at the Tuber Crops Research Sub-Centre, Munshiganj during 2021-22 with four types of mulch materials, namely M_1 = Rice Straw, M_2= Water Hyacinth, M_3= Rice Straw + Water Hyacinth including M_0 = Control (No mulching) with three spacing like S_1 = 75 cm x 50 cm, S_2 = 60 cm x 30 cm and S_3 = 50 cm x 20 cm with a view to findout the suitable combination of mulching and plant spacing on weed control and yield of sweet potato in Munshiganj region. Results showed that treatment combination M_2S_2 and M_3S_2 and closer spacing performed better to control weed than control plot (no mulching). In case yield, the maximum root yield (39.81 t/ha) was obtained from treatment combination M_2S_2 which was at par with M_3S_2. Therefore, consider the weed suppression, yield and yield contributing characters, mulch materials like M_2 = water hyacinth and M_3 = rice straw + water hyacinth with S_2 = 60 cm x 30 cm spacing may be practiced to cultivate sweet potato in our country to get maximum quality yield.

Sensory evaluation of sweet potato shoot as leafy vegetables

S. Parvin, M. M. Molla, Z. Alam, K. Alam, S. Sultana, H. H. Khan and S. Akhter

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 sixteen varieties and seven lines were studied. Considering taste/mouthfeel, bitterness and presence of fiber most of the participants in organoleptic evaluation preferred much BARI Mistialu-11 (scored 4.7) as leafy vegetables which was followed by sweet potato lines $AnIg_{22}$ (scored 4.6) and BARI Mistialu-17 (scored 4.2). levels of some nutrient in sweet potato leaves were determined using standard analytical methods. Vit-c and anthocynine ranged from 13.6 to 76.9 and 0.11 to 1.55 mg/100g, respectively for vit-c and anthocyanin while carbohydrate varied from 2.35 to 6.35%. These result reveal that leaves provide appreciable amount of a nutrients which

can be included in diets to base diets for the nutritionally vulnerable in rural and urban communities.

Effect of spacing on the yield of mukhikachu

M. Sultana, M. Z. H. Prodhan, M. T. Rahman, M. R. H. Mondol and M. A. Akhter

A field experiment was conducted at TCRSC, Seujgari, Bogura during *kharif*, 2020-21. The experiment consisted of seven treatment *viz*. T_1 = 60 cm × 35 cm, T_2 = 70 cm × 25 cm, T_3 = 70 cm × 30 cm, T_4 = 70 cm × 35 cm, T_5 = 80 cm × 25 cm, T_6 = 80 cm × 20 cm and T_7 = 60 cm × 45 cm. The highest corm yield was obtained from T_2 which was statistically similar with T_3.

Effect of planting time and varieties on yield of Mukhikachu in level barind tract (AEZ-25)

M. R. H. Mondol, M. Z. H. Prodhan, M. T. Rahman, M. A. Akther, M. M. sultana and S. Parvin

The experiment was conducted at TCRSC, Bogura during *kharif-1* 2020-21 to find out suitable variety and optimum sowing date for enhancing the productivity of mukhikachu. Two varieties *viz*. V_1 = BARI Mukhikachu-1 and V_2 = BARI Mukhikachu-2 along with five levels of sowing dates *viz*. D_1 = 10 February, D_2 = 20 February, D_3 = 2 March, D_4 = 12 March and D_5 = 22 March per hectare were included in the study. The results revealed that BARI Mukhikachu-2 on 10 February sowing combination showed better performance (37.19 t ha^{-1}) among the all treatment combination.

Evaluation of sweet potato varieties under organic farming system

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

Fifteen (15) varieties of sweet potato were evaluated to find the superior variety under organic cultivation system. This experiment was executed at 'Organic Block', TCRC research field, Gazipur over the period from Nov 2021 to April 2022. Soil fertility and pest management was done following organic practices and standards. Cow dung, Tricho compost and Neem Oil Cake (NOC); each one was applied @ 8t/ha and different botanicals were used to reduce the pest attack. There was significant difference among the varieties in respect of most of the yield contributing character. Accordingly, the highest root yield (24.05 t/ha) was found from the variety BARI SP 4 which was followed by BARI SP12 (20.03 t/ha) and was statistically different from all other varieties including check.

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

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

A field experiment was conducted at 'Organic Block' of tuber crops research centre, BARI during *rabi* season of 2021-22 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. T_1 = Salt @ 50kg/ha, T_2 = Vinegar @ 150ml/l, T_3= Neem oil @50 ml/l, T_4 = Eucalyptus oil @50ml/l and T_5 = Control (no weeding), with one potato variety BARI Alu-46. This investigation indicated that there was significant difference among the treatments in respect of weed control and organic tuber yield. The maximum weed control efficiency (78.15%) was recorded in eucalyptus oil treated plot (T4) while the highest organic tuber yield 26.90 (t/ha) was found in eucalyptus oil treated plot (T_4) and was statistically similar with T3(24.29 t/ha). Significantly lowest yield (20.34 t/ha) was obtained in control plot (T_5) and among the treatments, poor weed control efficiency (51.81%) was observed in salt treated plot.

Verification trial of newly developed red skin potato varieties in the farmers field

M. A. Akhter, M. Z. H. Prodhan, M. T. Rahman, R. H. Mondol, and M. Sultana

The trial was conducted at the farmer's field of Shibganj, Bogura during *rabi* 2021-22. Six BARI developed red skin potato varieties, namely BARI Alu-8, BARI Alu-25, BARI Alu-36, BARI Alu-41, BARI Alu-79, BARI Alu-90 along with BARI Alu-7 and BARI Alu-73 were evaluated in the study. The experiment was laid out in RCB design with three dispersed replications. The objective of this study to select suitable variety to disseminate to farmers field. All the newly developed red skin varieties are produced satisfactory yield. The highest yield was recorded from BARI Alu-73 which was statistically similar to BARI Alu-90.

Performance of newly developed high yielding early potato varieties in the banana-potato intercropping system

M. A. Akhter, M. Z. H. Prodhan M. T. Rahman, R. H. Mondol and M. Sultana

The trial was conducted at the farmer's field of Shibganj, Bogura during *rabi* 2021-22. Six varieties, namely BARI Alu-25, BARI Alu-54, BARI Alu-56, BARI Alu-84, BARI Alu-86, and BARI Alu-90 were evaluated in the study. The experiment was laid out in RCB design with three dispersed replications. The present study was undertaken to evaluate the performance of the varieties under farmer's field condition and popularize them among the farmer's to promote their adoption in this area. Among the tested varieties BARI Alu-86 and BARI Alu-84 produced higher yield.

Effect of spacing on the yield of Mukhikachu

M. Sultana, M. Z. H. Prodhan, M. T. Rahman, R. H. Mondol and M. A. Akhter

A field experiment was conducted at TCRSC, Seujgari, Bogura during *kharif* 2020-21. The experiment consisted of seven treatment *viz*. T_1 = 60 cm × 35 cm, T_2 = 70 cm × 25 cm, T_3 = 70 cm × 30 cm, T_4 = 70 cm × 35 cm, T_5 = 80c m × 25 cm, T_6 = 80 cm × 20 cm and T_7 = 60 cm × 45c m. The highest corm yield was obtained from T_2 which was statistically similar with T_3.

Soil Management and Soil Management Related Production Technology

Soil is the most important natural resource of Bangladesh and judicial 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, M.S. Hossain 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. There were six treatments: T_1 (Control, native nutrient), T_2 (100% recommended dose of fertilizers, RDF), T_3 (Poultry manure, PM @ 3t ha^{-1} + IPNS), T_4 (Cowdung, CD @ 6 t h^{-1} + rest from RDF), T_5 (125% RDF) and T_6 (Farmer's practice, FP). The experiment was laid out in a RCBD with three replications. The potato and rice grain yields were significantly influenced by the integrated nutrient management in potato-groundnut-T.aman cropping pattern. The highest potato tuber and rice grain yields were found in T_5 (125% RDF), which was identical to T_3 and T_4. The highest gross margin (Tk. 394520 ha^{-1}) was recorded in T5 while the maximum MBCR (5.10) was noted in T_3. The lower scab infection and the minimum cutworm infestation were observed in T_3 and T_4, respectively.

Assessment of atmospheric carbon absorption through potato

M. M. Islam, M. W. Rahman, M. A. K. Mian, M. S. Hossain 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: T_1 (BARI Alu-7 + Residues add), T_2 (BARI Alu-25 + Residues add), T3 (BARI Alu-41 + Residues add), T_4 (BARI Alu-7 + no residues add) and T_5 (BARI Alu-25 + no residues add) and T_6 (BARI Alu-41 + no residues add). The experiment was laid out in a RCBD with three replications. Yield of potato tuber was significantly ($p \leq 0.05$) influenced by the treatment. The maximum potato tuber yield (41.6 t/ ha) was found in T_3, which was identical to T_6 (39.9 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, stem and tuber biomass were found in T_3. The total carbon input from the potato plant (2.93 t/ha) was found in T_3, which was very closely followed by T_6 (2.79 t/ha).

Assessment of heavy metal uptake and translocation in wild taro (*Colocasia esculenta*) for phytoremediation of metal contaminated soil

M. M. Islam, T. Hasan, M.S. Alam and S. Akhter

The experiment was conducted to evaluate the potential of *Colocasia esculenta* as a

phytoremediator to absorb heavy metals from contaminated soils. *C. esculenta* seedlings were planted on seven levels of cadmium (T1 = Control, soil, T2 = 25 ppm Cd, T3 = 50 ppm Cd, T4 = 75 ppm Cd, T5 = 100 ppm Cd, T6 = 125 ppm Cd and T7 = 150 ppm Cd) and same levels of arsenic (As). The highest growth performance such as plant height, leaf length, leaf breadth, fresh weight of leaf, petiole and corm was found in uncontaminated soil. The lowest growth performance was in the highest level of As and Cd. *Colocasia esculenta* had high translocation factor (TF) and low bioconcentration factor (BCF) in soil at higher As concentrations. Heavy metal tolerance with high TF and low BCF values was suggested for phytoaccumulators of as contaminated soils. Moreover, it showed quick growth and has high tolerance to metal contaminated soil in low to medium concentration. It also showed the high BCF and TF factors in Cd contaminated soils. Therefore, *Colocasia esculenta* can be used as a potential phytoremediator for As and Cd contaminated soils to mitigate soil pollution.

Response of potato to phosphorous in Old Himalayan Piedmont Plain Soil

M. M. Islam, M. W. Rahman 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 - T_1 (0kg p/ha), T_2 (20 kg p/ha), T_3 (40 kg p/ha), T_4 (60 kgp/ha), T5 (80kg p/ha), T_6 (100kg p/ha) and T_7 (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. Yield of potato tuber was significantly ($p \leq 0.05$) influenced by the different levels of phosphorus. The highest potato tuber yield (46.0 t ha^{-1}) was found in T4, which was identical to T_5 and T_6. 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 50.0 kg ha^{-1} for Debiganj. The highest dry matter content (20.6%) of potato tuber was recorded in T_4. Scab infection and cutworm infestation were not found in the plots.

Effect of organic manure and inorganic fertilizer on anthocyanin rich BARI Mishtialu-17

M. M. Islam, T. Hasan and S. Akhter

An experiment was conducted to study the effect of organic manure and chemical fertilizers on the yield, quality component and storability of BARI Mistialu-17 under integrated nutrient management at Grey Terrace Soil of Joydebpur. There were six treatments: T_1 (Control, native nutrient), T_2 (100% recommended dose of fertilizers, RDF), T_3 (Poultry manure, PM @ 3t ha^{-1}+ IPNS), T_4 (Cowdung, CD @ 6 t h^{-1}+ IPNS), T_5 (125% RDF), T_6 (Farmer's practice, FP). The experiment was laid out in a RCBD with three replications. The yield of BARI Mistialu-17 was significantly ($p \leq 0.05$) influenced by the integrated use of organic manure and chemical fertilizers. The highest root yield (26.5 t ha^{-1}) was found in T_3 where poultry manure @ 3 t ha^{-1} along with reduced rate of recommended dose of chemical fertilizers were applied. The highest marginal benefit cost ratio (MBCR) (52.7) was also observed in the same combination. The highest dry matter content (31.1%) was recorded in T_4. The treatment having organic manure showed better performance regarding yield and dry matter content and MBCR. The experiment will be continued to verify the result.

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

M. H. Rashid, M. M. Masud, I.M. Ahmed, M. J. Alam, F. A. Anik, M. K. Alam, S. Parvin, M. M. Islam, M.S. Alam and S. Akhter

The experiment was conducted to study the effect of biochar with organic manure and inorganic fertilizer with the improvement of soil properties and potato tuber production. There were eight treatments e.g. T_1 = Control (No Fertilizer), T_2 = Biochar (3.6 kg), T_3 = Compost (Vermicompost 3.2 kg, Trichocompost 3.2 kg, NOC 3.2 kg and CD 4.3kg), T_4 = Recommended Fertilizer (Urea 252 g, TSP 159 g, MOP 216 g, Gypsum 144 g, $ZnSO_4$ 7.2 g, HBO_3 7.2 g, Sunfuran 14.4 g and CD 7.5 kg), T_5. Fertilizer 75% + Compost 25% (Urea 189 g, TSP 120 g, MOP 162 g, Gypsum 108 g, $ZnSO_4$ 5.4 g, HBO_3 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), T_6 = Compost + Biochar (T_3+T_2), T_7 = Fertilizer 75%+ Compost 25% + Biochar (T_5+ T_2) and T_8. Recommended Fertilizer+ Biochar (T_4+T_2). The experiment was laid out in RCB design with

three replications. T_8 exhibited the highest yield in each plot (20.53 kg), total marketable yield (28.47 ton/ha) and total yield in hector (28.51 ton) which was followed by T_4 yield in each plot (19.46 kg), total marketable yield (26.12 ton/ha) and total yield in hector (27.02 ton). On the other hand, the lowest yields were recorded in T_1 yield in each plot (9.90 kg), total marketable yield (13.00 ton/ha) and total yield in hector (13.75 ton) which was followed by T_2. Considering all yield contributing parameters, soil and plant sample analysis, yield and economic analysis it can be concluded that T_8 was suitable treatments for recommendation. The highest net return and BCR were recorded in T_8 which was followed by T_4 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 T_8 and T_4 were suitable treatments for recommendation. The highest net return and BCR were recorded in T_8 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.

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

M. R. H. Mondol, M. Z. H. Prodhan, M. T. Rahman, M. A. Akther, M. M. sultana and S. Parvin

The experiment was conducted at TCRSC, Bogura during *rabi* 2021-22 to find out optimum date of planting, fertilizer doses and productivity and profitability of beta-carotene content sweet potato. Four levels of planting dates *viz*. D_1 = 30 October, D_2 = 10 November, D_3 = 20 November and D_4 = 30 November along with four levels of fertilizers *viz*. F_0 =control, F_1=60-55-80 kg of NPK, F_2=80-75-100 kg of NPK and F_3= 100-95-120 kg of NPK per hectare were included in the study. The results revealed that 20 November planting date with 100-95-120 kg of NPK/ha fertilizer doses treatment combination performed better in considering yield (40.68 t ha^{-1}), gross margin (Tk 668,031/ha) and BCR (3.82).

Effect of integrated fertilizer management on productivity and profitability of organic potato production.

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

An experiment was conducted to select safe and profitable potato production system through application of bio-fertilizers under organic management practices. The experiment was executed at the organic block under TCRC research field, Joydebpur during the year of 2021-22. Two bio-fertilizers namely Azotobacter and Phosphorus Soloblizing Bacteria (PSB) which dosage were each one 8 ml per kg seed potato in liquid form and three organic fertilizers with different dosages name 10 t/ha and 8 t/ha were chosen as the treatment. The number treatment was 8 namely T_1 : Control, T_2 : Vermicompost 10 t/ha, T_3 : Trico-compost 10 t/ha, T_4 : ACI Organic Fertilizer 10 t/ha, T_5 : Bio-fertilizer (Azotobacter + PSB), T_6 : Vermicompost 8 t/ha + (Azotobacter + PSB), T_7 : Trico-compost 8 t/ha + (Azotobacter + PSB, T_8 : ACI Organic Fertilizer 8 t/ha + (Azotobacter + PSB). BARI Alu -25 was used as material produced under organic production system at organic block, TCRC, Gazipur following organic practices. The result showed that the maximum (18.27 t/ha) tuber yield was obtained from T_8 treatment which was treated with (ACI Organic Fertilizer 8 t/ha) + (Azotobacter + PSB) was on par with T_6 and T_7 treatment whereas the minimum fresh tuber yield was produced by treatment T_1 (control). Moreover, the highest gross return (Tk. 657720/ha) and net return (Tk. 128720/ha) and Benefit Cost Ratio (BCR)-1.24 found from T_8 treatment which was followed by T_6 treatment (Tk. 610920/ha) and net return (Tk. 81920/ha) and Benefit Cost Ratio (BCR)-1.15 and T_4 treatment (Tk. 582120/ha) and net return (Tk. 77120/ha) and Benefit Cost Ratio (BCR)-1.15, respectively.

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

M. R. H. Mondol, M. Z. H. Prodhan, M. T. Rahman, M. A. Akther, M. Sultana and S. Parvin

The experiment was conducted at TCRSC, Bogura during *rabi* 2021-22 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*. D_1 = 30 October, D_2 = 10 November, D_3 = 20 November and D_4 = 30 November along with four levels of fertilizers viz. F_0 =control, F_1=60-55-80 kg of NPK, F2=80-75-100 kg of NPK and F_3= 100-95-120 kg of NPK per hectare were included in the study. The experiment was laid out in split-plot design with three replications. The results revealed that among all

treatment combinations 20 November planting date with 100-95-120 kg of NPK/ha fertilizer doses treatment combination performed better in considering yield (40.68 t ha-1), gross margin (Tk 668,031/ha) and BCR (3.82).

Tuber crops disease management

General survey, monitoring and others

Survey on 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 medium in Rangpur, Kurigram, Dinajpur, Thakurgaon and Panchagarh and lower in Nilphamary, Lalmonirhat and Gaibandha districts. Bacterial wilt and Black leg disease incidence was medium 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.

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 seven varieties from BARI, namely BARI Alu-7, BARI Alu-8, BARI Alu-46, BARI Alu-53, BARI Alu-77, BARI Alu-90 and BARI Alu-91 and twelve lines namely 'Twinner', 'Twister', 'Ottawa', 'Dunster', 15.115, 15.117, 15.126, 15.134, 15.136, 15.35, 15.36 and 15.92 planted in the field trial for observing their performance against late blight caused by *P. infestans* and were conducted during 2021-22 cropping season to observe their performance in controlling late blight disease causing pathogen under laboratoty conditions. The tested varieties found resistant and susceptible to *P. infestans* with various level ranged from 0-100%. BARI Alu-90, 'Twister' and 'Twinner' provided complete resistant to *P. infestans* after 10 days of incubation, whereas BARI Alu-7, BARI Alu-8, BARI Alu-46, BARI Alu-77, and BARI Alu-91 and the lines namely 'Ottawa', 'Dunster', 15.115, 15.117, 15.126, 15.134, 15.136, 15.35, 15.36 and 15.92 provided susceptible to late blight. BARI Alu-53 gave 30% infection to late blight pathogen and provided very few tolerant level to *P. infestans*.

Screening of Potato Varieties and Germplasms Against Late Blight

M. M. Rahman, M. Z. Masud, A. K. Saha, M. M. Begum and B. C. Kundu

Late blight of potato, caused by *Phytophthora infestans* (Mont.), is one of the most important diseases of potato (*Solanum tuberosum* L.) in Bangladesh. The experiment was conducted under natural inoculum pressure in the isolated field of BSPC, BARI, Debiganj, Panchagarh to evaluate 36 (Thirty six) potato varieties/germplasm/cultivars against late blight disease during 2021-22 crop season. None of the variety/germplasm was found immune. BARI Alu-90, BARI alu-91 and germplasm 'Twinner' were found highly resistant and BARI alu-57 was found moderately resistant. Yield of BARI Alu-46 produced the significantly highest yield (36.43 t ha^{-1}) and it was identical with 'Twinner' (32.24 t ha^{-1}), BARI Alu-90 (29.11 t ha^{-1}), BARI Alu-79 (23.86 t ha^{-1}) and BARI Alu-57 (24.08 t ha^{-1}). In respect of resistance and tuber yield performance of promising germplasm 'Twinner' can be released as a late blight resistant variety.

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 2021-22. Eight botanicals, namely *Me ntha virdis, 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 to reduce disease severity (3.12%) which was followed by neem (4.17%) and mint

(5.08%), respectively and was statistically similar. Accordingly, the highest disease severity reduction over control (85.6%) as well the highest tuber yield (23.9 t/ha) was found in lantana which was followed by neem and mint. .

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

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

An experiment was conducted to evaluate the efficacy of seven different botanicals to suppress the bacterial growth in *in vitro* condition as well as to reduce soft rot disease under storage conditions. The *in vitro* part was conducted at TCRC, BARI, Gazipur while storage part was conducted at TCRSC, BARI, Munshiganj during the year of 2021-22. Seven botanicals namely *Allium cepa* (seed), *Allium sativum* (leaves), *Azadirachta indica* (leaves), *Capsicum annum* (Fruits), *Nicotiana tabacum* (leaves), *Lantana camara* (leaves) and *Swertia chirayita* (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 in *in vitro* as well as under storage condition. In laboratory, Chirota and lantana were found to be effective to suppress the bacterial (*E. carotovara.*) growth. More or less similar performance was observed in case of storage condition. Chirota showed the best performance (4.77%) to suppress disease incidence which was followed by lantana (5.95%) and was statistically similar. However, percentage of severity of tuber soft rot was observed better (3.39%) in case of neem which was followed by chirota and lantana, respectively and was statistically similar. The poor disease severity performance (28.6%) was observed in case of control treatment.

Performance of late blight resistant potato varieties in Joypurhat area

M. Sultana, M. Z. H. Prodhan, M. T. Rahman, R. H. Mondol and M. A. Akhter

The experiment was conducted in Joypurhat, during *rabi* 2021-22 to evaluate the performance of BARI developed late blight resistant potato varieties under farmer's field condition. The unit plot size was 4m×5m. Five BARI released varieties viz. BARI Alu-46, BARI Alu-53, BARI Alu-77, BARI Alu-90 and BARI Alu-91 along with check BARI Alu-25 (Asterix) were tested with three dispersed replications. In the study, no late blight symptom was observed.

Bacterial Disease Management

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

M. Z. Masud, M. M. Rahman, M. M. Bgum, A. K. Saha and B. C. Kundu

Seven different organic matter and their combination along with recommended chemical fertilizers *viz*. Cow dung @ 5.0 t/ha, Ash @ 5.0 t/ha, Cow dung @ 2.50 t/ha + Ash @ 2.50 t/ha, Mustard oil cake @ 0.50 t/ha, Tobacco dust @ 850 t/ha, Annapurna jaibo sar @ 1.0 t/ha and Kazi jaibo sar @ 1.0 t/ha, were tested for management of common scab disease and yield of potato in 2021-22 cropping season at Breeder seed production centre (BSPC), BARI, Debiganj, Panchagarh. Mustard oil cake and Tobacco dust significantly reduced common scab disease incidence and severity. Tobacco dust performed the best for disease control (Incidence 5.51%) and Severity i.e. PDI- 2.68). Whereas the highest potato tuber yield was recorded in Kazi jaibo sar 40.26 t/ha.

Monitoring of disease status of BARI released potato varieties against common scab

M. M. Begum

Twelve potato varieties *viz*. BARI Alu-7, BARI Alu-8, BARI Alu-25, BARI Alu-56, BARI Alu-62, BARI Alu-63, BARI Alu-66, BARI Alu-81, BARI Alu-82, BARI Alu-86, BARI Alu-90 and BARI Alu-91 were evaluated to screen resistant varieties against scab disease at TCRC, BARI, Joydebpur, Gazipur during 2021-22 cropping year under the field condition at *rabi* season. Considering scab incidence, BARI Alu-56, BARI Alu-62, BARI Alu-63, BARI Alu-66, BARI Alu-82, BARI Alu-86 and BARI Alu-90 performed better and found completely free from common scab of potato. The BARI Alu-81 also gave comparatively lower common scab infection by 2.0 % followed by BARI Alu-91.

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

M. M. Islam, M. W. Rahman and S. Akhter

An experiment was conducted to study the effect of thiovit as a source of sulphur in controlling scab disease caused by 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: T_1 (0 kg thiovit /ha), T_2 (20 kg thiovit /ha), T_3 (40 kg thiovit /ha), T_4 (60 kg thiovit /ha) and T5 (80 kg thiovit /ha). The experiment was laid out in a RCBD with three replications. The tuber yield of potato was significantly influenced by the thiovit rate. The highest tuber yield (34.9 t/ ha) was found in T_5 (80 kg thiovit/ha) followed by T_4 (32.5 t/ha) (60 kg thiovit/ha). The minimum scab infection and cutworm infestation were also recorded in T_4.

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 B. C. Kundu

Bacterial wilt (BW) caused by bacteria *Ralstonia solanacearum* is the most important disease of potato (*Solanum tuberosum* L.) in Bangladesh especially for table-stock crop purposes in the early planting Season. More than 100 different varieties are cropped in different regions only in Bangladesh. Potato growers usually crop multiple varieties on their farms in the northern part of Bangladesh to answer the market demands for table-stock potatoes for specific physical properties. For table-stock potato cultivation in earlier than the normal growing season temperature and humidity prevail higher in the environment thus crops affected highly by BW ultimately growers are economically suffered. In 2020-21 and 2021-22 growing season 11 (Ten BARI Released & one local cultivar seven) and 15 (Fourteen BARI Released & one local cultivar seven) potato varieties, respectively were evaluated at farmers' fields, Notun Bondar, Debiganj, Panchagarh under natural inoculum pressure to find out early varieties against bacterial wilt disease. In 2020-21, BARI Alu-13 (Granola) and BARI Alu-56 showed no BW disease, whereas BARI Alu-29 (Courage) showed maximum disease incidence (4.33%) which was 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 gave maximum tuber yield 16.34 t/ha, 12.15 t/ha and 11.81 t/ha, respectively after considering the disease incidence. In 2021-22, BARI Alu-13 (Granola) also showed no BW disease, whereas BARI Alu-29 (Courage) showed maximum disease incidence (7.33%) which was statistically similar with local cultivar seven (3.33%). In 2021-2022, among the tested Varieties BARI Alu-13 (Granola), BARI Alu-31 (Sagita), BARI Alu-73, BARI Alu-79 and BARI Alu-62 gave maximum tuber yield 12.69 t/ha, 12.45 t/ha, 14.99 t/ha, 15.44 t/ha and 12.23 t/ha, respectively after considering the disease incidence.

Viral Disease Management

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

M. M. Begum

Eighteen potato lines were evaluated against PLRV and PVY to find out the resistant source (s) at Joydebpur, Gazipur during 2021-22. Based on field observation and ELISA test, the uses 15.126, 15.92, 'Ottawa' and 'Twister' were found free from PLRV, PVY and other combine virus infection compared to other lines and 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 (second progeny)

M. M. Begum

Eighteen potato lines along with check Diamant 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 2021-22 at Joydebpur. The hybrid clones 16.28, 17.432, and 17.578 were found free from any other viruses. Considering all parameters, the hybrid clone 16.28 performed better among other two lines.

Evaluation of potato hybrid clones and exotic lines for PLRV and PVY resistance under the infection pressure (first progeny)

M. M. Begum

A total of twenty two hybrid clones, three exotic lines and along with check Diamant were evaluated against PLRV and PVY to find out the resistant source (s) at Joydebpur, Gazipur during 2021-212 as a first generation. All tested lines were found completely free from any type of virus including the check variety Diamant. This experiment will be repeated in the next year.

Observational trial of sweet potato varieties/germplasm against 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 2021-22 cropping season at TCRC, BARI, Gazipur. Twelve sweet potatoes germplasms were evaluated against virus diseases and only mild mosaic virus was observed in the field. Among 12 tested lines, eight lines BARI SP-17, BARI SP-12, BARI SP-13, Potuakhali, VSA-01, Japan, 199024.19 and WRF-001 performed as the best lines for showing virus free infection. The experiment will be repeated in the next season.

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 379 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 379 samples, 76% had completely virus free and 24% had infected with different alone and combine viruses. Among virus infected samples, the highest number of viruses found PVX and it was 37% and the second highest was PVY viruses (23%) and the third was PVS which was 17% followed by mixed viruses (12%). The lowest incidence was found as PLRV which was 1.0%.

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

M. K. Alam, M. M. Begum, 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 2021-22. Five botanicals, namely rape seed oil, mahogony 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 date (45 DAP), neem oil performed better in reduction of aphid infestation (0.89 per 10 plants) while Bioneem plus gave the best result (2.39 and 3.85 per 10 plants) at the latter stages (60 and 75 DAP, respectively) and both were statistically similar. More or less similar trends were observed in case of viral diseases. Furthermore, plant vigority (8.33) as well as tuber yield (23.8 t/ha) were found better from the plot treated with Bioneem plus which was identical with neem oil.

Post-Harvest Management and Storage

Monitoring of different released potato varieties against post-harvest diseases

M. M. Begum

Twelve potato varieties namely BARI Alu-7, BARI Alu-8, BARI Alu-25, BARI Alu-79, BARI Alu- 81, BARI Alu-82, BARI Alu-84, BARI Alu-85, BARI Alu-86, BARI Alu-89, BARI Alu-90 and BARI Alu-91 were evaluated to investigate post harvest rottage and shelf life at Joydebpur under natural storage conditions during 2021-22. All

tested varieties were found to be better for 90 days of preservation with lower rottage value, while BARI Alu-8 and BARI Alu-84 were found suitable for long shelf life up to 180 days followed by BARI Alu -90.

Global Biotechnology Potato Partnership (Second phase of FTFBPP)

Research report on GBPP project

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

A total of 27 isolates from potato and tomato was isolated successfully from different regions of Bangladesh. Twenty five isolates of *P. infestans* from potato and two isolates from tomato were maitained properly in pea agar and slant media for short and long duration. The all isolated cultures were sent to University of Idaho, USA for molecular characterization last year. The late blight resistant two events, namely DIA-MSU-015, DIA-MSU-255 and one susceptible event DIA-MSU-DIA were evaluated for testing their efficay against late blight causing pathogen by *P. infestans* through Detached Leaf Bioassay (DLBs). The two lines DIA-MSU-015 and DIA-MSU-255 were found completely resistant to late blight pathogen, while DIA-MSU-DIA found susceptible.

Insect pest management

Development of biorational based management approach against root aphid attacking potato

M. Z. H. Prodhan

The field trial was conducted at the farmer's field of Kichok, Shibganj, Bogura during 2021-22 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 Biomax (Abamectin and natural plant extracts) @ 1.0 ml/L of water) from initial stage of infestation at 10 days interval, $T_3 = T_1 + 2$ sprays of Fizimite (Sodium lauryl ether sulfate) @ 1 ml/L of water from initial stage of infestation at 10 days interval, T_4: Application of Phytomax N (Neem seed extracts 1% Azadiractin) @ 1 ml/L of water from initial stage of infestation at 10 days interval, $T_5 = T_1 + 2$ sprays of Thiamethoxam 0.5g/L of water from initial stage of infestation at 10 days interval and T_6= Untreated control. The experiment was laid out in RCBD with four replications. All biorational based treatment had minimum infestation over control. But in case of Marginal Benefit Cost Ratio, the highest value was also obtained from T_5 which followed by T_2.

Evaluation of advanced materials of potato against potato cutwrom (*agrotis ipsilon*) in field condition

M. Z. H. Prodhan and M. T. Rahman

Sixteen advanced materials, namely 15.12, 16.16, 16.28, 16.33, 16.7, 33.28, 33.33, 'Alcander', 'Deli Red', 'Dunstar', 'Hind', 'Innovator', 'Katadin', 'LalPakri', MSZ-1090PP, 'Twinner' along with eight released varieties, BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix), BARI Alu-29 (Courage). BARI Alu-97 (Al russet), BARI Alu-98 (Arigona), BARI Alu-99 (HZD-061249) and BARI Alu-100 (Ottawa) were evaluated against cutworm at TCRC, BARI, Bogura during 2021-22. The experiment was laid out in RCBD with three replications. Among the germplasms, BARI Alu-31, Katadin, Ottawa, 16.33, Deli Red, BARI Alu-7, Hind, HZD-061249. 33.33, BARI Alu-25, 'Innovator' and 'Twinner' had higher infestation. The rest germplasms showed comparatively lower infestation.

Development of 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 2021-22 to develop an effective integrated management approach for sweet potato weevil in field condition. There were five treatments *viz*. T_1: Pheromone trap + Earthing-up three times (30, 60 and 90 days after planting (DAP), T_2: Pheromone trap + Soil Recharge @ 3g/L of water at 45 and 90 DAP, T_3: Application of Phytomax (Neem seed extracts 0.1% Azadiractin) @ 2 ml/L of water at 60 and 90 DAP, T_4: Application of Chloranlraniliprole (Ferterra 0.4G@ 10 kg/ha at 60 and 90 DAP with irrigation, T_5: Untreated control. The experiment was laid out in RCBD with three dispersed replications. All the treatments had lower infestation and higher yield over control. Among them, 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 36.54 in T_1 and T_2 which reduced the infestation.

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

M. Z. H. Prodhan and M. T. Rahman

The field trial was conducted at Tuber Crops Research Sub Centre, BARI, Bogura during 2021-22 to find out the most effective management option for cutworm on potato. There were six treatments *viz*. T_1= Poison bait: (Rice husk 5kg + sugar 200g + Cartap + water) (Three times at 15 days interval starting from after emergence of the seedling), T_2= Chloranlraniliprole (Ferterra 0.4G) @ 10 kg/ha application during land preparation and earthing up, T_3=Sex pheromone mass trapping, T_4= T_1+ T_3, T_5= T_2+ T_3, T_6= Untreated Control. The experiment was laid out in RCBD with three replications. Very little infestation (0-2.18%) was observed in the study and 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 2021 to develop an ecofriendly management package against PTM under storage condition and to estimate the extent of damage. There were seven treatments *viz*. T_1 = Mass trapping for potato tuber moth with attract and kill method, T_2 = Pheromone mass trapping, T_3 = Spraying of Abamectin @ 1.5 ml/L of water, T_4 = Potato tubers covered with thin layer of dry sand, T_5 = Potato tubers covered with dried *Lantana camara* shoot (@ 30g/kg seed tuber, T_6 = Application of *Bacillus thuringiensis* subsp. kurstaki (Btk) and T_7 = Control. The experiment was laid out in three replications The lowest infestation was found in T_4 followed by T_2. Treatment T_2, T_5, T_3 and T_6 had also effective against PTM over control.

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*, 2021-2022. There were two treatments *viz*. T_1 = Pheromone mass trapping for potato tuber moth and T_2 = 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 2021-22 to document new pest arthropods infesting tuber crops. 10 insect pests on potato, 6 on sweet potato, and 10 on Jicama were found to attack, most of them are minor.

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

M. Z. H. Prodhan

Twelve advanced materials along with five checks of sweet potato were evaluated against sweet potato weevil at TCRC, Bogura during 2021-22. The experiment was laid out in a RCBD with three replications Among the genotypes, MOZ-1.15, W.F-1, BARI SP-12, $H_{9.7}$/12, 'Okinawa' and 'Murasaki' showed comparatively less infestation than other advanced materials/varieties.

Survey, monitoring and documentation of major insect pests of Mukhikachu

M. Z. H. Prodhan

A field survey was conducted in Bogura during 2021-22 to document the insect and mite pests of mukikachu. Several insect-mite pests viz. Common cutworm, white grub, spittle bug, aphid, spiralling whitefly, 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 2021-22 to observe the succession of the insect-mite pests of yam and their damage severity. Result revealed that 7 species of insect pests i.e. leaf roller, June beetle, hairy caterpillar, tussok moth, Common cutworm,

spiralling whitefly and aphid 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 2021-22 to observe the succession of the insect-mite pests of cassava and their damage severity. Three species of insect pest's i.e. mealy bug, common cutworm and spiralling whitefly were found to attack the crop at vegetative stage and caused minor damage.

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

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

Seven botanicals, namely *Lantana camara*, *Eucalyptus globulus*, *Tagetus minuta*, Pyretherum flowers *Azadiracthaindica*, *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 2021-22. BARI Alu-36 was used as test crop 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 is still continuing. Till today, tuber infestation was reduced in botanicals. Lantana and neem showed the better performance against PTM infestation. However, final conclusion would be drawn after completion of the experiment.

Tuber Crops Biotechnology and Seed Production

***In vitro* production and maintenance of potato varieties/germplasm**

M. M. H. Molla, F. Akhter, S. Islam and S. Akhter

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 15550 disease free plantlets of BARI released potato varieties were planted at Breeder Seed Production Centre, Debigonj for G_0 generation development during 2021-2022 Mother stocks of the varieties are being maintained by subcultures for future multiplications and short term conservation.

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 S. Akhter

A total of thirty meristems were isolated and cultured from two indigenous varieties, namely Shilbilati and Lalpakhri on basal MS media. Out of thirty meristems, DAS ELISA test has been conducted of fifteen 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 and S. Akhter

This study was conducted at the tissue culture lab, TCRC in BARI during 2021-2022 with a view to establishing 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-benzyla 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 fascinated 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 and S. Akhter

Plantlets of BARI Alu-46 and 73 were produced at tissue culture lab, TCRC, BARI, Gazipur and planted in the table of NFT. Plantlets were grown well having excellent growth and development. The range of tuber production per plant and tuber weight (g) of the varieties were 50.42 to 56.50 and 278.92 to 320.50 (g), respectively. Among the varieties BARI Alu-46 performed better compared to BARI Alu-53 and 73. Total harvested tubers were 1900 which was 10.79 Kg. Tubers were harvested 6 times from the varieties and found them significant variations among the harvest of varieties for tuber number, tuber weight. The highest number of tubers (22.58) harvested in June 10, 2022 from the variety of BARI Alu-53 followed by BARI Alu-73 (19.50). Similarly, the highest weight of tubers was found in April 4, 2022 from the variety of BARI Alu-46 (81.75 g) followed by BARI Alu-53 (43.93 g).

***In vitro* propagation protocol development in mukhikachu, panchamukhiachu and olkachu**

M. M. H. Molla, F. Akhter, S. Islam, S. Alam and S. Akhter

Mukhikachu, panchamukhikachu and olkachu were the experimental materials in this study. In this year we started with mukhi and panchamukhi kachu for in vitro protocol development. This study was conducted at the tissue culture lab, TCRC in BARI during 2021-2022 with a view to establishing a protocol for in vitro production from shoot tip of mukhikachu. Murashige and Skoog (MS) media supplemented with different concentration of 6-benzyl amino purine (BAP) and Indole butyric acid (IBA) were tested. 100% culture initiation was recorded on MS medium supplemented with 8 mg/l BAP + 0.5 mg/l IBA. Maximum number of shoots (5.5) per explant was found from this treatment after 4 weeks of culture followed by 70% shoot induction having 3.4 shoots/explant recorded in MS medium supplemented with 6 mg/l BAP + 0.5 mg/l IBA. Maximum number of roots (22) was obtained when well developed shoots were cultured in ½ MS medium supplemented with 0.5mg/l IBA for 4 weeks.

Molecular characterization of BARI released sweet potato varieties using SSR marker

F. Akhter, M. M. H. Molla, S. Islam, M. M. Rahman, S. Sultana and S. Akhter

The study was conducted at Molecular Biology Lab, TCRC, BARI, Gazipur during 2021-22. 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 Jacquardco-efficient ranging from 0.00- 0, 81 indicating high genetic diversity among those varieties.

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 was conducted using BARI released clone potato varieties. The varieties have been developed through hybridization by TCRC. DNA-based fingerprinting using SSR 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 (G1, G2 and G3) where G1 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 G3. 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 Ahmmed

Heat tolerant (BARI Alu-72 & 73), late blight resistant (BARI Alu-46, 53, & 77) and susceptible potato varieties (BARI Alu-7 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 Desireed chloroplast (DQ386163.2). The chloroplast genome sequences of the five genomes ranged from 176,021bp (BARI Alu-46) to 176,301bp (BARI Alu-77).The same typical quadripartite structure was displayed in the five cp genomes. Two IR regions (44,606 - 44,999 bp) were separated by an LSC region (85,738-85,986 bp) and an SSC region (690-717 bp). The GC content ranged from 36.81% to 35.77% for the five cp genomes. The five genomes contain genes ranging from 152 (BARI Alu-77) to 161 (BARI Alu-53) and protein-coding genes ranging from 118 (BARI Alu-77) to 127 (BARI Alu-53). All of them also contain 30 tRNA and 4 rRNA. FASTA sequenced data have been submitted to NCBI and received accession no. BankIt2580767 ON649731(BARI Alu-46), BankIt2600070 ON931241 (BARI Alu-53), BankIt2599879 ON920845 (BARI Alu-72), BankIt2595774 ON920844 (BARI Alu-73) and BankIt2593326 ON838212 (BARI Alu-77). There are 17 progenies developed through crossing between heat tolerant with susceptible BARI Alu-7 & 25 and late blight resistant potato varieties (BARI Alu-46, 53, 72 & 73) with susceptible BARI Alu-7 & 25. A lot of variations were found among the progenies for late blight disease resistance and tolerance to heat. After phenotypic evaluation of the progenies, a total of 15 late blight resistant and 14 heat tolerant lines were selected for further evaluation for variety development. Potential SSR marker STG0001 for marker-assisted breeding for LBR and Potential SSR marker STM1004 and STM1008 for marker-assisted breeding heat tolerant.

Secondary yield trial of combined PVY and PLRV resistance germplasm

S. Islam, M. M. H. Molla, F. Akhter, M. M. Rahman, M.S. Hossain, M. M. Begum, S. Akhter and David Douches

The breeding genotypes of M_2, and M_3 breeding populations had PVY and PLRV R-gene from MSR061-01 and Alca Tarma, respectively and they segregated in the population. They were resistant against PVY and PLRV. Combined analysis showed significant variations for days to emergence, plant vigour and tuber number per plant. Location wise yield performance was 29.02 and 31.28 t/ha in BSPC and TCRC, respectively. Genotype variations were also found significant for all the traits. The M2-25, M2-58 and M3-12 produced highest number of tubers per plant. Yield from the lines of M2-25, M2-28, M2-92, M2-92 and M3-12 was produced highest among these lines. When compare with locations and lines on an average M2-25, M2-28, M2-47, M2-92, M2-94 and M3-12 produced higher yield than others. Dry matter percent found highest in M2-34 line (21.85%). Some lines were found round and some them produced more than 30 t/ha.

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, S. Ahmed and S. Akhter

Indigenous potato tubers were collected from Rangpur and Jamalpur to see their virus presence. Tubers were planted in TCRC, Gazipur in 2019-20, 2020-21 and 2021-22. Most of the germplasm produced virus symptom and found PVY, PLRV most after ELISA test. RNAs were isolated from infested tubers and stored to for sequencing the viruses. Through RT-PCR, PVY was detected from all the tested potato germplasm. 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

S. Islam, M. M. H. Molla, F. Akhter, M. M. Rahman, M.S. Hossain, and S. Akhter

Fourtyone clones of a population were planted in BSPC, Debiganj in 2021-22 to screen them out from virus diseases. Visual inspection of virus infection of potato was recorded in BSPC. In virus infection, PLRV and PVM were observed and recorded in their specific clones of diploid resources. 41 clones of a population were produced and found 14 clones were infected with PLRV, PVM and virus complex. Only this year 27 clones did not show any virus symptom.

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

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

All the TCRC developed late blight resistant varieties, BARI Alu-46, BARI Alu-53, BARI Alu-77, BARI Alu-90 and BARI Alu-91 with CIP germplasm were planted in the crossing block in 2021-22 to get the TPS. Flowers from the planted potato varieties did not come at a time, whenever the chances of synchronization happened, crosses were made among the selected parents in the crossing. After some possible crosses, the following crosses were found success. The total number of TPS was 1473 from the weight of 860.2 mg. From the family of TB11, significant variations were found for the trait of rAUDPC*100, tuber number, tuber weight and yield. Some lines had excellent late blight resistance with good agronomic traits.

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 S. Akhter

The study was conducted at Molecular Biology Lab, TCRC, BARI, Gazipur during 2021-22. 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. Akhter

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 2021-22 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 Rgenes - in tetraploid potato for late blight

S. Islam, M. M. H. Molla, F. Akhter, M. M. Rahman and S. Akhter

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 2021-22 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

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

Late blight resistance CIP germplasm and as a control from the released resistance and susceptible

varieties of BARI were planted in TCRC Gazipur during 2021-22 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.

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

F. Akhter, M. M. H. Molla, S. Islam and S. Akhter

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+ 2.0 mg/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 Mistialu-4 and BARI Mistialu-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.

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 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 ($NH4NO_3$) and Potassium nitrate (KNO_3) 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. After 60 days after planting (DAP), analyzing all characters with the effect of treatments and performance of varieties it could be concluded that T_2. RHRS, Patuakhali developed low cost aeroponic solution which was the best treatments for aeroponic culture and BARI Alu-46 was the best variety among three. At 130 DAP of this experiment, observing the yield characters it could be concluded that T_1. CIP developed aeroponic solution (Existing) was the best treatments for aeroponic culture and BARI Alu-63 was the best variety among three.

Seed multiplication

Production and maintenance of minor crops seed

M. H. Rashid and S. Akhter

Seed production is a regular programme of TCRC for varietal maintaining and distribution to farmers or different adaptive or demonstration trials. Around 267.94 kg yam seed tuber of mentioned varieties and advanced lines were produced and 3625 cuttings of cassava advanced lines were produced on research field of TCRC, Gazipur.

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

M. M. Rahman, M. Rahman, M. M. H. Molla, F. Akhter and B. C. Kundu

This work was carried out to produce high quality minituber from in vitro plantlet. A total of 4704 kg

mini-tubers were produced from 85886 plantlets during 2021-22 cropping season at Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh. Minitubers of all varieties stored in Breeder seed production cold storage and used for next year multiplication for subsequent generation as well as to meet up BADC and other organization requirement. Minituber of different lines were multiplied for next year trial setup. The highest amount was contributed by the variety BARI Alu-25 (Asterix) 870 kg.

Production of breeder and foundation potato seed at BSPC, debiganj, panchagarh during 2021-2022

M. M. Rahman, A. K. Das, M. W. Rahman, M. Z. Masud, M. Rahman and B. C. Kundu

Breeder and Foundation seed Production of different potato varieties is the routine works of Breeder Seed Production Centre (BSPC), Debiganj, and Panchagarh. A total of 950.451-ton nucleus, breeder, foundation and germplasm seed were produced from 155 acre of land during 2021-22 cropping season. To produce breeder seed nucleus and G1 seed were used and in case of foundation seed production and experiment setup breeder seed were used. All varieties minituber were multiplied for next year Breeder seed production to meet up requirement of BADC and other organization. Minitubers of different germplasms were multiplied for next year trial setup. The highest amount of breeder and foundation seed was recorded by the variety BARI Alu-25 (Asterix).

Seed production and distribution of sweet potato and aroids

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

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, A.H.S. Jahan and S. Akter

An experiment was conducted at Tuber Crops Research Center, BARI during March to August 2021. Tubers of exotic potato varieties and clonal hybrids of RYT, AYT and SYT were evaluated for storage behavior under natural condition. Among clonal hybrids and exotic varieties 14.11, Ottawa, Tiamo, Al Russet and Dunstar under RYT showed better storage performance in natural condition. Among the five hybrid clones 15.112, 15.156 and 15.139 were the better performer at AYT. In case of the seven exotic varieties, Twister, Hind, Prada and Delia Red showed good storability at AYT. Regarding secondary yield trial (SYT), all the hybrid clones showed good performance.

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, A.H.S. Jahan and S. Akter

Eleven hybrid clones of SYT were studied for their processing quality in the form of Chips and French Fries. Processing quality of hybrid clones 17.172 and 17.24 under SYT showed better performance in producing chips whereas 17.66 and 17.29 were good at producing French fries. The colored fleshed hybrid clone 33.32 under SYT performed good regarding both chips and Frech fries. 16.7, 16.28 and 16.33 out of 6 hybrid clones exhibited better performance for chips while 16.16 were better for chips and French fries at AYT level. Among the exotic genotypes in RYT Alcander and Hind were better for chips and French fries. 15.112 and 15.139 among the hybrid materials for RYT, were better for producing chips and all the hybrid clones were better for producing French fries. None of the late blight resistant materials under RYT were suitable for producing chips but Twinner were good at producing French fries.

Technology Transfer

Potato

Adaptive trials with newly released potato varieties

M. M. Islam, S. Naznin, B.C.Kundu, M. N. Uddin, M.R. Islam, M.M. Hossain, O.A. Fakir, M. H. Rashid, M.K. Shahadat, M.S.I. Khan, M. M. Islam, M. S. Rahman, M.S. Uddin, M.M Kader, B. Anwar, M.K.U. Ahamed, M.H. Hossain, M.M. Kamruzzaman, M.M. Howlader, M. Asaduzzaman, M.S Ahamed, 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, and S, Akhter

Adaptive trials with new potato varieties were conducted at eighteen 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 37.74 t/ha was recorded in BARI Alu-46 followed BARI Alu-41 (35.87 t/ha) and BARI Alu-49 (35.61 t/ha). BARI Alu-35 was the lowest yielder (31.21 t/ha). Framers 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

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

Promotion and dissemination trials with Climate smart new potato varieties were conducted at three districts to promote as well as to know the farmers acceptance about the new potato varieties. In each district the trial was replicated 5 locations. The tested three varieties varied between and within location. Average yield over the location of BARI Alu-72 was 25.53 t/ha, BARI Alu-73 was 24.37 t/ha and BARI Alu-78 was 23.39 t/ha. Framers 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

M. M. Islam, S. Naznin, B. C. Kundu, M. N. Uddin, 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 and S, Akhter

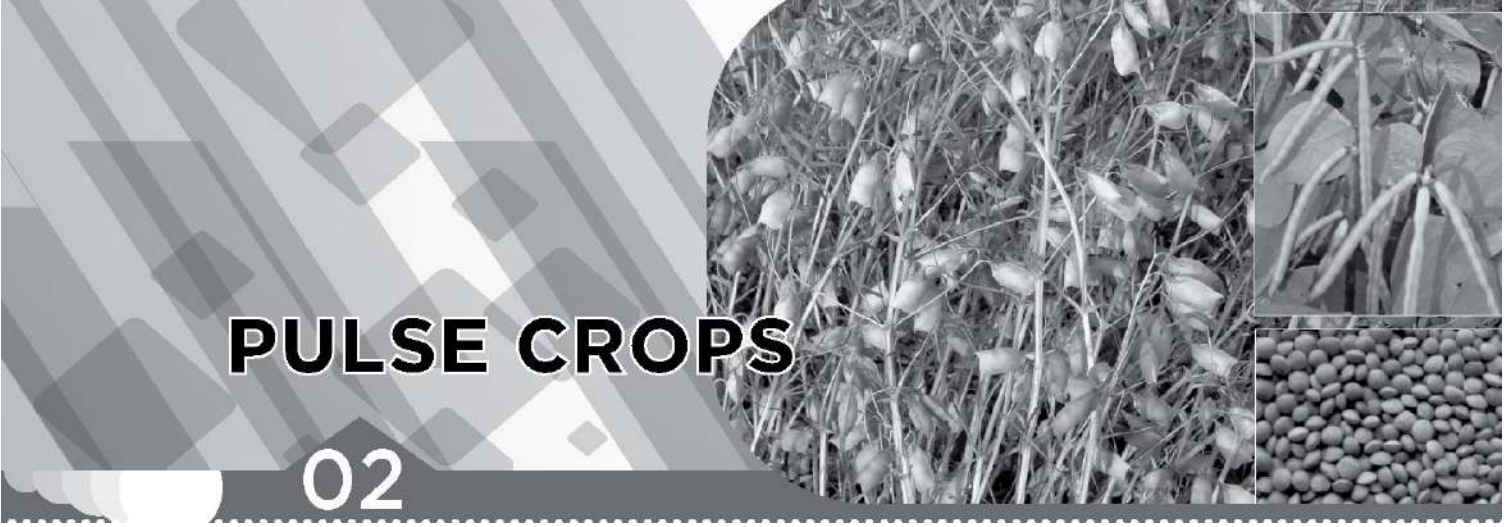
Fourty five field trials were conducted on BARI released late blight resistant potato varieties viz. BARI alu-46, BARI alu-53 and BARI Alu-77 (Sarpomira) at farmers' field of eight late blight disease prone districts in Bangladesh (Bogura, Gaibandha, Joypurhat, Kurigram, Lalmonirhat, Nilphamari, Panchagar and Rangpur) during 2021-2022 for promotion and dissemination. Yield of BARI Alu-46, BARI alu-53 and BARI Alu-77 (Sarpomira) ranged 29.73-43.72, 27.37-42.04, and 28.17-44.97 t/ha, respectively. 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.

Sweet Potato

Adaptive trials with sweet potato varieties

Z. Alam, M. A. H. Khan, M. S. Alam, M. Sultana, M. Z. H. Prodhan, M. M. Rahman, M. S. Rahman, M. M. Quader, M. Samsuzzaman, M. Mohiuddin, J. A. Mahmud, M. H. Hossain, M. M. Islam and S. Akhter

An adaptive trial at farmer's field of BARI Mistialu-4, BARI Mistialu-12, BARI Mistialu-14, BARI Mistialu-15, BARI Mistialu-16 and BARI Mistialu-17 of sweet potato was carried out in Bogura, Gazipur, Jamalpur, Kishoreganj, Kustia and Moulvibazar during the winter season of 2021-22. Farmers experienced very good mouth feel during testing BARI Mistialu-12 and BARI Mistialu-17 but BARI Mistialu-17 exhibited less tuber yield than BARI Mistialu-12. Considering the yield, BARI Sweet potato-15 was found suitable for Sylhet region.



Blackgram

Varietal Improvement

Hybridization of blackgram

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Hybridization of blackgram was conducted for creating genetic variability with desired gene combinations within the existing germplasm during Kharif II season, 2021 at Pulses Research Centre, Ishwardi, Pabna. Five parents with desired characters were used and a total of 147 successful crossed seeds were collected from ten cross combinations that will be sown during the next season for confirmation of blackgram F_1 generations.

Confirmation F_1 generation of blackgram

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

To ensure fertile crosses between the parents, confirmation is very much essential. Nine F_1s obtained from Kharif II, 2020 were grown along with their parents at Pulses Research Centre, Ishwardi, Pabna during Kharif II, 2021. On the basis of desired characters nine accessions were selected as confirmed crosses comparing between two parents and were harvested separately for the next year trial.

Growing and evaluation of F_2 generation of blackgram

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Fourteen F_2 segregates were grown along with one check BARI Mash-3 to advance the generation at Pulses Research Centre, Ishwardi, Pabna during Kharif II, 2021. The total population was bulked and harvested for retention of more variability which will be grown as F_3 segregation generation in the next season.

Growing and evaluation F_3 generation of blackgram

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Fifteen F_3s were grown along with check to advance the generation at Pulses Research Centre, Ishwardi, Pabna during Kharif II, 2021. The total population was bulked and harvested for retention of more variability which will be grown as F_4 segregation generation in the next season.

Growing and evaluation of blackgram F_4 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Nine F_4s progenies were evaluated and their seeds were bulked during Kharif-II, 2021 and each of the individual single plants will be grown in an individual line as F_5s generation in the next season where family selection will be done.

Growing and evaluation of blackgram F_5 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Genetic combination turns to more homozygous condition in F_5 and for this reason selection of family is done in this generation. To select appropriate and desired combinations nine F_5s were grown along with check varieties at Pulses Research Centre, Ishwardi, Pabna. Finally,fifty nine single plants were selected which will be grown in the next year at F_6 generation.

Observation trial of blackgram

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Eighteen accessions selected from last season's F_5 population were grown with check variety BARI

Mash-3 and BARI Mash-4 during kharif-II season of 2021 at Pulses research center, Ishwardi, Pabna following RCB design with two replications. Evaluating the yield contributing traits and performance of yield, eight genotypes out of eighteen; BBLXK2-016001-14, BBLXK2-016003-3, BBLXK2-016004-9, BBLXK2-016004-13, BBLXK2-016004-15, BBLXK2-016007-6, BBLXK2-016015-6 and BBLXK2-016015-14 were selected for next year PYT.

Participatory variety selection of blackgram

M M Hossain, M.S.U. Zaman, N.D. Kundu, M.E.A. Pramanik, J Rahman and Akmm Alam

The experiment was conducted at Ishurdi, Barind, Madaripur, Gaibandha and Jamalpur during Kharif-II season of 2021. Eight Blackgram genotypes *viz*. BBLXK2-12005-5, BBLXK2-12002-4, BLXK2-12005-6, BBLXK2-04001-1, BBLXK2-08008-2-1 and BBLXK2-12002-2 with two checks (BARI Mash-3 and BARI Mash-4) were evaluated in a RCB design with 3 replications. The highest plant height was found in BARI Mash-4 (54.4 cm) followed by BBLXK2-08008-2-1 and the lowest in BBLXK2-04001-1 (45.8cm). BARI Mash-4 gave the highest 4.37g 100 seed weight followed by genotype BBLXK2-08008-2-1 (4.25 g) and the lowest 100 seed weight was found in BBLXK2-12005-6 (3.75 g). The highest yield was found in BBLXK2-08008-2-1 (1301 kg/ha) followed by BBLXK2-12005-5 (1298kg/ha) and the lowest yield was found in BARI Mash-4 (1164 kg/ha) over location.

Screening of blackgram lines resistant to blackgram yellow mosaic virus

D. Sarkar, M. R. Humauan, B. Akhter, and M. M. Uddin

The production of Blackgram is seriously hampered by Blackgram Yellow Mosaic Virus (BYMV). The absence of resistant/tolerant sources against BYMV disease leads to tremendous crop yield losses. To identify the sources of resistance in Blackgram against BYMV, 27 genotypes were screened under natural condition in summer, 2021. Out of them, 2 were categorized as resistant (R), 4 moderately resitant (MR), 20 moderately susceptible, 6 susceptible (S) and 57 were highly susceptible (HS). The resistant and highly susceptible genotypes could be used as parents for the development of mapping population in order to validate the molecular markers to facilitate marker-assisted selection for the development of BYMV resistant breeding lines.

Lentil

Varietal Improvement

Hybridization of lentil

M. S. U. Zaman, M. J. Alam, A. K. M. M Alam and M. M. Uddin

Hybridization of lentil was conducted to develop high yielding and stemphylium blight resistant variety at Pulses Research Centre, Ishwardi, Pabna during Rabi 2021-22. Four parents were used in crosses and a total of 257 successful cross seeds were harvested from 5 cross combinations. The cross seeds will be sown next season for the confirmation of lentil F_1plants.

Confirmation of F_1 plants in lentil

M.S.U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

To confirm crosses between the parents is essential to advance the generation for variety development. Five F_1s obtained from Rabi 2020-21 along with their parents were grown at Pulses Research Centre, Ishwardi, Pabna during Rabi 2021-22. On the basis of phenotypic markers such as leaf color, stem pigmentation, flower color, leaf shape, presence/absence of tendril, time to flowering and maturity five accessions were confirmed by comparing between two parents and harvested separately for the next year F_2 generation.

Growing and evaluation of lentil F_2 generation

M.S.U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

Twelve F_2 populations along with check variety BARI Masur-7 and BARI Masur-8 were grown at Pulses Research Centre, Ishwardi, Pabna during rabi, 2021-22 to advance the generation. The individual population was harvested and bulked for retention of more variability which will be grown next year as F_3 segregation.

Growing and evaluation of lentil F_4 generation

M.S.U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

Twelve F_4 populations were evaluated during rabi 2021-22 at Pulses Research Centre, Ishwardi,

Pabna to advance the generations. At maturity, one to two seeds of each plants were collected and bulked crosswise/population wise. The bulked seeds from each population will be sown next year as F_5 generations.

Growing and evaluation of lentil F_5 generation

M. S. U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

Three F_5 populations were sown on 20 November during 2021-22 at Pulses Research Centre, Ishwardi, Pabna to advance the generation. At maturity, 1-2 pods per plant were harvested enmass cross-wise for growing F_6 generation next year.

Growing and evaluation of lentil F_6 generation

M. S. U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

Nine F_5 populations were sown on 20 November during 2021-22 at Pulses Research Centre, Ishwardi, Pabna to advance the generation. At maturity, individual plants from each of the crosses were selected and harvested separately based on days to maturity, branches/plant, number of pods/plant and disease reaction which will be grown in the next year as observation trial.

Preliminary yield trial of lentil

M. J. Alam, M. S. Zaman, N. Kundu, J. Rahman, S. Kobir, R. Uddin, Akmm Alam and M. M. Uddin

The experiment was carried out to assess the performance of yield and yield contributing traits of nine promising lentil genotypes at five different locations *viz.* Ishwardi, Madaripur, Jamalpur and Jashore during rabi, 2021-22. Significant variations were observed for days to flower, days to maturity, plant height, pods per plant hundred seed weight and the performance of yield in almost all locations. Among the genotypes, BLX-14001-1 flowered and matured earlier than the other genotypes. In comparison to plant height, genotype BLX-14002-6 showed the shortest plant type while BARI Masur-7 was the 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 (1643 kg ha^{-1}), but the yield of BLX-14004-3 was close to BARI Masur-8 with a SB disease score of 2-3 in two locations.

Regional yield trial of lentil

M. J. Alam, M. S. Zaman, N. Kundu, J. Rahman, S. Kobir, R. Uddin, Akmm Alam and M. M. Uddin

The experiment 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 average 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.

Efficacy of *rhizobium* on nitrogen compensation and yield of lentil

M.S. Alam, M.O. Ali, J. Hossain, M.M. Kamal M.S. Kobir and M.M. Uddin

A field experiment was conducted at PRC, BARI, Ishurdi, Pabna during Rabi season of 2021-2022 to evaluate the response of *Rhizobium* on nitrogen compensation and yield of lentil. The experiment was laid out in a Randomized Complete Block Design assigned with 3 replications and 8 different treatments. Treatments were as follows- T_1 = Native fertility, T_2 = Recommend dose of fertilizer (RD=$N_{21}P_{18}K_{20}S_{10}B_2$ kg ha^{-1}), T_3 = *Rhizobium* inoculant, T_4= *Rhizobium* + RD, T_5 = *Rhizobium* + 75% RDN T_6= *Rhizobium* + 50% RDN, T_7 = *Rhizobium* + 25% RDN, and T_8 = *Rhizobium* + 0% RDN and other fertilizers were used as blanket dose. The results revealed that *Rhizobium* + RD (T_4) gave higher plant height, branches $plant^{-1}$, pods $plant^{-1}$, seed yield (2.52 t ha^{-1}), maximum nodule number, additional income Tk. 78720 ha^{-1}, gross margin Tk. 73470 ha^{-1}, marginal benefit cost ratio (15) and yield increased (42%) over control. The higher MBCR (33) was found in T_3 due to minimum cost of *Rhizobium*. Regarding nitrogen

compensation, T_5 (*Rhizobium* + 75% RDN) reduced 25% nitrogen and also increased 35% yield over control.

Effect of seed rate and fertilizer management on growth yield of BARI Masur-8

M.S. Alam, M.O. Ali, J. Hossain, M.M. Kamal and M.M. Uddin

A field experiment was conducted at PRC, BARI, Ishurdi, Pabna during *Rabi* season of 2021-2022 to evaluate the optimum plant density and fertilizer management for higher yield of BARI Masur-8. The experiment was laid out in a split-plot design with three replications. The three seed rates were as follows: S_1= 20 kg seed ha^{-1}, S_2= 40 kg seed ha^{-1} and S_3= 60 kg seed ha^{-1} and four fertilizer treatments were as follows: F_1= 100% recommended dose (RD=$N_{21}P_{18}K_{20}S_{10}B_2$ kg ha^{-1}), F_2= 110% RD, F_3= 120% RD and F_4= 140 % RD. The results revealed that 40 kg ha^{-1} seed with 120% RD (S_2F_3) showed significant effect on nodulation (87 plant^{-1}), TDM (475 g m^{-2}), higher seed yield of lentil (3.01 t ha^{-1}). Yield increased 22% over recommended dose of fertilizer while the lower seed yield (2.36 t ha^{-1}) was recorded in 20 kg ha^{-1} seed with 100% RD (S_1F_1). The S_2F_3 combination also gave the higher gross margin (Tk. 145576 ha^{-1}) and BCR (3.12).

Effect of foliar spray of boron on yield of relay lentil

R. Uddin, M.O. Ali and M. R. Uddin

Lentil cultivation is declining over time in south central coastal region of Bangladesh due high temperature induced moisture depletion in relay sown condition provokes terminal heat injury during flowering, pollination, fertilization and grain growth. To optimize pollen fertilization and grain growth an attempt was undertaken to understand and justify low cost commercial boron application at varying doses. Five concentrations of commercial boron solution 0.5%, 1%, 1.5%, 2% and 2.5 % was compared with No spray (Control). The results revealed that yield and yield contributing characters of relay lentil was comparatively higher at 2% and 2.5% foliar application of boron. The highest seed yield (1325 Kg/ha) and BCR (3.32) can be observed from 2.5 % boron foliar application.

Development of integrated weed management practices of lentil in Jashore region

Ms Kobir, Mo Ali, Ms Alam, J. Hossain, D Sarkar, M Mohiuddin and Ku Ahammad

The experiment was conducted at Regional Agricultural Research Station, Jashore during Rabi 2021-2022. The experiment was conducted considering different weed management practices viz. T_1 = No weeding, T_2 = Weed free up to 60 DAS, T_3=pre-emergence herbicide, T_4 = Two times Hand weeding (4-5 weeks after sowing and 6-7 weeks after sowing), T_5 = Pre-emergence herbicide+ Hand weeding at 4-5 weeks after sowing, T_6 = post-emergence herbicide+ Hand weeding at 6-7 weeks after sowing in RCB design with 3 replications. The highest no. of weeds (507 m^{-2}, 277 m^{-2}) and the highest weed biomass (141.48 m^{-2}, 90.90 g m^{-2}) was found in control plot in the 40 days after sowing and 60 days after sowing, respectively. The highest grain yield was recorded in weed free plot (2675.60 kg ha^{-1}) followed by two times hand weeding treatment plot (2581.70) and pre-emergence herbicide+ hand weeding at 4-5 weeks after sowing (2270.70 kg ha^{-1}) treatment. The highest gross return was recorded in weed free treatment (133780 TK. ha^{-1}) followed by two times hand weeding treatment (129085 TK. ha^{-1}). The highest gross margin (86500TK. ha^{-1}) was recorded in two times hand weeding treatment followed by pre-emergence herbicide+ hand weeding at 4-5 weeks after sowing treatment (76780 TK. ha^{-1}) and the results revealed that the highest BCR (3.1) was found in pre-emergence herbicide+ hand weeding at 4-5 weeks after sowing treatment. Although weed free treatment gave the highest grain yield and two times hand weeding gave the highest gross margin, application of pre emergence herbicide and one hand weeding at 4-5 weeks after sowing gave highest BCR. Moreover, this approach is effective for grass and broad leaf weed control.

Determination of dose and spray schedule of trifloxystrobin and tebuconazole fungicides for controlling blight disease of lentil

D. Sarkar, M. R. Humauan, B. Akhter, S. Hossain and M. M. Uddin

Stemphylium blight (SB) (*Stemphylium botryosum* Wallr) is one of the major diseases of lentils. For effective control of this disease, foliar application of trifloxystrobin, tebuconazole and ipridione fungicides is recommended. To achieve sustainable

disease management practice, fungicide dose and spray schedule need to be considered. The aim of the study to evaluate the efficacy of trifloxystrobin and tebuconazole fungicides aganist SB. The experiment was conducted at Pulses Research Center (PRC), BARI, Ishurdi, Pabna during 2021-22 season. There was no significant difference among the tested fungicide doses for seed yield and disease severity. However, there was distinct statistical difference was observed between the spray schedule for seed yield but not for disease severity. Though, all fungicide treatments combinations significantly differ from control treatment for disease severity and seed yield production except Tebuconazole + Triflooxystorbin (0.25gm / L) & 2 time application. In Marginal Benefit Cost Ratio (MBCR), all the combinations performed better over control but most economical combination was Tebuconazole (Folicur) (1ml/ L) & two times application with highest MBCR of 1:13.3. The lowest MBCR (7.8) was found Triflooxystrobin and Tebuconazole (Nativo) @ 025.g / L and two time's application. From the presented data, it could be recommended that two times application of; Triflooxystrobin and Tebuconazole (Nativo) @ 05.g / L or Tebuconazole (Folicur) @ 1ml / L at 7 days interval for management of Stemphylium blight disease of lentil in Bangladesh.

Screening of lentil germplasm against stemphylium blight

D. Sarkar, M. R. Humauan, B. Akhter, and M. M. Uddin

Lentil is the most popular pulse in Bangladesh which also known as poor men's meat. The potential yield of lentil could not achievable because of pathological factor especially Stemphylium Blight (SB) caused by *Stemphylium botryosum* Wallr. It causes severe leaf drop, resulting in defoliated plants which sometimes causes even 100 per cent crop loss. A field experiment was carried out during rabi season of 2021-22 at the Pulses research station, Ishurdi to evaluate the host resistance of lentil genotypes against Stemphylium blight. Twenty seven lentil genotypes were screened. These accessions were screened in natural field environment and showed varying level of resistance. Percent disease severity ranged from 9.02 % to 90.24 %. Eighteen entries (BLX-9001, LRIL-22-70, ILL-2530, ILL-5077, ILL-4705, ILL-5144, ILL-6325, LRIL-22-151 etc) showed Moderately resistant (Disease grade-3) and eight entries (ILL-5117, LT-8, ILL-4702, ILL-6418, ILL-6324, ILL-5109, LRIL-22-189, ILL-6344, LT-07) were found Moderately susceptible (Disease grade-5). Out of 18 MR lines 8 lines were early and they are escaping SB disease. Only Check entry (BARI Masur-1) showed highly susceptible (Disease grade-9). These Moderately resistant genotypes can be used as good donor for evolving resistant varieties against Stemphylium blight in lentil.

Biological controls of root rot disease of lentil in field condition

D. Sarkar, M. R. Humauan, B. Akhter, and M. M. Uddin

Pulses crop play an important role in agriculture contributing food and nutritionally security and sustainable farming system. Root rots disease of lentil caused by soil borne as well as seed borne fungi, which attack destructively at the seedling stage. The biocontrol agent has the potential to protect seedlings against several plant pathogenic fungi as well as plant growth enhancers. Results revealed that, there was no significant difference among the treatments for plant population, number of branch and plant height but remarkable difference at pods per plant and yield. The highest pods per plant (107) observed at Trichocompost treated plot which was statistically distinct from other treatment and lowest was (65) controlled plot. The maximum yield (1173 Kg/ha) was found at Bacillus treated plot which was statistically identical to all treatments except Tricost and untreated plot. However, the minimum yield (846 Kg/ha) was observed at controlled plot. For the root rot disease incidence, all biological agents are effective to control the disease, however only 15.65% disease incidence was recorded in controlled plot. The lowest root rot disease incidence (5.2) was found at Lentil Rhizobium treated plot. In this experiment, it mentioned clear and efficient biocontrol of plant pathogenic fungi by Rhizobium and Bacillus strains for lower disease incidence and severity and higher yield.

Prevalence of pathogens associated with root rot disease of lentil

D. Sarkar, M. R. Humauan, B. Akhter, and M. M. Uddin

The major threats for production of the lentil in Bangladesh are root rots diseases. To identify which soil borne pathogens are associated with root

rot disease complex on lentil and to determine their prevalence, a survey was conducted from October, 2021 to March 2022 at Pulses research center (PRC) Ishurdi, Pabna. Lentils root rot symptoms were obtained from 5 Research plot in PRC. Rotted roots were washed, potential pathogens were cultured, and isolates were putatively identified into the major pathogen groups based on morphology. Among the 88 isolates obtained, *Fusarium* (46.6%) was recovered at the highest prevalence and *Rhizoctonia* and *Sclerotium*exhibited a consistent presence, ranging from 30.6% and 22.7% respectively. This survey provided baseline information on the prevalence of critical soil borne pathogens of lentil in Ishurdi region. In the future, additional genetic markers will be utilized to further identify organisms, a species characterization will be conducted to assess pathogenicity and virulence, and lentil germplasm will be screened for resistance.

Grasspea

Varietal Improvement

Confirmation of grasspea F_1 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Ten cross combinations of grasspea were grown along with their parents during the rabi season 2021-22 at PRC, Ishwardi, Pabna. A total of 27 individual F_1s plants have been confirmed and harvested separately from nine cross combinations and these individual single plants will be grown as F_2s generation in the next season for advancement of segregating generations.

Growing and evaluation of F_2 generation of grasspea

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Twelve F_2 segregates were grown along with check variety BARI Khesari-3 to advance the generation at Pulses Research Centre, Ishwardi, Pabna during rabi, 2021-22. The total population was bulked and harvested for retention of more variability which will be grown in the next rabi season as F_3 segregation generation in the next season.

Growing and evaluation of grasspea F_3 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Nine F_3 progenies were evaluated and their seeds were bulked during rabi 2021-22 and these bulked populations will be grown and evaluated as F_4s generation in the next season for advancement of grasspea segregating populations.

Growing and evaluation of grasspea F_4 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Six F_4s progenies were evaluated and their seeds were bulked during rabi, 2021-22 and each of the individual single plants will be grown in an individual line as F_5s generation in the next season where family selection will be done.

Observation trial of grasspea

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Nine genotypes selected last year from germplasm of ICARDA were grown with check variety BARI Khesari-3 and BARI Khesari-6 during rabi season of 2021-22 at Pulses research center, Ishwardi, Pabna following RCB design with two replications. After evaluating the yield contributing traits and performance of yield, six genotypes; 66054, 114505, 116755, 116690, IGYT124 and 114585were selected for next year PYT.

Preliminary yield trial of grasspea

M. J. Alam, M. S. Zaman, N. Kundu, J. Rahman, S. Kobir, R. Uddin, Akmm Alam and M. M. Uddin

The experiment was carried out to evaluate the performance of seven grasspea genotypes with check BARI Khesari-5 for yield and yield related traits in five locations *viz.* PRC, Ishwardi, Pabna; RPRS, Madaripur; RARS, Barishal; RARS, Jashore and RARS Jamalpur during Rabi 2021-22. Significant variations was found among the genotypes across the environments. The genotype IGYT-122 flowered and matured earlier considering the mean values of four locations followed by BARI Khesari-5. BARI Khesari-5 also showed the highest average plant height (85 cm), while the lowest in IGYT-110 (74 cm). The

number of pods varied across locations. Highest mean pods per plant (46) found in IGYT-122 followed by BARI Khesari-5. The highest average 100 seed weight (6.3 g) recorded in IGYT-123 followed by IGYT-110 (5.7 g). The genotype IGYT-125 produced the highest average seed yield (1973 kg/ha) followed by BGP-13009, while the lowest yield (1725 kg/ha) performed by check variety BARI Khesari-5. In respect to location, IGYT-110 exhibited the highest seed yield (1725 kg/ha) in Jashore. Compared to three locations, almost all the genotypes produced higher yield at Jashore.

Screening of grasspea germplasm under waterlogging stress at germination and seedling stage

Md Shahin Uz Zaman

Grasspea (*Lathyrus sativus* L.) crops are exposed to waterlogging at different growth stages when grown as relay in rice-based cropping. A total of 52 germplasm were evaluated in 10 days waterlogging treatments at germination and 21 days for seedling stage in the pot to identify waterlogging tolerance at germination and seedling. Germination was reduced significantly by the waterlogging treatments. The mean for germination was 27%. The germination of twenty four genotypes exceeded the mean under WL stress. Six genotypes- BD- 5535, BD- 5516, IGYT- 123, BD- 5626 and BD- 5621 showed more than 50% germination with a highest germination (65%) of germplasm BD- 5621. Stress tolerance index (STI) of traits in PCA analysis showed 48.5% variability by first principal component while 18.4% in second principal component. With the PCA biplot, genotypes that have high values of the indices will be high yielding under stress and non-stress environments. Based on that, the genotypes 15 (X2009-24-12S-11), 33 (Barisal-Kechuganj local), 10 (66054), 2 (BGP- 130), 11 (116820) and 32 (BARI Khesari-3) were suitable genotypes under both conditions. The highly sensitive genotypes were 52 (BD- 5626), 30 (BARI Khesari-1), 26 (BKX-0002-4) and 5 (IGYT- 125). Such marked differences in waterlogging tolerance at germination and seedling in grasspea illustrate prospects for selection to improve adaptation to relay sowing in Bangladesh.

Effect of rice straw height on the yield and better adaptation of grasspea

J. Hossain, M.S. Alam, M.O. Ali and M. M. Uddin

The experiment was conducted at the Pulses Research Centre, Ishurdi, Pabna during 2021-2022 to find out the optimum rice straw height for better growth, establishment and yield of grass pea. Rice stubble was cut at six different heights in this experiment i.e. 0 cm, 10 cm, 20 cm, 30 cm, 40 cm and 50 cm. The trial was laid out in a Randomized Complete Block Design with three replications. Results showed that 50 cm stubble height gave the highest plant height (100 cm) followed by 40 cm stubble height and 0 cm stubble height provided the lowest plant height (68 cm) at harvest due to mechanical support to the grass pea vine to climb. Among all levels of straw retentions, the 30 cm rice straw height performed well in increasing yield (851 kg ha^{-1}) of grass pea due to higher number of branches $plant^{-1}$(10.13) and pods $plant^{-1}$(34).

Adaptation of BARI newly released grasspea varieties in relay sown condition in Barishal

R. Uddin M.O. Ali and M. R. Uddin

Grasspea is a major pulse crop in South Central coastal region of Bangladesh. Relay sown grasspea with T. Aman rice is suitable and sustainable technology. Adaptation and validation of new grasspea varieties in situ relay sown condition is essential to uplift its productivity and yield. A field experiment was conducted at RARS, Rahmatpur, Barishal during Rabi season of 2021-22 to evaluate and validate the performance of new grasspea varieties in relay sown condition. Three selected grasspea varieties viz. BARI Kheshari-3, BARI Kheshari-5 and BARI Kheshari-6 were evaluated in the trial. Results showed that, BARI Kheshari-5 had produced the longest root (65 cm), the highest root volume (0.65 cm^3), higher leaf area (705.81 cm^2), the maximum number pod per plant (74) in situ relay sown condition. The highest seed yield can be observed from BARI Kheshari-5 (1222 Kg/ha) in relay sown condition.

Collection and evaluation of indigenous grasspea germplasm in Barishal

R. Uddin, M.O. Ali and M. R. Uddin

Grasspea has been cultivated over centuries in South Central coastal region of Bangladesh. Genetic resources of indigenous grasspea is wide and

scattered. Collection and evaluation of indigenous grasspea to explore stress tolerance is a necessity. A field experiment was conducted at RARS, Rahmatpur, Barishal during Rabi season of 2021-22 to evaluate the indigenous grasspea germpalsms. Seven selected grasspea indigenous germplasms and one check variety BARI Kheshari-3 were evaluated in the trial. Results showed that, seed yield of late seeded grasspea was correlated with grain weight. The entry E_5 had produced the highest seed yield (1216.7 kg/ha) which was 8% yield increment over the check in late seeded condition.

Chickpea

Varietal Improvement

Hybridization of chickpea

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Hybridization of chickpea was undertaken for creation of genetic variability with desired gene combinations at PRC, Ishwardi, Pabna during rabi 2021-22. Five parents were used followed by half-diallel fashion and a total of 161 successful crossed derived seeds were harvested separately from ten cross combinations.

Confirmation of chickpea F_1 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Ten cross combinations were grown along with their male and female parents in both sides during rabi season 2021-22 at PRC, Ishwardi, Pabna. A total of 23 individual F_1s plants have been confirmed and harvested separately from 10 combinations and these single plants will be grown as F_2 generation in next season for advancement of chickpea segregating population.

Growing and evaluation of F_2 generation of chickpea

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Ten F_2 segregates were grown along with one check BARI Chola-5 to advance the generation at Pulses Research Centre, Ishwardi, Pabna during rabi, 2021-22. The total population was bulked and harvested for retention of more variability which will be grown as F_3 segregation generation in the next season.

Growing and evaluation of chickpea F_4 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Seven F_4s progenies were evaluated and their seeds were bulked during rabi, 2020-21 and each of the individual single plants will be grown in an individual line as F_5s generation in the next season where family selection will be done.

Growing and evaluation of chickpea F_5 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Genetic combination turns to more homozygosity in F_5 and for this reason selection of family is done in this generation. To select appropriate and desired combinations nine F_5s were grown along with check varieties at Pulses Research Centre, Ishwardi, Pabna. Finally, eighteen lines/families were selected which will be grown in the next year at observation trial.

Observation trial of chickpea

M.S.U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

Nineteen entries selected from last season's F_5 families were grown with check variety BARI Chola-10 during rabi season of 2021-22 at Pulses research center, Ishwardi, Pabna following RCB design with two replications. Significant variation was found in yield and yield contributing traits. Among the tested entries, ICCV- 181633 flowered earlier (77 days) than the other entries. The highest plant height (92 cm) was recorded in ICCV-181624 followed by ICCV- 181635, while the lowest (65 cm) in BCX-16011-4. The entry ICCV-181635 showed the highest number (175) of pods/plant followed by BCX-16011-2. The highest yield (1968 kg/ha) was found in ICCV- 181635 followed by BCX-16006-6 and BCX-16006-4. In respects to Botrytis Gray Mold disease, we did not find any symptom of the disease this year.

Preliminary yield trial of chickpea

M. J. Alam, M.S.U. Zaman, M. E. Pramanik, M.S. Kobir, M. M. Hossain, R. Uddin, Akmm Alam and M. M. Uddin

The experiment was conducted at five locations to evaluate the performance of twelve chickpea

genotypes along with check BARI Chola-5 and BARI Chola-10. It was laid out in a RCB design with three replications. Significant variation was observed in days to maturity and seed yield. The highest average yield (1655 kg/ha) across the locations was found in genotype ICCV-181627 followed by ICCV-181634 and ICCV-181635. In respects to Botrytis Gray Mold disease, there was no appearance of disease symptom this year. Regarding locations, entries performed relatively better at Ishurdi and poor at Gazipur and Barishal compared to others. Considering yield and yield contributing traits, four entries ICCV-181627, ICCV-181624, ICCV-181635 and ICCV-181634 were selected to evaluate next year under RYT.

Regional yield trial of chickpea

M. J. Alam, M.S.U. Zaman, M. E. Pramanik, M.S. Kobir, M. M. Hossain, R. Uddin, Akmm Alam and M. M. Uddin

The experiment was conducted at five locations to evaluate the performance of six chickpea genotypes along with check BARI Chola-5 and BARI Chola-10. It was laid out in a RCB design with three replications. Significant variation was observed in days to maturity and seed yield. The highest average yield across the locations was found in genotype BCX-13005-3 followed by BCX-13002-2 and BARI Chola-5. Moreover, the entry BCX-13005-3 showed the better yield performance in Ishwardi and Gazipur; while the entry BCX-13002-2 exhibited the highest yield at Barind, Rajshahi and Jashore. In respects to Botrytis Gray Mold disease, there was no appearance of disease symptom this year. Considering yield and yield contributing traits, two entries BCX-13005-3 and BCX-13002-2 were selected to evaluate next year under PVS trial.

Effect of bio-fertilizer and phosphorus on yield of chickpea (BARI Chola-10)

M.S. Alam, M.O. Ali, J. Hossain, M.M. Kamal, M.S. Kobir and M. M.Uddin

A field experiment was conducted at PRC, BARI, Ishurdi, Pabna during Rabi season of 2021-2022 to evaluate the effect of bio-fertilizer and phosphorus on growth and yield of chickpea. The experiment was laid out in a Randomized Complete Block Design with three replications. The treatments were as follows- T_1= Control (Native fertility), T_2= *Rhizobium* inoculant, T_3= Recommended dose of fertilizer (RD=$P_{18}K_{20}S_{10}B_2$ kg ha^{-1}), T_4= *Rhizobium* + 110% P (P_{20} kg ha^{-1}), T_5= *Rhizobium* + 120% P (P_{23} kg ha^{-1}) and T_6= *Rhizobium* + 140% P (P_{25} kg ha^{-1}) and other fertilizers were used as blanket dose. The results revealed that *Rhizobium* + 110% P (T_4) showed significant effect on nodulation (46 $plant^{-1}$). Higher yield of chickpea (2.68 t ha^{-1}) and yield increased 38% over control and the lowest seed yield (1.65 t ha^{-1}) was obtained from T_1 (native fertility). The higher additional income (Tk 72100 ha^{-1}) and gross margin (Tk. 66374 ha^{-1}) was obtained from T_3. The Maximum MBCR (53) was found in T_2 due to low price of *Rhizobium*. On the basis of yield and nodulation *Rhizobium* + 110%TSP (T_4) performed better than other treatments.

Seed germination, vigor and seedling performance of chick pea as influenced by priming with vinegar

M. M. Rashid, M. S. Uddin and M. O. Ali

The experiment was carried out at the laboratory of Regional Pulses Research station, BARI, Madaripur during 2021-2022, to study the effect of vinegar as a priming agent on seed germination, vigor, and seedling performance. Results revealed that priming with vinegar is not suitable for chickpeas. Hydropriming for 4 hours is mostly preferable for seed germination of chickpea.

Incidence of chickpea pod borer, *Helicoverpa armigera* (Hubner) on the promising varieties of chickpea

Md. Altaf Hossain

Incidence of chickpea pod borer, *Helicoverpa armigera* (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 Faridpur sadar, during rabi 2021-22. Six promising varieties of chickpea considered as treatments of the experiment which were: T_1 = BARI Chola-5, T_2 = BARI Chola-9, T_3 = BARI Chola-10, T_4 = BARI Chola-11, T_5 = BINA Sola-4 and T_6 = BINA Sola-8. The highest pod borer infestation was found at Godagari, Rajshahi (7.94 to 16.29%) followed by RARS, Jashore (9.40 to 11.74%); Faridpur Sadar (5.83 to 7.43%) and the lowest were at PRC, Ishurdi (3.74 to 5.32%) irrespective of varieties.

Varietal performance of pod borer infestation showed difference among the varieties in the locations. No specific variety showed specific resistance in pod borer infestation in the locations. The highest yield was found at Faridpur (2202 to 2746 kg/ha) followed by Rajshahi (1440 to 1945 kg/ha), Jashore (1057 to 1325 kg/ha) and the lowest was at Rajshahi (937 to 1205 kg/ha). Yield loss due to pod borer infestation were the highest at Rajshahi (94 to 204 kg/ha) followed by Faridpur (148 to 204 kg/ha), Jashore (124 to 167 kg/ha) and the lowest was at Ishurdi (65 to 100 kg/ha) irrespective of varieties.

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

M. S. Rahman, M. A. M. Miah and M. A. Rashid

Chickpea is an important pulse crop widely grown in Bangladesh. BARI has developed many improved chickpea varieties and disseminated to the farmers fields. The up-to-date information regarding adoption and financial profitability of this crop are unknown to the researchers and policymakers. Therefore, the study was conducted in Rajshahi district to determine the adoption status and profitability of BARI chickpea production and to examine the factors affecting the yield of BARI chickpea during 2020-2021. The study revealed that 58% farmers cultivated BARI chickpea varieties in the study area. The average level of adoption of BARI Chickpea-1, BARI Chickpea-2, BARI Chickpea-3 and BARI Chickpea-5 were 25%, 3%, 5% and 25%, respectively at farm level. The cultivation of BARI chickpea was profitable to the farmers since the per hectare total cost, gross return and gross margin of BARI chickpea cultivation were Tk 77406, Tk 85,760 and Tk 41913, respectively. Unavailability of latest BARI chickpea seed, lack of technical know-how, lack of training, and diseases (root rot) were the main constraints to BARI chickpea cultivation at farm level.

Fieldpea

Varietal Improvement

Confirmation of fieldpea F_1 generation

M.S.U. Zaman, M.J. Alam, Akmm Alam and M. M. Uddin

To confirm crosses between the parents is essential to advance the generation for variety development. Three F_1s obtained from Rabi 2020-21 along with their parents were grown at Pulses Research Centre, Ishwardi, Pabna during Rabi 2021-22. On the basis of desired characters three accessions were confirmed by comparing between two parents and harvested separately for the next year F_2 generation.

Growing and evaluation of fieldpea F_3 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Seven F_3 populations were grown along with check variety BARI Motor-3 to advance the generation at Pulses Research Centre, Ishwardi, Pabna during rabi, 2021-22. The individual population was harvested enmass and bulked for retention of more variability which will be grown next year as F_4 segregation.

Growing and evaluation of fieldpea F_5 generation

M. J. Alam, M. S. U. Zaman, Akmm Alam and M. M. Uddin

Nine F_5 populations of fieldpea were grown along with check variety BARI Motor-3 at Pulses Research Centre, Ishwardi, Pabna during 2021-22 to advance the generation. At maturity, 127 individual plants from each of the crosses were selected and harvested separately which will be grown in the next year as F_6 generation under OT.

Observation trial of fieldpea

M.S.U. Zaman, M.J. Alam, Akmm Alam and M. M. Uddin

Ten entries selected from last season's F_5 families were grown with check variety BARI Motor-2 and BARI Motor-3 during rabi season of 2021-22 at Pulses Research Center, Ishwardi, Pabna following RCB design with two replications. Significant variations were found among the genotypes in regards to yield and yield contributing traits. The variety BARI Motor-2 flowered (30 days) and matured (88 days) earlier followed by BFPX-16004. The highest plant height (196 cm) was recorded in BFPX-16010 while the lowest (69 cm) in BARI Motor-2. The genotype BFPX-16002 exhibited the highest number (38) of pods/plant followed by BFPX-16007 and BFPX-16010. The highest yield (1396 kg/ha) was found in BARI Motor-3 followed by BFPX-16005. The test entries will further be evaluated next year as PYT.

Preliminary yield trial of fieldpea

M. J. Alam, M. S. Kobir, Akmm Alam and M. M. Uddin

The experiment was carried out to evaluate the performance of seven fieldpea genotypes along with check BARI Motor-2 and BARI Motor-3 for yield and yield related traits at Pulses Research Centre, Ishwardi, Pabna and Regional Agricultural Research Station, Jashore during Rabi 2021-22. Significant variations were observed for days to flower, days to mature, plant height (cm), pods per plant, 100 seed weight and the performance of seed yield. Among the genotypes, BARI Motor-2 flowered and matured earlier than the other genotypes. The highest plant height was recorded in BFP-15004-3 followed by BFP-15002-2 in both locations. BFP-15004-6 exhibited the highest number of pods per plant among the tested genotypes in both locations. In case of seed weight, BARI Motor-2 is significantly larger in compared to other genotypes, whereas the lowest in BFP-15009-1 in both locations. In regards to average seed yield across locations, the genotype BFP-15004-8 produced the highest mean seed yield followed by BFP-15002-2 and BFP-15004-5.

Selection of suitable herbicides for controlling *parthenium* weed in field pea

J. Hossain, M.O. Ali, M.S. Alam and M. M. Uddin

A field experiment was conducted at Pulses Research Centre, Ishurdi, Pabna during 2021-22 to find out the suitable herbicide to control *parthenium* weed in field pea. Nine treatments were viz. T_1: Panida-33EC (Pendimethaline @ 3.7 L ha^{-1}), T_2: Fielder (2,4-D Amine L ha^{-1}), T_3: Pull (Quizalofop-p-ethyle @ 750 ml ha^{-1}), T_4: Triozin (Atrazine + Mecitrone @ 3 L ha^{-1}), T_5: Activar (Oxadizon @ 1 L ha^{-1}), T_6: Extrapower (Bispiriback Sodium @ 150 g ha^{-1}), T_7: Sunrice (Ethoxisulphuran @ 200 g ha^{-1}), T_8: Hand weeding and T_9: Control (No Weeding). 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. Triozin control the highest number of parthenium weeds but it affected the germination, which decreased the yield of field pea. Although Seed yield was higher in hand weeding (1947 kg ha-1) , but based on gross margin (25157 Tk. ha-1) and MBCR (11.48), Fielder (1901 kg ha-1) was a suitable herbicide for controlling Parthenium weed in field pea.

Competition dynamics of parthenium weed infestation in field pea

J. Hossain, M.S. Alam, M.O. Ali and M. M. Uddin

The experiment was conducted at the Pulses Research Centre, Ishurdi, Pabna during 2021-2022 to estimate the effect of Parthenium weed on the performance of field pea at different competition durations. Six treatments viz., T_1: season-long weed-free, T_2: weed-free after 2weeks of crop emergence, T_3: weed-free after 4 weeks of crop emergence, T_4: weed-free after 6 weeks of crop emergence, T_5: weed-free after 8 weeks of crop emergence, T_6: season-long weedy (Control) were included in this experiment. This was laid out in Randomized Complete Block Design with three dispersed replications. Parthenium weed plants grew taller and attained more biomass as the competition duration prolonged. The yield and yield-related attributes of field pea were negatively affected with increasing competition duration. The highest seed yield was recorded from Weed free (2062 kg ha^{-1}) followed by 2 weeks after emergence (1901 kg ha^{-1}) and the lowest seed yield (1491 kg ha^{-1}) in weedy. The season-long competition caused the highest reductions in plant height, pods plant and grain yield (28%) of field pea.

Pigeon pea

Varietal Improvement

Adaptation of pigeon pea germplasm in different agro-ecological locations in Bangladesh

J. Hossain, M.S.Uz. Zaman, M. J. Alam, D. Sarkar, M. S. Alam, M.O. Ali, M. A. Hossain, M.S. Kabir, J. Rahaman, M.B. Sarker, N.D. Kundu and M. M. Uddin

The study was conducted at PRC, Ishurdi (Isd), RARS, Rangpur (RP), Jamalpur (JP), Jashore (JR) and RPRC, Madaripur (MP) during 2021-2022 to find out the suitable high yielding and short duration germplasm across locations for developing variety. Five pigeon pea germplasm, i.e. BD-3121, BD-3124, BD-3131, BD-3135 and Naogaon local were studied. The experiment was laid out in Randomized Complete Block Design with three replications.

Naogaon local showed minimum duration to flower (162 days), 50 per cent flowering (167 days) and hundred percent podding (179 days), and was relatively short duration physiological maturity (258 days) as compared to BD-3121 (294 days), BD-3124 (301 days), BD-3131 (292 days) and BD-3135 (290 days), which was about 36 days earlier maturity than others. BD-3124 gave the highest seed yield (2063 kg ha^{-1}) followed by Naogaon local (1942 kg ha^{-1}) and the lowest seed yield $plant^{-1}$ (1556 kg ha^{-1}) was recorded in BD-3135. Therefore, considering the duration of flower initiation, pod initiation, physiological maturity, maturity type, yield and yield contribution characters, Naogaon local could be suitable germplasm for improvement of pigeon pea.

Survey and documentation of insect pests of pigeon pea and their natural enemies

M. A. A. Mumin, F. M. A. Rouf, M. A. Hossain, J. Hossain, D. Sarkar and M. M. Uddin

A survey program was conducted in Ishurdi and adjacent areas of Pabna district during September 2021-April 2022 to document the infestation of various insect pests of pigeon pea at different growth stages of the crop. Four species from the recorded insects named bean flower thrips/oriental bean thrips (*Megalurothrips usitatus*), legume pod boer/bean pod borer (*Maruca vitrata*), bean plataspid/kudzu bug/lablab bug (*Megacopta cribaria*) and black aphid (*Aphis craccivora*) were considered as major pests while the rest were of minor importance. Appearance of both major and minor pest species were maximum during flowering to pod setting stages of the crop and pollinators were more active at flowering stage.

Cowpea

Varietal Improvement

Adaptation of cowpea genotypes for southern region

A.K.M.M Alam, R. Uddin and M. M. Uddin

An experiment was implemented at RARS, Rahmatpur, Barishal during Rabi season of 2020-21 to evaluate the performance of seven selected cowpea germplasms with one check variety in southern agro-climatic conditions. Seven selected cowpea germplasms viz. 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 were evaluated in the trial. Results revealed that, Yield contributing traits of cowpea germplasm were not significant except the trait number of seed per pod. But considering numerical seed yield, CPL-6-17 gave higher yield over check and CPL-2-17, CPL-3-17 and CPL-4-17 gave satisfactory seed yield. Days to flowering and number of seed per pod were the major yield determining traits.

Evaluation of cowpea exotic lines

A.K.M.M Alam, R. Uddin and M. M. Uddin

In climate change situation, cowpea cultivation in coastal region is uplifting the economic progress of smallholder farmers in a significant way. The crop faces multifarious challenges through its life span including salinity, submergence, heat stress etc. The adversities can be ameliorated by replacing the existing land races and varieties in terms of salinity, submergence and heat tolerance through varietal improvement. Selected thirty IITA exotic cowpea germplasm out of 350 core collection were evaluated in south central coastal region of Bangladesh. Results indicated that, the lines were highly diversified for different traits. There existed phenotypic and genotypic variation among the germplasm. Variance was mainly governed by the traits plant number/line, total pod production, seed/pod and seed yield/line. The line TVU-16253 had produced the higher number of pod and hence gave the highest seed yield/line over control. Considering major yield and yield contributing traits, other germplasms TVU-5307, TVU-1650, TVU-1886, TVU-2252, TVU-1637, TVU-2598, TVU-1036 and TVU-1280 can be considered from cowpea improvement programs.

Screening of cowpea germplasm for salinity

Akmm Alam, M M Hossain and M. M Uddin

Cowpea is an important legumes in southern part of Bangladesh. A study was conducted at glass house to evaluate the exotic cowpra germplasm for salinity tolerance. A total of twenty were evaluated in the trial. Based on SPAD vale and Na^+/K^+ ratio E-15, E- 20, and E-12 were found promising.

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

M.O. Ali, Kn Islam, Mm Islam and Msi Khan

This trial was carried out at the farmer's field of Kuakata, Kalapara, Patuakhali during Rabi season of 2021-22. In the saline area, soil moisture is

rapidly lost during the late Rabi season which is a critical problem for producing winter crops. 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 straw mulch, rice husk and polythene mulch was tasted under randomized complete block design with three replications. BARI Felon-1 was used as the variety. Results revealed that, polythene mulch (1.69 t ha^{-1}) significantly increased the seed yield of cowpea whereas the lowest (1.48 t ha^{-1}) was obtained from no mulch. Both Polythene mulch and Straw mulch gave about 10% higher yield of cowpea (1.64 t ha-1) than No mulch (1.48 t ha-1). Straw mulch had maximum gross margin (31965 Tk. ha^{-1}) and BCR (1.49) in the saline areas due to low cost of materials.

Mungbean

Varietal Improvement

Hybridization of mungbean

M.S.U. Zaman, M. J. Alam, A.K.M.M Alam and M. M. Uddin

Hybridization program was conducted during Kharif-I, 2022 at PRC, Ishwardi, Pabna for creating the genetic variability among the existing germplasm for desired gene pool. Four parents were used having desired genetic combinations. A total of 230 successful cross seeds were harvested from four cross combinations. The cross seeds will be sown next season for the confirmation of lentil F_1 plants.

Confirmation of mungbean F_1 genetration

M.S.U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

To confirm crosses between the parents is essential to advance the generation for variety development. Eleven F_1s obtained from Kharif- I, 2021 along with their parents were grown at Pulses Research Centre, Ishwardi, Pabna during Kharif- I, 2022. On the basis of phenotypic markers such as leaf color, stem pigmentation, flower color, leaf shape, time to flowering and maturity eleven accessions were confirmed by comparing between two parents and harvested separately for the next year F_2 generation.

Growing and evaluation of mungbean F_2 generation

M.S.U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

Six F_2 populations along with check variety BARI Mung-6 were grown at Pulses Research Centre, Ishwardi, Pabna during Kharif- I, 2022 to advance the generation. The individual population was harvested and bulked for retention of more variability which will be grown next year as F_3 segregation.

Growing and evaluation of mungbean F_3 generation

M.S.U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

Ten F_3s progenies were evaluated and their seeds were bulked during Kharif- I, 2022 and these plants will be grown and evaluated as F_4s generation in the next season for advancement of mungbean segregating populations.

Growing and evaluation of mungbean F_4 generation

M.S.U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

Nine F_4 populations were evaluated during Kharif-I, 2022 at Pulses Research Centre, Ishwardi, Pabna to advance the generations. At maturity, 1-2 pods per plant were harvested enmass cross-wise for growing F_5 generation based on the phenotypic traits such as plant type, disease reaction, pod bearing, pod shape, seed size and maturity.

Growing and evaluation of mungbean F_5 generation

M.S.U. Zaman, M. J. Alam, Akmm Alam and M. M. Uddin

Twenty three F_5 populations were sown on 08 April during Kharif-1, 2022 at Pulses Research Centre, Ishwardi, Pabna to advance the generation. At maturity, individual plants from each of the crosses were selected and harvested separately based on days to maturity, branches/plant, number of pods/plant and disease reaction which will be grown in the next year as observation trial.

Preliminary yield trial of mungbean

The experiment was conducted at PRC, Ishurdi and RARS, Barisal during Kharif-I, 2022 to find out desirable genotypes of Mungbean. The eight

mungbean genotypes viz BMXK1-16009-5, BMXK1-16010-3, BMXK1-16009-1, BMXK1-16010-1, BMXK1-16006-8, BMXK1-16008-5 and BARI Mung 7 & BARI Mung-8 included as a check in the study. Considering the overall performances, four genotypes BMXK1-16010-3, BMXK1-16010-1, BMXK1-16006-8, BMXK1-16008-5 were selected.

Participatory variety selection of mungbean

Three genotypes with two check variety BARI Mung-7 & 8 were evaluated at Pulses Research Centre, Ishurdi, Pabna; RARS, Barisal during Kharif-I, 2022. Considering mean values over location the tested entries showed lower yield compared to check variety BARI Mung 7. So, These entries were not selected for further evaluation.

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

M.S. Alam, M.O. Ali, J. Hossain, M.M. Kamal and M.M Uddin

A field experiment was conducted at PRC, BARI, Ishwardi, Pabna during 2020-2021 to evaluate the biological nitrogen fixation potentiality of *Rhizobium* inoculant and yield of mungbean. The experiment was laid out in a Randomized Complete Block Design with three replications. The treatments were as follows, T_1= Native fertility, T_2=Recommend dose of fertilizer (RD=$N_{21}P_{18}K_{20}S_{10}B_2$ kg ha^{-1}), T_3= *Rhizobium* inoculant, T_4=*Rhizobium*+ RD, T_5= *Rhizobium*+75% RD, T_6= *Rhizobium*+50% RD, T_7= *Rhizobium*+25% RD, and T_8= *Rhizobium*+ 0% RD and other fertilizer used as blanket dose. The results revealed that *Rhizobium* + RD (T_4) showed significant effect on nodulation at before flowering (56 $plant^{-1}$) and higher seed yield of mungbean (2.04 t ha^{-1}) and yield increased 51% over control and the lower seed yield (0.99 t ha^{-1}) was obtained from the native fertility (T_1). The higher additional income (Tk. 73500 ha^{-1}) and MBCR (12) were found in *Rhizobium* +RD.

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

Md. Altaf Hossain

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 during kharif-I, 2022. Flower thrips and pod borer infestation was reduced by the application of micro and macro-nutrients in mungbean but non-significantly. Flower infestation reduction over control ranged from 3.80 to 9.49% and pod borer infestation reduction ranged from 8.47 to 21.57%. The highest percentage of flower infestation reduction (9.49%) was found in McChili+ Solubor sprayed plots followed by Muriate of Potash and Nutra-phos. The highest percentage of pod borer infestation reduction (21.57%) was found in Muriate of Potash sprayed plots followed by Nutra-phos. The yield increase over control ranged from 3.49 to 19.49%. The highest yield (1643 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 (4.07) than that of Nutra-phos sprayed treatment. So, it is seen that foliar application of Thiovit, Nutra-phos or McChili+ Solubor would be profitable option for managing flower thrips and pod borers of mungbean with higher yield and benefit compared to untreated ones.

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

Md. Altaf Hossain

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 during kharif-I 2022. All of the management packages significantly reduced flower infestation by thrips, thrips population and pod borer infestation in mungbean. The lowest percentage of flower infestation (23.33%) was found in 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 other IPM packages and recommended practice (Farmers practice). The lowest percentage of pod borer infestation was observed in IPM package 2: (Installing blue sticky trap + two spraying of Bio-Chamak (*Celastrus angulatus* !%

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) which was also at par with other IPM packages and recommended practice. The highest yield and accordingly additional return come from IPM package 2: (Installing blue sticky trap + two spraying of Bio-Chamak (*Celastrus angulatus* !% 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. But the highest benefit (MBCR 4.07) 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* !% 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 in the production, processing & marketing of mungbean seed in some selected areas of Bangladesh

N. D. Kundu, M.S. Rahman and M. S. Uddin

Assessment of financial profitability and constraints in the production, processing and marketing of mungbean seed in two southern districts viz. Jhalokathi and Barisal was conducted through an extensive field survey during 2020-2021. The study revealed that the farmers of these areas use very low doses of fertilizers. 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 high insects infestation, insecticides not work properly, lack of training, high price of insecticides, lack of labour, lack of good seed, disease infestation.

Waterlogging tolerance at germination and vegetative stage of winter pulse crops

Md Shahin Uz Zaman

Pulse crops are exposed to waterlogging (WL) at different growth stages when grown on puddled soil in rice-based cropping. Four most popular cultivars- BARI Felon-1, BARI Khesari-2, BARI Motor-3 and BARI Musur-8 were evaluated at two growth stages in four waterlogging treatments to assess their ability to grow in waterlogged soils, and to recover after drainage. In germination stage, the emergence was reduced significantly with the increase of waterlogging duration. At 10 days WL, emergence was reduced for BARI Khesari-2 to 65%, for BARI Motor-3 to 30%, for BARI Masur-8 to 5% and for BARI Felon-1 to 8%. At vegetative stage, plant height, main root length, shoot and root dry mass of all varieties was reduced with the increase of waterlogging duration. The number of adventitious root formation was also varied with a highest number in BARI Felon-1 followed by BARI Khesari-2. During recovery compared to the waterlogging period, the chlorophyll content was increased in BARI Felon-1 and BARI Khesari-2 across the treatments, while decreased in BARI Motor-3 and BARI Masur-8. In comparison to control, the relative growth rate (RGR) of shoot and root was increased in BARI Felon-1 and BARI Khesari-2, while decreased in BARI Motor-3 and BARI Masur-8. At 14 d WL, shoot relative growth rate (RGR) of BARI Felon-1 and BARI Khesari-2 was 2.9 and 25.3 mg/plant/day in compared to 2.5 and 21.1 mg/plant/day respectively in control. In contrast, BARI Motor-3 and BARI Masur-8 showed a decreased RGR of -1.24 and 5.97 mg/plant/day than control 24.38 and 21.74 mg/plant/day respectively. Similarly, root RGR was 13.52 and 25.58 mg/plant/day in BARI Felon-1 and BARI Khesari-2 respectively in compared to 2.15 and 18.03 mg/plant/day in control. However, the RGR was decreased to -1.79 and -

4.38 mg/plant/day in BARI Motor-3 and BARI Masur-8 respectively in compared to 26.95 and 1.09 mg/plant/day in control. The results showed BARI Felon-1 sensitive at germination, however, tolerant at the vegetative stage; BARI Khesari-2 tolerant in both stages; BARI Motor-3 moderately tolerant at germination but sensitive at vegetative and BARI Masur-8 sensitive in both stages. Such contrasting response to WL tolerance will help in breeding for developing WL tolerant pulses varieties.

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

J. Hossain, M.O. Ali, M.S. Alam and M. M. Uddin

A field experiment was carried out at Pulses Research Centre, BARI, Ishurdi, Pabna during 2020-21 to increase cropping intensity and soil health through pulse crops. The experiment was carried out with six different cropping patterns e.g i) CP_1: Lentil– Mungbean – *T.Aman*, ii) CP_2: Lentil– Boro rice – T.*Aman*, iii) CP_3: Chickpea – Mungbean– T.*Aman*, iv) CP_4: Fieldpea –*Boro* rice – Blackgram, v) CP_5: Grasspea – Mungbean – T.*Aman*, vi) CP_6: Lentil– Mungbean – Blackgram (Native Fertility). The trial was laid out in Randomized Complete Block Design with three dispersed replications. BARI Masur-8 (CP_1) gave the highest seed yield (2.71 t ha^{-1}) and the lowest (1.46 t ha^{-1}) in BARI Chola-10 (CP_3) among winter pulse crops. Lentil– Mungbean – T.Aman performed better regarding rice equivalent yield (19.25 t ha^{-1}) and gross return (462000 Tk ha^{-1}) and Fieldpea –Boro rice – Blackgram gave the lowest REY (9.90 t ha^{-1}) and GR (23760 Tk ha^{-1}).

Climatic stresses, adaptation strategies and capacity assessment of pulses growing farmers in the coastal areas of Bangladesh

N. D. Kundu, M.S. Rahman and M. S. Uddin

Climate change and its variability cause different biotic and abiotic stresses that negatively affecting the agricultural crops and the livelihoods of coastal farmers. But data and information regarding these issues are scarce in Bangladesh. Therefore, the study was conducted to assess the adaptation knowledge and strategies to cope with climate variability stresses, identify the factors that determine the adaptation capacity of the farmers, and identify potentiality and problem of adaptation to climate variability stresses faced in pulse crop production by the farmers. The study revealed that draught and uneven rain (100%) were the severe stresses followed by water salinity (30%), soil salinity (25%), disease infestation (21%) and insect attack (21%) that negatively affect the yield of crops. Climate variability stresses negatively affect the crops yields which in turn give low return to the farmers. To adapt adverse situation farmers adopt different measures like reserve rain water, digging well, use salt tolerant variety, irrigation, drainage system, use pesticides, use insecticides, and migrate to other occupations on a temporary basis. Age, family members, experience, farm size were identified as the significant determinants of adaptation capacity of the farmers to the climate variability stresses. Lack of capital, lack of adequate seed of salt, water and draught tolerant variety of crops, lack of adequate irrigation equipment's, lack of proper knowledge on soil and water conservation technique were found to be the major constraints to adapt climate variable stresses.

A. Rapeseed- Mustard (*Brassica Spp*)

Varietal Development

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

M A Latif Akanda, M S Uddin and A B M Khaldun

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 2021-22 in order to maintain the existing germplasm of oliferous *B. rapa* L., *B. juncea* L. and *B. napus* L. and to use in future breeding programme.

Development of short duration inbred lines in *Brassica rapa*

M A Latif Akanda, M S Uddin and A B M Khaldun

Tori-7, 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. One hundred and nine rows were sown following plant to row. Days to flowering ranged from 28-34 days and days to maturity ranged from 77-87 days. Three hundred and eighty six plants were selected for selfing for advancing s_5 to s_6 generation from eleven source populations. Total 1710 buds were selfed from which 1075 effective siliquae and 6672 seeds were obtained. Selfed seeds were stored for maintaining as inbred lines in the next year.

Evaluation of F_6 generation in *Brassica rapa*

M A Latif Akanda, M S Uddin and A B M Khaldun

BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-17 and BARI Sarisha-6 were used as female parents and S_6 generation of BARI Sarisha-9 and Tori-7 were used as male parents to develop single crosses during 2014-15. F_1s were crossed with BARI Sarisha-6 and BARI Sarisha-17 to develop three-way crosses during 2015-16. F_1 –F_5 were developed through selfing during 2016-21. Days to maturity ranged from 84-86 days. Early and desirable plants were selected for selfing and 46 plants were selfed. One hundred and ninety nine siliquae were obtained from which 2314 seeds were obtained. Selfed seeds of individual plant were stored for evaluation in the next season.

Growing of F_5 generation originated from 16 parents of *B. rapa*

U. Kulsum, M. Shalim Uddin and M. M. Ali

A complex/multiple crosses along with the parents were used in the experiment for the accumulation of desired genes from sixteen parents into a single parent. A total of 307 single plants of which 102 were yellow seeded and 205 were brown seeded selected based on seed coat color, plant height, pod length, branches per plant, pod per plant, seeds per plant, and yield per plant. The seeds of selected single plants will be grown as F_6 next year.

Evaluation of segregating generations of *Brassica rapa*

M A Latif Akanda, M S Uddin and A B M Khaldun

Families of F_6 generation of two cross combinations having both yellow and brown seed coat colour were evaluated. Single plant selection method was followed. Considering earliness (maturity duration up to 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.

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

M. Shalim Uddin, M A Latif Akanda and A B M Khaldun

Twelve 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 82-89 days. Four lines were matured within 87 days. The highest number of siliquae per plant recorded in BS-14x-BS-15-1 and the highest number of seeds per siliqua recorded in BC-2014-Y02-1-2. Seed yield ranged from 1155-1944 kg/ha. Considering earliness, seed yield and other yield contributing characters, three lines BC-2014-Y014 (1759 kg/ha), BS-14XS-15-4 (1789 kg/ha) and BC-100614(4)-9 (1926 kg/ha) were selected for the next trial and other variety development activities.

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

M Shalim Uddin, A B M Khaldun and M A Latif Akanda

Eleven lines of Brassica rapa having brown seed coat colour along with two checks as BARI Sarisha-9 and BARI Sarisha-14 were evaluated with two replications under observation trial of *Brassica rapa* (Set-II) at Gazipur. Days to flowering and maturity duration ranged from 35-38 and 82-90 days, respectively. The highest number of siliquae per plant was recorded in BS-14XBS-15-10. Seed yield ranged from 644-1303 kg/ha. Considering earliness, seed yield and other yield contributing characters, two lines BS-14 X SAU-1-4 (1282 kg/ha) and BC-100614(4)-4(b) were selected for the next trial.

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

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

Eleven lines of *Brassica rapa* having yellow seed coat colour along with one check as BARI Sarisha-14 were evaluated at Gazipur, Ishurdi and Jashore. Days to maturity ranged from 84-88 days and seed yield ranged from 325-1971 kg/ha at all the locations. The line BC-100614(8)-7produced the highest seed yield (1382 kg/ha) at all the locations. Considering earliness, seed yield and other yield attributing characters, four lines like BC-100614(8)-7 (1383 kg/ha), BC-100614(8)-1 (1255 kg/ha), BC-100614(7)-3 (1219 kg/ha) and BC-100614(4)-10 (1208) kg/ha) were selected for RYT in the next year.

Regional yield trial of *Brassica rapa* L.

M Shalim Uddin, A B M Khaldun, M A Latif Akanda, M Khorshed Alam, M R Humauan, M H Rahman and M A Monim

Eight lines of *Brassica rapa* L. along with BARI Sarisha-14 as check were evaluated at Gazipur, Jamalpur, Ishurdi and Jashore for seed yield and yield contributing characters. Maturity duration ranged from 76-99 days. Plant height ranged from 60-120 cm. Number of siliquae/plant and number of seeds/siliqua ranged from 27-115 and 11-45, respectively. 1000-seed weight range 2.28-4.01 g. The variation of seed weight was highly significant which is desirable from the entries used for the trial of advanced lines. Seed yield ranged from 800-2156 kg/ha. The additive main effects multiplicative interaction (AMMI) analysis showed that environments (E), genotypes (G) and GE interaction (GGE) effects were significant for seed yield and yield contributing traits. Using multi-trait genotype-ideotype distance index (MGIDI) and stability statistics and clustering, which allowed identifying three main groups based on their stability concepts. The biplot rendered using the weighted average of absolute scores (WAASB) and mean seed yield and yield contributing traits identified superior genotypes in terms of performance and stability. Hence, these regions are suggested as discriminative sites for the selection of high-yielding and stable rapeseed genotypes. The highest seed yield was recorded in BC-100614 (4)-7 all over the location. Considering stability parameter, MGIDI, earliness, seed yield and other yield attributing characters, the lines like BC-100614 (4)-7 (1293 kg/ha) was selected for adaptive trials in the next year.

Observation yield trial of *Brassica napus*

M K Alam, M I Riad and M Kadir

An observational yield trial of *Brassica napus* was conducted with 30 genotypes including two check varieties BARI Sarisha-8 and BARI Sarisha-13 at RARS Jamalpur during *rabi*, 2021-2022 to evaluate the yield and yield contributing characters. Nap-20021 produced the highest yield among the genotypes included in this trial. It was produced 13% and 23% higher yield than check varieties BARI Sarisha-8 and BARI Sarisha-13 respectively. The second highest yield was found from Nap-5002, which was 7% and 17% higher yield than check varieties BARI Sarisha-8 and BARI Sarisha-13, respectively. The third highest yield was obtained from Nap-32021. They also took 82-84 days to mature.

Preliminary yield trial of *Brassica napus*

M K Alam, M R Humaun, M A Monim, M A Latif Akanda and M M Kadir

Preliminary yield trial of *Brassica napus* was conducted with 14 genotypes at RARS Jamalpur,

Ishurdi, Jashore and Joydebpur during rabi, 2021-2022 to evaluate the yield and yield contributing characters. Maturity duration ranged from 82-87 days at Jamalpur location. Seed yield ranged from 1716 to 1353 kg/ha at Jamalpur. Maturity duration over locations ranged from 88-90 days. Seed yield ranged from 1701-1836 kg/ha over the locations. Nap-18009 produced the highest seed yield among the genotypes included in this trial. It produced 10% and 28% higher seed yield than check variety BARI Sarisha-8 and BARI Sarisha-13. Nap-21010 produced the second highest yield which was 3% and 20% higher yield than check varieties BARI Sarisha-8 and BARI Sarisha-13, respectively. The third highest grain yield was recorded from Nap-20002 among the entries. Nap-18009, Nap-21010 and Nap-20002 these three entries took 84 to 87 days to maturity. Considering location wise seed yield and other yield contributing characters, four lines Nap-18009, Nap-20002, Nap-16021 and Nap-21010 were selected for regional yield trial in the next year.

Regional yield trial of *Brassica napus*

M K Alam, M R Humaun, M A Monim, M A Latif Akanda and M M Kadir

A regional yield trial of *Brassica napus* L was conducted with 12 genotypes at RARS Jamalpur, Jashore, Ishurdi and Joydebpur during rabi 2021-2022 to evaluate for yield and yield contributing characters. Maturity duration ranged from 82-86 days at Jamalpur location. Seed yield ranged from 2558 -1764 kg/ha at Jamalpur location and Nap-18005 has produced the highest yield among the genotypes included in this trial. It produced 23% and 24% higher yield than check varieties BARI Sarisha-8 and BARI Sarisha-9, respectively. The second highest yield was recorded from Nap-16013. It produced 19% and 20% higher yield than check varieties BARI Sarisha-8 and BARI Sarisha-9, respectively. The third highest yield was recorded from Nap-16006. It gave 13% higher yield than check variety BARI Sarisha-8.

Evaluation of segregating generation of *Brassica juncea*

M A Latif Akanda, M S Uddin and A B M Khaldun

A total of 96 plants from thirteen cross combinations having brown seed coat colour and 15 plants from two cross combinations having yellow seed coat colour were selected in F_6 generation (Set-I). A total of 13 families from three cross combinations having black/brown seed coat colour were selected and 10 families from three cross combinations having yellow seed coat colour were selected in F_6 generation (Set-II). Plants were selected considering erect, seed colour, seed size and siliqua shape. Harvested seeds from selected plants and progenies were stored for further evaluation in the next year.

Observation trial of *Brassica juncea*

M Shalim Uddin, M A Latif Akanda and A B M Khaldun

Thirteen lines of *Brassica juncea* along with BARI Sarisha-11 as check were evaluated at Gazipur with two replications in 2021-22 seasons. Maturity duration ranged from 100-109 days. Seed yield ranged from 678-1507 kg/ha. The highest seed yield recorded in BJ-2014-B06 (y) (2235 kg/ha) followed by BJ-2014-b04 (1507 kg/ha). Considering earliness, seed yield and other yield contributing characters, four lines BJ-2014-B14 (1391 kg/ha), BJ-2014-B10 (1404 kg/ha), BJ-2014-B07 (1462 kg/ha) and BJ-2014-B04 (1507 kg/ha) were selected for the next trial.

Preliminary yield trial of *Brassica juncea* L.

M Shalim Uddin, 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. Days to maturity ranged from 103-110 days. Plant height ranged from 93-175 cm. Number of siliquae per plant ranged from 87-350. Number of seeds per siliqua ranged from 11-20. Seed yield ranged from 860-2300 kg/ha. The highest seed yield was recorded in BJ-10-10104 (Y) (1553 kg/ha). Considering seed yield and other yield contributing characters, one line like BJ-10-10104(Y) were selected for evaluation in RYT.

Regional yield trial of *Brassica juncea* L.

M Shalim Uddin, 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 and Jashore for yield and yield contributing characters. Plant height ranged from 122-170 cm. Number of siliquae per plant ranged from 90-243. The highest number of siliquae per plant (236.9) was recorded in BJ 1110 (12)-1. Number of seeds per siliqua ranged from 13-16.

Seed yield ranged from 940-2450 kg/ha. The line BJ 1110 (12)-1 (1664 kg/ha) produced the highest seed yield all over the location. Considering seed yield and other yield contributing characters, three lines BJ 11536 (12)-1 (1664 kg/ha), BJ DH -20 (1631 kg/ha) and BJ DH -05 (1635 kg/ha) were selected for adaptive trial in the next year.

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

M A Latif Akanda, M S Uddin and A B M Khaldun

The experiment consisted of two CMS lines like $CMSZ_1$ (248) and $CMSZ_2$ (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 24-25 days and 95 days, respectively. In total 401 buds of 55 plants of two CMS lines were crossed with two maintainer lines. Three thousand nine hundred and seventy eight seeds were obtained from 315 siliquae. Days to flowering and maturity for restorer and maintainer lines were 24-25 days and 95 days, respectively. Seven hundred and twenty five buds were selfed from 99 plants. In total 9099 seeds were obtained from 619 siliquae. Seeds were stored for future breeding programme.

Development of hybrid variety in rapeseed

M A Latif Akanda, M S Uddin 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 patental 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.

Heterosis study of hybrids developed through selected restorers

U. Kulsum, M. M. Ali and M A Latif Akanda

An attempt has been taken to develop hybrid through selected restorer. Most of the hybrids were over yielded compared to check variety BARI Sarisha-13. Out of fifteen hybrids, thirteen have been shown positive standard heterosis in seed yield. Maximum heterosis was observed in the hybrid-18 (44.6%) followed by hybrid-8 (34.1%) in seed yield (kg/ha).

Hybrid seed production of *Brassica napus*

M Shalim Uddin, U. Kulsum and M A Latif Akanda

The experiment was conducted at field PGRC, Bangladesh Agricultural Research Institute, Joydebpur to increase the seed stock of the selected hybrid for conduct RYT and adaptive trails and future use. The produced 12.0 kg rapeseed hybrid seed will be grown in for conduct RYT and adaptive trails and future use.

Observation trial of entries developed from interspecific hybridization among *B. carinata* and *B. napus*

U. Kulsum, M Shalim Uddin and M. M. Ali

An attempt of interspecific hybridization has been taken to incorporate desirable characters from *B. carinata* species into the existing variety BARI Sarisha-13 of *B. napus*. In *B. napus*, three entries produced higher seed yield compared to the check variety BARI Sarisha-13. The highest yield obtained from 13CA92014 and 13CA52014 which were 21% and 16% higher than check variety. The *B. napus* lines were almost determinate types.

Regional yield trial of canola type rapeseed

M. K. Alam, M I Riad and Mm Kadir

The experiment was conducted at RARS, Jamalpur during rabi season of 2021-22 to select erect type, short duration and high yielding canola varieties to fit into the existing rice based cropping pattern rice-mustard-rice. Among the entries Nap-02 x Nap-14055 gave the highest seed yield. It produced 1933 kg/ha, which was 12% higher yield than check variety BARI Sarisha-18. The line MR-13 x Nap-14055 showed the second highest yield. It was produced 1834 kg/ha, which was 7 % higher yield than check variety BARI Sarisha-18 followed by Nap-02 x Nap-0717-2. Nap-02 x Nap-0717-2 gave the 3rd highest seed yield. The lowest seed yield was also observed in tobin x BC-15024 (1013 kg/ha).

Development of double low short duration genotypes through interspecific hybridization

Evaluation of F_6 generation

M A Latif Akanda, M S Uddin 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-14-011of *Brassica napus* having low erucic acid, high yielding but long duration. Developed $15F_6$s were selfed to advance generation. Maturity duration for 15 cross combinations ranged from 83-96 days. Seven hundred and sixteen buds from 118 plants were selfed to advance generation. Four hundred and sixty three siliqua were obtained from which 6374 seeds were obtained. Selfed seeds were stored for evaluation in the next season.

Development of multi-parent advanced generation inter-cross (MAGIC) populations

M Shalim Uddin and M A Latif Akanda

The experiment was conducted at green house of plant breeding division, Bangladesh Agricultural Research Institute, Joydebpur to develop 16-way magic population to accumulate all favorable genes from multi-parents into a single parent and to create genetic variability. Sixteen parental lines were used and 18 single crosses, 8 three-way crosses and 2 four way crosses were made successfully.

Development of hexaploidy *Brassica* spp.

M Shalim Uddin and M A Latif Akanda

The experiment was conducted at green house of plant breeding division, Bangladesh Agricultural Research Institute, Joydebpur to incorporation of sufficient genetic diversity to form a basis for breeding and improvement of this potential crop species and to improvement of agronomic traits to the level of "elite" breeding material in the diploid and allotetraploid crop species. First generation produced 25 seed and second generation produced 35 allohexaploid seeds successfully will be grown in the next season along with their parents for confirmation and the subsequent generations.

Development of nested association mapping (NAM) populations

M Shalim Uddin and M A Latif Akanda

The experiment was conducted at green house of plant breeding division, Bangladesh Agricultural Research Institute, Joydebpur to develop NAM population to create genetic variability and to phenotyping of NAM lines under multiple stresses. Twenty parental lines were used, and 10 single crosses were made successfully.

Introgression of heat tolerance gene in rapeseed-mustard from wild relatives

M Shalim Uddin and M A Latif Akanda

The experiment was conducted at green house of plant breeding division, Bangladesh Agricultural Rresearch Institute, Joydebpur to develop 16-way magic population to accumulate all favorable genes from multi-parents into a single parent and to create genetic variability. Sixteen parental lines were used and 18 single crosses, 8 three-way crosses and 2 four-way crosses were made successfully.

Identification of climate smart rapeseed-mustard

M Shalin Uddin, U Kulsum, M K Shahadat, M H Rashid and M A Latif Akanda

One hundred ninety-nine (199) magic population RIL lines of rapeseed (B. r*apa*) was evaluated at OFRD, Bari, Khulna in saline soil to select diverse saline tolerance parents based on multiple traits selection index for the future breeding program. This selection was done focusing on a total of seventeen qualitative and quantitative traits variation and genetic parameters namely, phenotypic and genotypic variance (PV and GV) and genotypic and phenotypic coefficients of variation (GCV and PCV), broad-sense heritability (h^2_bs), genetic advance, traits association, genotype by trait biplot (G×T), heatmap analysis and multi-trait index based on factor analysis and genotype-ideotype distance (MGIDI). Descriptive statistics and analysis of variance revealed a wide range of variability for morpho-physiological traits. Estimated hbs for all the measured traits ranged from 10.6% to 93%, indicating that all the traits were highly inheritable. Genetic variances were low to high for most morpho-physiological traits, indicating complex genetic architecture. Yield per plant was significantly correlated with fruit diameter, fruits per plant, percent fruits infestation by brinjal shoot and fruit borer, and fruit weight traits indicating that direct selection based on fruit number and fruit weight might be sufficient for improvement of other traits. The first two principal components (PCA) explained about 81.27% of the total variation among lines for thirty-eight brinjal morpho-physiological traits. Genotype by trait (G×T) biplot revealed superior genotypes with combinations of favorable traits. The average genetic distance was 3.53, ranging from 0.25 to 20.01, indicating high levels of variability among the germplasm. The heat map was

also used to know the relationship matrix among all the brinjal genotypes. MGIDI is an appropriate method of selection based on multiple trait information. Based on the fourteen qualitative and ten quantitative traits and evaluation of various genetic parameters, the germplasm M-26, M-1, M-127, M-171, M-106, M-160, M-58, M-65, M-38 and M-28 might be considered as best parents as a saline tolerance for the future breeding program for rapeseed improvement.

Crop and soil management

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

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

The experiment was conducted at research field of Oilseed Research Centre (ORC), BARI, Gazipur during the rabi season of 2021-2022. There were five treatments viz. T_1: Irrigation at as and when necessary (4 times), T_2: Irrigation at vegetative and flowering stage, T_3: Irrigation at vegetative and seed development stage, T_4: Irrigation at flowering and seed development stage and T_5: Irrigation at vegetative, flowering and seed development stage. The experimental design was RCB with three replications. Seeds of BARI Sarisha-18 were sown on 11 November 2021 at Gazipur with a plot size of 3m x 4m. Fertilizers were applied at the rate of $N_{88}P_{34}K_{80}S_{28}Zn_3B_2$ kgha^{-1} in the form of urea, TSP, MoP, gypsum, zinc oxide and boric acid, respectively. Irrigation was applied according to the treatment followed. Plant samples were collected at one month interval starting from 20 DAS to measure the LAI (leaf area index), and total dry matter content. Percentage of oil content was estimated for each treatment after harvesting the crop. The maximum seed yield (2.00 t/ha) was recorded in T_1 treatment (Irrigation as and when necessary; four times irrigations were applied) followed by T_5 treatment (Irrigation at vegetative, flowering and seed development stage (1.62 t/ha)). But the highest BCR (1.66) was obtained from T_5 treatment. The maximum oil content (42.50%) was recorded in T_1 treatment. From the study, it may be revealed that three irrigations at vegetative, flowering and seed development stage would be optimum for canola type mustard. For confirmation of the result need to be repeated next year.

Determination of fertilizer dose 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, BARI, Gazipur during rabi season of 2021-22 to find out the optimum dose of fertilizer for newly developed canola type mustard variety BARI Sarisha-18. The experiment was conducted with five treatments viz. T_1: Recommended dose (RD) (N_{138} P_{35} K_{50} S_{32} $Z_{2.5}$ B_7) for BARI Sarisha-18. T_2: 20% less than RD, T_3:20% more than RD. T_4: 30% more than RD, and T_5: 40% more than RD. The experiment was laid out in RCB design with three replications. 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 Sarisha-18 was done on 21 February, 2022. Randomly five plants from each plot were tagged to take data on different agronomic parameters of BARI Sarisha-18. Seed yield (1.91 t/ha) was maximum in T_3: 20% more than RD and lowest (1.70 t/ha) in T_2: 20% less than RD. From the cost and return analysis, it was revealed that the highest gross return (Tk. 1680*80*/ha) was obtained from T_3 treatment (20% more than RD) and the lowest gross margin (Tk. 140800/ha), BCR (2.50) was obtained from T_2 treatment (20% less than RD). It may be concluded that 20% more than recommended dose was found optimum and profitable dose of fertilizer for the production of BARI Sarisha-18.

Effect of sowing time and tillage methods on the yield of mustard in south-western saline areas

O. A. Fakir, F. Begum and M. M. Hossain

The experiment was conducted at farmer's field in Satkhira sadar during the rabi season of 2021-22 to find out optimum sowing time and sowing method for mustard yield in saline areas. The soil belonged to the AEZ-11 and AEZ-13. The land topography was medium low. The soil of the experimental field was clay loam in texture with pH 7.15. There were seven treatment combinations in two factorial RCBD approach with three replications where factor A was sowing times viz. T_1, 15 November, T_2, 30 November and T_3, 15 December. On the other hand,

factor B was sowing methods considering 3 levels viz. S_1, Farmer's practice (Broadcasting after tillage by power tiller), S_2, broadcasting with no tillage and S_3, sowing with reduced tillage by PTOS. Soil salinity at different dates was recorded at 09:00-10:30 a.m. every 15 days interval, starting from sowing until harvest. The salinity was measured by EC meter (HANNA: HI 9835). Data were taken at the middle of the plot. Once a week, a calibration for the meter was made by comparing with laboratory data. The conventional tillage for farmers practice was conducted by a power tiller, whereas the Reduce tillage was maintained by PTOS. Broadcasting was done by the hand spreading of seeds in a non-tilth land without maintaining any spacing and depth. The mustard variety was BARI Sorisha-18. Unit plot size was 5m X 3.6m. The crop was harvested on 20 February 2022 for T_1, 28 February 2022 for T_2 and 07 March 2022 for T_3. Two times irrigation at 30 and 60 days after sowing was applied during the growing period. Weeding was done at 14 days after sowing followed by thinning. Disease and insect pests were always well controlled using suggested applies (BARI, 2014). The crop was harvested at the time of maturity. Fertilizers were applied following fertilizer recommendation guide 2018 (BARC, 2018). 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 seed sowing as per treatment. The rest half of urea was applied in equal amounts at 25 & 50 days after emergence. Among different treatment combinations, significantly higher grain yield (1.52 tha^{-1}) was obtained from 30 November sowing with reduced tillage by PTOS (T_2S_3). Seed sowing on 15 December broadcasting with no tillage (T_3S_3) produced the lowest seed yield (0.17 tha^{-1}). The lowest level of average soil salinity (3.55 dS/m) was recorded from T_1S_2 at the sowing time $_{and}$ the highest level of average salinity (8.25 dS/m) was recorded for T_3S_3 at the harvesting time. From one year data the results revealed that minimum tillage through PTOS produced the maximum yield of mustard. It was the first year of experiment. Therefore it should be replicated for next three years for final recommendation.

On-farm adaptive trial of mustard genotype in level barind tract areas

Ms Alam, Mra Mollah and Ma Islam

The experiment was conducted at the MLT site, Joypurhat, under the AEZ-25 during the *rabi* season of 2021-22 to assess the yield potentiality of mustard genotypes compared to check variety BARI Sarisha-16. The experiment was laid out in an RCB design with three replications. It consisted of four treatments, i.e., T_1= BARI Sarisha-16, T_2=Jun-536, T_3=. BJDH-11 and T_4= BJDH-12. The unit plot size was 20 m^2. Seeds of each variety were sown continuously in the field, maintaining a distance of 30 cm from row to row on 30 November, 2021. The fields were fertilized with 120-34-45-30-1.8 kg N-P-K-S-B ha^{-1} respectively. The total amount of all the fertilizors and half of urea fertilisers were applied during final land preparation. The rest half of urea was applied as a top-dress at 26 DAS, followed by irrigation. Single weeding to control dryland weeds alongwith thinning were done before irrigation to keep the optimum plant population on the field. The fields were infested with aphids and *Alternaria* leaf spots. Insecticide Sobicron and fungicide Rovral 50wp were applied three times at 7 to 10 days, depending on pest incidence. The crops were harvested on 15 March 2022. All the relevant data were recorded carefully and analysed statistically. The highest seed yield of 2.19 t ha-1 was recorded from BARI Sarisha-16,followed by Jun-536 (1.91 t ha-1), and BJDH-11 (1.75t ha-1), and the lower seed yield of 1.63 t ha-1 was obtained from BJDH-12. The highest yield contributed to the highest gross return (Tk. 201780 ha-1) and gross margin (Tk. 156437ha-1) in BARI Sarisha-16, followed by Jun-536, whereas the lowest gross return Tk. 150670 ha-1 and gross margin Tk. 105327 ha-1 was recorded in BJDH-12. It was found that, the tested genotypes i.e., BARI Sarisha-16 and Jun-536 were higher yielders than BJDH-11 and BJDH-12. As it was first-year of observation, therefore, the tested genotypes needed next year's trial for final recommendation.

Disease Management

Screening of rapeseed-mustard varieties/lines against alternaria blight disease of mustard

M. S. Hossain

The experiment was conducted for screening of mustard lines against *Alternaria* leaf blight disease at Oilseed Research Centre, BARI, Joydebpur during rabi 2021-2022. Thirty-nine (39) lines of *B. campestris* were used in the study. Seeds were sown on 25 November 2021 in a randomized block design with three replications. A susceptible variety BARI

Sarisha-14 was used in the experiment as check. Every test lines were sown in two rows of 3 m long separated by single row of susceptible infector (BARI Sarisha-14). Cultural and intercultural operations were done as recommended by Oilseed Research Centre (ORC), BARI. Disease data were recorded at 60 days after sowing(DAS) for leaf and 70 DAS for pod following standard disease rating.

Result indicate that all the test lines were found susceptible.

Efficacy of different group of commercial fungicides against alternaria blight of mustard

M. S. Hossain

The experiment was conducted during 2021-2022 cropping season in the field of Oilseed Research Centre (ORC), BARI, Joydebpur. Seeds of BARI Sarisha 14 was sown on 22 November 2021. The experiment was designed in RCB with 3 replications where plot size was 3m x 1.6m with 40 cm row spacing. The fnugicides were Rovral 50 WP (Iprodian), Dithane M- 45 (Mancozeb), Secure (Phenamidan 10% + Mancozeb 50%), Ridomil Gold MZ 68 WG (Mancozeb 64% + Metalaxyl 4%), Autostin 50 WDG (Carbendazem), Infinity Pro (Fluopicolide 6% + Propinabe 66.7%), Nativo 75WG (Tebuconazole50% + Tryfloxystrobin 25%),Tilt250 EC (Propiconazole), Folicur250 EC (Tebuconazole), Score 250EC (Dyfenoconazole), Tipoff 28 SC (Azoxystrobin20% + Cyporoconazole 8 %), Amister Top 325 SC (Azoxytrobin + Difenoconazole), The fungicides were sprayed 3 times at 10 days intervasl.

Result indicate that all the fungicides significantly reduced the disease as compared to control. Among the fungicides Rovral, Amistertop, Scure, Nativo, Folicur,Tip off performed better than the other fungicides. In case of yield the highest yield was obtained from Rovral followed by Amister top.

Insect Pest Management

Development of a management approach against flea beetle attacking mustard

M.A. Islam and R. Islam

The experiment was conducted during *robi* season 2021-22 at ORC research field, BARI, Gazipur. The experiment was laid out in a randomized complete block design with three dispersed replications. Mustard seeds (BARI Sorisha-18) were sown on 22 December 2021 at Gazipur. The unit plot size was 5.0 m x 4.0 m with 1.0 m row to row and 30 cm distance. The normal intercultural operations were done as and when necessary. The treatments were as follows: T_1= White sticky trap + Antario (Bt+abamectin) @ 1.0 ml/L of water, T_2= White sticky trap + Bio-chamak (Celastras 56ngulates 1% EW) @ 2.5 ml/litre of water, T_3= White sticky trap+ Spraying of Biotrin (0.5% Matrin) @ 1.5ml/L of water, T_4= White sticky trap+ Spraying of Spinosad (Success2.5 SC) @ 1.2 ml/ L of water , T_5= Spraying of Proclaim 5 SG (Emamectin benzoate) @ 2g/L of water, T_6= Untreated control.

Results indicate that (White sticky trap + Bio-chamak (Celastras 56ngulates 1% EW) @ 2.5 ml/litre of water) as well as Proclaim 5 SG (Emamectin benzoate) @ 2g/L of water were effective against flea beetle with higher yield and marginal benefit cost ratio.

B. Sesame (*Sesamum indicum* LINN.)

Crop and soil management

Effect of sowing time on yield and yield components of sesame in Cumilla region

M A H Khan and M O Kaisar

The experiment was conducted at regional agricultural research station (RARS), Bangladesh Agricultural Research Institute (BARI), Cumilla during kharif-i 2021. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 3.0 m × 3.0 m. The experiment was conducted with five treatments, viz. 5 sowing time i) 20 February ii) 2 March iii) 12 March iv) 22 March and v) 2 April 2021. The variety was used in BARI Til-4. The seeding was done in continuous sowing and row was 30 cm apart from each other. Fertilizers were applied @ 120: 80: 60: 40: 4: 1 kg ha^{-1} of N: P: K: S: Zn and B from urea, tsp, mop, gypsum, zinc sulphate and boric acid respectively. Half of the urea and all other fertilizers were applied during final land preparation. The rest of the urea was applied at flower initiation stage. The seedlings were thinned after few days of germination. All intercultural operations were done timely to raise a good crop. Plants were maintained in good condition by adopting all recommended package of practices. The plants were harvested at maturity stage at five different times. Ten plants of

each plot from each replication were randomly selected for recording data. The plot yield was converted into kg ha^{-1}. The highest plant height (127.3 cm), number of seeds $capsule^{-1}$ (65.3), 1000 seed weight and the highest seed yield (1366 kg ha^{-1}) was obtained from the crop sown on 20 February 2021. Most of these characters were statistically identical and very close to 2 March sowing. Significantly the lowest yield was recorded in 2 April sowing. The highest seed yield was obtained from 20 February to 2 March sowing and thereafter reduced with delay in sowing. The results indicated that, 20 February to 2 March sowing would be the optimum sowing time for sesame to have maximum seed yield and higher economic return in Cumilla region.

Insect Pest Management

Development of IPM package against the major insect pests of sesame

M.A. Islam and R. Islam

The experiment was conducted during *kharif* season 2022 at ORC research field, BARI, Gazipur to develop effective management approach against major insect pest of sesame. The experiment was laid out in a randomized complete block design with three dispersed replications. Sesame seeds (BARI Till-4) were sown on 08 March 2022 at Gazipur. The unit plot size was 3.0 m x 2.0 m with 30 cm row to row and 1 m plot to plot distance. The normal intercultural operations were done as and when necessary. The treatments were as follows: T_1(IPM Package 1) = Hand Picking of larvae + Perching + spraying Spinosad (Success 2.5 SC) @ 1.2 ml/L of water, T_2(IPM Package 2) = Hand Picking of larvae + Perching + spraying Bt-Kurstaki @ 0.5ml/L of water, T_3(IPM Package 3) = Hand picking of larvae + Perching + spraying Bio-chamak (*Celastras angulatas* 1% EW) @ 2.5 ml/litre of water, T_4 = Farmers practice (Spraying of Nitro 505 EC (Cypermethrin+ Chlorpyriphos) @ 1.0 ml/L of water), T_5 = Untreated control.

Result indicate that (Nitro 505 EC) @1.0 ml/L of water) as well as (White sticky trap + Perching+ Bio-chamak (Celastras angulatas 1% EW) @ 2.5 ml/litre of water) were effective against major insect pest of sesame with higher yield and marginal benefit cost ratio.

C. Groundnut (*Arachis hypogaea* L.)

Varietal Development

Maintenance and evaluation of groundnut germplasm

K C Saha and M S Uddin

A total of 241 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 30 December, 2021. 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 53-67 days, 138-163 days, 24-63 cm, 15-53, 32-66, 55-78 and 910-3680 kg/ha respectively. The highest coefficient of variation (CV %) was recorded for the character plot yield (42.69%). 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 in groundnut through hybridization

K C Saha and M S Uddin

A total of 222 pods were harvested from 487 pollinated buds out of fifteen crosses. On an average 45% crosses were successful. The pollinated pods will be grown in the next Rabi season for F_1 confirmation. Two batches of six parental lines were sown on ten days interval in 02 January, 2022 and 11 January, 2022 at Joydebpur. The seeds of individual parents were planted in raised bed of 2 rows x 4 m long with the spacing of 50 cm 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 and M S Uddin

Seeds of five cross combinations from F_2, 8 entries from F_3, 20 entries from F_4, 12 entries from $F_{5\ and}$ 7

entries from F_6 respectively were sown on December 30, 2021 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 number of mature pods per plant, cluster pod formation, dwarf canopy of the plant, pod surface and diseases and insect reaction a number of single plants as well as bulk populations from different cross combinations of different segregating generations were selected. A total of 23, 37, 90, 56 and 35 single plants were selected from F_2, F_3, F_4, F_5 and F_6 generations respectively. The seeds from selected single plants of F_2 were collected and stored for advancing the generation as F_3 in the next season. On the other hand, the seeds from selected plants of F_3 were collected and stored according to the cross and generation will be advanced as F_4 generation. From the F_4 generation 90 plants were selected from 20 accessions and will be tested their performance as F_4 generation in the next season. From the F_5 generation 56 plants were selected from 12 accessions and will be tested their performance as F_6 generation in the next season. From the F_6 generation 35 plants were selected from 7 accessions and will be tested their performance as observation trial in the next season.

Observation trial of groundnut (Set-I)

K C Saha and M S Uddin

Twenty genotypes including two checks Dhaka-1 and BARI Chinabadam-8 were evaluated at Joydebpur during Rabi 2021-22. Seeds were sown on 29 December, 2021 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 percentage were found in the genotypes ISD 1314 (70%), ICGV 01105 (70%) and BARI Chinabadam-8 (70%).Highest pod yield (2977 kg/ha) was obtained from the genotype ICGV 284 followed by the genotype ICGV 01105 (2853 kg/ha), BDGV 9112-2-1-2 (2827 kg/ha), JL-24 (2817 kg/ha), ICGV 07220 (2687 kg/ha), ICGV 07210 (2680 kg/ha), BDGN 14 (2663 kg/ha) and ICGV 9118 (2617 kg/ha) which were 22%, 17%, 16%, 15%, 10%, 10%, 9% and 7% higher than the check variety BARI Chinabadam-8 respectively. Maximum number of mature pods per plant was observed from the entry ICGV 284 (33). Highest 100 kernel weight (56 g) was obtained from the variety BARI Chinabadam-8. Considering the pod yield eight genotypes ICGV 284, ICGV 01105, BDGV 9112-2-1-2, JL-24, ICGV 07220, ICGV 07210, BDGN 14 and ICGV 9118 have been selected for PYT.

Observation trial of groundnut (Set-II)

K C Saha and M S Uddin

Nineteen genotypes including two checks Dhaka-1 and BARI Chinabadam-8 were evaluated at Joydebpur during Rabi, 2021-22. Seeds were sown on 29 December, 2021 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 (2937 kg/ha) was obtained from the genotype BDGV 9112-5-1-1 followed by the genotype ICGV 1352 (2803 kg/ha), BDGV 7112-2-2-1(2743 kg/ha), TMV-2 (2647 kg/ha), ICGV 92269 (2633 kg/ha), ICGV 07406 (2557 kg/ha), BDGV 9112-2-1-1(2533 kg/ha) and Mahshwa (2417 kg/ha) which were 23%, 18%, 15%, 11%, 11%, 7 %, 6% and 2% higher than the check variety BARI Chinabadam-8 respectively. Highest value for hundred kernel weight were found in the Beijing-3 (62 g) 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 BDGV 9112-5-1-1 (35). Considering the bold seeded, pod yield and duration eight genotypes BDGV 9112-5-1-1,ICGV 1352, BDGV 7112-2-2-1, TMV 2, ICGV 92269, ICGV 07406, BDGV 9112-2-1-1 and Mahshwa have been selected for PYT.

Observation trial of groundnut (Set-III)

M K Alam, M I Riad and M Kadir

The experiment was conducted at RARS, Jamalpur during Rabi 2021-2022 with 30 lines of groundnut including BARI Chinabadam-8 and BARI Chinabadam-9 as checks. The plot size was 4 rows 5m long. Seeds were sown on the 20th November, 2021 in 15 cm seed to seed and row was 30 cm apart from each.

It was observed from the table that the groundnut line G-1 produced the highest nut yield. It produced 2536 kg/ha yield which was 19 % and 54 % higher than the check variety, BARI Chinabadam-8 and BARI Chinabadam-9, respectively. It produced significantly higher yield among the lines included in this trial. It took 153 days to mature. The line G-2 produced the 2nd highest yield. It produced 2512 kg/ha nut yield which was 18 % and 53 % higher than the check variety, BARI Chinabadam-8 and BARI Chinabadam-9, respectively. It took 153 days to mature. The third highest yield was recorded from ICGV-07406. It produced 2486 kg/ha which was 16% higher than check variety, BARI Chinabadam-8. This groundnut line took 154 days to mature. These lines may easily be grown and harvested before fresh flood at char area and selected for preliminary yield trial in next year.

Preliminary yield trial of groundnut (Set-I)

M K Alam, M I Riad and M Kadir

The experiment was conducted at RARS, Jamalpur during Rabi 2021-2022 with 16 lines of groundnut including BARI Chinabadam-8 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 8th November, 2021 in 15 cm seed to seed and row was 30 cm apart from each.

It was observed from the table that the groundnut line ICGV-15273 produced the highest nut yield. It produced 1851 kg/ha yield which was 6% higher than the check variety BARI Chinabadam-8. It produced significantly higher yield among the lines included in this trial. It took 155 days to mature. The line ICGV-15003 produced the 2nd highest yield. It produced 1807 kg/ha nut yield which was 3% higher than BARI Chinabadam-8. It took 154 days to mature. The third highest yield was recorded from ICGV-15270. It produced 1767 kg/ha which was 1% higher than check variety, BARI Chinabadam-8. This groundnut line took 155 days to mature. These three lines may easily be grown and harvested before fresh flood at char area. These lines may be selected for evaluation in regional yield trial in the char area.

Preliminary yield trial of groundnut (Set-II)

M K Alam, M I Riad and M Kadir

The experiment was conducted at RARS, Jamalpur during Rabi 2021-2022 with 14 lines of groundnut including BARI Chinabadam-6 and BARI Chinabadam-7 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 18th November, 2021 in 15 cm seed to seed and row was 30 cm apart from each. Fertilizers were applied

It was observed from the table that the groundnut line PN-02 produced the highest nut yield. It produced 1842 kg/ha yield which was 66 % and 24 % higher yield than the check varieties BARI Chinabadam-6 and BARI Chinabadam-7, respectively. It produced significantly higher yield among the lines included in this trial. It took 154 days to mature. PN-04 produced the 2nd highest yield. It produced 60 % and 20 % higher yield than the check varieties BARI Chinabadam-6 and BARI Chinabadam-7, respectively. It took 155 days to mature. The 3rd highest yield was recorded in PN-01. These three lines may easily be grown and harvested before fresh flood at char area. These lines may be selected for evaluation in regional yield trial.

Regional yield trial of groundnut (Set-I)

K C Saha, M S Uddin and M B Sarker

The experiment was conducted with eighteen 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 29 December, 2021 at Joydebpur and 28 November, 2021 at Burirhat. 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 1stflowering studied at Joydebpur. Maturity duration ranged from 139-152 days. Highest number of mature pods/plant (32) was obtained by the entry ICGV 07219. The range of hundred kernel weight was 42-62 g. Highest shelling percentage was recorded in the genotype ICGV 07219 (74%). Average days to maturity at two locations were almost similar to the check varieties except ICGV-07219. ICGV-07219 took lowest no. of days to mature over two locations. Average days to maturity was 141. On an average the entry ICGV 07219 produced maximum pod yield (2815 kg/ha) followed by Jhaldhaka (2341 kg/ha), ICGV SL-1 (2074 kg/ha), PK-1 (2062 kg/ha), 14-103 (2036 kg/ha), Choko 0314 (1985) and ISD 2914 (1878 kg/ha) which were 56%, 30%, 15%, 15%, 13% ,

10% and 4% higher than the check varieties. Seven genotypes ICGV 07219, Jhaldhaka, ICGV SL-1, PK-1, 14-103, Choko 0314 and ISD 2914 have been selected for Adaptive Trial.

Regional Yield Trial of Groundnut (Set-II)

K C Saha, M S Uddin and M B Sarker

The experiment was conducted at Joydebpur, Gazipur and RARS, Burirhat, Rangpur during Rabi 2021-22 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 29 December, 2021 at Joydebpur and 28 November, 2021 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 142-149 days. Highest number of mature pods/plant (31) 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 146 to 150 days. The genotype ICGV 0207 produced the highest yield (2594 kg/ha) followed by ICGV 35-1 (2370 kg/ha), ICGV 93420 (2295 kg/ha), TG 37 (2279 kg/ha), TG 51 (2252 kg/ha) and ICGV 0704 (2247 kg/ha) over two locations which were higher than the check varieties. Six genotypes ICGV 0207, ICGV 35-1, ICGV 93420, TG 37, TG 51 and ICGV 0704 have been selected for Adaptive Trial.

Regional Yield Trial of Groundnut (Set-III)

M K ALAM, M I RIAD and M KADIR

The experiment was conducted at RARS, Jamalpur during Rabi 2021-2022 with 12 lines of groundnut including BARI Chinabadam-8, BINA Chinabadam-4 and Dhaka-1 as checks. The plot size was 8 rows 5m long. The experiment was laid out in RCBD with three replications. Seeds were sown on the 20th November, 2021 in 15 cm seed to seed and row was 30 cm apart from each.

It was observed from the table that the groundnut line BAG-19005 produced the highest nut yield. It produced 2416 kg/ha yield which was 51 % higher than the traditional variety Dhaka-1. It produced significantly higher yield among the lines included in this trial. It took 153 days to mature. The line TG-51 produced the 2nd highest yield. It produced 2296 kg/ha nut yield which was 44 % higher than Dhaka-1. It took 153 days to mature. The third highest yield was recorded from ICGV-93280. It produced 1971 kg/ha which was 23 % higher than check variety, Dhaka-1. This groundnut line took 154 days to mature. These three lines may easily be grown and harvested before fresh flood at char area. These lines may be selected for evaluation in adaptive trial in the char area.

Adaptive trial of groundnut advanced lines at char area In Jamalpur

M K Alam, M I Riad and M Kadir

The experiment was conducted at Naubangerchar, Jamalpur sadar, Jamalpur during Rabi 2021-22 with 6 lines of groundnut including Dhaka-1, as checks. The plot size was 8 rows 10 m long. Seeds were sown on the 22th November, 2021 in 15 cm seed to seed and row was 30 cm apart from each.

It was observed from the table that the groundnut line ICGV-00338 produced the highest nut yield. It produced 2205 kg/ha yield which was 49 % higher than the traditional variety Dhaka-1. It took 146 days to mature. The line ICGV-07220 produced the 2nd highest yield. It produced 2078 kg/ha nut yield which was 41 % higher than Dhaka-1. It took 149 days to mature. The third highest yield was recorded from BARI Chinabadam-11. It produced 1993 kg/ha which was 35 % higher than check variety, Dhaka-1. This groundnut line took 142 days to mature. These three lines may easily be grown and harvested before fresh flood at char area. ICGV-07219 produced 27% high yield and took 148 days to mature. It has the potentiality to tolerate drought stress. These lines may be selected for further evaluation in adaptive trial in another char area.

Crop and soil Management

Intercropping bunching onion with groundnut

P. Roy, F. Begum and M M Karim

The field experiment was conducted at the research field of Oilseed Research Centre, Bangladesh Agricultural Research Institute, Gazipur during rabi season of 2021 -2022. There were six treatments viz. T_1 = Sole groundnut, T_2 = One row of bunching onion

(15cmX10cm) in between two normal rows of groundnut (40cmX15cm), T_3 = Two rows of bunching onion in between two normal rows of groundnut, T_4= Two groundnut rows alternate with two rows of bunching onion & T_5=Bunching onion broadcast in between two normal rows of groundnut (40cmX15cm). The experiment was laid out in Randomized Complete Block Design with three replications. The unit plot size was 4m x 5m. Groundnut seeds (BARI Chinabadam-8) were sown on 23 November, 2021 and bunching onion (BARI Bunching onion-1) were transplanted (40 days seedling) in the main field at same date. Fertilizers at the rate of $N_{12}P_{31}K_{43}S_{55}B_{1.5}$ 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 bunching onion, fertilizers at the rate of TSP $_{275}MoP_{150}Urea_{250}Gypsum_{110}Zn_{10}$ kg/ha 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). In sole bunching onion plt all the fertilizers applied during final land preparation except urea and MoP. Half of them applied during final land preparation and rest were applied into 3 split later at the 25 days, 55 days and 75 days of plant. At harvest, the yield data was recorded plot wise. Collected data were analyzed statistically and means were adjusted by LSD test at 5% level of significance using SPSS. 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 bunching onion yield. Total productivity in terms of groundnut equivalent yield (GEY) (7.68 t/ha) was found the highest from T_2 (One row of bunching onion (15cmX10cm) in between two normal rows of groundnut (40cmX15cm)) treatment while the lowest (5.24 t/ha) in T_4 (Two groundnut rows alternate with two rows of bunching onion). Highest benefit cost ratio (BCR) (3.18) was also recorded in T_2 treatment (one row of bunching onion in between two normal rows of groundnut. Results revealed that one row of bunching onion in between two normal rows of groundnut would be agronomically feasible and economically profitable for the farmers in intercropping system.

Intercropping firingi with groundnut

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

The field experiment was conducted at the research field of Oilseed Research Centre, Bangladesh Agricultural Research Institute, Gazipur during rabi season of 2021 -2022. There were five treatments viz. T_1 = Sole groundnut, T_2 = One row of firingi (15cmX10cm) in between two normal rows of groundnut (40cmX15cm), T_3 = Two rows of firingi in between two normal rows of groundnut, T_4= Two groundnut rows alternate with two rows of firingi & T_5=Firingi broadcast in between two normal rows of groundnut (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 23 November, 2021. Fertilizers at the rate of $N_{12}P_{31}K_{43}S_{55}B_{1.5}$ 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 $N_{80}P_{34}K_{68}S_{20}$ 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. Collected data were analyzed statistically and means were adjusted by LSD test at 5% level of significance using SPSS. 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) (7.97 t/ha) was found the highest from T_2 (One row of firingi (15cmX10cm) in between two normal

rows of groundnut (40cmX15cm)) treatment while the lowest (2.30 t/ha) in T_1 (sole groundnut). Highest benefit cost ratio (BCR) (8.4) was also recorded in T_2 treatment (one row of firingi in between two normal rows of groundnut).

Validation of intercropping black cumin with groundnut in charland areas

M. A. H. Khan, S. Roy, T. Tasmima and M. M. Rahman

The experiment was conducted at the MLT site Bhuapur, Tangail under AEZ # 8 during the Rabi season 2021-22. The experiment was laid out following RCB design with five replications. The unit plot size was 5 m x 4 m. There were four treatments viz., T_1= Sole groundnut (100%), T_2= One row of black cumin in between two normal rows of groundnut, T_3= Two rows of black cumin in between two normal rows of groundnut, T_4= Sole black cumin (100%). Spacing of groundnut was maintained at 40 cm × 15 cm and black cumin (15 cm x 10 cm). The plot was fertilized with 45-36-75-30-2-1 kg NPKSB ha^{-1} for sole and intercropping treatments. ½ N and full quantity of other fertilizers will be applied as basal. The remaining N will be top dressed at the flowering stage and covered with soil followed by irrigation. The variety of groundnut was BARI Chinabadam-9 and black cumin (BARI Kalozira-1). Seeds of groundnut and black cumin were planted on 3 November, 2021. Intercultural operations were done properly for the normal growth and development of the crops. The black cumin was harvested on 20 March, 2022, and the groundnut on 30 March, 2022. Data on yield and yield contributing attributes were recorded and analyzed with CropStat analytical package. The cost and return analysis were computed on the basis of the prevailing market price. Groundnut equivalent yields were recorded higher from all intercrop treatments as compared to sole groundnut and sole black cumin production. Analysis of intercropping treatments revealed that two rows of black cumin in between two rows of groundnut resulted in the highest groundnut equivalent yield (3.06 t ha^{-1}) as well as gross margin (Tk. 99398 ha^{-1}) and the lowest groundnut equivalent yield (1.43 t ha^{-1}) as well as gross margin (Tk. 29848 ha^{-1}), were obtained from sole groundnut treatment. From the results, it can be concluded that groundnut can be grown with black cumin. Farmers can earn better economic benefits by following the cultivation of two rows of black cumin (15cmX 5cm) in between two normal rows of groundnut (40cmX 15cm).

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

M. T. Islam and F.Begum

The experiment was carried out at the farmers' field of On-Farm Research Division, Bangladesh Agricultural Research Institute (BARI), Bandarban during the rabi season, 2021-22 to find out the suitable intercropping system for increasing crop productivity and profitability of black cumin with groundnut intercropping system. The treatments were T_1=sole groundnut, T_2=sole black cumin, T_3= one row of black cumin in between two rows of groundnut and T_4= two rows of black cumin in between two rows of groundnut. Spacing of groundnut was maintained at 40 cm × 15 cm and black cumin (15 cm x 10 cm). Treatments were arranged in a randomized complete block design 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 (T_4), 15 cm line-line and 10 cm plant-plant distance were maintained. Both groundnut and black cumin seeds were sown on 13 November, 2021. 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 12-14 March, 2022 and groundnut was harvested on 04 April, 2022. 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. Index of yield was calculated by the following formula: (Index of yield= Intercrop yield/Sole crop yield × 100). Land equivalent ratio (LER) was computed according to Shaner et al. (1982) as follows: LER= yield of sole groundnut/ yield of intercrop groundnut + yield of sole black cumin / yield of intercrop black cumin. Between

intercropped treatments, single row of black cumin within paired rows of groundnut (T_3) showed higher groundnut equivalent yield (3331.12 kg ha^{-1}), highest land equivalent ratio (1.43), gross return (Tk. 199867 ha^{-1}), net return (Tk. 149367 ha^{-1}) and benefit cost ratio (3.96) over the respective sole groundnut crop (T_1), sole black cumin (T_2) and Two rows of black cumin in between two rows of groundnut (T_4). 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 chili with groundnut in haor areas

M. I. Nazrul and F.Begum

The experiment was conducted at MLT site, Moulvibazer during the year 2021-22. Three intercrop combinations, T_1: Groundnut sole, T_2: Groundnut (100%) + 1 row of chilli at 40 cm spacing (seedling to seedling) and T_3: Groundnut + 1 row of chilli at 60 cm spacing (seedling to seedling) 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 × 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, 2021. 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 2022 and groundnut was harvested during 10-15 May, 2022. 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 (2.62 t ha-1) was observed in T2 (groundnut+ 1 row chilli at 40 cm spacing). On the contrary, in intercrop situation the yields of chilli 6.48 and 5.97 t ha-1 was obtained in T2 (groundnut+ 1 row of chilli at 40 cm spacing) and T3 (groundnut + 1 row of chilli at 60 cm spacing), respectively. The highest groundnut equivalent yield (10.84 t ha-1) was also recorded in T2 (groundnut+ 1 row of chilli at 40 cm spacing) with gross return of Tk. 650400 ha-1 and gross margin of Tk. 509500 ha-1, respectively. Finally, T3 combination (groundnut + 1 row of chilli at 60 cm spacing) provided higher BCR (4.95) compared to that of T2 (groundnut+ 1 row of chilli at 40 cm spacing) and sole groundnut. From the result it was found that intercrop combinations was better than sole crop in terms of yield and economic return. The intercrop combination T_3 (groundnut + 1 row of chilli at 60 cm spacing (seedling to seedling) performed better and contributed higher benefit cost ration. It can be a good option to haor farmers for cultivating groundnut with chilli intercropping system.

Validation of intercropping garlic, onion, fenugreek, black cumin with groundnut in charland areas Bhuapur

S. Roy, M. A. H. Khan, M. M. Rahman and T. Tasmima

The experiment was conducted at the MLT site Bhuapur, Tangail under AEZ # 8 during the rabi season 2021-22. The experiment was laid out following RCB design with four replications. The unit plot size was 5 m x 4 m. There were five treatments viz., T_1= Sole groundnut (100%), T_2= Two rows of black cumin in between two rows of groundnut, T_3= One row of fenugreek in between two rows of groundnut, T_4= One row of garlic in between two rows of groundnut, T_5= One row of onion in between two rows of groundnut. Spacing of groundnut was maintained at 40 cm × 15 cm. The plot was fertilized with 45-36-75-30-2-1 kg N-P-K-S-Zn-B ha^{-1} for sole and intercropping treatments. All fertilizers and ½ N of Urea were applied during final land preparation and the rest of Urea was top dressed at flowering stage and covered with soil followed by irrigation. The variety of groundnut was BARI Chinabadam-9, black cumin (BARI Kalozira-1), fenugreek (BARI Methi-1), garlic (BARI Rashun-2), and onion (Taherpuri). Seeds of groundnut and onion were planted on 4 November, 2021. Intercultural operations were done properly for the normal growth and development of the crops. The onion was harvested on 8 March, 2022, black cumin on 20 March, 2022, garlic on 29 March, 2022, fenugreek on 28 March, 2022 and the groundnut on 30 March, 2022. Data on yield and yield contributing attributes were recorded. Analysis of intercropping treatments revealed that one row of onion in between one row of groundnut resulted in the highest groundnut equivalent yield (9.48 t ha^{-1}) as well as gross margin (Tk. 450348 ha^{-1}) and the lowest groundnut equivalent yield (1.47 t ha^{-1}) as well as gross margin (Tk. 32248 ha^{-1}), were obtained

from sole groundnut treatment. From the result it was found that intercrop combinations was better than sole crop in terms of yield and economic return. The intercrop combination one row of onion without a significant reduction in groundnut yield. Farmers can earn better economic benefits by following the cultivation of one row onions (15 cm x 5 cm) in between two rows of groundnut (40 cm x 15 cm).

Validation of intercropping garlic, onion, fenugreek, black cumin with groundnut in char land area Jamalpur

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

The experiment was conducted at Nawvanger char, sadar, Jamalpur, Bangladesh 24°57´ north latitudes and 89°55´ east longitudes. 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 *rabi* 2021-2022 to find out the suitable combination of groundnut for higher productivity and profitability of charland area stakeholders. Design of the experiment was RCB with 03 (three) replications having the unit of plot 3m × 2m. BARI Badam-9, BARI Methi-2, BARI Rasun-2, BARI Piaj-4 and BARI Kalozira-1 were used as a variety in the experiment. Treatments included in the experiment were: T_1=Sole groundnut, T_2= two rows of black cumin in between two normal rows of groundnut, T_3= one row of fenugreek in between two normal rows of groundnut, T_4= one row of garlic in between two normal rows of groundnut and T_5 = one row of onion in between two normal rows of groundnut. ½ 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 23, 2021 and harvested from April 02, 2022 to April 29, 2022. Intercultural operations like watering, weeding and spraying insecticides were followed as and when necessary. Analysis of intercropping treatments revealed that one row of onion in between one row of groundnut resulted in the highest groundnut equivalent yield (7.04 t ha-1) as well as BCR (4.48) and the lowest groundnut equivalent yield (2.10 t ha-1) as well as BCR (1.63) were obtained from sole groundnut treatment. The increased yield with the intercropping was largely due to improved interspecies interaction and facilitation. Intercropping in order to improve land use efficiency, take advantage of intercropping facilitation and improve economic benefits. Also, linked with the higher yield, the associated higher amount of spice-legume by-product is preferred for animal feed or human consumption. Therefore, groundnut/spices intercropping systems increase productivity, economic and nutritional development of charland stakeholders.

Performance of groundnut varieties at charland in Faridpur

S. Ahmed, Afm R. Quddus and F.Begum

The experiment was conducted at charland of Faridpur named North channel under AEZ-10 during the kharif I, 2021 to find out a suitable groundnut variety for the charland and to popularize the variety (ies) among the farmers. Three improved varieties of groundnut viz., BARI Chinabadam-8, BARI Chinabadam-9, BARI Chinabadam-10 and one local variety (Dhaka-1) was used as check in the experiment. The experiment was laid out in randomized complete block design (RCBD) with five dispersed replications. Crop management practices used was shown in Table 1. Before sowing, seeds were treated with Provax @ 0.2% to prevent seed and soil borne diseases. The entire amount of urea, TSP, MP, gypsum, zinc sulphate mono hydrate and boric acid were applied during final land preparation. One hand weeding was done at 45 DAS. The cost and return were calculated on the basis of prevailing market price of the commodities. At harvesting stage, different data were collected properly and analyzed statistically using open-source software "R" and the means were separated by DMRT (Gomez and Gomez, 1984).

The highest average nut yield (2.75 t ha-1) was recorded in BARI Chinabadam-10 which was statistically similar with other tested varieties except local. The highest number of nuts plant-1 and 100 kernel weights were closely associated providing the highest nut yield ha-1 of BARI Chinabadam-10. 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. The highest gross return (Tk. 192500 ha-1) and gross margin (Tk. 107802 ha-1) was also observed in BARI Chinabadam-10 variety might be due the highest yield potentiality. The yields of all the high yielding groundnut varieties were higher than local one. The yield was 60% higher in BARI Chinabadam-10 over Dhaka-1. The HYV groundnut varieties were also less susceptible to pest infestation as compares to Dhaka-1. This was first year trial. For final decision, next year trial will be conducted.

Disease Management

Screening of groundnut line(s) against leaf spot and rust diseases

M. S. Hossain

The experiment was conducted at ORC, BARI, Joydebpur during 2021-22 cropping season. Forty entries of groundnut were evaluated during 2021-2022 rabi season under natural epiphytotic condition against leaf spots and rust diseases using infector row method. Every tested genotypes were sown in two rows of 3 m long separated by single row of highly susceptible variety Dhaka-1 as infector. Disease severity was recorded using 0-5 and 1-9 scale respectively, for leaf spot and rust 5 days before harvest the crop.

The result indicate the all sixteen lines were selected as moderately resistant for rust and leaf spot diseases

Efficacy of different group of commercial fungicides against leaf spot and rust diseases of groundnut

M. S. Hossain

The experiment was conducted at Oilseed Research Centre, BARI, Joydebpur during 2021-2022. Seeds of Groundnut variety Dhaka 1 was sown on 29 December 2021. The experiment was designed in RCB with 3 replications where plot size was 3m x 1.6m with 40 cm row spacing. All intercultural operations were done timely to raise a good crop. Twelve fungicides of different groups namely Rovral 50 WP (Iprodian), Dithane M-45(Mancozeb), Secure(Phenamidan 10% + Mancozeb 50%), Ridomil Gold MZ 68 WG(Mancozeb 64% + Metalaxyl 4%), Autostin 50 WDG (Carbendazem), Infinity pro(Fluopicolide 6% + Propinabe 66.7%), Nativo75WG(Tebuconazole 50% + Tryfloxystrobin 25%), Tilt 250 EC(Propiconazole), Folicur250 EC (Tebuconazole), Score 250EC (Dyfenoconazole), Tipoff 28 SC (Azoxystrobin20% and Cyporoconazole 8 %), Amister Top 325 SC (Azoxytrobin + Difenoconazole),

Result indicate that among the fungicides Amister Top 325 SC, Score 250 EC, Nativo 75WG, Folicur 250 EC, Infinity Pro, Tip off performed better than the other fungicides in case of both the diseases. Autostin performed good for leaf spot but not for rust

Insect Pest Management

Relative susceptibility of groundnut cultivars against sucking insect pests, hairy caterpillar and leaf roller

M.A. Islam and R. Islam

The experiment was conducted during *rabi* season 2021-22 at ORC research field of BARI, Gazipur to check the relative susceptibility of the BARI released groundnut varieties. The experiment was laid out in a randomized complete block design with three dispersed replications. Homogenous seeds of groundnut cultivars were sown in a well prepared seed bed on 02 January 2022. The unit plot size was 4.0 m x .30 m with 30 cm row to row and 5 cm plant to plant distance. The normal intercultural operations were done as and when necessary. Eleven varieties of groundnut were evaluated against sucking pest, leaf roller and hairy caterpillar infestation. The varieties were as follows: V1 =Dhaka-1, V2 =Basonti Badam, V3=Tridana Badam, V4 =Jhinga Badam, V5 =BARI Chinabadam-5, V6 = BARI Chinabadam-6, V7 = BARI Chinabadam-7, V8 = BARI Chinabadam-8, V9 = BARI Chinabadam-9, V10 = BARI Chinabadam-10, V11 = BARI Chinabadam-11.

Results indicate that the variety Basonti Badam, BARI Chinabadam-5, BARI Chinabadam-6, BARI Chinabadam-7 and BARI Chinabadam-10 are less susceptible, variety Dhaka-1, Tridana Badam and BARI Chinabadam-11 are more susceptible.

D. Soybean (*Glycine max* L.)

Varietal Development

Development of recombinant inbred lines (RIL) of soybean

M Shalim Uddin and U. Kulsum

A total of nine single plants were selected and harvested based on earliness, flower color and bearing habit. The seeds of selected single plants with desirable characters were stored separately for next year sowing as F_3 generation.

Observation trial of soybean

U. Kulsum and M Shalim Uddin

Twelve selected entries including two check variety, BARI Soybean-6 and BARI Soybean-7 were evaluated at ORC, BARI. The minimum days to

mature was observed for BARI Soybean-7 (107 days) and maximum in Hayman (127 days). The entry ST-1 produced the highest pods per plant (83). The entry ST-1 produced the highest pods per plant (83). Besides, ST-1, MTD-453, Hayman and LG-92p-1825 were over yielded 31%, 24%, 16% and 7% respectively compared to the check variety BARI Soybean-7. So, the entries ST -1, MTD -453, Hayman and LG-92p-1825 will be used for the next year yield trail program.

Preliminary yield trial of soybean

U. Kulsum and M Shalim Uddin

Twelve entries of soybean including two check varieties BARI Soybean-6 and BARI Soybean-7 were evaluated at Joydebpur, BARI to find out suitable soybean entries with desirable characters. Among the entries, BARI Soybean-7 was the earliest maturing (106 days) and most dwarf one (25.9 cm). Maximum pods per plant were observed in USDA 72 while minimum in BS-29. In average, the entry USDA ST-1 produced the highest seed yield followed by MTD-453, USDA-40 and USDA-107 which were 24% 16%, 11% and 7% higher than the check variety BARI Soybean-7. So, considering yield and other yield contributing characters, ST-1 (2135 kg/ha), MTD-453 (1992 kg/ha), USDA-40 (1901 kg/ha) and USDA-107 (1837 kg/ha) will be selected for regional yield tri**a**l program.

Crop and Soil Management

Effect of spacing on growth and yield of BARI Soybean-7

M M Karim, F Begum and P Roy

The experiment was conducted at the research field of Oilseed Research Centre (ORC), BARI, Gazipur during the rabi season of 2021-2022 to identify the suitable plant to plant and row to row spacing of newly developed BARI Soybaen-7 variety in Bangladesh. There were four treatments viz. T_1 : 40cm x 10cm, t_2: 35cm x 10cm, t_3: 30cm x 10cm and t_4: 40 cm x 5cm, t_5: 45cm x 10cm (recommended spacing). The crop variety was BARI Soybaen-7. The experiment was design in RCB with three replications. Seed were sown in 27 December 2021 at Gazipur. 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). Two times irrigation at 30 & 70 days after sowing were applied during the growing period. Tenb plants were selected for collecting data on various parametre. Data on yield and yield contributing characters were recorded. The 100 seed weight (g) was recorded maximum (13gm) in the treatment of t1: 40cm x 10cm and it was followd by t5: 45cm x 10cm treatment. The seed yield was obtained highest (1.85 t/ha) in the treatment of t1 and lowest (1.68 t/ha) in the treatment of t5. Though the no of pod/plant was not highest in the treatment of t1 but yield was maximum it may be due to number of seed/pod and 100 seed weight were height. So t1: 40cm x 10cm treatment is suitable spacing for maximizing the yield of BARI Soybean-7.

Performance of soyabean genotypes in southern region of Bangladesh

M. M. Hossain, O. A. Fakir, M. M. U Chowdhury, A. H. M. Amir Faisal and F. Begum

The experiment was conducted at Agricultural Research Station (ARS), Binerpota, Satkhira and at West Al-Amin, Subarnachar upazilla in Noakhali during *rabi* season, 2021-2022. The objective of the study was to examine the variation in salt tolerance of selected soybean genotypes under salinity condition. Four soyabean genotypes viz. Shohag, BARI Soybean-5, BARI Soybean-6 and BARI Soybean-7 were taken as treatment in this experiment. The experiment was laid out in RCB design with six dispersed replications. The soil was sandy clay loam to silty clay loam belonging to Young Meghna Estuarine Flood plain of Bangladesh (AEZ 18) at Noakhali location. The unit plot size was 5m x 3m. The land was prepared by 2-3 ploughing followed by laddering to gain suitable tilth condition and was fertilized with 28-35-60-21-2 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 22 December, 2021 in *joe* condition. The seeds were sown @ 50 kg ha^{-1} from 18 January to 20 January 2022 in line with the spacing of 30 x 5 cm at Noakhali. Before sowing seeds were treated with Provax-200 WP and seeds sown in line maintaining 30 cm row to row spacing. Weeding and thinning were done as and when necessary. No disease was seen at standing crop but leaf roller infestation was observed and controlled by spraying Sevin 20 EC @ 2g/L for 4 time keeping 10 days interval. The crop

was harvested on 6 April, 2022 at maturity stage and harvesting was done from 26 April to 7 May, 2022 (Satkhira and Noakhali). Yield and yield components of soybean were recorded and data were analyzed statistically and mean differences were calculated by Duncan's Multiple Range Test (Gomez and Gomez, 1984) at Satkhira location. Data on different plant, yield and yield contributing characters were recorded. The collected data were analyzed by the R project for statistical Computing software (Version 3.3.3) at Noakhali. All the tested genotypes gave statistically similar yield but BARI Soyabean-6 produced the highest yield (1.48 t/ha) and the lowest yield was recorded in BARI Soyabean-7 (1.17 t/ha). But at Noakhali, the highest seed yield was obtained from BARI Soybean-6 (2.10 t ha^{-1}) and the lowest yield (1.87 t ha^{-1}) was obtained from Shohag. Other genotypes are also promising for saline area in terms of yield.

Effect of different tillage conditions on the growth and yield of soybean varieties in southern region of Bangladesh

M.A. Rahman, F. Begum and M.M. Rahman

The field experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during the Rabi season of 2021-22 under the project entitled, "Enhance Production of Oilseed Crops (EPOC)" ORC, BARI to evaluate the performances of soybean varieties under different tillage conditions in southern region of Bangladesh. The treatments of this experiment were of two factors viz., Factor A. Three tillage conditions (T_1 = Conventional tillage, T_2 = Minimum tillage and T_3 = Zero tillage i.e. relay cropping with T.aman rice); Factor B. Three soybean varieties (V_1 = Bangladesh Soybean-4, V_2 = BARI Soybean-5 and V_3 = BARI Soybean-6). The experiment was laid out in randomized complete block design with three replications. The tillage condition created significant differences in plant population/$m^{2,}$ root length/plant, root surface area/plant, days to 50% flowering, days to maturity, plant height, number of branches/plant, number of pod/plant and seed and straw yields. Treatment T_1 gave the highest yield of seed (2075 kg/ha) and the lowest yield (1194 kg/ha) was obtained from T_3 treatment. Seed yield achieved from T_2 treatment was 1548 kg/ha. The soybean varieties had significant effects on plant population/m^2, days to maturity, number of pod/plant and seed yield. Among the tested varieties, V_3 gave the highest yield of seed (1763 kg/ha), which was partially similar to V_1 (1619 kg/ha) and the lowest yield was obtained from V_2 (1434 kg/ha). The interaction effects of tillage condition and variety were found to be significant in terms of plant population/$m^{2,}$ root length/plant, days to 50% flowering, days to maturity, plant height, number of pods/plant and seed yield. The interaction of T_1V_3 gave the highest yield of seed (2233 kg/ha) that was partially identical to that of T_1V_1 (2122 kg/ha) and T_1V_2 (1869 kg/ha). Besides, seed yields recorded in T_2V_3, T_2V_1, T_2V_2, T_3V_1, and T_3V_3 were 1794, 1536, 1314, 1200 and 1261 kg/ha, respectively. Among the interactions, the highest gross return of Tk. 180175/ha was obtained from T_1V_3. Almost similar gross return was also obtained from the interactions of T_1V_1 (Tk. 171171) and T_1V_2 (Tk. 150969/ha). The highest gross margin (Tk. 109103/ha) was obtained from the interaction of T_1V_3 that was to some extent similar to that of T_1V_1 (Tk. 101261/ha) and T_1V_2 (Tk. 80478/ha). The interaction of T_1V_3 showed the highest value (2.54) of benefit cost ratio (BCR). Higher BCR values were also found in T_1V_1 (2.45), T_1V_2 (2.14), T_2V_3 (1.88) and T_2V_1 (1.87). Therefore, BARI Soybean-6 and Bangladesh Soybean-4 could be cultivated under conventional tillage condition for getting higher yields and economic returns under rice based cropping systems in southern region of Bangladesh.

Insect Pest Management

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

M.A. Islam and R. Islam

The experiment was conducted during *rabi* season 2021-22 at ORC research field of BARI, Gazipur to check the relative susceptibility of the BARI released soybean varieties. The experiment was laid out in a randomized complete block design with three dispersed replications. Homogenous seeds of soybean cultivars were sown in a well prepared seed bed on 06 January 2022. The unit plot size was 4.0 m x .30 m with 30 cm row to row and 5cm plant to plant distance. The normal intercultural operations were done as and when necessary. Five varieties of soybean were evaluated against sucking pest, leaf roller and hairy caterpillar infestation. The varieties were as follows: V_1 =Shohag, V_2 =Bangladesh soybean-4, V_3 =BARI Soybean-5, V_4 =BARI Soybean-6, V_5 =BARI Soybean-7.

Result indicate that the variety BARI Soybean-7 are less susceptible, variety shohag is moderately susceptible and variety BARI Soybean-5 BARI Soybean-6 are more susceptible. The experiment will be repeated next year for further investigation.

Minor Oilseeds

E. Sunflower (*Hellanthus annus* L.)

Varietal Development

Maintenance of sunflower germplasms

S H Habib

Forty-three sunflower genotypes including two check varieties BARI Surjamukhi-2 and BARI Surjamukhi-3 were grown in the experimental field of oilseed research centre, BARI, Gazipur during the rabi season 2020-2021. Five plants from each genotype were intermate to maintain the heterozygosity. At maturity that heads were harvested and bulked and will be grown in the next season for maintain the germplasm.

Development of dwarf inbred lines in sunflower: family selection from s_7 generation

S H Habib

Bulked seeds from fifteen S_7 sunflower genotypes were grown separately allowed to intermate and evaluated and dwarf, early and high yield potential genotypes were selected. The selected genotypes will be grown in the next rabi season for competitive yield trial with check variety.

Identification of parental lines for development of hybrid variety in sunflower

S H Habib

S_6 seeds of CN001 and CN002 and S_8 seeds of Hysun-33 were grown and self-fertilized manually to find parental lines. Seeds from both male parents and CMS plants were stored for advancing generations.

Development of synthetic and composite sunflower variety

I) Development of synthetic sunflower variety

S H Habib

Four inbred lines with best general combining ability (P1: P-S-2-OP1, P2: P-S-2-OP3, P6: P-S-2-OP2, and P8: P-S-2-OPB) were selected in rabi season 2018-19. To develop synthetic sunflower variety, all possible crosses (both cross and reciprocal cross)) were made between the inbreeds in rabi season 2019-20. Equal amount of seed from each cross and reciprocal cross were mixed, grown as syn-1 and evaluated for yield attributes during rabi season 2020-2021. During rabi season 2021-22, syn-2 generation was grown from desired heads of syn-1 generation and evaluated for yield and yield components.

Development of synthetic and composite sunflower variety

II) Development of composite sunflower variety

S H Habib

The seeds from composite-5 (a mixed of equal number of seeds from eight inbred lines of sunflower) were grown and allowed for intermating to develop composite sunflower variety. The average plant height was 95.69 cm and takes 101 days to mature. Most of the plants show uniformity and homogeneity in different characters. Therefore, after discarding the undesirable plants, the mature heads were harvested in bulk and kept for growing in yield competitive trial with check variety in the next rabi.

Creating new genetic variability in sunflower using induced mutation:

I) evaluation of M5 mutant created by gamma radiation

S H Habib

Gamma radiation treated M5 seeds of released variety BARI Surjamukhi-2 were evaluated to develop suitable mutant sunflower variety. In M5 generation, based on plant height and plant stature mutants were grouped into very dwarf (plant height <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). The individual plants from each group were harvested and kept. The family mutants will be grown using each group and will be evaluated in the next rabi season.

Creation of sunflower mutant through ems

II) Evaluation of M4 mutants

S H Habib

Chemical mutagenic agent ethyl methane sulfonate (EMS) treated M4 seeds of released variety BARI Surjamukhi-2 were evaluated to develop mutant sunflower inbreed lines. In M4 generation, mutants were grouped into very dwarf, dwarf, and medium dwarf, tall and very tall based on plant height. Mutants with thick stem, bigger head and larger leaf also were selected. All the desired mutants were harvested separately and kept for growing in the next rabi season as family mutants.

Molecular characterization of sunflower dwarf mutants by the expression analysis of GA2ox1 gene sequence

S H Habib and Md Motiar Rahman

Ems treated mutants of sunflower variety BARI Surjamukhi-2 were characterized molecularly. GA2ox gene was found to be expressed in leaf tissue of sunflower mutant. Expression analysis of this plant height manipulating dwarfing gene in both ems and gamma radiation treated and control plants are ongoing.

Molecular characterization of sunflower mutants

I) By the expression of fad and sad gene sequences

S H Habib and Md Motiar Rahman

Ems treated 13 mutants of sunflower variety BARI Surjamukhi-2 was characterized molecularly for sad and fad gene expression. Sad gene was found to be expressed in 12 and fad gene was found 7 among 13 plants, respectively.

Screening of diverse genotypes of oilseed crops using SSR primers Assessment of genetic diversity in *Brassica rapa* genotypes using SSR markers

S H Habib, Pryanka Roy and Umme Kulsum

Brassica rapa species represent one of the most important oilseed crops in Bangladesh, nevertheless, their genetic diversity is barely known. A better understanding on this topic is essential for the proper utilization of genotypes in breeding programs. We evaluated the genetic diversity among 30 *Brassica rapa* genotypes including varieties/lines using 17 highly polymorphic SSR markers. A total 178 alleles were amplified across 17 markers among all the 30 genotypes. Genetic diversity varied from minimum 0.69 for marker q2 to maximum 0.95 for marker niab_ssr022 with an average value of 0.84. Polymorphism information content (pic) value of the markers varied from minimum of 0.62 with the marker q2 and maximum of 0.93 with primer niab_ssr022 with a mean value of 0.83, so these primers can further be used for diversity analysis.

Nucleus seed production of BARI Surjamukhi-3 and seed increase of dwarf advance lines of sunflower

S H Habib

A total of 27 kg nucleus seed of released dwarf sunflower variety BARI Surjamukhi-3 was produced. A total of 1.2, 1.1, 0.7 and 0.7 kg seed were produced from four advance lines of sunflower viz. P1 (synthetic), P2(synthetic), P6(synthetic) and P8(synthetic), respectively. The nucleus seeds will be used to maintain the varietal purity and the seed of advance lines will be used in breeding program.

Crop and Soil Management

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

P. Roy and F. Begum

The experiment was conducted at Oilseed Research Centre, BARI, Gazipur during rabi season of 2021-22. The treatments of the experiment were five transplanting time viz., t_1 = 7 November 2021, t_2 = 22 November 2021, t_3 = 12 December 2021 (delay sowing due to rain), t_4 = 27 December 2021 & t_5=11 January 2022. 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 (1.81 t/ha) with higher no. of seed/plant and higher seed weight was found in t_2 treatment (22 November). The lowest yield (1.05 t/ha) was recorded in t_5 treatment (11 January). The maximum matured seed number (1008) and the highest 1000 seed weight (79.00g) were obtained from t_2 (22 November) treatment. Sunflower could be cultivated with 15 days age seedling transplanting at 22 November just after early harvesting of t.aman rice. This year outcome might be hampered due to rain and therefore final recommendation will be made by repeating the experimentation in the next year with other locations in the southern region of Bangladesh.

Effect of plant growth regulators on production traits of sunflower

M A H Khan and M O Kaisar

The experiment was conducted at Regional Agricultural Research Station, BARI, Cumilla during 2021-22. The experiment was laid out in randomized complete block design with five treatments; i) IAA- 100 ppm ii) IAA- 150ppm iii) GA_3-100 ppm iv) GA_3-150 ppm & v) Control. The 100 ppm and150 ppm solutions of plant growth regulators were prepared by dissolving 100 mg and 150 mg is in small quantity of acetone dissolve all granules of PGR in acetone completely. Make final volume of 1 litre by adding distilled water slowly. Finally 100 ppm and 150 ppm concentrations of plant growth regulator solutions were prepared. The unit plot size was 2.5 m × 2.0 m. The variety was BARI Surjamukhi-3. The seeding was trans planted on 8 November 2021 in 50 × 30 cm spacing. Fertilizers were applied @ 120: 80: 60: 40: 4: 1 kg ha^{-1} of N: P: K:S:Zn and B from urea, TSP, MoP, gypsum, zinc sulphate and boric acid respectively. Half of the urea and all other fertilizers were applied during final land preparation. The rest of the urea was applied two splits at 25 days after germination and 45 days after germination. All intercultural operations were done timely to raise a good crop. Ten plants of each plot from every replication were randomly selected for recording data. The plot yield was converted into kg ha^{-1}. The seed yield and yield attributes like head diameter, seed per head and thousand seed weight were influenced significantly due to application of plant growth regulators. The highest seed per head (583), thousand seed weight (62.8) and seed yield (2320 kg ha^{-1}) was found at GA_3-150 ppm concentration. The lowest value of these parameters was found at control condition. The highest BCR (2.33) was achieved in GA_3-150 ppm followed by (2.29) IAA-150 ppm. About 10-15% seed yield was increased when plant growth regulators was applied to the sunflower.

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

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

The field experiment was conducted at the research field of Oilseed Research Centre, Bangladesh Agricultural Research Institute, Gazipur during rabi season of 2021-2022. There were six treatments viz. 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. The experiment was laid out in Randomized Complete Block Design with three replications. The unit plot size was 4m x 5m. Seeds of sunflower (BARI Surjomukhi-3), khesari (BARI Khesari-4) and gardenpea (BARI Motorshuti-3) were sown on 21 November, 2021. Fertilizers at the rate of $N_{88}P_{34}K_{80}S_{28}Zn_3B_2$ $kgha^{-1}$ 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).

At harvest, the yield data was recorded plot wise. Collected data were analyzed statistically and means were adjusted by LSD test at 5% level of significance using SPSS. 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. Although intercropping reduced sunflower yield but total productivity was increased due to addition of pea and khesari yield. Total productivity in terms of sunflower equivalent yield (SEY) (6.64 t/ha) was found the highest from T_3(two rows of pea in between two normal rows of sunflower treatment while the lowest (1.72 t/ha) in T_1 (sole sunflower). Highest benefit cost ratio (BCR) (3.80) was recorded in T_2 treatment (one row of gardenpea in between two normal rows of sunflower) with highest gross margin (Tk.244012/ha).

Intercropping of soybean with sunflower in southern region of Bangladesh

M.A. Rahman, F. Begum and M.M. Rahman

The field experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during the Rabi season of 2021-22 under the project entitled, "Expanded Production of Oilseed Crops (EPOC)" ORC, BARI to find out the suitable sunflower and soybean intercropping system(s) for the southern region of Bangladesh. Eight treatments (intercrop ratio) viz., T_1 = Sunflower: Soybean = 1:1, T_2 = 1:2, T_3 = 1:3, T_4 = 2:1, T_5 = 2:2, T_6 = 2:3, T_7 = Sole sunflower and T_8 = Sole soybean were evaluated in this experiment. The plant spacing for sunflower single row was row to row distance 50 cm and plant to plant distance 25 cm. Spacing for sunflower double row was row to row 40 cm and plant to plant distance 25 cm. Spacing for soybean was row to row distance 30 cm and plant to plant distance 5 cm in between two sunflower sows as well as for sole soybean. The experiment was laid out in randomized complete block design with three replications. Sunflower and soybean varieties were BARI Surjomukhi-3 (dwarf type) and BARI Soybean-6, respectively. All the studied parameters of sunflower varied significantly except plant height and number of seed/head. The highest photosynthetically active radiations were recorded in both sole sunflower and soybean crops (605.44 and 603.00 µmol $m^{-2}s^{-1}$, respectively), which were identical to T_6 treatment (413.22 µmol $m^{-2}s^{-1}$). In case of sunflower crop, sole sunflower gave the highest yield (2643 kg/ha) and partially similar yields were also obtained from T_4 and T_5 treatments (2541 and 2420 kg/ha, respectively). The treatments varied significantly in terms of all the studied parameters of soybean, Sunflower equivalent yield (SEY) and Land equivalent ratio (LER). For soybean, sole soybean gave the highest yield of seed (1726 kg/ha). In respect of SEY, treatment T_2 showed the highest yield (2983 kg/ha), which was partially similar to the treatments of T_6 (2871 kg/ha), T_4 (2708 kg/ha), T_5 (2682 kg/ha) and T_3 (2673 kg/ha). The highest LER (1.34) was computed in T_2 treatment and statistically similar value (1.28) was also observed in T_6 treatment. The gross margin became higher in T_2 and T_6 treatments (Tk. 144614 and 137200/ha). Among intercropping systems, treatments T_2 (Sunflower : Soybean = 1-row : 2-row) and T_6 (Sunflower : Soybean = 2-row : 3-row) gave more Sunflower equivalent yield (SEY) and Land equivalent ratio (LER) and economic return than that of other treatments. The SEY and LER values of T_2 and T_6 treatments indicated their suitability towards increasing the total productivity and land use efficiency in southern region of Bangladesh. The treatment T_2 and T_6 were also more profitable as compared to that of other treatments.

Performance of sunflower genotypes in southern region of Bangladesh

O. A. Fakir and F. Begum

The experiment was conducted at Agricultural Research Station (ARS), Binerpota, Satkhira during rabi season, 2021-2022. The objective of the study was to evaluate the performance of BARI developed two sunflower varieties in saline area of Satkhira. Two sunflower varieties. BARI Surjomukhi-2 and BARI Surjomukhi-3 were taken as treatment in this experiment. The experiment was laid out in randomized complete block design (RCBD) with three replications. The unit plot size was 11mx4m. The land was prepared by 2-3 ploughing and fertilized with 90-35-80-30-4 kg/ha of N-P-K-S-Zn+5 t/ha CD in the form of urea, TSP, MoP, gypsum and zinc sulphate. All fertilizers and half of total amount of urea were applied as basal during final land preparation. Rest amount of urea was broadcasted at 25 and 45 days after emergence (before flowering). Seeds were sown on 22 December, 2021 in joe condition. Before sowing seeds were treated with Provax-200 WP at the rate

of 2.5 g/kg of seed. Weeding and thinning were done as and when necessary. The land was irrigated two times. No insect and disease was seen at standing crop. The crop was harvested on 24 March, 2022 at physiological maturity stage. Yield and yield components of sunflower were recorded and data were analyzed statistically.

Yield was significantly varied. Between two varieties BARI Surjomuhi-2 gave the highest yield and it was 2.73 t/ha while BARI Surjomukhi-3 produced 2.17 t/ha. During crop growing period the average soil salinity was 4.65 to 5.75 dS/m.

Performance of sunflower genotypes in the hilly areas of Bangladesh

M. A. Hossain, M. Islam and M.Karim

An experiment was conducted at the Hill Agricultural Research Station, Raikhali, Kaptai, Rangamati Hill District during rabi season 2021-22. There were two varieties of Sunflower BARI Surjamukhi-2 and BARI Surjamukhi-3 . The objective was to compare the performance of developed varieties of sunflower. The land was prepared with 4-5 crossed plough and harrowing for pulverizing the soil. The seeds were sown on 14 December 2021 maintaining 50 × 25 cm spacing. The fertilizer applied @ 200 kg urea, 150 kg TSP and 150 MoP, 120 kg gypsum, 8-10 kg Zinc Sulphate, 10 kg Boric acid per hectare. Urea was applied as split and One third Urea and other fertilizers were applied during land preparation. The rest of urea was applied during 20-25 days and 40-45 days after germination. Other intercultural operations were done according to BARI technology hand book. The crop was harvested on Mid-March 2022. The days taken for first flowering of BARI Surjamukhi-2 was 61.3 which was similar to BARI Surjamukhi-3 (59.3) . The variety BARI Surjamukhi-3 was the most dwarf (93.3 cm) and significantly different from BARI Surjamukhi-2 (172.0 cm). Head weight was highest in the BARI Surjamukhi-2 (144.0 g) followed by BARI Sunflower-3 (136.3 g). Hundred seed weight was higher in BARI Surjamukhi-2 (9.3 g). The seed yield was significantly higher in BARI Surjamukhi-2 (2.3 t/ha) followed by variety BARI Surjamukhi-3 (1.9 t/ha) . Both varieties of sunflower showed good performance. Considering the yield and other character, both varieties of sunflower may be recommended for cultivation in hilly areas.

Performance of sunflower varieties in Borguna

M M Islam, KN Islam and MSI Khan

The experiment was conducted at Amtoli, Borguna during the Rabi season, 2021-22 to evaluate the performance of advanced lines and varieties of sunflower in coastal saline environment under farmers field condition. Three sunflower varieties BARI Surjamukhi-2, BARI Surjamukhi-3 and Hysan-33 were evaluated in the trial. BARI Surjamukhi-2 and 3 were composite variety. Hysan-33 is a hybrid variety marketed by BRAC. The materials are evaluated in RCB design with 3 compact replications. The experimental land was ploughed with 4 pass then laddered to prepare plots. Chemical fertilizer was applied @ $N_{90}P_{75}K_{30}S_{25}$ kg/ha. Half Urea and full doses of all other fertilizers were applied at final land preparation. The rest Urea was applied in two equal split at 25 days after sowing (DAS) and 45 DAS. Unit plot size was 8mx5m. Seeds were sown on 07 January 2022 maintain 60cm x 25cm spacing. The field was irrigated twice at 25 DAS and 45 DAS in the growing season. To control catterpiller, Admair and Cortan Plus were sprayed twice at flowering stage and grain filling stage. Soil samples were collected from each plot at 15 days interval for salinity measurement in laboratory. The crops were harvested 10 April to 25 April 2022. Yield and yield attributes were recorded properly and analyzed over the location. Statistically significant differences were found in grains/head, 1000 grain wt. and grain yield. The highest yield was observed from the Hysun-33 (1.98 t/ha) that are statistically similar to BARI Surjamukhi-2 (1.95) and the lowest yield was obtained from the BARI Surjomukhi-3 (1.72t/ha).

Farmers opined that among the three varieties Hysun-33 performed better, plants were similar in height, flowers initiation start in a same time in all the plants. The yield of BARI Surjomukhi-2 is about to same of Hysun-33. Plants of BARI Surjomukhi-3 are very short but yield is very low and bird attack is severe in this variety. The farmers showed their interest to grow sunflower next year to fulfill their oil consumption if the seeds were made available in the local market.

Insect Pest Management

Development of IPM package against the major insect pests of sunflower

M.A. Islam and R. Islam

The experiment was conducted during *rabi* season 2022 at ORC research field, BARI, Gazipur to develop effective management approach against major insect pest of sunflower. The experiment was laid out in a randomized complete block design with three dispersed replications. Sunflower seeds (BARI Surjamukhi-3) were sown on 22 November 2021 at Gazipur. The unit plot size was 4.5 m x 4.0 m with 30 cm row to row and 1 m plot to plot distance. The normal intercultural operations were done as and when necessary. The treatments were as follows: T_1(IPM Package-1) = Hand picking of larvae + Sex pheromone mass trapping of *Spodoptera litura*+ Application of Spinosad (Success 2.5 SC) @ 1.2 ml/litre of water, T_2(IPM Package-2) = Hand picking of larvae + Sex pheromone mass trapping of *Spodoptera litura* + Application of SNPV @ 2 g/10 litre of water, T_3(IPM Package-3) = Hand picking of larvae + Sex pheromone mass trapping of *Spodoptera litura*+ Bio-chamak (*Celastras angulatas* 1% EW) @ 2.5 ml/litre of water, T_4 = Farmers practice (Application of Nitro 505 EC @ 0.1ml/litre of water),T_5 = Untreated control.

Results indicate that (Nitro 505 EC) @1.0 ml/L of water) as well as (White sticky trap + Perching+ Bio-chamak (Celastras angulatas 1% EW) @ 2.5 ml/litre of water) were effective against major insect pest of sunflower with higher yield and marginal benefit cost ratio**.**

F. Linseed (*Linum usitatissimum*)

Maintenance and evaluation of linseed germplasm

Towhidi Almas Mujahidi

Forty linseed genotypes including check variety Neela were evaluated and maintained in the experimental field of Oilseed Research Centre, BARI, Gazipur during rabi 2021-22. The highest % CV was recorded for the parameter plot yield followed by number of branches.

G. Niger (*Guizotica abyssinica* Cass.)

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

Towhidi Almas Mujahidi

A total of twenty Niger genotypes were grown to evaluate and maintain at ORC, BARI during rabi 2021-22. 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*)

Towhidi Almas Mujahidi

A total of six Niger lines including released variety Shova were evaluated at ORC, BARI, Gazipur during rabi 2021-22. Among the genotypes the most dwarf genotypes were Nig-3606 and the tallest entry was Shova. The maximum yield (kg/ha) were obtained from Nig-3706 followed by Shova.

H. Safflower (*Carthamus tinctorius*)

Maintenance and evaluation of safflower germplasm

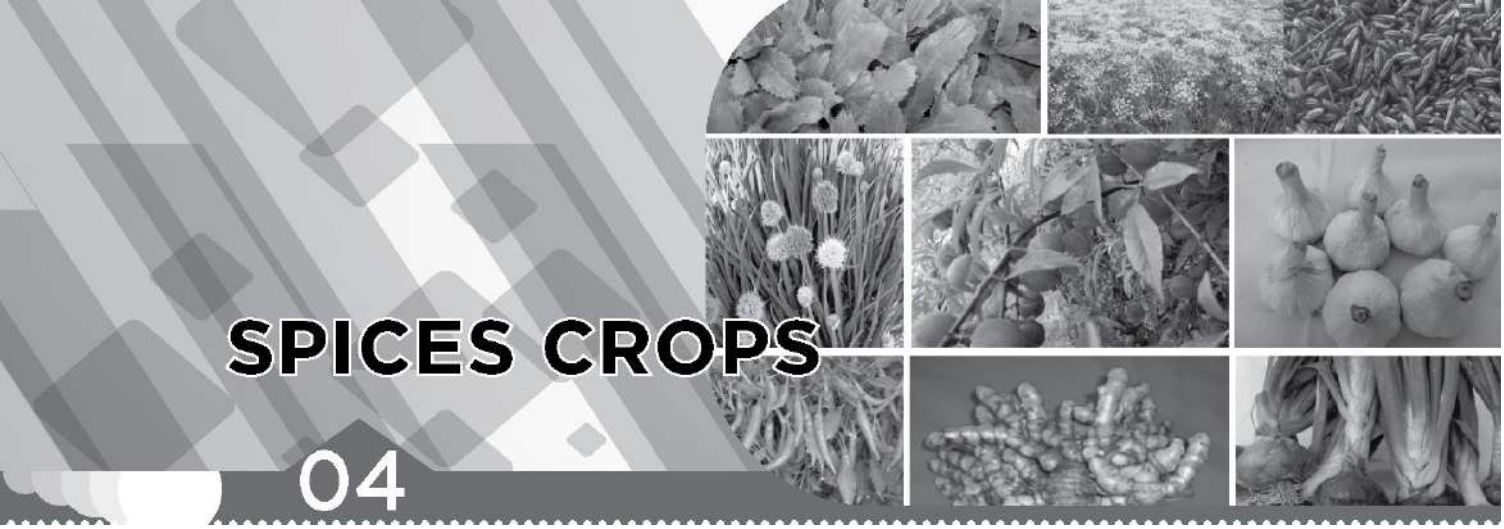
Towhidi Almas Mujahidi

Seven safflower genotypes including released variety BARI Saff-1 were grown to maintain and evaluation during rabi 2020-21. Maximum % CV were found for the parameter10 plant yield (g) followed by number of pod per plant. Collected seeds were preserved properly which would be grown next year for further research work.

Observation trial of safflower (*Carthamus tinctorius*)

Towhidi Almas Mujahidi

A total of five safflower lines including released variety BARI Saff-1 were evaluated at ORC, BARI, Gazipur during rabi 2021-22. Among the genotypes the most dwarf genotype was Saff-503. The maximum yield (kg/ha) were obtained from Saff-t-2017.



Onion

Varietal development

Development of diverse onion germplasm through hybridization

M. A. Alam, M. A. Khan, A. H. F. Fahim, S. N. Mazumder, H. Reza and M. M. Anwar

An experiment was conducted to produce F_2 bulbs from F_2 seeds with the main goal to develop diverse onion germplasm through hybridization at Spices Research Centre, Shibganj, Bogura during 2021-22. BARI Piaz-1, BARI Piaz-4 and BARI Piaz-6 were used in this study. Diallel mating design was followed for crossing in the season 2018-19. Approximately 6-20 Kg bulbs of six different populations were harvested from the F_2 seeds. Few crosses were found promising and might be advanced to develop elite breeding lines for onion.

Development of inbred lines of onion (Advancing of generation S_1 seed to S_1 bulb)

M. A. Alam, M. M. Hasan, A. H. F. Fahim, S. N. Mojumdar, M. H. Reza and M. M. Anwar

An experiment was conducted to develop superior homogenous and homozygous inbred germplasm at Spices Research Centre, Shibganj, Bogura during 2021-22. Segregating germplasm (Parent-Ac Gaz 379) were used in this study. Approximately 7 Kg of S_1 bulbs were harvested from S_1 seed which will be used to produce S_2 seeds in the next season.

Development of Inbred lines in onion (S1 Bulb to S2 Seed) Set-II

M. A. A. Khan, S. N. Mozumder, S. Brahma, R. Ara, M. I. Haque, M. S. Zaman

Four poly crossed onion bulb population was planted in separate line for random mating in a netting cage. Random mating was allowed among the population and seed from the individual lines were harvested and stored separately for utilization in next generation.

Development of inbred lines in onion (S_1 seed to S_1 Bulb) Set-III

M. A. A. Khan, S. N. Mozumder, S. Brahma, R Ara, M. N. Yousuf & H. C. Mohanta

An experiment was conducted to Advance S_1 seed to S_1 bulb generation of onion for Inbred line development at Regional Spices Research Centre, BARI, Gazipur during 2021-22. Twenty one collected onion lines were grown for advancing seed to bulb generation. Total 38.64 kg Bulb were collected from different onion lines and preserved for advancing generation in the next year.

Population development in onion

M. A. A. Khan; M. N. Yousuf; S. Brahma ; S. N. Mazumder and H. C. Mohanta

Three exotic onion genotypes were crossed with BARI Piaj-1 and BARI Piaj-4 at Regional Spices Research Centre, BARI, Gazipur during *rabi* 2021-22 in order to create variability. Six successful crosses were obtained with minute amount of seeds. F_1 seeds were stored and will be grown in the next growing season to test the cross confirmation.

Mass selection of short-day onion

M. A. A. Khan, S. N. Mozumder, R. Ara, S. Brahma, M. N. Yousuf and H. C. Mohanta

An experiment was conducted to grow and evaluate local and exotic open pollinated promising onion genotype for mass selection at Regional Spices Research Centre, BARI, Gazipur during rabi 2021-22. Thirty-six onion genotypes including two Check varieties BARI Piaz-1 & 4 were characterized and evaluated in this experiment. The experiment was randomized in alpha lattice design with two replications. On the basis of traits association with bulb yield and mean performances of the genotypes

Ac Bog409, Ac Bog411, Ac Bog414, Ac Bog419, Ac Bog420, Ac Bog427, Ac Bog428, Ac Bog433, Ac Gaz381, Ac Gaz382, Ac Gaz383, Pc03 and Pc04 were found promising for mass.

Searching of male sterile and maintainer lines of onion

M. A. Alam, M. A. Khan, M. N. A. Chowdhury, S. N. Mazumder and H. Reza

An experiment was conducted to search male sterile and maintainer lines of onion at Spices Research Centre, Shibganj, Bogura during 2021-22. A total of 18 experimental test cross F_1 were used in this study. Topcross (Line x Tester) design involving single male parent) mating design was followed for crossing in the season 2020-21. Approximately 3.46 to 16.8 Kg of F_1 bulbs were harvested from different cross combinations which will be used to produce F_2 seeds in the next season. Performances of some F_1's were promising and could be utilized in future breeding program to develop superior inbred lines or base population.

Evaluation and selection of poly-crossed onion population

M. A. A. Khan, S. N. Mozumder, R. Ara, S. Brahma, M. N. Yousuf and H. C. Mohanta

After one generation of selfing, seven poly crossed onion bulb population was planted in separate line for random mating in seed production. Random mating was allowed among the population and total 1145 g seeds from the individual plots were harvested and stored separately for utilization in next generation.

Evaluation of selected polycrossed onion bulb population

S. N. Mozumder, R. Ara, M. A. A. Khan, M. I. Haque and M. Shahiduzzaman

The field experiment was carried on at Regional Spices Research Centre, BARI, Joydebpur, Gazipur during *rabi* 2021-22. Four selected polycrossed fourth 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 PC_3Gaz 001 gave the highest bulb yield (15.36 t/ha) while the lowest yield (13.67 t/ha) was obtained from PC_3Gaz 003. Poly-crossing over generation showed gradual uplifting of bulb traits specially bulb size and yield.

Evaluation of onion advanced lines for winter season

M. N. A. Chowdhury, S. N. Mozumder, M. H. Reza and M. M. Anwar

The experiment was conducted at Spices Research Centre, Shibganj, Bogura during November 2021 to April 2022 with a view to evaluating the onion advanced lines for winter season and to select promising winter onion line (s). The experiment was laid out in RCBD with three replications. Eleven advanced lines of onion (ON0333, ON0333-1, ON0333-2, ON0353, ON0353-1, ON0353-2, ON0377, India-1, India-2, Ac Bog Exo 001 & Ac Bog 002) with BARI Piaz-4 and BARI Piaz-6 were used as check in the study. The higher bulb diameter and single bulb weight (5.50 cm & 52.61 g, respectively) was recorded from ON0353 and the lowest (4.20 cm & 28.80 g, respectively) was observed from Ac Bog Exo 001. The highest bulb yield (30.36 t/ha) was found from ON0353 while the lowest (12.50 t/ha) was recorded from Ac Bog 001. The line, ON0353 gave the highest TSS (14.38%) and the lowest (10.23%) was found from Ac Bog Exo 001. Moderately resistant to purple leaf blotch disease was recorded from ON0333-1, ON0333-2, ON0353, ON0353-2, ON0377, India-1, BARI Piaz-4 and BARI Piaz-6 and rest of them showed moderately susceptible. Considering all the characters, ON0333-2, ON0353, ON0353-1, ON0353-2 and India-1 were performed promising.

Advanced yield trial of onion

M. A. Alam, M. M. Hassan, A. H. F. Fahim, M.A. Rahman, M. A. Mottalib, S. N. Mazumdar, M. M. Anwar and H. C. Mohanto

The present experiment was conducted to select superior winter onion germplasm for higher yield at Spices Research Centre, Shibganj, Bogura during 2021-22. Twelve onion genotypes including BARI Piaz-4 as check were used in this study. The experiment was laid out in alpha lattice design with two replications. Quite a few genotypes out yielded the check entry BARI Piaz-4. Considering yield and other attributes the genotype Ac Bog 429, Ac Bog 431, Ac Bog 414 etc. were found promising.

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

M. A. Khan and M. M. Rahman

A field experiment was conducted at SRSC, BARI, Faridpur, Bangladesh during 2020-21. 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. After sowing the onion seeds, no seed of AC Bog 426 and AC Bog 430 was germinated due to unidentified factors. However, AC Bog 413 was compared with the check variety. The trial was evaluated in a RCBD with four replications. The results revealed that promising line AC Bog 413 had superior in incidence of bolting (0.00%), disease severity score (1.97), polar diameter of bulb (4.50 cm), equatorial diameter of bulb (4.53 cm), individual bulb weight (39.43 g), split bulb (0.03%) and fresh yield (24.30 t/ha), dry yield (3.42t/ha) over the check variety BARI Piaz-1. The AC Bog 413 gave around 34.89% and 35.08% higher fresh and dry bulb yield, respectively than those of BARI Piaz-1. Anyway, the BARI Piaz-1 had stronger pungency score (5.00) than that of AC Bog 413 (4.00). The AC Bog 413 expressed light red skin colour and reddish flesh colour of bulb. Moreover, BARI Piaz-1 exhibited bronze red skin colour but white flesh colour of bulb. The AC Bog 413 showed flat to globular shape of bulb while BARI Piaz-1 demonstrated flat shape of bulb. The bulb firmness score of BARI Piaz-1 and AC Bog 413 was similar to each other. Finally, the AC Bog 413 was found as superior line for conducting RYT of winter onion.

Advanced yield trial of white onion

M. N. A. Chowdhury, S. N. Mozumder, M. H. Reza and M. M. Anwar

The experiment was conducted at Spices Research Centre Shibganj, Bogura during November 2021 to April 2022 with a view to studying the performance of white onion lines and to select promising one for for testing regional adaptability especially for dry powder. Two advanced lines of white onion (ON0331 & ON0357) with BARI Piaz-1 and BARI Piaz-6 were used as check in the study. The experiment was laid out in RCBD with four replications. It was found that the highest percentage of mortality (9.60) was observed from BARI Piaz-1 and the lowest (4.07) was recorded in ON0357. BARI Piaz-6 showed higher percentage of bolting (9.60) and the lowest (2.80%) was found in ON0357. The higher percentage of splitted bulb (6.80) was observed from BARI Piaz-1 while the lower (2.10%) was found in ON0331 folowed by ON0357 (3.97%). The highest bulb yield (18.07 t/ha) was recorded from ON0357 and the lowest (12.80 t/ha) was recorded from ON0331. Considering all the characters, ON0357 was found promising.

Advance yield trial of negi onion (*Allium fistulosum* L.) genotypes

M. A. Khan, M. M. Rahman, M. I. Haque, S. Brahma, M. M. Alam, M. K. Hasan and S. N. Mozumder

A field study was carried out at SRSC, BARI, Faridpur, Bangladesh during 2021-22 to find out the superior line on growth, yield and quality of two negi onion genotypes (AF Far 002 & AF Far 003) in Bangladesh conditions. The study revealed that the genotype AF Far 002 of Negi onion exhibited the best performance on the growth, yield of pseudostem & seed and quality aspects in Bangladesh.

Regional yield trial of winter onion

M. N. A. Chowdhury, M. O. Kaiser, M. A. Khan, M. M. Zaman, M. M. Ahamed, S. N. Mozumder, M, H. Reza and M. M. Anwar

The experiment was conducted at Spices Research Centre, Shibganj, Bogura, Regional Spices Research Center Gazipur, Magura and Cumilla, Spices Research Sub-center Faridpur and Lalmonirhat during November 2021 to April 2022 with a view to studying 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 RCBD with four 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 (20.00 t/ha) was recorded at Bogura location and the lowest yield (11.92 t/ha) was recorded at Gazipur location. In case of onion lines, the highest yield (19.36 t/ha) was found from ON0375 while the lowest (13.03 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 (24.99 t/ha) was obtained from ON0375 at Bogura location, while the lowest yield (11.02 t/ha) was obtained from BARI Piaz-1 at Gazipur location. Considering all the characters, ON0375 was found promising for variety release.

Regional yield trial of winter onion against thrips

M. N. A. Chowdhury, M. O. Kaiser, M. M. Ahamed, M. R. Islam, M. M. Rahman, S. N. Mozumder, M. H. Reza and M. M. Anwar

The study was conducted at Spices Research Centre, Shibganj, Bogura, Regional Spices Research Center, Gazipur, Magura and Cumilla and Spices Research Sub-center Faridpur during November 2021 to April 2022 with a view to studying 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 RCBD with four replications. It was found that significantly the highest number of thrips and IYSV per plant (11.71 and 12.64, respectively) was recorded at Bogura location and the lowest (9.84 and 10.07, respectively) was found at Magura location. In case of bulb yield, the highest yield (17.71 t/ha) was obtained at Bogura location and the lowest (10.90 t/ha) was recorded at Faridpur location. The line ON0332 gave the lowest number of thrips and IYSV per plant (3.58 and 4.04, respectively) and the highest (17.16 and 8.51, respectively) was found from BARI Piaz-4. Significantly the highest bulb yield (15.23 t/ha) was found from ON0332 while the lowest (11.44 t/ha) was found from BARI Piaz-1. Considering the thrips population and bulb yield the line ON0332 performed better in all locations. In respect of soil health, environmental issue and other yield contributing traits, ON0332 was found promising for variety release.

Assessment of keeping quality in onion genotypes for long term storage

M. A. Alam, M. M. Hassan, A. H. F. Fahim, M.A. Rahman, M. A. Mottalib, S. N. Mazumdar, M. H. Reza and M. M. Anwar

In Bangladesh, there is a scarcity of information on bulb onion storage losses and their causes, which hampers the development of postharvest loss reduction techniques. A three-year study on storage onion bulb was conducted in 2019, 2020, and 2021 to quantify postharvest losses and choose the best genotypes for storability. The genotypes were cultivated under the same conditions and kept at room temperature. Total rotten were found 27.50% to 36.76% and total sprouted were observed 4.09% to 10.64%. Total moisture losses were found from 33.44% to 42.17%. There was significant variation were present among genotypes in terms of % total rotten, % total sprouted and % total moisture loss in the three years. The gradual change in time interval were found % of rotten (2.96%) to 6.87% at first observation, whereas the 9th observation the range were 27.50% to 42.91%. Percent moisture losses were 3.3% to 8.23% at 1st observation on the contrary 33.44% to 42.17%. Per observation average % rotten ranges were 4.97% to 6.23% and % sprouted 0.67% to 2.26% whereas % moisture losses were found 5.39% to 8.39%. Based on storability the genotype Ac Bog 421, Ac Bog 423, Ac Bog 425, Ac Bog 430, Ac Bog 431, Ac Bog 413, Ac Bog 414, Ac Bog 420, Ac Bog 379 were selected for future use in breeding program.

Study on winter onion varieties on the quality of onion bulb (Allium cepa L.)

M. A. Khan and M. M. Rahman

The experiment was conducted at SRSC, BARI, Faridpur, Bangladesh during 2021-22 to observe the potentialities of quality including dry yield of existing three winter onion varieties (BARI Piaz-1, BARI Piaz-4 and BARI Piaz-6). The check variety LalTeer King was taken, developed by LalTeer Seed Litimited, Bangladesh. The results of the experiment revealed that the quality parameter studied were significant among the varieties except days to maturity of bulb. The BARI Piaz-4 had significantly the maximum dry yield (3.27t/ha) and minimum percent bolting (11.51%) over other three varieties. The BARI Piaz-1 exhibited superior performance on dry matter, TSS, bulb firmness, pungency and quantity & quality (texture/colour) of Beresta (caramelized onions). The BARI Piaz-6 gave the best performance on incidence of split bulb and pungency. The variety LalTeer King performed best on the incidence of diseases. The BARI Piaz-1, BARI Piaz-6, BARI Piaz-4 and LalTeer King expressed bronze red, next to bronze red, pink red and light red skin colour, respectively. The flesh colour of bulb was reddish in BARI Piaz-4 and LalTeer King. But, BARI Piaz-1 and BARI Piaz-6 demonstrated white flesh colour in bulb. Only BARI Piaz-1 had the flat shape bulb. Globular to torpedo shaped bulb was observed in BARI Piaz-4. However, BARI Piaz-6 and LalTeer King showed the similar shaped of bulbs (flat to globular). The variety BARI Piaz-1, BARI Piaz-6, LalTeer King gave highly crispy, crispy, light crispy and soft

Beresta, respectively. The excellent (richly brown) and good (brown) colours of Beresta were observed in BARI Piaz-1 and BARI Piaz-6, respectively. However, the colours of Beresta for BARI Piaz-4 and LalTeer King were very poor (darkish).

Purification of BARI released onion varieties

M. A. Alam, M. A. Khan, H. Reza and M. M. Anwar

An experiment was conducted to purify existing onion varieties at Spices Research Centre, Shibganj, Bogura during 2021-22. BARI Piaz-1 and BARI Piaz-4 were used in this study. Approximately 50 and 45 Kg bulbs of BARI Piaz-1 and BARI Piaz-4 varieties respectively were selected and conserved as true to type. At the same time approximately 38 and 34 Kg bulbs of BARI Piaz-1 and BARI Piaz-4 varieties, respectively were discarded due to different size, shape and color.

Stress breeding

Screening of onion germplasm for salinity tolerance

M. A. Alam, M. A. Rahman, M. M. Hassan, M. S. Naher, A. H. F. Fahim, S. N. Mozumder and M. H. Reza

The present experiment was conducted to evaluate the performance of onion across different salinity stress conditions at Spices Research Centre, Shibganj, Bogura during 2021-22. Twenty-four onion genotypes including BARI Piaz-4 as check were used in this study. Quite a few genotypes performed better than the check entry BARI Piaz-4. Few of the studied genotypes were found promising and need to be further evaluated at replicated pot to confirm the result and to recommend as elite breeding lines for cultivation at coastal belt having elevated salinity levels.

Cultural management

Yield and quality of seed bulb of onion after seed production

R. Ara, S. N. Mojumder, S. Brahma, M. N. Yusuf, A. A. Khan, M. M Ahmed and M. M Rahman

An experiment was conducted at RSRC, Gazipur, SRSC, Faridpur and SRSC, Lalmonirhat during 2021-22 with a view to assessing the yield and study the performances of onion seed / mother bulbs after seed production regarding quality and shelf life. Three onion varieties were the test crops following disperse design. Bulbs were planted on 18- 20 November 2022. The unit plot size was 5.0 m × 1.2 m and 3.0 m x 1.0 m, respectively maintaining 30 cm line to line and 15 cm plant to plant spacing. Seeds were harvested separately on 01-02 April 2022 and after harvesting the seeds, mother bulbs were started to harvest from 8-10 April 2022. It was found that the performance of BARI Piaz-4 was the best among three varieties at Gazipur while BARI Piaz-1 performed better compared to BARI Piaz-6 at Faridpur location. A noticeable amount of bulbs (7.98 t/ha, BARI Piaz-4 at Gazipur and 8.6 t/ha, BARI Piaz-1 at Faridpur) can be harvested after seed production and the quality as well as shelf life was also satisfactory. It is a first- year result. All attributes of quality and shelf life are to be studied including normal bulbs (from Seedling) in next season.

Effect of planting method and sowing time on yield and quality of onion (*Allium cepa* L.)

M. A. Khan and M. M. Rahman

The research work was conducted at Spices Research Sub-Centre (SRSC), BARI, Faridpur during the season of 2021-22. The trial was laid out to compare the two planting methods (growing onion through conventional set method and growing onion by late transplant kharif onion) and three sowing times (October 10, October 25 and November 10). The study was placed down in RCBD with three replications. The study revealed that the maturity of bulbs, yield and quality of onion were responded significantly by the planting methods, sowing times and their combined effects with minor exception. The higher bolting (37.34%), split bulb (88.28%), TSS content (19.29°brix) and dry matter content of bulb (20.96%) were found from set method. Set planting method gave the minimum days to maturity of bulb (80.28 days), diameter of bulb (3.79 cm), individual bulb weight (24.57g) as compared to those (114.12days, 4.43cm and 32.73g) of late kharif onion, respectively. The higher dry bulb yield was recorded from set method (4.44t/ha) which was 2 times more than that (2.11t/ha) of kharif onion. October 10 sowing had the maximum (43.28%), days to maturity of bulb (100.92days), diameter of bulb (4.35cm), weight of individual bulb (34.50g) and fresh (24.67t/ha) & dry (3.78t/ha). November 10 sowing showed the minimum bolting (20.12%), days to maturity of bulb (93.55days), diameter of bulb (3.72cm), weight of

individual bulb (20.61g) and fresh (17.02t/ha) & dry yield (2.82) t/ha. The combined effect of onion set planting x October 25 had the highest dry yield of onion (4.99t/ha).

Effect of sowing time and bulb size on seed yield of BARI Piaz-6 in AEZ-3

M. E. Haque, M. M. Ahmed and M. N. Farid

The experiment was conducted at Spices Research Sub-Center, BARI, Lamonirhat, during October 2021 to April 2022 to find out the optimum sowing time and seed bulb size for true onion seed production of BARI Piaz-6in northern region of Bangladesh. The factorial experiment was designed with threes sowing times *viz*., 25th October 10th November and 25th November along with two seed bulb sizes i.e., small (15± 5g) and medium (25±5g). The trial was laid out in RCB design with three replications. Medium size bulb sown on 10 November consistently accomplished all the parameters studied. Medium size bulb sown on 10 November performed the highest seed yield (676.80 kgha^{-1}) followed by 25-October planting × Medium (25± 5 g) size bulb (558.47 kgha^{-1}). The lowest seed yield of 157.34 kgha^{-1} was harvested on 25 November × Small (15± 5g) size bulb. Planting of medium size onion bulb in early November is suitable for true seed production of BARI Piaz-6 in the northern part of Bangladesh.

Effect of variety and seed rate on the yield and quality of onion (*Allium cepa* L.) Sets

M. A. Khan and M. M. Rahman

A field study was carried out at Spices Research Sub-Centre (SRSC), BARI, Faridpur during the season of 2021-22. The experiment was conducted with the objectives of searching optimum seed rate and comparing varieties in producing onion sets. The treatment consisted of varieties, namely BARI Piaz-1, BARI Piaz-4, BARI Piaz-6 & LalTeer king and six seeding rate such as 2 g seeds/m^2, 4 g seeds/m^2, 6 g seeds/m^2, 8 g seeds/m^2, 10g seeds/m^2 & transplanting of seedlings densely. The trial was designed with RCBD in 3 replications. The data revealed significant difference in all characters studied in the present trial due to the main effects of variety with minor exception, seed rates and their combined effects. The variety BARI Piaz-1 had the highest optimum (4-6g) sets (60.64%), significantly followed by BARI Piaz-4 (57.53%) and BARI Piaz-6 (57.50%) and LalTeer King showed the lowest optimum sets of onion (51.07%). In addition, reverse finding to percent optimum set was recorded in undersized (<4g) sets for same varieties. The maximum and minimum bolting were counted from BARI Piaz-1 (2.96%) and BARI Piaz-6 (2.33%). LalTeer King produced the highest set yield (13.57t/ha) and BARI Piaz-1 gave the lowest yield (11.65t/ha). Onion sets matured so late (154.15days) in transplants method as compared to seeding methods. Among the seeding method, seeding 10g/m^2 took the lowest time to mature of sets (129.70days). The transplant method had the highest bolting (6.48%) and seeding 10g/m^2 was the lowest (1.07%) bolting. The shape index of set was increased with the increasing in plant density ranging from 1.10-1.38. The shape index in transplant was 1.16. The highest optimum set was obtained from seeding 6g/m^2 (65.74%) significantly followed by seeding 4g/m^2 (61.15%) and transplanting of seeding (60.59%). Seeding 10g/m^2 and transplanting of seedlings exhibited the maximum (33.14%) and the minimum (9.29%) undersized sets, respectively. The set yield was increased with the increase in seeding rate up to 8g/m^2 and thereafter the set yield was decreased. However, transplant produced the highest set yield (13.50t/ha) and seeding 2g/m^2 gave the lowest yield (9.71t/ha). The sets of BARI Piaz-1 and BARI Piaz-4 were the least and the most prone to be thinned/heightened in excess plant density, respectively.

Performance of varieties on the yield and quality of onion (*Allium cepa* L.) Through set to bulb method

M. A. Khan and M. M. Rahman

The experiment was laid out at Spices Research Sub-Centre (SRSC), BARI, Faridpur during the winter season of 2021-22. The study was conducted to explore potentialities of new developed varieties such as BARI Piaz-4, BARI Piaz-6, LalTeer King and BARI Piaz-1 (as check) for getting higher yield and quality of onion in set to bulb method. The trial was carried out in RCBD with three replications. The finding depicted that the varieties responded significantly on the parameters studied except days to maturity of bulb and disease rating. The variety BARI Piaz-4 and LalTeer King showed the best performance on the basis of incidence of bolting, split bulb, diameter of bulb, individual bulb weight and yield of onion in set to bulb method. On the

other hand, BARI Piaz-1 had the highest dry matter content and total soluble solid content against other varieties. Finally, new developed varieties such as BARI Piaz-4 and LalTeer King would be used to produce early green onions in set to bulb method.

Study of maturity indices on the true seed production of different winter onion varieties

M. M. Ahmed, M. E. Haque, and M. N. Farid

A field trial was carried out during the *rabi* season of 2021-22 at Spices Research Sub-Centre, BARI, Lalmonirhat to study the effects of maturity indices of different onion varieties on the quality true seed production. Three onion varieties *viz*., (BARI Piaz-1, BARI Piaz-4 & BARI Piaz-6) were examined at three levels of maturity indices (10% exposed of onion seed; 20% exposed of onion seed & 30% exposed of onion seed) were used as treatment having a RCBD with three replications. The highest result was recorded in respected of germination percentage (66.0%), shoot length (4.09 cm), seedling length (4.99 cm) and vigor index (352.14) except root length under BARI Piaz-1 followed by BARI Piaz-4 & BARI Piaz-6. Regarding maturity indices, all parameters responded in highest performance with 30% exposed of onion seed but a statistically similar trend was found in 20% exposed of onion seed regarding seedling length and vigor index. However, the treatment combination of BARI Piaz-1 with 20% exposed to onion seed performed highest in respect of all parameters which is statistically similar to treatment combination BARI Piaz-1 with 30% exposed to onion seed followed by the rest of other treatment combination.

Soil and water management

Effect of different organic fertilizers on yield and quality of onion

M. A. Rahman, M. N. A. Chaudury, K. M. Khalequzzaman, M. A. Alam, M. H. Reza, M. M. Anower and H. C. Mohanta

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the *rabi* season of 202 -22 to know the effect of different organic fertilizers on yield and quality of onion. There were four treatment combinations *viz*., T_1: 100% recommended dose of chemical fertilizer (RDCF) + 5 t/ha compost (control), T_2: 75% RCF + 25% from vermicompost, T_3: 75% RCF + 25% from tricho-vermicompost and T_4: 75% RCF + 25% from tricho-compost studied in RCBD with five replications. Positive effects of different treatments were recorded on yield and yield contributing characters of onion. Highest yield (18.22 t/ha) was found in T_3. Storage capacity of bulb after 2 months was recorded highest in T_3 and T_4 in respect of number and weight percentage. Highest level of gross margin (tk. 266182), BCR (1.50) and MBCR (1.57) were obtained from T_4.

Effect of different levels of nutrients on growth, yield and storage capacity of winter onion

M. A. Rahman, M. N. A. Chaudury, M. A. Alam, M. H. Reza, M. M. Anower and H. C. Mohanta

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the *rabi* season of 2021 - 2022 to know the effect of different fertilizer management practices on growth, yield and storage capacity of winter onion. There were five treatment combinations *viz*., T_1: N_0 K_0 S_0 + other nutrients as per FRG recommendation (Control), T_2: N_{110} K_{75} S_{50} + other nutrients as per FRG recommendation, T_3: N_{140} K_{120} S_{70} + other nutrients as per FRG recommendation, T_4: N_{160} K_{160} S_{80} + other nutrients as per FRG recommendation and T_5: N_{200} K_{200} S_{100} + other nutrients as per FRG recommendation studied in a RCBD with four replications. Positive effects of different treatments were recorded on yield, yield contributing characters and storage capacity of onion. Highest yield (20.75 t/ha) was found in T_5. Storage capacity of bulb after 2 months was recorded highest in T_4 in respect of number (10.52%) and weight (3.98%). Highest level of gross margin (tk. 266182), BCR (1.50) and MBCR (1.57) were obtained from T_4. Highest level of gross margin (tk. 563731), BCR (2.19) and MBCR (7.08) were obtained from T_5.

Nutrient management on growth and bulb yield of onion

M. N. Yousuf, S. Brahma, M. A. A. Khan, M. I. Haque, R. Ara and H. C. Mohanta

A field experiment was conducted at Regional Spices Research Centre, BARI, Gazipur to find out the varietal efficacy under different nutrient management package of onion (*Allium cepa* L.) during *rabi* season of 2021-22. The experiment was designed in Factorial RCBD having three replications. The treatment composed of three onion varieties, namely [BARI Piaz-1(V_1), BARI Piaz-4 (V_2) and BARI Piaz-6 (V_3)] with three nutrient management packages i.e., 100% RDF (120-60-100-

20-3-1.5 kg N-P-K-S-Zn-B ha^{-1}) + Cowdung 5 tha^{-1} (N_1), and 100% RDF + Poultry manure 3 t ha^{-1} (N_3) kg ha^{-1}. The individual as well as interaction effect of onion varieties and nutrient management packages showed significant effect on yield and yield contributing parameters, of onion. The highest bulb yield (29.24 t ha^{-1}), marketable bulb yield (27.87 t ha^{-1}) were recorded when onion variety BARI Piaz-4 cultivated under 100% RDF + Vemicompost 3 t ha^{-1} (N_2) in the study area. Total PLW was higher (16.3% in Gazipur and 21.1% in Lalmonirhat) with irrigation was given applied at 10% depletion of field capacity and application of 150 kg N ha^{-1} during 60 days of storage.

Insect pest management

Population dynamics and management of thrips in bulb onion by using trap crops

M. M. Hossain, H. C. Mohanta, M. H. Reza, M. A. Sarker and N. K. Dutta

The field study was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh (geographic coordinates 25.0167° N, 89.3167° E) during *rabi* season of 2021-22 to study the population dynamics and to evaluate the effectiveness of trap cropping Marigold, Carrot, Tomato and French bean with onion for the management of onion thrips. BARI Piaz-6 was the onion variety. The treatments were T_1=Onion protected by trap cropping with marigold; T_2= Onion protected by trap cropping with carrot; T_3= Onion protected by trap cropping with tomato; T_4= Onion protected by trap cropping with French bean and T_5= Sole onion. Infestation of onion thrips was started from the first week of February than it become gradually increases to the first week of April after that it was declined. Thrips population were positively correlated with temperature and negatively correlated with relative humidity and rainfall. Average temperature influenced the thrips population by 64 per cent (R^2= 0.64) and a unit increase in average temperature increased the thrips population by 1.27 numbers. Relative humidity and rainfall contributed about 86 per cent and 22 per cent (R^2= 0.86 and R^2= 0.22) in influencing the thrips population and a unit increase in relative humidity and rainfall decreased the thrips population by 0.81 and 0.27 numbers, respectively. Onion protected by trap cropping with marigold, carrot and tomato significantly reduced thrips population up to 58.97%, 52.42% and 48.84%, respectively, but French bean had no significant effect. Significant impact of trap crops to attract the population of T. tabaci as the highest population of *T. tabaci* was recorded on marigold (9.98±0.58 thrips/plant) followed by French bean (7.61±0.51 thrips/plant) whereas the minimum population was observed on carrot (4.12±0.58 thrips/plant) followed by tomato (6.72±1.10 thrips/plant). Maximum onion bulb yield of 15.24 t/ha was obtained in onion protected by trap cropping with marigold followed by onion trap cropped with carrot (13.48 t/ha) and tomato (12.62t/ha), whereas minimum bulb yield was registered in sole onion crop (10.60 t/ha). This study showed that marigold or carrot trap crop should be planted within onions to divert the population of *T. tabaci* from onion, thus lower the damage to onion.

Disease management

Effect of fungicides on quality seed production by reducing purple blotch and stemphylium blight of onion

M. E. Haque, M. M. Ahmed and M. N.Farid and K. M. Khalequzzaman

The experiment was conducted at Spices Research Sub-Center, BARI, Lamonirhat, during October 2021 to April to find out the effective fungicidal package for quality onion seed production. The experiment was laid out in RCB design having four treatments, *viz*., T_1=Seed treatment and foliar spraying with Rovral 50 WP (Iprodion) @ 2g$litre^{-1}$ water, T_2=Seed treatment and foliar spraying with Luna Sensation (Fluopyram +Tryfloxystrobin) @ 1ml $litre^{-1}$ water, T_3=Seed treatment and foliar spraying with Amistar Top (Azoxystrobin +Difenoconazole) @ 1ml$litre^{-1}$ water and T_4=Untreated control. Seed bulb onion treated with Luna Sensation (Fluopyram +Tryfloxystrobin) @ 1ml $litre^{-1}$ water along with foliar spray after first disease appearance successfully controlled purple blotch and Stemphylium blight of onion. Seed treatment and spraying with Amistar Top (Azoxystrobin +Difenoconazole) @ 1ml $litre^{-1}$ water could also be another option for controlling those diseases.

Efficacy of new fungicides for controlling purple blotch disease of onion

M. R. Islam, M. M.Rahman, M. I. Faruk

The experiment was conducted at Regional Spices Research Centre, BARI, Magura during 2021-22 to

find out the effect of different fungicides for controlling purple blotch disease of onion. BARI Piaz-4 was used as the test variety. The experiment was laid out in RCBD with three replications. Total 17 different fungicides with a control were evaluated and significant differences regarding yield and yield attributes were observed among different treatments. The highest yield (15.88 t/ha) was found from fungicide code name 712 which was significantly higher than those of other treatments. The lowest yield (10.26 t/ha) was found from control plot. Significantly higher Plant height (69.00 cm), number of leaves/plant (10.33), bulb diameter (6.62 cm), individual bulb weight (62.44 g) and lowest disease incidence (6.50 %) were observed from fungicide code name 712 plot and the highest disease incidence (28.85 %) was observed from control plot.

Information and communication technology

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

M. A. Alam, M. A. Mottalib, G. Mahboob, A. F. M. Tariqul Islam, K. Hassan, S. N. Mojumdar and M. H. Reza

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 81% and 84% and Kappa values of 0.78 and 0.76 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 6.98% 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.

Agricultural engineering

Field performance evaluation of BARI power tiller operated multi-crop seeder in spices crop production

M. A. Mottalib, M. A. Alam, A. H. F Fahim, M. M. Hasan, M. M. Alam, M. A. Haque, M. A. Hossain, K. Hassan, S. N. Mozumder, M. H. Reza

This paper demonstrates for enhancing different spices crops like onion, black cumin and coriander crop productivity through BARI power tiller operated multicrop seeder machine**.** An evaluation of the performance of the seeder machine was done to find out for its performance and techno-economic feasibility in field condition**.** Field tests were conducted in season of 2021 at the SRC research field. An inclined plate metering device was used for planting onion, black cumin and coriander directly (32 grooves for onion and black cumin and 28 grooves for coriander planting). Incase of onion and black cumin seed planting, seed was mixed with rice husk in 6:1 proportion which depend on seed germination quality. Seed damage observed for different seeds was negligible. The working performance of the machine during idle run was satisfactory. The metering device performance was found acceptable for sowing of onion and black cumin except in case of coriander. This experiment was first year trial so experiment will be continued to next year for better result.

Technology transfer and validation

Optimization of seed rate of onion mixed with black cumin in charland of AEZ-3

M. E. Haque, D. M. M. Ahmed and M. N. Farid

An experiment was conducted in farmer's field at charlands of Char Gonai, Kaunia, Rangpur during

Rabi season of 2021-22 to determine the seed rate of onion mixed with black cumin under Charland conditions. The trial was conducted with five treatments viz., Recommended Seed Rate (RSR) of onion+10% RSR of black cumin, RSR of onion+20% RSR of black cumin, RSR of onion+30% RSR of black cumin and Sole Onion set in a RCBD with three replications. The highest bulb yield was recorded in sole onion (18.0 tha^{-1}) and the lowest was harvested in RSR of onion+30% RSR of black cumin (7.0 tha^{-1}). All the parameters showed variations due to the varied seed rate of companion crop black cumin except plant height (cm), active pods plant [1]. The highest grain yield was recorded in sole black cumin (548.15kg ha^{-1}) and the lowest was harvested in RSR of onion+20% RSR of black cumin (337.04 $kgha^{-1}$). The maximum land equivalent ratio (1.39) was estimated in RSR of onion+10% RSR of black cumin and the minimum (0.81) was calculated in RSR of onion+30% RSR of black cumin. The highest gross return Tk.360000 ha^{-1} and gross margin Tk.179900 ha^{-1} with highest benefit cost ratio of 3.21 was calculated in Sole onion and the lowest gross return Tk. 192400ha^{-1} and gross margin Tk.12300ha^{-1} with lowest benefit-cost ratio of 1.07 was obtained in RSR of onion+30% RSR of black cumin. Sole BARI Piaz-4 may be a good option for higher yield and economic return in Charland situations. Seed rate of black cumin mixed with BARI Piaz-4 should be around 10% in Charland. In case of Charland, direct seeded onion seed rate should be less than the recommended dose for successful and viable economic return. BARI Piaz-4 should be introduced in the char areas to increase its production.

Optimization of seed rate of onion mixed with coriander in charlandof AEZ-3

M. E. Haque, D. M. M. Ahmed and M. N. Farid

To ascertain the seed rate of onion combined with coriander, an experiment was carried out in a farmer's field at Charland of Char Gonai, Kaunia, Rangpur, during the *rabi* season of 2021–22. Five treatments *viz*., Recommended Seed Rate (RSR) of onion+10 % RSR of coriander, the RSR of onion+20% RSR of coriander, the RSR of onion+30% RSR of coriander and the sole onion was used in the experiment, which was carried out using RCBD with three replications. To increase yield and production, BARI Piaz-4 and BARI Dhania-2 should be planted in Char regions of the Rangpur region. The sole onion produced the highest bulb yield (19.89 t ha^{-1}), whereas the RSR of onion plus 30% RSR of coriander produced the lowest yield (2.38 t ha^{-1}). With the exception of plant height, all the metrics fluctuated as a result of the companion crop, coriander's variable seed rate. The solitary coriander variety produced the highest grain yield (1722.2 $kgha^{-1}$), whereas the RSR of onion plus 30% RSR of coriander variety produced the lowest (937.0 $kgha^{-1}$). The uppermost land equivalent ratio (1.07) was estimated in RSR of onion+10% RSR of coriander and the minimum (0.66) was calculated in RSR of onion+30% RSR of coriander. The sole coriander yielded the lowest gross return of Tk. 93400 ha^{-1}, the sole onion yielded the highest gross return of Tk. 360000 ha^{-1} and the sole onion yielded the highest benefit cost ratio of 2.56. The RSR of onion plus 30% RSR of coriander yielded the lowest gross return of Tk.93400 ha^{-1}. For a larger yield and financial return in Charland circumstances, the sole BARI Piaz-4 may be a smart option. In Charland, the seed rate of coriander combined with BARI Piaz-4 should be less than 10%. For a profitable and financially sustainable return in the case of Charland, direct seeded onion seed rate should be lower than the advised rote. Introducing BARI Piaz-4 in the Char areas is necessary to boost up production.

Garlic

Varietal development

Evaluation of garlic germplasm

M. A. Islam, M. M. Anawer and H. C. Mohanta

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura during *rabi* season 2021-22 to select the promising garlic germplasm for releasing a variety. Eleven different garlic germplasm (GC0040, GC0030, GC0042, GC0055, GC0012, GC0048, GC001, GC0043, GC0031, GC0027, GC0056) and BARI Rashun-1 as check were 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 (11.00 t/ha) was obtained from GC0056 and the lowest (6.38 t/ha) was found from BARI Rashun-1. Disease severity was also lower in GC0056. Significantly all the yield contributing characters were vfound better from GC0056.

Advanced yield trial of garlic line

M. A. Islam, M. M. Anawer and H. C. Mohanta

The study was conducted at the farm of Spices Research Centre, BARI, Shibgonj, Bougra during *rabi* Season 2021-22 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, GC0050, GC0017, GC0036, GC005 and GC0019) including BARI Rashus-1 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 GC0050 and the lowest (5.96. t/ha) was found from GC0047. Disease severity was also lower in GC0050.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 GC005 and GC0017 were found promising and selected for next year RYT trial.

Regional yield trial of promising garlic line

M. A. Islam, M. M. Zaman, M.A. Khan, M. M. Ahmed and M. M. Anawer

The experiment was conducted at Spices Research center (SRC), Bogra, Spices Research Sub-center (SRSC), Lalmonirhat, Regional Spices Research Center (RSRC) Magura and Spics Research Sub-center (SRSC), Faridpur during November 2021 to March 2022. Four advanced 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 (9.28 t/ha) was recorded in SRC, Bogra on the other hand the lowest yield was recorded (7.30 t/ha) in SRSC, Faridpur. In case of germplasm/line the highest yield (11.69 t/ha) was found from GC0049 while the lowest (7.00 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 (12.40 t/ha) was obtained from GC0049 at SRC, Bogra location, while the lowest yield (6.0 t/ha) was obtained from BARI Rashun-3 at SRSC, 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 confarmation further trial will be needed next year.

Regional yield trial of garlic (Allium sativum L.)

M. M. Rahman, M. A. Khan, S. N. Mozumder, R. Ara, M. A. Islam, M. M. Ahmed, M. Moniruzzaman and M. R. Islam

A regional yield trial was conducted for two years (2020-21 and 2021-22) at the farm of SRSC, Faridpur; SRC, Bogura; RSRC, Magura; SRSC, Lalmonirhatand and RSRC, Gazipur during *rabi* season to assess the regional performance of garlic advance lines. 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 treatments, the highest average yield (8.84 t/ha) was obtained from AS Far 005 in 2020-21 and in 2021-22 it was 8.56 t/ha from AS Far 004. The lowest average was obtained (5.84 t/ha) from check variety in 2021-22. In 2021-22, the genotype AS Far 005 showed highest Individual bulb weight (21.92 g) but it was statistically similar to AS Far 004 (21.76 g). AS Far 004 gave the greatest individual clove weight (1.64 g), clove length and breadth (26.79mm and 10.50 mm) but No. of cloves per bulb was highest in AS Far 005(24.03). Total soluble solid and dry matter percentage were found highest in BARI Rashun-3 (42.42 ^{o}brix and 41.94%). Combined effect of location and garlic lines showed significant results.

Soil and water management

Effect of different organic fertilizers on yield and storage quality of garlic (*Allium sativum* L.)

M. N. Farid, D. M. M. Ahmed and M. E. Haque

A field experiment was carried out at Spices Research Sub-Centre, Bangladesh Agricultural Research Institute, Lalmonirhat during November 2021 to April 2022 to assess the effect of organic manures on yield and storage quality of garlic. The treatments comprised T_1: Recommended Dose of Chemical Fertilizer (RDCF) + 10 tha^{-1} Cowdung T_2: RDCF + 3 tha^{-1}Vermi compost, T_3: RDCF + 5 tha^{-1} Mustard Oil Cake (MOC), T_4: RDCF + 2 tha^{-1} Bone meal and T_5: RDCF (Control). The experiment was laid out in RCB design with three replications using BARI Rashun-3 as test material. The application of different combinations of organic fertilizers affected all the parameters studied. The single bulb weight

(23.87g) was found highest in T_4 (RDCF + 2 tha^{-1} Bone meal) and minimum (20.53g) was recorded in treatment T_3 (Recommended Dose of Chemical Fertilizer (RDCF) + 5 tha^{-1} Mustard Oil Cake). Among the treatments, the highest bulb yield of 7.38 t ha^{-1} was obtained from treatment T_4 (RDCF + 2 t ha^{-1} Bone meal) and the lowest yield was 6.70 t ha^{-1} from treatment T_1: Recommended Dose of Chemical Fertilizer (RDCF) + 10tha^{-1} (Cowdung).

Effect of nitrogen and variety on yield and yield components of garlic

S. Brahma, M. N. Yousuf, M. I. Haque, M. A. A. Khan, R. Ara and H. C. Mohanta

A field experiment was carried out at Regional Spices Research Centre, Bangladesh Agricultural Research Institute, Gazipur during winter (*rabi*) season of 2021-22 to find out optimum dose of nitrogen and suitable garlic variety for higher yield. The experiment was laid out in factorial RCD with three replications. BARI Rashun 1, 2, 3 and 4 were used as test materials in this trial. Four different levels of nitrogen *viz*. N_0, N_{50}, N_{100} and N_{150} kg ha^{-1} were applied in the experiment. The crop was raised with $P_{60}K_{160}S_{20}Zn_2B_1$kg ha^{-1} along with 5 t cowdung per hectare. Both the variety and nitrogen level significantly influenced yield and yield components of garlic. Highest bulb yield of 8.07 t ha^{-1} was obtained from BARI Rashun -2 with 100 kg N ha^{-1} but the Highest N use efficiency (53.92%) was obtained BARI Rashun-1 along with application of 50 kg Nha^{-1}. Considering the respone curve nitrogen 102.49 kgha^{-1} was suitable rate for garlic cultivation in Grey Terrace Soil of Madhuipur Tract (AEZ-28).

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

M. A. Rahman, M. A. Islam, M. A. Alam, M. H. Reza, M. M. Anower and H. C. Mohanta

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the *rabi* season of 2021 - 2022 to know the effect of foliar application of different micronutrients on reducing tip burn of garlic. There were thirteen treatment combinations viz. T_1 = $ZnSO_4$ @ 0.2% (2 g/L), T_2 = $ZnSO_4$ @ 0.35% (3.5 g/L), T_3 = $ZnSO_4$ @ 0.55% (5.5 g/L), T_4 = H_3BO_3 @ 0.1% (1 g/L), T_5 = H_3BO_3 @ 0.2% (2 g/L), T_6 = H_3BO_3 @ 0.3% (3 g/L), T_7 = $CuSO_4$. 5 H_2O @ 0.1 % (1 g/L), T_8 = $CuSO_4$. 5 H_2O @ 0.25 % (2.5 g/L), T_9 = $CuSO_4$. 5 H_2O @ 0.5 % (5 g/L), T_{10} = $ZnSO_4$ 0.1% + H_3BO_3 @ 0.1% + $CuSO_4$. 5 H_2O @ 0.1 %, T_{11} = $ZnSO_4$ @ 0.25% + H_3BO_3 @ 0.2% + $CuSO_4$. 5 H_2O @ 0.25 %, T_{12} = $ZnSO_4$ @ 0.5% + H_3BO_3 0.3% + $CuSO_4$. 5 H_2O @ 0.5 % and T_{13} = farmer's practice (recommended dose of urea, TSP, MoP, gypsum and zinc sulfate) studied in a RCBD with three replications. Highest ratio of green portion of leaf to burned portion was recorded in T_{11} (3.31), ratio of number of green leaves to the number of burned leaf/plant was recorded highest in T_{11} (3.02), per plant tip burn was recorded lowest in T_{13} (5.17) and per plot tip burn was recorded lowest in T_{11} (7.18). Highest yield was recorded in T_{11} (10.98 t/ha) including highest level of BCR (3.38) and Biomass content (%) as well. Chlorophyll a (mg/g), chlorophyll b (mg/g), total chlorophyll and carotenoids content (mg/kg) were recorded highest in T_{11}.

Study on nitrogen and variety for secondary sprouting of garlic

M. R. Islam, A. J. M. Obaidullah and M. M. Zaman

A field experiment was carried out at Regional Spices Research Centre, BARI, Magura during November 2021 to April 2022 to find out the reason of secondary sprouting/splitting of garlic. The two factor experiment was designed in RCB design with three replications. The treatments comprised of three varieties of garlic and four dose of nitrogen. Significant differences regarding yield and yield attributes were observed among different treatments. The highest plant height (92 cm), number of leaves per plant (10.33), neck diameter (12.67 mm), individual bulb weight (30.33 g) and yield per hectare (13.30 t/ha) were obtained from the treatment T_4V_3 (local garlic variety with nitrogen@ 235kg/ha). The lowest plant height (69.67 cm), number of leaves per plant (7.67), neck diameter (8.00 mm), individual bulb weight (23.67 g) and yield per hectare (8.31 t/ha) from the treatment T_2V_1 (BARI Rashun-3 with nitrogen@185kg/ha).

Study on irrigation and variety for secondary sprouting of garlic

A. J. M. Obaidullah, M. R. Islam and M. M. Zaman

A field experiment was carried out at Regional Spices Research Centre, BARI, Magura during November 2021 to April 2022 to find out the reason of secondary sprouting/splitting of garlic. The two factor experiment was designed in RCBD with three replications. The treatments comprised three

varieties of garlic and four schedule of irrigation. Significant differences regarding yield and yield attributes were observed among different treatments. The highest Plant height (89.00 cm), number of leaves/plant (9.00), neck diameter (11.00 mm), individual bulb weight (25.66g), yield/ha (10.65t) and maximum secondary sprouting infected plant (19.84%) was observed from T_4V_3 (local garlic variety with irrigation at 15 days interval) whereas lowest highest Plant height (65.66 cm), number of leaves/plant (7.33), neck diameter (7.66 mm), individual bulb weight (19.33 g), yield/ha (6.26 t) and minimum secondary sprouting infected plant (3.33%) was observed from T_1V_2 (BARI Rashun-3 with irrigation at 30 days interval).

Information and communication technology

Assessment of in-season machinery determination in garlic cultivation using geo-spatial technique

M. A. Mottalib, M. A. Alam, A. H. F. Fahim, M. A. Rahman, M. A. Islam, M. M. Hasan, M. M. alam, G. Mahboob, A. F. M Tariqul Islam, S. S. A. Kamar, M. A. Hoque, M. A. Hossain, K. Hassan, S. N. Mojumdar and M. H. Reza

To promote modern agricultural technology, proper resource planning is needed with proper information management for sustainable crop production to ensure food security. The advanced geoinformatics-based techniques such as remote sensing, global positioning system and geographical information system can be of great use for proper resource planning, assessment and management. The purpose of this study was to delineate the garlic cultivated area along with the statistics for predicting tillage machinery required to cultivate them using high-resolution Sentinel-2 satellite imagery in two study areas of Bangladesh. The preprocessed multiple-band images were classified which derived from different vegetation indices calculation resulting satisfactory overall accuracy in ranges from 81% to 83% with Kappa values ranges from 0.76 to 0.79. Subsequently the required number of tillage machines was work out on the basis of estimated annual use of machine average crop hectreage that to be needed for crop cultivation during a cropping season in the study areas. The results conclusively revealed that the computer-aided geospatial analysis techniques for identifying and estimating area of specific crop types could be necessary and useful particularly to provide a better insight to the policymaker as to how many and what type of agricultural machinery intervention need to be introduced either by adoption or replacement for crop cultivation. The study experience creates an opportunity for future study in upazila, district, or country level for making the best decisions for appropriate modern agricultural technologies adoption, dissemination and management planning in order to ensure the proper agricultural mechanization.

Agricultural engineering

Development of a power tiller operated garlic planter

M. A. Mottalib, M. A. Hoque, M. A. Hossain, M. A. Islam, M. M. Alam, K. Hassan, S. N. Mozumder and M. H. Reza

The aim of this investigation is to develop locally manufacturing planting 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 2020-21and *and* its performance was evaluated at SRC, BARI, Bogura field. The results showed that the modified machine is capable of planting 540 $kgha^{-1}$ of garlic clove at the seeding depth and spacing of 10-11.8 and 20 cm, respectively. The observed mechanical clove damage was 9**.**80 % during field test of planter. But, due to fabricational error, seed metering box will be redesigned and tested in the next season**.**

Post-harvest technology

Studies on the processing and preservation of garlic paste

M. M. Alam and H. C. Mohanta

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 benjoate,

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 360 days of storage. The color, flavor and texture of three samples of garlic pastes; treated with citric acid plus sodium benzoate plus sodium chloride (T_7), treated with citric acid plus KMS plus sodium chloride (T_8) and blanched garlic paste (T_9) were acceptable up to 360 days of storage at room temperature. In refrigerated storage the color, flavour and texture of garlic paste were accepted up to 360 days of storage when it was treated with citric acid plus sodium benzoate(T_5) , citric acid plus KMS (T_6), citric acid plus sodium benzoate plus sodium chloride (T_7), citric acid plus KMS plus sodium chloride (T_8) and citric acid alone (T_{13}). But garlic paste rendered more excellent colour up to 360 days of storage when stored in refrigerated temperature. The study showed that garlic paste without any preservative (control) could not be stored more than 60 days at room temperature and 90 days at refrigeration temperature. In order to determine the suitability of two samples of garlic paste (which were found better in RT and RFT) in a curry, it was decided to conduct organoleptic taste test of dry fish curry using above 2 samples (T_7 and T_8) with fresh garlic paste. The results showed that all the samples were statistically identical in respect of colour, flavour, pungency, taste and overall acceptability though there was little bit difference in scoring among each attributes.

Chilli

Varietal development

Development of chilli hybrids for higher yield, more edible dry powder, higher color and oleoresin content with improved nutritional quality

M. A. Alam, M. M. Haque, I. Haque, M. M. Hasan, A. H. F. Fahim, H. Reza and M. M. Anwar

The present experiment was conducted to select superior winter chilli germplasm for higher yield at Spices Research Centre, Shibganj, Bogura during 2021-22. Thirty-six chilli genotypes including BARI Morich-2 and BARI Morich-3 as check were used in this study. The experiment was laid out in alpha lattice design with two replications. Some of the studied genotypes were produced higher yield than the check varieties. Considering yield and other attributing traits promising genotypes need to evaluate in next season.

Production of single cross chilli hybrids through diallel mating design

M. A. A. Khan, M. I. Haque, S. Brahma, M. N. Yousuf

Single sets of crosses following half diallel fashion were made to produce F_1s 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 F_1 seeds of each hybrid were stored separately after selection and would be evaluated in the coming rabi season.

Evaluation of single cross chilli hybrids

M. A. A. Khan, M. I. Haque, M. N. Yousuf, S. Brahma, R. Ara and H. C. Mohanta

This study was undertaken to confirm F_1 population and identify the better cross combinations obtained from a 5×5 half diallel at RSRC, BARI, Gazipur. Parents and their F_1 progenies were grown in replicated trail during *rabi* 2021-22. Variation was observed in different traits among studied the genotypes. In terms of days to 50% flowering and fruiting P_1 x P_2, P_1 x P_4, P_1 x P_5, P_2 x P_4 and P_2 x P_5 F_1s were desirable. Based on yield (t/ha) 4F1s, P_1×P_5, P_1×P_5, P_2×P_3, P_2×P_5 and P_3×P_5 showed significantly positive better parent heterosis which were selected for next generation evaluation.

Searching of CMS and maintainer lines of chilli

M. N. A. Chowdhury, M. I. Haque, R. Ara and M. M. Anwar

The experiment was conducted at Spices Research Centre, Shibganj, Bogura during 2021-22 with a view to increasing the seeds of A and B line, to searching the maintainer line of chilli and to make CMS and 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 A lines and BARI Morich-2 were planted on

20 April 2022. Now they are at vegetative stage. At the time of flowering crossing will be done.

Development of inbred lines of chilli (advancing of generation S_2 to S_3)

M. A. Alam, M. I. Haque, M. M. Hasan, A. H. F. Fahim, S. N. Mojumdar and M. H. Reza

The present experiment was conducted to produce S_3 generation from S_2 with the goal to develop superior homozygous inbred lines of chilli at Spices Research Centre, Shibganj, Bogura during 2021-22. Segregating germplasm of S_2 generation derived from hybridization e.g., ON20 x BARI Morich-2 and ON20 x BARI Morich-3 along with the corresponding parents were used in this study. Some of the studied population were produced higher yield than the parental germplasm. Promising population will be further advanced in next season.

Evaluation of local germplasm of chilli in cumilla region

M. Rahman and M. O. Kaisar

A total of twenty germplasm of chilli were collected from different upazilla of Cumilla district. The trial was conducted during *rabi* season of 2021-22 at RSRC, BARI, Cumilla to study the performance of different chilli lines for developing variety having higher yield. The experiment was laid out in RCBD with three replications. The highest plant height (110.60 cm) was recorded from CA Cum-014 and the lowest plant height (44.65 cm) was recorded from CA Cum-35 followed by CA Cum-009. The highest fruit length (9.28 cm) was recorded from CA Cum-018 and the lowest fruit length (2.66 cm) was recorded from CA Cum-009. The highest yield (8.14 t/ha) on green weight was recorded from CA Cum-016 followed by CA Cum-018 and The lowest yield (0.67 t/ha) on green weight was recorded from CA Cum-037.

Characterization and evaluation of ornamental chilli germplasm

A. H. F. Fahim, M. A. Alam, M. A. Rahman, M. M. Anwar and H. C. Mohanta

The research was carried out at the experimental field of Spices Research Centre (SRC), BARI, Shibganj, Bogura during the *rabi* season, 2021-22 to identify chilli germplasm suitable for ornamental as well as table purpose. The land was medium-high and the soil was clay loam in texture. The experiment was laid out in RCBD with 3 replications. The unit plot size was 1.5m x 3m. Eight 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 per plant (0.821 kg) was harvested from the the check variety BARI Ornamental Morich-2. Because it produced higher number of fruits per plant. The lower amount of fruits per plant (0.088 kg) was harvested from the germplasm OC023 which was identical to OC009 (0.089 kg) followed by OC014 (0.109 kg). Among the ornamental chilli germplasm, the check variety BARI Ornamental Morich-2 performed better in terms of yield potentiality. But the other germplasm also gave impressive results due to their different colored fruits and attractive canopy structure. However, this trial will be repeated in the next year for confirmation of the results.

Advanced yield trial of chilli

M. A. Alam, S. N. Mozumdar, I. Haque, M. M. Hasan, A. H. F. Fahim and H. Reza

The present experiment was conducted to select superior chilli germplasm for higher yield at Spices Research Centre, Shibganj, Bogura during 2021-22. 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. The entry EW200-50 outyielded the check entry BARI Morich-3. The genotype EW200-50 might be evaluated at multiple locations in next season.

Advanced yield trial of chilli genotypes against thrips and mite

M. M. Hossain, H. C. Mohanta, M. M. Ahmed, A. Sarkar and N. K. Dutta

The field study was conducted at Spices Research Centre, Shibganj, Bogura, Bangladesh (geographic coordinates 25.0167° N, 89.3167° E) during *rabi* season of 2021-22 to test the performance of different chilli genotypes against thrips and mite. Eleven different chilli genotypes (C0718, C01245, C0145, C0649, C0650, C01111, C0701, C0613, C0614, C01212 and C01236) along with BARI Morich-1, 2 and 3 were evaluated against thrips and mite. Out of eleven chilli genotypes screened against

thrips and mites, none was found completely free from the attack of pests. The three genotypes, C0145, CO718 and C01212 recorded lowest number of thrips, mite and leaf curl were found resistant, three genotypes, C0701, C01236 and BARI Morich-2 were found moderately resistant, five genotypes, *viz*., C0649, C0650, C01245, BARI Morich-1 and 3 were found susceptible and three genotypes *viz*., C01111, C0613 and C0614 were found highly susceptible to both thrips and mite. Thrips and mite populations are negatively correlated with Chlorophyll Concentration Index of leaf. Further resistant and moderately resistant genotypes showed thick and dark green colour leaves, very thin and light green colour leaves was observed in highly susceptible genotypes. The highest total phenol content was recorded from the genotype CO1212 (22.60 mg/g) followed by CO718 (21.40 mg/g) and CO145 (18.80 mg/g) and the lowest total phenol content was recorded from the genotype CO614 (12.34 mg/g) followed by CO613 and CO1111 with 12.50 and 13.00 mg/g of total phenol content. The maximum fruit yield of chilli was also obtained from the genotype C01212 (16.73 t/ha) followed by the genotype C0718 (15.79 t/ha) and C0145 (14.29 t/ha).

Advanced yield trial of ornamental chilli

A. H. F. Fahim, M. M. Hasan, M. A. Alam, M. A. Rahman, M. M. Anwar and H. C. Mohanta

The experiment was carried out at the experimental field of Spices Research Centre (SRC), BARI, Shibganj, Bogura during the *rabi* season, 2021-22 to identify superior ornamental chilli germplasm in terms of yield potrntiality and colour variations. The land was medium-high and the soil was clay loam in texture. The experiment was laid out in RCBD with three replications. The unit plot size was 1.5m x 3m. Six advanced ornamental chilli germplasm (OC004, OC005, OC006, OC007, OC011 and OC018) were characterized and evaluated for their performance against BARI Ornamental Morich-1 and 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 fruits per plant (0.576 kg) was harvested from the germplasm OC018 which was identical to OC011 (0.553 kg). The lower amount of fruits per plant (0.099 kg) was harvested from the germplasm OC006 followed by OC004 (0.216 kg). Among the ornamental chilli germplasm, OC018 and OC011 showed better performance than the check varieties. These two germplasm will be selected for Regional Yield Trial in the next year to validate their yield potentiality at different agro-echological zones.

Regional yield trial of chilli (Set-I)

M. A. Alam, S. N. Mozumdar, I. Haque, M. M. Hasan, A. H. F. Fahim and H. Reza

The experiment was conducted at Spices Research Centre, Shibganj, Bogura; Spices Research Sub-Centre, Faridpur and Spices Research Sub-Centre, Lalmonirhat during 2021-22. Six chilli genotypes including BARI Morich-2 and BARI Morich-3 as check were used in this study. Few genotypes out yielded both the checks BARI Morich-2 and BARI Morich-3. Considering yield and attributing traits genotype INDCH-41, Mohona-2 and INDCH-33 were found promising. 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

M. N. A Chowdhury, M. I. Haque, R. Ara, M. M. Ahammed, M. O. Kaisar, S. Naher, M. S. Huda, M. H. Reza and M. M. Anwar

The study was conducted at Spices Research Centre Shibganj, Bogura; Regional Spices Research Centre, Cumilla and Agrcultural Research Station, Dinajpur during November 2021 to May 2022 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 RCBD with four replications. Among the location, it was found that the highest number of fruits per plant and green chilli yield (379 and 12.82 t/ha, respectively) was found at Dinajpur location and the lowest number of fruits and green chilli yield (359 and 12.05 t/ha, respectively) was found at Bogura location. Significantly the highest fruits weight per plant and green chilli yield (447.31 g and 15.15 t/ha, respectively) was recorded from C0701 followed by C0650 (415.17 g and 12.65 t/ha, respectively) and the lowest (380.41g and 10.26 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 fruits weight per

plant and green chilli yield (458.60 g and 16.15t/ha, respectively) in Dinajpur location. The lowest fruit weight per plant and green chilli yield (342.62 g and 9.33 t/ha, respectively) was found from BARI Morich-3 in Bogura location. In respect of green chilli yield, the lines CO701 performed better over the location.

Regional yield trial of chilli (Set-III)

M. I. Haque, M. S. Zaman, R. Ara S. Brahma and M. A. A. Khan

The present study was conducted on 6 Chilli genotypes in RCBD with three replications during 2021-22 to evaluate the performance of Chilli genotypes. Significantl variation was observed for almost all the traits except number of branches/plant and fruit diameter. The highest green fruit yield was recorded from the line CO 631 (11.90 t/ha) which was slightly higher than the check variety BARI Morich-2 (11.68 t/ha).

Stress breeding

Screening of waterlogging stress tolerance chilli germplasm

S. Brahma, I. M. Ahmed, M. A. A. Khan, M. N. Yousuf and R. Ara

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, biomass of shoot/root, cell membrane stability index (CMSI), relative water content (RWC), net photosynthetic rate (Pn), total soluble sugar (TSS) and total antioxidant content (TAC) 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, CMSI, RWC, Pn, TSS, TAC and STI G7, G12, G16, G21, G22, G24, G13, G17, G23, G20, G3, G2, G11, G15 and G11 can be selected as relatively tolerant genotypes against waterlogging.

Cultural management

Effect of spacing on the yield of Naga chili

M. H. M. B. Bhuyan, F. Ahmed, J. C. Sarker and S. M. L. Rahman

The experiment was conducted during February 2022 to April 2022 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 RCBD with three replications. Six different levels of spacing were used as treatments viz. T_1 (80 cm × 60 cm), T_2 (90 cm × 70 cm), T_3 (100 cm × 60 cm), T_4 (110 cm × 60 cm), T_5 (120 cm ×75 cm) and T_6 (130 cm × 60 cm). The tallest plant (73.66 cm) was recorded at both T_2 and T_4 while the shortest plant (59.00 cm) was recorded at T_1. Plants spread maximum (80 cm × 83 cm) at T_4 but minimum (58.33 cm × 62.33 cm) at T_1. Maximum stem diameter (2.28 cm) was found at T_4 while the lowest at T_1 (1.52 cm). Fruits plant^{-1} varied from 119 to 174. The maximum number of fruits plant^{-1} (174.00) was recorded at T_4. On the other hand, the lowest number of fruits plants^{-1} (118.67) was recorded at T_1. Longest fruit (4.93 cm) was recorded at T_3 while shortest fruit (3.40 cm) was found at T_1. Widest fruit (2.43 cm) was obtained from T_4. On the other side statistically similar fruit breath (2.10 cm) was recorded at all the other treatments. Single fruit weight was maximum (5.05 g) at Treatments T_4 but minimum fruit weight (3.75 g) was noticed at T_1. The maximum yield plant^{-1} (879.08 g) was obtained at T_4 but the lowest yield (445.74 g) was obtained at T_1. Moreover Treatment T_4 produced maximum yield (8.16 t ha^{-1}) followed by T_3 (8.14 t ha^{-1}) while T_6 produced the lowest (4.42 t ha^{-1}). The highest gross return, gross margin, and BCR were recorded from T_3 (1.83) followed by T_4 (1.80) and T_2 (1.80). On the other hand, the lowest gross return, gross margin, and BCR were recorded from T_6 (0.84). Therefore, the results obtained from the study suggested that 100 cm × 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.

Soil and water management

Effect of organic fertilizer for safe Naga chili production

M. H. M. B. Bhuyan, F. Ahmed, J. C. Sarker and S. M. L. Rahman

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 February 2022 to April 2022 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. The tallest plant (72.66 cm) was recorded in T_6 while the shortest plant (53 cm) was recorded in T_1. Plant spread was maximum (75.33 cm × 68 cm) at T_6 but minimum (66.66 cm × 57.33 cm) at T_1. The number of primary branches was maximum (2.66) in T_6. Maximum stem diameter (3.29 cm) was found in T_5 followed by T_6 (3.28 cm) while the lowest (2.11 cm) was in T_1. Both fruit length (5.18 cm) and breadth (2.93 cm) were found maximum in T_6. Contrary, treatment T_1 produced shortest leaf. Profuse bearing (159 number plants^{-1}) was noticed in T_6. On the other hand, T_1 bore the least number (65 numbers plants^{-1}). Individual fruit weight was maximum (5.14 g) in T_6 but thinnest fruit (4.31 g) in T_1. The maximum yield plant^{-1} (817.83 g) was obtained in T_6 but the lowest yield (281.57 g) was obtained in T_1. So T_6 produced maximum yield (8.24 t ha^{-1}) while T_1 produced the lowest yield (2.83 t ha^{-1}). The highest gross return, gross margin, and BCR were recorded from T_6 (1.76). Therefore, the results obtained from the study suggested that farmers practice that means use of inorganic fertilizer had a significant effect on Naga chili and it maximized its yield compared to other organic fertilizer in the north eastern region of Bangladesh.

Effect of lime on the growth and yield of Naga chili

F. Ahmed, M. H. M. B. Bhuyan, J. C. Sarker and S. M. L. Rahman

The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, jaintapur, Sylhet during the period from February 2022 to April 2022 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 RCBD with three replications. Six different levels of lime were used as treatments *viz*., 0, 2.0, 2.5, 3.0, 3.5 and 4.0 t/ha. There were significant variations among all the treatments. Among the treatments maximum plant height (81.00 cm), Maximum plant canopy (84 cm × 77 cm), Thickest stem (3.20 cm), heaviest fruit (5.31g), maximum fruits/ plant (158 nos.) recorded at T_2. On the other hand, treatment T_1 recorded least amount in all the parameters. That's why treatment T_2 obtained maximum yield (8.48 t ha^{-1}) but treatment T_1 obtained lowest yield 3.47 t ha^{-1}). The highest gross return, gross margin and BCR was recorded from T_2 =2.0 t ha^{-1}. The results obtained from the study showed that lime had great effect to increase the yield of Naga chili.

Insect pest management

Development of bio-rational based management approach against major insect pests of chilli

M. M. Hossain, H. C. Mohanta, M. A. Sarker and N. K. Dutta

The field experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during *rabi* season of 2021-22 to develop a bio-rational based management approach against major insect pests of chilli. The treatments were six including control. Pheromone trap with spraying of Spinosad (Spinomax 2.5SC) @ 1ml/L and Fizimite (Sodium lauryl ether) @ 1ml/L as well as soil application of Lycomax (Metarhizium anisopliae + Trichodarma) @3g/L resulted the lowest aphid (0.85 aphid/leaf), thrips (0.67 thrips/leaf), mite (0.95 mite/leaf) and fruit borer i.e *Helicoverpa armigera* (0.24 larvae/plant) and Spodoptera litura ((0.51 larvae/plant) with highest marginal benefit cost ratio of 3.84. Chilli fruit borer populations are negatively correlated with average temperature and rainfall but positively correlated with relative humidity. The highest percentage of aphid (85.42%), thrips (91.20%) and mite (85.45%) population reduction over control with maximum red ripe chilli yield (14.50 t/ha) was also obtained from Pheromone + Spinosad+ Fizimite + Lycomax. So, Pheromone mass trapping with spraying of Spinosad (Spinomax 2.5SC) and Fizimite (Sodium

lauryl ether) as well as soil application of Lycomax (Metarhizium anisopliae + Trichodarma) may be recommended for effective management of insect pest's complex in chilli field

Effect of different mulching materials against insect pest complex of chilli

M. M. Hossain, M. H. Reza, H. C. Mohanta, A. Sarker and N. K. Dutta

The field experiment was conducted at Spices Research Centre, Shibganj, Bogura, Bangladesh during *rabi* season of 2021-22 to study the effect of different mulching materials against insect pest complex of chilli. BARI Morich-3 were mulched with silver reflective transparent polythene, dry banana leaf, black polythene, rice straw and insecticide Karate were used as a standard check. The results revealed that the mulch materials significantly affected the insect pests of chilli. Among the different mulching materials tested, chilli mulched with silver reflective transparent polythene mulch and chemical insecticide Karate performed well by recording lowest population of sucking pests and larval population of *Helicoverpa armigera* and Spodoptera litura. The lowest number of aphid (2.70/twig), thrips (0.37/leaf), white fly (2.15/leaf), larval population of *Helicoverpa armigera* (0.72/plant) and Spodoptera litura (0.45/plant) were observed from chemical insecticide Karate treated plot which was closely followed by transparent polythene mulch plot. Whereas, the highest pest population of aphids (7.52/twig), thrips (3.37/leaf), white fly (6.89/leaf) and larval population of H. *armigera* (4.74/plant) and S. litura (2.10/plant) were recorded when no mulch material was applied to the chilli plants. However, the maximum numbers of natural enemy like Cheilomenes sp. (2.85/plant) was recorded from transparent polythene mulch and the minimum numbers of these insect were recorded from chemical insecticide Karate treated plot (0.50/plant). The organic mulches like rice straw and dry banana leaf also increased the yield components of chilli. Mean yield data revealed that, insecticide Karate treated plot recorded the highest red ripe chilli yield of 12.00 t/ha and it was statistically similar with silver reflective transparent plastic mulch (11.20 t/ha). The results indicated that chilli mulched with silver reflective transparent polythene mulch or application of chemical insecticide Karate 2.5 EC may be recommended for effective management of insect pest complex in chilli field.

Disease management

Control of foot and root rot disease of chilli

K. M. Khalequzzaman, M. N. A. Chowdhury and M. H. Reza

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during *rabi* season of 2021-22 to find out the effective control measures against foot and root rot disease of chilli. The test variety was BARI Morich-3. Eleven different treatments were used in this experiment. Foot and root rot incidence under different treatments ranged from 7.86 to 21.66%, while Poultry refuse @ 5 t/ha + T_1 (Autostin @ 0.2%) treated plots resulted the lowest disease incidence which was followed by Companion 75 WP @ 0.2% with 8.56% and Cabriotop @ 0.3% with 9.99%, where untreated control plot showed the highest incidence. The highest plant height (89.92 cm), single fruit weight (3.22 g), fruit length (9.12 cm), number of fruits/plant (346.45) and weight of fruits/plant (919.82 g) were recorded in Poultry refuse @ 5 t/ha + T_1 (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 + T_1 (Autostin @ 0.2%) showed the highest fresh yield (22.59 t/ha) which was statistically similar to Companion 75 WP @ 0.2%, but untreated control showed the lowest fresh yield (9.84 t/ha) of chilli.

Efficacy of new fungicides for controlling anthracnose of chilli

M. R. Islam, M. M.Rahman, M. I. Faeuk and M. Arifunnahar

A field experiment was conducted at Regional Spices Research Centre, BARI, Magura during 2021-22 to evaluate the efficacy of some fungicides *viz*., 48, 121, 246, 306, 341, 396, 430, 449, 450, 452 with control were tested to reduce the anthracnose and increase the yield of chilli. BARI Morich-2 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 t/ha) was obtained from Code 142 and code 215 fungicides and where lowest was recorded from control treatment in case of both set experiment.

Controlling disease and pest for safe Naga chili production

M. H. M. B. Bhuyan, M. M. Rahman, F. Ahmed, J. C. Sarker and S. M. L. Rahman

The experiment was conducted at Spices Research Sub-station, Citrus research station, BARI, Jaintiapur, Sylhet during the period from January 2022 to May 2022. The experiment was laid out in RCBD with three replications. The experiment consisted of five different treatments: T_1=Control (Spraying only water), T_2=Farmers practice (Spraying chemical pesticides), T_3=Mahogany seed extract spray, T_4=Garlic extract spray, T_5=Neem oils spray. The results illustrated that there were significant differences among the treatments. Maximum total number of fruits (191.33), maximum number of marketable fruits (180.10) and marketable yield (14.23 t ha $^{-1}$) was recorded from T_2. The botanicals also performed better regarding number of marketable fruits per plant, and marketable fruit yield. Among the botanical treatments T_5 (neem oil) performed better regarding individual fruit weight (4.5 g), number of marketable fruits (170.33) and marketable yield (13.03 t ha^{-1}).

Post-harvest technology

Efficacy of different seed drying and storage method on quality of chilli seed and its effect on chilli production

R. Ara, S. N. Mojumder, M. N, Yusuf, S. Brahma, M. M Hoque, M. A. A. Khan and M. I. Hoque

A lab experiment was carried out at Regional Spices Research Centre, BARI, Joydebpur, Gazipur during the month from April, 2021 to May, 2022 to study the efficacy of different seed drying and storage method on quality of chilli seed and to find out the suitable seed drying and storage method for chilli seed production. The experiment included three different levels of drying method, *viz*., D_1= Air drying, D_2 = Sun Drying, D_3= Bead drying and three storing method, *viz*., S_1= Aluminium foil packet, S_2=Double polythylene packet, S_3 = Tin container and S_4 = Hermetic container (Bead box). The experiment was laid out in RCB design with 3 replication. Seeds were extracted from red ripe chillies of BARI Morich-3 and dried in netted wooden frame following air and sun drying methods. Seeds were also dried with beads (D_3) and stored in Hermetic container (Bead box). After weighing a represented sample of seeds and moisture % in different drying method and temperature (^{0}C) and relative humidity (%) was recorded from starting date (April 11,2021) of drying (10.00 am- 2.00 pm) maintaining two hours interval) and continued till seed moisture attained in < 8 %. Five gm of dried seeds were then stored considering different storing method and kept for six months. Weight of dried seeds were decreased day by day in different drying method and seeds drying at sun and bead took two days while air dried seeds took one more day to attained minimum moisture. Seeds dried in sun and stored in bead box took minimum days (6.00) to 50% germination followed by seeds dried and stored in bead box (6.33) which was statistically similar. Seeds dried in sun and bead box and both stored in bead box gave the maximum germination % (100). The maximum vigour indices were recoded when seeds dried in sun and bead along with stored in aluminum foil packet and bead box. The highest number (110.0) and heavier (223.54g) chilli fruits were obtained from the seeds which dried in bead box and stored in aluminium packet followed by sun drying seeds stored in aluminum packet.

Ginger

Varietal development

Evaluation of ginger germplasm

M. A. Islam, R. Ara, M. M. Anawer and H. C. Mohanto

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura during April 2021 to February 2022 to select the promising ginger germplasm for releasing a variety. Sixteen different ginger germplasm (G0047, G0042, G0046, G0034, G0043, G0036, G0048, G0021, G0020, G0045, G0032, G001, G004, G0025, G0049 and G0032) with BARI Ada-1 as check were evaluated based on their yield and other characters. The experiment was laid out in RCBD with 3 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 G0048. The highest yield (63.91 t/ha) was also obtained from G0048 and the lowest yield (24.62 t/ha) was found from G0043 line.

Evaluation of exotic ginger germplasm

R. Ara, S. N. Mojumder, M. M. Hoque, S. Brahma and M. N. Yusuf

The experiment was conducted at Regional Spices Research Centre, Gazipur during April 2021 to January 2022 to characterize some plant and rhizome characters as well as to find out some promising lines in respect of heavier rhizome and different yield contributing characters. Fourteen ginger germplasm were collected from different countries from 2014, considered in the trial. Each entry was planted on 16 April 2021 in plot (two rows) 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, 2022. The rhizomes were evaluated by characterization regarding plant and rhizome. Among 14, only ten characters were evaluated *viz*., plant growth habit, plant height (cm), number of tillers, height of tiller, number of leaves, rhizome thickness, rhizome shape and habit, finger length and clump weight (g). Different plant and rhizome characters of ginger varied in different germplasm. Among the germplasm, GO GAZ 001, GO GAZ 003, GO GAZ 004 and GO GAZ 005 possessed of heavier clump with satisfactory performances regarding different plant and rhizome characters. So, a secondary yield trial may be conducted with above ginger materials.

Advance yield trial of mutant ginger

R. Ara, M. A. Islam, M. M. Ahmed, M. N. Yusuf, S. N. Mojumder and M. A. K. Azad

The experiment was conducted at Regional Spices Research Centre, BARI,Gazipur, Spices Research Center, Shibgonj, Bogra and Spices Research Sub Center, Lalmonirhat during April 2021 to March 2022 to assess the performances of selected promising mutant line at three locations. One mutant line G0025 (5 GY) was included in the study with G0025 and BARI Ada-1 as check. The experiment was laid out in RCBD with three replications. Significant differences among the materials were observed in both the locations regarding different attributes. Number of tillers per hill (7.43), number of leaves per hill (84.33) and number of fingers (21.00) were recorded the highest from G0025 (5 GY) followed by G0025 (5.59, 77.67 and 15.67) and BARI Ada-1 (5.22, 73.00 and 17.00), respectively at Gazipur location. Similarly number of tillers per hill (17.47), number of leaves per hill (237.60) and number of fingers (36.33) were recorded the highest from G0025 (5 GY) followed by G0025 (16.00, 225.10 and 35.13) and BARI Ada-1(14.07,225.20 and 35.00), respectively at Bogura location. The heavier primary rhizome (37.00 g), fingers (517.27 g) and clump (554.30 g) were found the maximum at the same location followed by G0025 and BARI Ada-1. The mutant line GOO25 (5GY) performed better in both the locations. For more confirmation the experiment should be repeated for the next year in more locations.

Regional yield trial of promising ginger line

M. A. Islam , M. M. Ahmed, R. Ara, M. M. Anawer and H. C. Mohanto

The experiment was conducted at Spices Research Centre, BARI, Shibgonj, Bogura and Spices Research Sub Center, Lalmonirhat during April 2021 to March 2022 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 RCBD with three replications. Significant differences among the ginger germplasm were observed in both the locations regarding different parameters. Significantly the highest rhizome yield was found from G005 in Bogra (31.21 t/ha) and Lalmonirhat (30.10 t/ha) while the lowest rhizome yield was found from BARI Ginger-1 in both location (19.20 t/ha and 17.72 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 27.50 and 26.58 was found from G005 in Bogura and lalmonirhat location, respectively. The lowest dry matter 18.90% and 17.94% 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

A. H. F. Fahim, M. M. Haque, M. A. Islam, M. A. Rahman, M. A. Alam, R. Ara, M. M. Anwar and H. C. Mohanto

The study was conducted at Spices Research Centre, BARI, Shibganj, Bogura during *Kharif* season of 2022 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 CRD for raising ginger seedlings in pro-tray and RCBD to establish produced seedlings in the main field. Eight different growing media *viz*., coco dust, saw dust, rice husk, rice bran, ash, vermicompost, trico-compost 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. Among the different growing media coco dust and saw dust produced the best quality seedlings. Also sand and ash may be good alternative. 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

A. H. F. Fahim, M. M. Haque, M. A. Islam, M. A. Rahman, M. A. Alam, R. Ara, M. M. Anwar and H. C. Mohanto

The study was conducted at Spices Research Centre, BARI, Shibganj, Bogura during *Kharif* season of 2022 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 CRD for raising ginger seedlings in pro-tray and 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. It was found that all the rhizome size were proceed seedling but 6g to 10g 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.

Soil and water management

Effect of different organic fertilizers on yield and quality of ginger

M. A. Rahman, M. A. Islam, K. M. Khalequzzama, M. A. Alam, M. H. Reza, M. M. Anower and H. C. Mohanta

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the *rabi* season of 2021-22 to know the effect of different organic fertilizers on yield and quality of ginger. There were four treatment combinations *viz*., T_1: 100% recommended dose of chemical fertilizer (RDCF) + 5 t/ha compost (control), T_2: 75% RCF + 25% from vermicompost, T_3: 75% RCF + 25% from tricho-vermicompost and T_4: 75% RCF + 25% from tricho-compost studied in a RCBD with five replications. Positive effect of different treatments was recorded on yield and yield contributing characters of ginger. Along with major yield contributing traits, the highest ginger yield was recorded in T_3 (10.61 t/ha) but maximum BCR (1.29) and MBCR (1.34) were obtained from T_4 treatment.

Disease management

Fungicidal management of leaf spot disease of ginger

K. M. Khalequzzaman, M. A. Islam and M. H. Reza

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during 2021-22 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 (7.60%) was recorded in T_1 (Rhizome treatment and foliar spraying with Ridomil Gold @ 0.2%) which was followed by T_5 (Rhizome treatment and foliar spraying with Companion 75 WP @ 0.2%) and T_2 (Rhizome treatment and foliar spraying with Autostin @ 0.15%), and the highest leaf spot (22.38%) was recorded in untreated control. T_1 gave the highest weight of rhizome per clump (762.06 g) which was followed by T_5 and T_2, and control resulted the lowest weight of rhizome per clump (550.48 g). Yield was varied from 18.26 to 28.02 t/ha, while T_1 showed the highest yield which was followed by T_5 and T_2, and control treatment showed the lowest yield which was statistically dissimilar to other treatments. The highest yield increased over control (53.45%) was recorded in T_1 which was followed by T_5 and T_2, and the lowest yield increased over control (10.73%) was recorded in T_3 (Rhizome treatment and foliar spraying with Homai 80 WP @ 0.2%).

Post-harvest technology

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

M. M. Alam, M. G. F. Chowdhury and H. C. Mohanta

This experiment was carried out to investigate the effect of preservatives, storage conditions and storage duration 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 benjoate, potassium metabisulphide (KMS), 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 360 days storage. The color, flavor, texture and overall acceptability of the ginger-garlic pastes, treated with citric acid plus sodium benjoate (T_5), were acceptable up to 150 days of storage but when treated with citric acid plus KMS (T_6), sodium cloride plus citric acid plus sodium benjoate (T_7), sodium cloride plus citric acid plus KMS (T_8), citric acid (T_{13}) and stored in glass container at room temperature (RT) were acceptable up to 360 days of storage. On the other hand the color, flavor, texture and overall acceptability of the ginger-garlic pastes of all the above sample (T_5 ,T_6 ,T_7 ,T_8,T_{13}) were acceptable up to 360 days of refrigerated storage. The color and flavor were more acceptable in refrigerated storage compared to ambient temperature storage. The study has shown that ginger-garlic paste without any preservative (control) could not be stored more than 60 days at room temperature and 90 days at refrigeration temperature. In order to determine the suitability of two samples of ginger-garlic paste (which were found better in RT and RFT), it was decided to conduct organoleptic taste test of chicken and beef curry using above 2 samples (T_7 and T_8) with fresh ginger-garlic paste. The results showed that all the quality attributes of these samples were statistically almost identical in respect of colour, flavour, pungency, taste and overall acceptability though there was little bit difference in scoring among each attributes.

Turmeric

Varietal development

Evaluation of turmeric germplasm

M. A. Alam, M. M. Zaman, M. M. Hasan, A. H. F. Fahim, M. R. Islam and M. M. Anwar

The present experiment was conducted to select superior turmeric lines for higher yield at Spices Research Centre, Shibganj, Bogura during 2021-22. Fifty-two 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. Three genotypes were outyielded the best check entry BARI Holud-4. The promising genotypes need to be evaluated in a large plot under advanced yield trial in next season.

Evaluation of turmeric (*Curcuma longa* L.) germplasms

M. M. Rahman and M. A. Khan

An evaluation trial was conducted at the farm of SRSC, Faridpur during 2021-22 to assess the performance of turmeric genotypes. The experiment was laid out in RCB design with three replications. Six different turmeric genotypes (CL Far 001, CL Far 002, CL Far 003, CL Far 004, CL Far 005 and CL Far 006) and BARI Holud -4 and BARI Holud-5 as check varieties was used as treatments. They were evaluated based on their yield and other desirable characters. Among the treatments, the highest average yield (22.06 t/ha) was obtained from CL Far 006. The check varieties BARI Holud-4 and BARI Holud-5 showed 16.35 and 13.40 t/ha, respectively.

Advanced yield trial of turmeric

M. A. Alam, M. M. Zaman, M. M. Hasan, A. H. F. Fahim, S. N. Mojumdar and M. M. Anwar

The present experiment was conducted to select superior turmeric lines for higher yield at Spices Research Centre, Shibganj, Bogura during 2021-22. Eight turmeric genotypes including BARI Holud-4 and BARI Holud-5 as checks were used in this study. The experiment was laid out in alpha lattice design with three replications. Genotype T0098 and T0073 outyielded both the check entries, which was followed by BARI Holud-4. The trial needs to be continued including a new set of promising genotypes in next season.

Advance yield trial of turmeric

M. R. Islam, R. Ara, M. M. Zaman, M. A. Alam and A. J. M. Obaidullah

The experiment was conducted at Regional Spices Research Centre, BARI, Magura during April 2021 to March 2022 to evaluate different turmeric lines and to select the promising one for releasing a variety. The experiment was laid out in RCBD with three replications. Two different turmeric lines (T073-1 and T0137) including BARI Holud-4 and BARI Holud-5 as checks were evaluated based on their yield and other desirable characters. Significant differences regarding plant height, number of leaves per clump, number of tillers per clump, number of mother rhizomes, weight of mother rhizome per clump, number of primary fingers, weight of primary fingers , number of secondary fingers per clump, weight of secondary fingers, weight of rhizome per clump and fresh yield were observed among different lines. Significantly the highest dry yield (11.97 t/ha) was observed from T0137 turmeric line followed by T073-1, whereas the lowest dry yield (5.04 t/ha) was observed from BARI Holud-4.

Cultural management

Integrated weed management in turmeric

M. R. Islam, M. M. Zaman and A. J. M. Obaidullah

The experiment was conducted at Regional Spices Research Centre, BARI, Magura during April 2021 to March 2022 to find out the best management practices for controlling weed of Turmeric. The experiment was laid out in RCBD with three replications. Nine different treatments and a control treatment were used. Significant differences regarding yield and yield attributes were observed among different treatments. Significantly the highest plant height (125.27 cm), number of leaves per clump (35.00), number of tillers per clump (4.33), number of mother rhizomes (3.33), weight of mother rhizome per clump (165.95g), number of primary fingers (14.67), weight of primary fingers (703.26g), number of secondary fingers per clump (22.33), weight of secondary fingers (605.00g), weight of rhizome per clump (1500 g) was observed from the treatment T_5 (Glyphosate @ 4 L/ha + Straw mulch10t/ha + 1 HW at 70 DAP). The highest fresh yield (64.63 t/ha) was found from treatment T_5 (Glyphosate @ 4 L/ha + Straw mulch@10t/ha + 1 HW at 70 DAP) and the lowest yield (20.16 kg/ha) was found from control plot $T_{10.}$ Maximum weed control efficiency (91.97%) was found from treatment T_5 (Glyphosate @ 4 L/ha + Straw mulch@10t/ha + 1 HW at 70 DAP).

Yield performance of turmeric in mango orchard

M. Rahman and M. O. Kaisar

The experiment was conducted at the Regional Agricultural Research Station, BARI, Cumilla during April 2021 to January 2022 to find out the yield performance of turmeric in mango orchard. 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 RCBD with three replications. It was observed that the highest plant height (159.83 cm), number of tillers clump-1 (4.00), population plot-1(104.33), yield of rhizomes clump-1 (827.67g) and yield (29.19 t/ha) were found in BARI Holud-4. So, the result revealed that BARI Holud-4 performed well in mango orchard regarding higher yield and yield contributing characters.

Coriander

Varietal development

Evaluation of coriander germplasm

M. M. Hasan, M. A. Alam, A. H. F. Fahim, S. N. Mazumdar, M. Anwar and H. C. Mohanta

The experiment was conducted to evaluate the germplasm collected from different sources and to identify the best genotype with higher yield and desirable characters at Spices Research Centre, BARI, Shibganj, Bogura during *rabi* 2021-22. Thirty-one different coriander genotypes with BARI Dhonia-1 as a check were evaluated based on their yield attributes and yield. The experiment was laid out in RCB design with three replications. All traits were significant except no of branches/plant and no of umbellets/umbel considering among the genotypes. The genotype COR 20 performed better in case of plant height (131.77cm), no of branch/plant (7.40), umbels/plant (90.20) and 1000 seeds weight (17.17 g) over others. The highest seed yield was found in COR40 (1.44 t/ha) and the lowest (0.73 t/ha) was COR20. Considering yield the genotype COR40 was found promising.

Technology transfer and validation

Performance of coriander varieties in charland of AEZ-3

M. E. Haque, D. M. M. Ahmed and M. N. Farid

An experiment was conducted in farmer's field at Charlads of Char Gonai, Kaunia, Rangpur during *rabi* season of 2021-22 with BARI Dhania-2 and local coriander to select suitable variety for higher yield of coriander in under Charland condition. The trial was conducted in a RCBD with 3 replications. BARI Dhania-2 showed statistically higher seed yield of 1330 kgha^{-1} while the lower was obtained from local variety (510 kg ha^{-1}). BARI Dhania-2 should be introduced in Char areas of Rangpur region to get higher yield and productivity.

Black cumin

Stress Breeding

Screening of black cumin germplasm for salinity tolerance

A. J. M. Obaidullah, M. M. Zaman and M. R. Islam

The experiment was conducted at Agricultural Research Station, BARI, Benarpota, Satkhira during November 2021 to March 2022 to find out salinity tolerance of some black cumin germplasm. There were nine black cumin line *viz*., BC 011, BC 012, BC 014, BC 016, BC 19-2, BC 19-6, BC 026, BC 028, BC 029 along with BARI Kalozira-1. The experiment was laid out in RCBD with 3 replications. BC-14 (0.98 t/ha) gave the highest yield and BC-29 (0.07 t/ha) had the lowest yield. The lowest level of soil salinity was recorded in sowing time (0.50 dS/m) and the highest level of salinity was recorded at the harvesting stage (4.65 dS/m).

Soil and Water Management

Growth and yield of black cumin as influenced by integrated nutrient management

M. A. Rahman, M. R. Ali, J. Rahman, A. H. F. Fahim, M. A. Alam, M. H. Reza, M. M. Anower and H. C. Mohanta

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the *rabi* season of 2021-22 to know the effect of different nutrient management practices on growth and yield of black cumin. There were five treatments *viz*., T_1=recommended fertilizer dose (RFD) ($N_{60}P_{24}K_{45}S_{15}Zn_2B_{1.4}$ kg/ha) (FRG, 2018), T_2=125% of RFD, T_3= Integrated Plant Nutrient System (IPNS) with 3 t/ha PM, T_4= Integrated Plant Nutrient System (IPNS) with 3 t/ha FYM and T_5= Farmers' practice ($N_{58}P_{19}K_{38}S_{14}Zn_2B_{1.4}$ kg/ha) studied in a RCBD having three replications. Highest black cumin seed yielder (1.43 t/ha) treatment was T_4 with higher level of BCR (1.33). Maximum MBCR (8.09) was recorded from T_4 (IPNS + 3 t/ha FYM).

Technology Transfer and Validation

Adaptive yield trial of black cumin under different sowing methods under charland condition

M. E. Haque, D. M. M. Ahmed and M. N. Farid

An experiment was conducted in farmer's field at charlands of Char Gonai, Kaunia, Rangpur during *rabi* season of 2021-22 with BARI Kalozira-1 and Local black cumin variety to find out suitable black cumin variety and sowing methods under charland condition. The trial was conducted in a RCBD with three replications. The highest seed yield of 620.81kgha^{-1} was recorded from the interaction of BARI Kalozira-1×Line sowing method and the lowest 471.5 kgha^{-1} was harvested from Local × broadcast sowing method. Line sowing method is more suitable than broadcast sowing method 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.

Fenugreek

Varietal development

Evaluation of fenugreek germplasm

A. H. F. Fahim, M. M. Hasan, M. A. Rahman, M. A. Alam, M. M. Anwar and H. C. Mohanta

The trial was conducted at Spices Research Centre, BARI Shibganj, Bogura during the *rabi* season of 2021-22 to evaluate the germplasm collected from different sources in terms of their yield potentiality and to identify the superior one (s). The experiment was laid out in a RCBD with 3 replications. Twelve different fenugreek germplasm (FK25, FK27, FK30, FK31, FK32-1, FK32-2, FK33, FK34, FK36, FK39, FK40 and FK41) 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 (4.03 t/ha) was harvested from the germplasm FK31 followed by FK33 (3.75 t/ha), FK40 (3.63 t/ha), FK34 (3.61 t/ha) and FK27 (3.52 t/ha). The lower amount of seed (2.45 t/ha) was harvested from FK41 followed by the BARI Methi-3 (2.67 t/ha). Among the germplasm FK31, FK33, FK40, FK34 and FK27 performed better. This is first-year trial and the experiment will be repeated in the next year for confirmation of the results.

Regional yield trial of fenugreek

A. H. F. Fahim, M. M. Hasan, M. M. Ahmed, M. N. Yousuf, M. R. Islam, M. M. Rahman, M. Rahman, S. N. Mozumder and H. C. Mohanta

The trial was conducted during *rabi* season of 2021-22 to evaluate the performance of advanced fenugreek germplasm at different Agro-Ecological Zones (AEZs) and to select the promising one for releasing a variety. The experiment was laid out in a factorial RCBD with four replications. Three advanced fenugreek germplasm FK28, FK29 and FK37 were evaluated against recommended variety BARI Methi-3 as check. The trial was conducted at six different locations *viz*., Spices Research Centre (SRC), Bogura; Regional Spices Research Centre (RSRC), Gazipur; Regional Spices Research Centre (RSRC), Magura; Spices Research Sub-centre (SRSC), Faridpur; Spices Research Sub-centre (SRSC), Lalmonirhat and Regional Agricultural Research Station (RARS), Cumilla. Seed yield and other yield contributing characters were varied significantly among the germplasm in different location. Among the locations, the higher amount of seed (3.98 t/ha) was harvested in Magura location followed by Cumilla location (3.59 t/ha). The lower amount of seed (1.39 t/ha) was harvested in Lalmonirhat location. Among the variety /germplasm, the highest seed yield (3.21 t/ha) was obtained from the fenugreek germplasm FK29 which was statistically identical to FK37 (3.07 t/ha) and the lowest amount of seed (2.26 t/ha) was harvested from the check variety BARI Methi-3 which was identical to FK28, 2.41 t/ha. In case of combined effect of location and fenugreek germplasm, the highest amount of seed (4.68 t/ha) was harvested from the advanced fenugreek germplasm FK29 in Cumilla location followed by FK37 in Cumilla location (4.48 t/ha) and FK29 in Magura Location (4.44 t/ha). The lower amount of seed (1.07 t/ha) was harvested from the germplasm FK28 in Gazipur location. It was found that the advanced fenugreek germplasm FK29 performed better in all locations. Moreover, this germplasm had shorter lifecycle as like as BARI Methi-3 and produced higher sized seeds. This is the first-year results, so that the experiment will be repeated in the next year for confirmation of the results.

Cultural management

Effect of sowing time on the yield and yield components of fenugreek in Cumilla region

M. Rahman, M. A. H. Khan and M. O. Kaisar

The experiment was conducted at the Regional Agricultural Research Station, BARI, Cumilla during *rabi* season of 2021-22 to find out the optimum sowing time for fenugreek in Cumilla region. The experimental treatments included (i) 4 dates of sowing *viz*., S_1=15 October, S_2=30 October, S_3=15 November, S_4=30 November. The experiment was laid out in RCBD with three replications. Results revealed that sowing time had significant influences on various crop characters and seed yield. Among the planting time treatments, S_3, (Sowing on 15 November) was superior in relation to plant height, number of primary branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, Pod length and 1000-seed weight which resulting the highest seed yield (4.53 t/ha^{-1}) compared to S_1 and S_4 treatments. So, the results revealed that sowing time (S_3=15 November) had significant influences for getting higher seed yield in Fenugreek

Disease management

Fungicidal management of rust disease of fenugreek

K. M. Khalequzzaman and M. H. Reza

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during *rabi* season of 2021-22 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 incidence of fenugreek under different treatments ranged from 9.44 - 30.46%, 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 (61.23) was counted in Tilt 250 EC (0.05%) sprayed plots which was statistically similar to Folicure

(0.1%) and the lowest (45.00) 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 (22.26) and weight of seeds per pod (0.51 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 (1013.68), weight of seeds per plant (10.24 g) and seed yield (2.36 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.

Sickle fruit fenugreek

Varietal development

Evaluation of sickle fruit fenugreek germplasm

M. M. Hasan, M. A. Alam, A. H. F. Fahim, S. N. Mazumdar, M Anwar and H. C. Mohanta

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during *rabi* season of 2021-22 to evaluate the germplasm collected from different sources and to identify the best genotype with higher yield and desirable characters. The experiment was laid out in RCB design with three replications. Six different sickle fruit fenugreek (Firingi) genotypes were evaluated for yield and yield contributing characters. Seed yield and other yield contributing characters were significantly different except no of branch/plant, no of pods/ plant and single pods weight among the studied genotypes. The highest plant height was recorded from FRG 01 (71.20 cm). The lowest plant height was found in FRG 03 (63.33 cm). FRG02 performed best in respect of growth character and produced the highest seed yield (0.80 t/ha).

Fennel

Varietal development

Evaluation of fennel germplasm

M. M. Hasan, M. A. Alam, A. H. F. Fahim, S. N. Mazumdar, M Anwar and H. C. Mohanta

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during *rabi* season of 2021-22 to evaluate the germplasm collected from different sources and to identify the best genotype with higher yield and desirable characters. The experiment was laid out in RCB design with three replications. Fourteen different fennel genotypes with as a check BARI Mouri-1 were evaluated for yield and yield contributing characters. Seed yield and other yield contributing characters were significantly different among the genotypes except plant height (cm) and 1000 seed weight (g). The highest plant height was recorded from FN24 (161.67cm). The higher seed yield was obtained from BARI Mouri-1 (1.15 t/ha). The lowest seed yield was recorded from FN22 (0.89 t/ha).

Evaluation of fennel (*Foeniculum* vulgare) germplasm

M. M. Rahman and M. A. Khan

A fennel germplasm was collected from Saudi Arabia during 2019. After that it was growing for two years for normal observation, but during 2021-22, an experiment was conducted at Spices Research Sub-Centre, Faridpur to evaluate that germplasm. The experiment was laid out in RCB design with seven replications. FV Far 001 and BARI Mouri-1 were used as treatments. Highest seed yield (1882.16 kg/ha) and 1000 seed weight (5.82g) was found in FV Far 001. BARI Mouri-1 performed 1536.83 kg/ha yield and 5.38 g 1000 seed weight.

Soil and water management

Effect of N, P, K and S on growth and yield of fennel

M. N. Yousuf, S. Brahma, M. A. A. Khan, M. M. Haque, R. Ara and H. C. Mohanta

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 2021-22 at experimental field of Regional Spices Research Centre, BARI, and Gazipur. It consisted of twelve fertilizers treatment of fennel in RCBD with three replications. The growth and yield parameters of fennel cumin were significantly affected by the different fertilizer treatments. The maximum seed yield (2.30 tha^{-1}) and the maximum harvest index (94.18%) of fennel was obtained in 130-70-80-30 kg NPKS ha^{-1}. The fennel fertilized by 130-70-80-30 kg NPKS ha^{-1} might be the recommended as nutrient package for satisfactory seed yield in the study area.

Dill

Varietal development

Evaluation of dill germplasm

M. M. Hasan, M. A. Alam, A. H. F. Fahim, S. N. Mazumdar, M. Anwar and H. C. Mohanta

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during *rabi* season of 2021-22 to evaluate the germplasm collected from different sources and to identify the best genotype with higher yield and desirable characters. The experiment was laid out in RCB design with 3 replications. Nine different dill genotypes with BARI Soluk-1 as check were evaluated for yield and yield contributing characters. Seed yield and other yield contributing characters were significantly different except 1000- seed weight (g) among the genotypes. The highest plant height was recorded from AG03 (151.67 cm) and the lowest plant height was found in BARI Soluk-1 (122.80 cm). In case of seed yield, AG05 performed best (1.01 t/ha).

Celery

Varietal development

Evaluation of celery germplasm

A. H. F. Fahim, M. M. Hasan, M. A. Alam, M. A. Rahman, M. M. Anwar and H. C. Mohanta

The experiment was conducted at the research field of Spices Research Centre (SRC), Shibganj, Bogura during Rabi season of 2021-22 to evaluate the performance of different celery germplasm and to identify the superior genotypes. The land was medium high and the soil was clay loam in texture. The experiment was laid out with RCB Design with 3 replications. Eight celery germplasm (CL002, CL004, CL005, CL006, CL007, CL011, CL012 and CL015) collected from different places of Bangladesh were tested for the experiment with the check variety BARI Radhuni-1. It was found that all the parameters were statistically significant except number of umbellets per umbel and 1000-seed weight. All the germplasm performed better than the check variety in terms of yield potentiality. The higher amount of seeds 1.06 t/ha were harvested from the celery germplasm CL006 and the lower amount of seeds 0.68 t/ha were harvested from the check variety BARI Radhuni-1. Among them CL006, CL002 and CL007 showed better performance. However, the experiment will be repeated in the next year for confirmation of the results.

Ajowan

Varietal development

Regional yield trial of ajowan (*Trachyspermum ammi* L.)

S. N. Mozumder, M. M. Rahman, M. A. Khan, R. Ara and M. M. Ahmed

The experiment was conducted at three different locations of Bangladesh such as SRSC, Faridpur; SRC, Bogura; RSRC, Gazipur; RSRC, Magura and SRSC, Faridpur during *robi* season of 2020-21 and six different location such as SRSC, Faridpur; RSRC, Gazipur; SRSC, Lalmonirhat, SRC, Bogura; RSRC, Magura and RARS, Cumilla to evaluate the performance of advanced Ajowan lines based on agronomical and morphological characteristics. Two advanced lines were assessed against a local line. The line TC GAZ 002 gave the highest seed yield (1.1 t/ha and 0.96 t/ha) during 2020-21 and 2021-22, respectively.

Isabgol

Varietal development

Regional yield trial of isabgol (*Plantago ovata*)

M. R. Islam, M. M. Zaman, M. M. Haque, R. Ara, M. M. Ahmed, A. H. F. Fahim, A. J. M. Obaidullah and M. N. Farid

The experiment was conducted at the research field of Regional Spices Research Centre, Magura; Spices Research Centre, Bogura and Spices Research Sub-Centre, Lalmonirhat during November 2021 to March 2022 to evaluate the performance of different Isabgol (*Plantago ovata*) germplasm and to select the promising one (s) for releasing a variety. The experiment was laid out in RCB design with 5 replications in each location. The highest Plant height (44.39 cm), number of tillers per plant (7.78), number of leaves per plant (63.60), number of spikes per plant (105.89), length of spike (3.80 cm), seeds per spike (47.94), number of seeds per plant (5363) and 1000-seeds weight (1.50 g) was obtained from Magura location and the lowest Plant height (41.06 cm), number of tillers per plant (6.80), number of leaves per plant (55.40), number of spikes

per plant (93.57), length of spike (3.31 cm), seeds per spike (44.89), number of seeds per plant (4962) and 1000 seed weight (1.45 g) was obtained from Bogura location. Among the two lines the highest seed yield (504.62 kg/ha) was found from PO Mag-001 and the lowest seed yield from (378.20 kg/ha) from PO Mag-002.

Bay leaf

Varietal development

Evaluation of bay leaf germplasm

M. H. M. B. Bhuyan, J. C. Sarker, F. Ahmed and S. M. L. Rahman

The study was conducted at Spices Research Sub-Station, BARI, Jaintapur, Sylhet during July 2021 to May, 2022. 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.

Cinnamon

Varietal development

Evaluation of cinnamon germplasm

F. Ahmed, M. H. M. B. Bhuyan, J. C. Sarker and S. M. L. Rahman

The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet during the period from May 2021 to May 2022 to identify the best germplasm of cinnamon.Three cinnamon germplasm *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 and weight. The maximum fresh quill thickness (0.26 mm) was recorded with CC Jai-003. On the other hand, the minimum fresh quill thickness (0.11 mm) was found at CC Jai-002. Quill fresh weight found maximum (73.32 g) at CC Jai-003 but lowest (42.97 g) at CC Jai-002. The germplasm CC Jai-002 performed best among the treatments under study.

Plum

Post-harvest technology

Development of shelf stable value added chatney from plum (*Prunus domestica*)

M. M. Alam and H. C. Mohanta

The present study was concerned with the different ingredients of developed plum chatnies depending on the processing techniques used. The acceptability of processed chatnies 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 7.4 to 8.20, ranking 'like moderately to 'like very much'. The test score indicated that among three samples, the chatnies which was processed with less spices was most acceptable. Storage studies were carried out for up to twelve months at room temperature (25-30^{0}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 thequalities of chatnieswas satisfactory. The study thus showed that high quality shelf-stable plum chatnies 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 jam from plum (*Prunus domestica*)

M. M. Alam and H. C. Mohanta

The present study was concerned with the different ingredients of developed plum jam depending on the processing techniques used. The acceptability of processed jam 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 6.7 to 8.40, ranking 'like very much to 'like slightly'. Storage studies were carried out for up to twelve months at room temperature (25-30^{0}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 jams were accepted by the panelists. Among three samples the chemical composition of best sample S_1 (evaluated by the panelists) was determined and it was observed that the qualities of jams were satisfactory. The study thus showed that high quality shelf-stable plum jam 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 murobba from plum (*Prunus domestica*)

M. M. Alam and H. C. Mohanta

The present study was concerned with the different ingredients of developed plum murobbas depending on the processing techniques used. The acceptability of processed murobbas 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 6.5 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^{0}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 murobbas were accepted by the panelists. Among three samples the chemical composition of best sample S_3 (evaluated by the panelists) was determined and it was observed that the qualities of murobba was satisfactory. The study thus shows that high quality shelf-stable plum murobba can be developed utilizing available low cost processing processes and thereby, post-harvest losses of plum can be reduced to an acceptable level.

Black pepper

Varietal development

Evaluation of black pepper lines

F. Ahmed, M. H. M. B. Bhuyan, J. C. Sarkera S. M. L. Rahman

The experiment was conducted at spices Research Sub-Station, Citrus Research Station, BARI, Jaintapur, Sylhet during the period from May 2021 to May 2022 to evaluate the new germplasm of black pepper comparison with BARI Golmorich-1. The variety BARI Golmorich-1 and PN Jai-101 were evaluated and recorded. BARI Golmorich -1 was taller (200 cm) than PN Jai- 101 (150 cm). The other characteristics were dissimilar and that were distinguished character. BARI Golmorich-1 showed longer (14 cm) and wider (8 cm) leaves. On the other hand PN Jai-101 recorded shorter (10 cm) and narrower (7 cm) leaves. PN Jai-101 noted thicker (0.5 cm) leaves than BARI Golmorich-1 (0.3 cm) leaves. BARI Golmorich-1 had ovate-elliptic leaf lamina, round leaf base and campylodromous leaf veining. Contrary PN Jai-101 had ovate leaf lamina, cordate leaf base and acrodromous leaf veining. BARI Golmorich -1 were in flowering stage but PN Jai-101were in vegetative stage.

Cultural management

Effect of different living and non-living standards on the establishment, growth and yield of black pepper cv. Bari golmorich-1

J. C. Sarker, F. Ahmed, M. H. M. B. Bhuyan and S. M. L. Rahman

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. The experiment consisted of three different living and non-living standards as treatment *viz*. T_1= Reinforced concrete posts, T_2=Bhadi tree (*Lannea coromandelica* (Houtt.) Merr.) and T_3=Mandar tree **(***Erythrina variegate* L.). The experiment was conducted in RCBD with 4 replications. The vines in Bhadi tree exhibited superior performance with respect to average height of vine (474.7cm), average number of branches/vine (58.53), number of spikes per vine (164.5) and yield (1.3 kg plant $^{-1}$).

Standardization of single node cutting for quick multiplication of black pepper

M. H. M. B. Bhuyan, S. M. L. Rahman, F. Ahmed and J. C. Sarker

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 were 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.

Betel Leaf

Varietal development

Physio-morphological study on betel leaf (*Piper betle* L. cv. Khasia Pan)

J. C. Sarker, M. H. M. B. Bhuyan, F. Ahmed and S. M. L. Rahman

An experiment was conducted to find out the promising genotype for commercial cultivation in the region. All the germplasm differed in their growth characters. Five khasia pan designated as PB Jai-001 through PB Jai-005 were collected from different locations of Bangladesh and found remarkable variations in vegetative growth, morphological features, yield and yield attributes. The leaf length (6.2-9.9 cm), leaf breadth (6.5-9.8 cm) remarkably varied among the cultivars. Maximum fresh weight of 100-leaves was 425 g. Highest Leaf number per meter vine (37) and leaf number per plant per year (115) were found in PB Jai-002. The highest annual per plant yield was obtained from PB Jai-002 (488 g) followed by PB Jai-001 (359 g) and PB Jai-001 (354 g). Variations were also existed among the cultivars in leaf colour, leaf shape, leaf tip and pungency of leaf. No pungency of leaf was found in PB Jai-002. So, PB Jai-002 was seemed to be a better germplasm in respect of yield and quality of betel leaf.

Insect pest management

Development of bio-rational based management approach against sucking pests of betel leaf

M. M. Hossain, M. H. Reza, H. C. Mohanta, A. Sarker and N. K. Dutta

The field study was conducted in seven years old standing betel vine 'boroj' at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh (geographic coordinates 25.0167° N, 89.3167° E) during January 2021-December 2022 to study the population buildup of sucking insect pests as influenced by climatic factors and to evaluate the efficacy of different bio-rational based management approach against sucking insect pests complex of betel leaf. BARI Pan-3 was used as test crop for this trial. The treatments were T_1= Sanitation + Alternate spraying of Spinosad (Spinomax 2.5SC) @ 1ml/l and Abamectin (Biomax 1.8 EC) @ 1ml/l; T_2= Sanitation + Alternate spraying of Azadirachtin (Bioneem plus1EC) @ 1ml/l and Antatio wp (Bt + Abamectin 0.1%) @ 0.5g/l; T_3= Sanitation + Alternate spraying of Abamectin (Biomax 1.8 EC) @ 1ml/l and Fytoclean (Potassium salt of fatty acid) @ 5ml/l; T_4= Sanitation + Alternate spraying of Fizimite (Sodium lauryl ether) @ 1ml/l and Antatio wp (Bt + Abamectin 0.1%) @ 0.5g/l; T_5= Farmers practice : Spraying of Imidacloprid (Admire 200SL) @ 0.25 ml/l and T_6= Untreated control. Population of sucking pest (black fly, white fly, red mite and mealy bug) was found active throughout the year but the maximum (22.7, 17.2, 16.1 and 14 adult/vine) and minimum (3.2, 2.8, 2.6 and 1.5 adult/vine) was recorded during the month of October and January. Multiple linear regression analysis showed significant variation and the R^2 value suggested that biotic factor contribute 57.9%, 50.9%, and 51.3% and 53.7% variation in black fly, white fly, red spider mite and mealy bug population. Among the five bio-rational based management approach, the highest mortality

(80.56%, 84.73%, 82.44% and 90.96%) of black fly, white fly, red mite and mealy bug with the lowest number (3.11, 1.33, 1.28 and 0.64 adult/vine) of insect population was found in the Sanitation + Three alternate spraying of Fizimite and Antario treated plot and the highest number of those sucking insect was recorded from untreated control plot. However, the highest vine yield (18.61 t/ha) was also obtained from sanitation + alternate spraying of Fizimite and Antario and the lowest yield (9.11 t/ha) was recorded from untreated control plot that indicated better control of sucking insect pest compared to other treatments. So, Sanitation of belel leaf garden along with three alternate spraying of Fizimite (Sodium lauryl ether) @ 1ml/l and Antario wp (Bt + Abamectin 0.1%) @ 0.5g/l may be recommended for effective management of sucking insect pest's complex of betel vine 'boroj'.

Chaba

Varietal development

Regional yield trial of chaba (*Piper chaba*)

M. R. Islam, M. M. Zaman, A. J. M. Obaidullah, R. Ara, A. Alam, A. H. M. Fahim, M. M. Hasan, M. E. Haque and M. N. Farid

The experiment was conducted at the research field of Regional Spices Research Centre, Magura; Dumoria, Khulna, and Kaligonj, Lalmonirhat during July, 2018 to July 2021 to evaluate the performance of different Chaba germplasm and to select the promising one(s) for releasing as a variety. The experiment was laid out in RCB design with 3 replications in each location. Among the two germplasm highest plant height (2.7m in 2018-19, 5.81m in 2019-20 and 13.33m 2020-21), number of branches per plant (17.67 in 2018-19, 36.00 in 2019-20 and 81.67 in 2020-21), number of leaves per plant (111.67 in 2018-19, 250.00 in 2019-20 and 330.00 in 2020-21), internodes length (15.83cm in 2018-19, 16.08cm in 2019-20 and 16.67cm in 2020-21) and stem diameter (1.73cm in 2018-19, 2.89cm in 2019-20 and 8.17cm in 2020-21) was recorded from PCmag-001 line in Dumoria, Khulna location. The highest yield (edible stem) (2.25 kg/plant in 2018-19, 6.18 kg/plant in 2019-20 and 12.27 kg/plant in 2020-21) was recorded from PCmag-001 line in Dumoria, khulna location.

Disease management

Survey on major disease of chaba (*Piper chaba*)

M. R. Islam, M. M. Zaman and A. J. M. Obaidullah

A survey was conducted in Khulna, Bagerhat, Jashore, Chuadanga and Magura during July 2020 to July 2021 to find out major disease of Chaba. Four diseases had been identified from different locations viz; foot and root rot, leaf rot, leaf spot and leaf rust. The highest disease incidence was observed in Dumoria, Khulna. Disease incidence ranged from 7.33% to 16.73%. Among the four observed disease percent incidence was highest in leaf rot followed by root rot.

Cardamom

Varietal development

Collection, conservation, and characterization of small and large cardamon germplasm

J. C. Sarker, F. Ahmed, M. H. M. B. Bhuyan and S. M. L. Rahman

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 tallest plant was recorded in AS Jai-002 (110.33 cm) but both AS Jai-004(93.00 cm) and AS Jai-005(93.00 cm) recorded shortest plant. The maximum number of tillers clump^{-1} was found in AS Jai-005 (33.33) while the minimum was in AS Jai-001 (4.66). AS Jai-005 produced the highest (6.33) number of leaves tiller^{-1} while AS Jai-003 produced the lowest (3.33) number of leaves tiller^{-1}. Longest (36.33 cm) and widest leaf (8.33 cm) was found in AS Jai-005. On the other hand AS Jai-001 produced shortest (19 cm) and narrowest (3.66 cm) leaves.

Collection and evaluation of indigenous spices crop Under sylhet region

J. C. Sarker, F. Ahmed, M. H. M. B. Bhuyan and S. M. L. Rahman

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.

VEGETABLE CROPS

05

Eggplant

Evaluation of local eggplant (Potha Begun) germplasm

M. R. Islam, M. M. Rahman and Z. A. Firoz

The experiment was carried out with seventeen local potha begun lines at the research field of HRC, RARS, Hathazari, Chattogram during the winter season of 2021-22 to find out superior local eggplant genotypes. In case of 'Potha Begun' lines significant differences were observed in all the parameters studied except fruit length, fruit diameter and number of fruits per plant. The earliest 50% flowering was found in the genotype SM (P)-10 (61.0 days) followed by SM (P)-08 (67.0 days) and it was delayed in SM (P)-06 (91.0 days) and SM (P)-11 (90.6 days). The highest individual fruit weight containing genotype was SM(P)-14 (49.3g) and SM(P)-01 (49.0g) followed by SM(P)-04 (46.3g) and it was the lowest in SM(P)-06 (26.3g). The highest significant fruit yield/plant or yield/hectare observed in SM(P)-09 (1.38 kg/plant or 19.86 t/ha), followed by SM (P)-12 (1.20 kg/plant or 18.53 t/ha), SM (P)-04 (1.16 kg/plant or 18.40 t/ha) and it was the lowest in SM (P)-06 (0.52 kg/plant or 8.01 t/ha). The 1000-seed weight was the highest in SM (P)-08 (8.0g) followed by SM (P)-13 (7.0 g) and SM (P)-17 (7.0g). Considering all the characters the genotypes SM (P)-04, SM (P)-09 and SM (P)-12 were found promising. A trial should be conducted taking these promising 'Potha Begun' genotypes for generation advancement in the next year.

Performance of summer eggplant variety at different sowing time at Jamalpur

A. Akter, M. A. Hossain, H. Rahman, M. S. Rahman, R. Sultana and H. E. M. K. Mazed

An experiment was conducted at the HRC field, Regional Agricultural Research Station, Jamalpur during 2020-21 to study the effect of sowing time on the growth and yield of eggplant. Four sowing time *viz*., S_1= 1st week of December, S_2= 1st week of March, S_3= 1st week of June, and S_4= 1st week of September were considered as factor-A and eggplant variety *viz*. V_1=BARI Begun-8 and V_2=BARI Begun-10 were considered as factor-B. The yield of eggplant was significantly affected by different sowing time and eggplant varieties. Significantly highest number of fruits per plant (19) obtained from the combination 1st week of September sowing and BARI Begun-8 and the lowest (12) from 1st week of March sowing and BARI Begun-8 combination. A perusal of data revealed that the four sowing time showed their significant influence on fruit yield per plant. Significantly highest individual fruit weight (129.20 g) was recorded with 1st week of December sowing in BARI Begun-10 while in 1st week of September sowing and BARI Begun-8 combination individual fruit weight was lowest (117.67 g). Significantly highest yield (2.23 kg /plant and 42.58 t/ha) was registered in 1st week of September and BARI Begun-8 combination. These combinations may be profitable due to low eggplant shoot and fruit borer infestation and higher yield. On the other hand, 1st week of March sowing and BARI Begun-8 was recorded the lowest (1.42 kg /plant and 27.05 t/ha). Significantly second highest yield (2.15 kg /plant and 41.01 t/ha) was found from 1st week of December and BARI Begun-10 combination. These combinations also may be profitable due to higher yield and highest market price.

Advanced yield trial of white coloured eggplant lines

A.K.M. Quamruzzaman, Ferdouse Islam, M. Nazim Uddin and L. Akter

A performance trial with nine 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 2021-22 to

observe the performance in relation to yield potential and horticultural traits. There was diverged variability observed among the 9 white-colored eggplant lines. The range of the number of marketable fruits/plant was 12.5-33.5, while the average fruit weight was 93 - 283g. The range of fruit length and fruit diameter was 13.0 cm to 30.3 cm and 3.3 cm to 9.6 cm, respectively. The infestation of eggplant shoot and fruit borer (ESFB) ranged from 11.3% to 21.5%, with 6 lines showing zero percent mortality by bacterial wilt and the other three lines showing only 5–10% mortality. The range of fruit yield was 34.32–55.12 t/ha, while the maximum was in SM 465 (55.12 t/ha), followed by SM 312A (53.30 t/ha), SM 467 (52.72 t/ha), and SM 323A (46.02 t/ha). Considering earliness, high yield, EFSB infestation, BW infection tolerance, fruit shape and color, the lines SM 465, SM 312A, SM 467, SM 323A were found promising and may be recommended for RYT.

Regional yield trial of eggplant lines resistance to pest and diseases

A.K.M. Quamruzzaman, F. Islam, M. Nazim Uddin and L. Akter

The study was conducted with two green colored [SM (I) 35, SM 275] , three purple colored [SM 216, SM 233, SM (P) 405] and three white colored eggplant lines [SM 310, SM 312, SM 023A] along with check varieties [BARI Begun-4, BARI Begun-6] at the farm of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur along with different RARS (Ishwardi and Burirhat) of BARI during the winter season of 2021-22] to develop new high yielding variety having tolerance to eggplant fruit and shoot borer and bacterial wilt. Significant variation was observed in ten green colored, purple colored and white colored eggplant lines/varieties. In the Gazipur location, the range of the number of marketable fruit and average fruit weight was 11.1-48.9 and 87-380 g, respectively. A higher number of fruits were harvested in purple colored eggplant lines viz., SM 216 (46.4), SM 233 (48.9), rather than green white colored lines. But the average fruit weight was higher in green (258-265g) and white (177–220g) colored lines compared to purple-colored eggplant lines. The range of ESFB and BW infestation was 12.3%–31.3% and 0.0–10.0%, while except for SM 310, all the lines showed less than 0.0% BW infestation. In Gazipur, the higher fruit yield/ hectare was produced in SM 216, SM 233, SM (P) 405, SM 275, SM (I) 35, SM 023A, while SM 216, SM (I) 35 and SM (P) 405 performed best over three locations. Since consumer preferences have diverged, we have selected the best lines considering earliness, tolerance to fruit infection by EFSB, bacterial wilt infestation for green color [SM (I) 35], purple color [SM 216, SM (P) 405], and white color [SM 023A]. So, these four lines might be selected for release as new green, purple, and white eggplant varieties.

Genetic diversity of eggplant germplasm

A.K.M. Quamruzzaman, M. Nazim Uddin, F. Islam and L. Akter

The study was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during 2021-22 to assess the extent of genetic diversity among 23 eggplant germplasm. The collected germplasm originating from PGRC, BARI was subjected to cluster analysis. The germplasm was constellated into five distinct groups, with a range of 2 germplasm in cluster II to 7 germplasm in cluster V. In all cases, the inter-cluster distance was larger than the intra- cluster distance. The intra cluster distance was maximum in cluster V (1.574) and minimum in cluster II (0.673). Regarding inter cluster distance, cluster III showed maximum genetic distance with cluster V (18.525) followed by the genetic distance from cluster III and IV (13.184), cluster II and cluster III (12.289) and cluster I and cluster III (10.267). Considering the group distance and inter-genotypic crosses between the members of cluster III and V, cluster III and IV and cluster II 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 II, cluster III, cluster V performed well. Therefore, inbreds belong to cluster I, cluster II, cluster III, cluster V will be given higher priority for crossing in future eggplant hybridization program.

Heterosis study in green colored eggplant lines

A.K.M. Quamruzzaman, M. Nazim Uddin, L.Akter and Ferdouse Islam

The study was conducted with sixty four green colored eggplant hybrids along with standard hybrids *viz*., BARI Hybrid Begun-4 (BHB4), Purbani Hybrid (PH) at the farm of Olericulture

Division, HRC, BARI, Gazipur during the winter season of 2021-22 to develop new high yielding hybrids having tolerance to eggplant fruit and shoot borer and bacterial wilt. The range of negative heterosis for days to first harvest was -0.98% to -5.88% and -0.97% to -6.80% over standard hybrids BHB4 and PH, while the range for the number of marketable fruit was -14.69% to -67.19% and -44.74% to 43.68%. A wide range of standard heterosis was observed among the 64 hybrids for the fruit yield trait, while the range was -49.09% to 34.11% and -47.24 to 39.00%. For EBFB, the standard heterosis was -169.18% to 178.75% and -136.69% to 47.85%, while for bacterial wilt infection, the same trend was observed and was -100.00% to 100.00% and -100.00% to 100.00%. Considering standard heterosis over BHB4, PH nineteen hybrids *viz*., F_1 13x333, F_1 21x309A, F_1 83Ax221B, F_1 253Bx220, F_1 262x83B3, F_1 262x220, F_1 262x221B, F_1 275x83B3, F1 275x220, F_1 275x333, F_1 334x83B3, F_1 357x220, F_1 357x309A, F_1 358x220, F_1 358x221B, F_1 358x309A, F_1 400x333, F_1 407x83B2, F_1 407X332 might be selected for further confirmation.

Performance of purple coloured eggplant hybrids

M. Nazim Uddin and A.K.M. Quamruzzaman

Ten 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 2021-22 to assess their performance in relation of yield potentiality, pest and disease tolerance. Variability observed among the 10 purple colored eggplant hybrids, while all parameters were significant except days to first harvest and bacterial wilt infection. There was diverged variability observed among the 10 purple colored eggplant hybrids, while all parameters were highly significant except days to first harvest and bacterial wilt infection. The range of number of marketable fruits and single fruit weight were 13-33 and 153-262 g, respectively. The fruit yield/ plant was the maximum in F_1 14x359 (4.3kg) followed by F_1 14x216 (4.63 kg), BARI Hybrid Begun-3 (4.0). The lowest yielder cross was 5x203 (2.5 kg). The range of fruit length and fruit diameter were 10.0-25.0 cm and 3.2-10.1 cm, respectively. The range of plant height at last harvest and EFSB infestation were 89-109 and 12-17 %, respectively. The range of fruit yield/ ha was 38-60 t, while the highest fruit yield/ ha was produced in F_1 14x359 (59.4 t/ha). Considering earliness, high yield, EFSB infestation, BW infection tolerance, fruit shape and color the hybrids 5X405, 14X359, 18X405 were found promising and may be recommended for AYT with other hybrids.

Regional yield trial of eggplant hybrids

A.K.M. Quamruzzaman, M. Nazim Uddin, L. Akter and Ferdouse Islam

The study was conducted with six green colored eggplant hybrid/ varieties *viz*., F_1 11x353A, F_1 12X11, F_1 12X253B, F_1 21X11, BARI Hybrid Begun-5 (BHB5), Purbani Hybrid (PH) and eight purple colored eggplant hybrid/ varieties viz., F_1 5X216, F_1 14X233, F_1 18X233, F_1 203X5, F_1 203X233, F_1 233X216, BARI Hybrid Begun-6 (BHB6), Purple King (PKH) at the farm of Olericulture Division, HRC, BARI, Gazipur along with different RARS (Gazipur, Ishwardi, Hathazari, Rahmatpur, Burirhat) of BARI during the winter season of 2021-22 to develop new high yielding hybrids having tolerance to eggplant fruit and shoot borer and bacterial wilt. The standard heterosis for four green colored hybrids over standard hybrids BHB5, PH and for six purple colored hybrids over standard hybrids BHB6, PKH were used to calculate the heterosis for yield and yield contributing parameters. Maximum parameters were found significant in the study. Two green colored hybrids, *viz*., F_1 11x353A (13.30%) and F_1 21X11 (13.88%), showed heterosis over standard hybrid (PH), while none for BHB5 for fruit yield. Several purple colored hybrids showed significant heterosis over standard hybrids BHB5 and PH, while two purple colored hybrids, *viz*., F_1 5X216 (14.65% and 25.14%), F_1 14X233 (14.53% and 25.00%), showed significant heterosis over both standard hybrids BHB6 and PKH. Negative significant standard heterosis for green colored hybrids over BHB5 and PH was ranged from -27.36% to -38.50% and -32.94% to -43.23%, respectively, while for purple colored hybrids, the range of heterosis over standard hybrids BHB6 and PKH was -25.43% to -53.17% and -7.35% to -41.82%, respectively. All purple colored hybrids were found to have negative heterosis, indicating less infestation was observed in the new purple colored hybrids. Considering mean fruit yield over 5 locations and standard heterosis over BHB5, PH two green colored hybrids *viz*., F_1 11x353A, F_1 21X11 and over BHB6, PKH three

purple colored hybrids viz., F_1 5X216, F_1 14X233, and F_1 18X233 might be selected for release as new green and purple colored eggplant hybrid varieties.

Effect of sowing time on yield and quality of BARI Begun-12

E. Mahmud, M.R. Karim, N. Akter, M.M. Islam, M.I.A. Howlader

The experiment was carried out in the experimental field of Regional Horticulture research Station, BARI, Lebukhali, Dumki, Patuakhali to identify the optimum sowing time of BARI Begun 12 to obtain higher quality fruit and maximum yield. Five treatment *viz*. T_1=1-Aug sowing, T_2=16-Aug sowing, T_3=1-Sep sowing, T_4=16-Sep sowing and T_5=1-Oct sowing were used. T_1 and T_2 treatment gave the earliest harvest with highest yield and highest harvest interval. T_3 treatment gave the largest fruit and T_5 treatment gave the poor yield with shortest harvest period and late harvesting. So BARI Begun 12 can be suggested to grow within august to September to the farmer. Seed sowing in October or later than that may cause very poor yield, thus may not be profitable to the farmers.

Feasibility study of plastic mulch laying on eggplant cultivation

A. R. Gazi, F. Islam, M. N. Uddin and M. R. Karim

An experiment was carried out in the experimental field of Olericulture division, HRC, BARI, Gazipur during the year 2020-21. The experiment which was carried out to evaluate comparative performance of mechanized plastic mulch laying with manual mulching and the yield performance of vegetables using plastic mulch. In this study data were collected for several parameters. The experiment was conducted with three treatments: T_0: Not mulch T_1: Laying conventional mulching T_2: Laying mechanized mulching. The highest yield was recorded 49.29 (t/ha) for the treatment of laying mechanized mulching (T_2) which was almost similar to manual mulching. On the other hand, cost of mulching + weeding was found four times cost intensive in comparison with control (Not mulch) treatment and cost was double than manual mulching (T_2). Furthermore, labor involvement for crop production was less than conventional/manual mulching (T_2). Highly significant difference was found for the parameters particularly time and cost of mulching plus weeding among all treatments. Considering all attributes and analyzed findings, it is concluding that mechanized mulch laying is the most feasible and profitable for eggplant cultivation.

Integrated nutrient management on growth and yield of eggplant

S. D. Setu, M. R. Islam, S. Hasna, M. G. Kibria, and M. R. Uddin

The study was conducted at the experimental farm of horticulture division, RARS, Rahmatpur, Barishal during the winter season of 2021-22. The experiment was laid out in RCBD with 3 replications and six treatments. T_1: Control (no fertilizer), T_2: Recommended dose of fertilizer (RDF, 2018) T_3: Vermicompost (5t/ha) T_4: Poultry manure (5t/ha), T_5: 50% recommended dose of fertilizer plus vermicompost, T_6: 50% recommended dose of fertilizer plus poultry manure were used as treatments of the experiment. The highest days to 1st flowering was found in T_6 (46.33 days) and the lowest in T_3 (41.33 days). Highestdays to 50% flowering was found in T_4 (54.33 days) and the lowest in T_1 (51.33 days). The highest days of 1st harvest were obtained in T_2 (90days) and other treatments were statistically similar (86 days). Highest Plant height at 1st harvest was obtained in T_2 (106.27 cm) and lowest in T_4 (93.67 cm). The highest no. of fruits per plant was found in T_6 (8.10) followed by T_5 (7.83) and the lowest was observed in T_1 (5.40). Weight of fruit per plant was maximum in T_5 (6.67) and minimum in T_3 (3.37). The highest individual fruit weight was found in T_5 (849.40g) and the lowest in T_3 (547.93g). The highest yield was found in 50% recommended dose of fertilizer plus vermicompost T_5 (83.23t/ha), this was probably because of higher nutrient and moisture absorption from soil and the lowest in vermicompost (42.10 t/ha). Verimcompost is a good source of nutrient in enhancing growth and yield of brinjal. From this experiment, it was observed that applying 50 % of the recommended dose of fertilizer plus 5t/ha vermicompost exhibited best results.

Effect of decomposed water hyacinth on growth and yield of brinjal

M. A. Habib, M. Samsuzzaman, M.A. sumi M. S. Alam and M. H. Hossain

The experiment was conducted at the experimental field of RARS, BARI, Moulvibazar, during the *rabi* season of the year of 2021-22 to assess the effect of decomposed water hyacinth on the yield and yield related traits of brinjal. The highest plant height

(99.66 cm) was recorded in T_3 treatment and the lowest plant height (87.33cm) was recorded in T_4 treatment. The highest number of fruits per plant (31.43) was observed in T_3 followed by (31.33) in T_1 treatment. The lowest number of fruits per plant (23.33) was observed in T_4. Maximum single fruit weight (89.66g) was obtained from T_3 treatment and minimum (80g) from T_1 and T_4 treatments, respectively. Maximum fruit yield (2.76 Kg plant^{-1}) was observed in T_3 treatment and the minimum (1.80 kg plant^{-1}) inT_4. Similarly, the highest fruit yield (32.70 t ha^{-1}) was recorded in T_3 treatment and lowest yield (21.16 t ha^{-1}) was recorded in the treatment T_4.

Effect of beneficial microorganisms for safe brinjal (cv. BARI Begun-10) production

M.H.M.B. Bhuyan, M.M. Rahman, F. Ahmed, J.C. Sarker and S.M.L. Rahman

The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet, during December 2022 to May 2022 under field condition. The experiment was laid out in RCBD with 4 different treatments and 03 replications. The treatments were T_1=Control (water spray), T_2=Spray of effective microorganism, T_3=Soil application of *Bacillus* sp., T_4=Spray of Clybio (Japanese formulation). The results illustrated that there were significant differences among the treatments. It was observed that maximum number of marketable fruits was produced from T_3 (21.54). The effective microorganisms also increased the fruit size, where the maximum fruit size was recorded in T_2 (24.30×3.36 cm). Maximum weight of individual fruit was found from T_3 (2.61 g), maximum yield plant^{-1} (2.61 kg) and yield (70.52 t ha^{-1}) was found from T_3. But regarding BCR T_2 (3.53) was found best followed by T_3 (3.44). This was the first year of study, so the experiment should be repeated for confirmation of the results.

Controlling disease and pest for safe vegetable (cv. BARI Begun-10) production

M.H.M.B. Bhuyan, M.M. Rahman, F. Ahmed, J.C. Sarker and S.M.L. Rahman

The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet, during December 2022 to May 2022 under field condition. The experiment was laid out in Randomized Complete Block Design with 5 (five) different treatments and 03 (Three) replications. The treatments include T_1=Control (Spraying only water), T_2=Farmers practice (Spraying chemical pesticides), T_3=Mahogany seed extract spray, T_4=Garlic extract spray, T_5=Neem oils spray. Maximum plant height (110.23 cm), stem diameter (2.50 cm) and canopy spreading (65.66 cm) was found from T_2, but the number of primary branches/plant plant (4.5) was recorded highest in T_5. There were differences among the number of total leaves, infested leaves, twigs and fruits also, where lowest number of infested leaves were found from T_2 (5.47). But the lowest number of infested twigs as well as fruits were found from T_5 (2.45 and 5.65.23 respectively). In a similar way maximum number of marketable fruit (22.87) and marketable yield (61.77 t ha^{-1}) was found from T_2. Among the botanical treatments T_5 (neem oil) performed better regarding individual fruit weight (105.25 g) and marketable yield (56.70 t ha^{-1}). Based on the results of the experiment, it may be inferred that all the botanicals used significantly enhanced growth, yield and fruit quality of brinjal. Although T_2 (Spraying chemical pesticide) showed the maximum yield but the botanicals are very closer to the farmers practice. This is the first year of study, so the experiment should be repeated for confirmation of the results.

Controlling disease and pest for safe vegetable (cv. BARI Begun-10) production

M. H. Rahman, S. M. M. Rahman, A. K. M. M. Rahman and R. Akter

The experiment was conducted at Regional Horticulture Research Station, BARI, Shibpur, Narsingdi, during October, 2021 to May, 2022 under field condition. There were differences among the parmeters where the lowest insect incidence of 3.24% of infected fruit was found from T_2 (Mahogany seed extract). In a similar way maximum number of marketable fruit (129.67 no.) and marketable yield (40.07 t ha^{-1}) was found from T_1 (Bordeaux mixture). Among the botanical treatments T_4 (Garlic clove extract) performed better regarding individual fruit weight (114.13 g) and marketable yield (40.76 t ha^{-1}). Based on the results of the experiment, it may be inferred that all the botanicals used significantly enhanced yield and fruit quality of brinjal. Although T_1 (Spraying chemical pesticide) showed the maximum yield but the botanicals are very closer to the farmers practice (T_1). This is the first year of study. The experiment should be repeated for the confirmation of the results.

Soil health management for safe eggplant (cv. BARI Begun-10) production using organic fertilizers

M.H.M.B. Bhuyan, M.M. Rahman, F. Ahmed, J.C. Sarker and S.M.L. Rahman

The experiment was conducted at the Citrus Research Station, BARI, Jaintapur, Sylhet, during December 2022 to May 2022 under field condition. The experiment was laid out in RCBD with 6 different treatments and 03 replications. The treatments include T_1=Native nutrients (soil without manures and fertilizers), T_2=Farmers practice (RDF according to FRG from chemical fertilizers), T_3=Farmyard manure (10 t ha^{-1}), T_4=Vermicompost (6 t ha^{-1}), T_5= Poultry manure (5 t ha^{-1}), T_6=Mustard oil cake (4 t ha^{-1}). Results showed that like the farmers practices the organic practices also increase the growth and yield of brinjal. Among the treatments vermicompost performed best followed by poultry manure ad the farmyard manure. Based on the results of the experiment, it may be inferred that all the organic manures used significantly enhanced growth, yield and fruit quality of brinjal. Although T_2 (Farmers practice) showed the maximum yield but focusing on the BCR the organic manures are very closer to the farmers practice. Therefore, farmers can produce eggplant organically but there should be different markets or atleast different sections in the markets for organic and inorganic vegetables. Then the organic farmers will be able to compete with the products produced using chemical fertilizers. The experiment should be continued for further confirmation.

Tomato

Evaluation of tomato germplasm

A.K.M. Quamruzzaman, F. Islam and L. Akter

A study was conducted with 28 tomato germplasm at the Olericulture Division, HRC, BARI, Gazipur during the winter season of 2021-22 to evaluate the yield and yield related components along with pest and diseases reaction. There was significant variability observed among the 28 tomato germplasm varieties. Significant variation was observed in the number of fruits per plant and single fruit weight, while the range was 15-52 and 23-97g, respectively. In this study, 11 germplasm produced more than 70.00 t/ha, with SLA34 producing the highest yield (95.24 t/ha), followed by SLA15-7 (91.24 t/ha), SLA15-1B (86.63 t/ha), SLA36 (85.47t/ha), BARI Tomato-15 (81.35 t/ha), SLA15-6 (79.43t/ha), SLA15-1 (77.22 t/ha). The range of yield was obtained from 26.57-95.24 t/ha. The range of TSS was 2.9% (SLA20) to 6.5% (SLA34), while higher TSS contained germplasm were viz., SLA34 (6.5%), SLA15-5, SLA15-6 (5.2%), SLA15, SLA32 (5.1%). Significant variation was observed for TYLCV infection and leaf-sucking pest infestation, which varied from 0–10% and 0–20%, respectively. Considering yield and yield contributing parameters, the germplasm viz., SLA34, SLA15-7, SLA15-1B, SLA36, SLA15-6, SLA30, SLA15-1, SLA15-4, SLA27, SLA15, SLA32, and SLA11 may be investigated further for developing better tomato varieties.

Preliminary yield trial of summer tomato lines

A.K.M. Quamruzzaman, F. Islam and L. Akter

The study was conducted with 20 tomato lines at the Olericulture Division, HRC, BARI, Gazipur during the summer season of 2021 to evaluate yield and yield-related components, as well as pest disease infestation. During the summer season, there was significant variation among the 20 tomato lines/varieties. The number of fruits per plant and single fruit weight ranged from 6.0 to 8.0 and 24.4g to 184.9g, respectively, while fruit length and diameter ranged from 2.2-11.6cm and 1.9-7.3cm, respectively. TSS ranged from 3.2 to 7.0 percent, with higher TSS contained lines being SLA-15 (7.0 percent), AVTO 1715 (6.3 percent), AVTO 1911 (6.0 percent), AVTO 1702 (5.6 percent), and SLA-05 (5.6 percent) (5.6 percent). There was a significant difference in TYLCV infection and leaf sucking pest infestation, which ranged from 3.3–30 percent and 3.3–30 percent, respectively. Fruit yield ranged from 5.56-42.46 t/ha, with higher yielding lines being AVTO 1717, AVTO 1911, AVTO 1409, AVTO 1713, AVTO 1715, and AVTO 1921. Taking into account yield and yield contributing parameters, as well as pest disease infestation, the lines AVTO 1717, AVTO 1911, AVTO 1409, AVTO 1713, AVTO 1715, and AVTO 1921 may be selected further for developing better summer tomato varieties and inbred development.

Advanced yield trial of winter tomato lines

A.K.M. Quamruzzaman, F. Islam, L. Akter and S.R. Mallick

A study was conducted with 20 tomato lines at the Olericulture Division, HRC, BARI, Gazipur during

the winter season of 2021 to evaluate the yield and yield-related components and pest disease infestation. There was significant variability observed among the 20 winter tomato lines/varieties. Significant variation was observed in the number of fruits per plant and single fruit weight, with the range of 21–35 and 71g–125g, while the range for fruit length and fruit diameter was 23.5–6.6cm and 2.6–8.3cm, respectively. The range of TSS was 1.7–6.7%, while the higher TSS contained lines were viz., AVTO 1911 (6.7%), AVTO 1711 (5.4%), and AVTO 1717 (5.0%). Significant variation was observed for TYLCV infection and leaf sucking pest infestation, which varied from 0-6.7% and 6.7-16.7%, respectively. The range of fruit yield was 51.11-121.28 t/ha, while higher yielding lines were, viz., AVTO 1720 (121.28 t/ha), AVTO 1713 (113.32 t/ha), AVTO 1705 (102.37 t/ha), AVTO 1921 (98.62 t/ha), AVTO 1409 (99.33 t/ha), AVTO 1711 (97.66 t/ha), AVTO 1717 (94.25 t/ha), AVTO 1616 (92.72 t/ha), and AVTO 1010 (90.82 t/ha). Considering yield and yield contributing parameters and pest disease infestation, the lines viz., AVTO 1720, AVTO 1713, AVTO 1705, AVTO 1921, AVTO 1409, AVTO 1711, AVTO 1717, AVTO 1616, AVTO 1010 may be selected further for developing better winter tomato varieties as well as inbred development.

Evaluation of tomato germplasm

M. A. Goffar, A.K.M. Ariful Hoque, M.S Alam and M. M. R salim

A study was conducted with 15 tomato germplasm at research field of Olericulture Division of HRC, BARI, Gazipur during the winter season of 2021-22 to identify promising tomato lines in respect of high yielding resistant breeding sources. There were 15 tomato germplasm collected from WVC viz., SL0425, SL0426, SL0427, SL0428, SL0429, SL0430, SL0431, SL0432, SL0433, SL0434, SL0435, SL0436, SL0437, SL0438 and SL0439 included for this study. All the lines showed statistically significant difference in all the parameters studied. The largest average fruit weight was harvested from the line SL0433 and SL0432 which were 250.00 and 160.00 g respectively. It indicated that the larger size of fruits, while other lines exhibited medium single fruit weight which was range from 71.50 to 158.00g. The highest yield (2.75 kg) per plant was recorded from the line SL0432, while 10 lines exhibited more than 2.0 kg yield per plant. Total soluble solid (TSS) was varied from 2.30 to $4.5B^0$. Among the lines, SL0425 showed 2.3^0 brix that tasted sour which is very desirable. The keeping quality attribute or shelf life was studied for the tomato lines and it was observed that the fruits were marketable up to 7.0-16.0 days at ambient condition prevailing 27-28^{o}C temperature. Another important parameter was number of seeds per fruit that varied among the lines. The highest number of seed (145.0) counted from the line SL0425. No virus or bacterial wilt infection found to be infected in the field condition. There were seven lines- SL0425, SL0428, SL0429, SL0432, SL0433, SL0434, and SL0439 found to be promising. Considering the plant growth habit, flowering trends and other horticultural traits, aforementioned seven lines may be selected for preliminary yield trial in the next year, while these lines may also be used as breeding materials for further tomato improvement program.

Advanced yield trial of semi determinate tomato lines

M. A. Goffar, A.K.M. Ariful Hoque, M.S. Alam and M. M. R Salim

An advanced yield trial with selected semi determinate tomato lines was conducted at Olericulture Division of HRC, BARI, Gazipur during the winter season of 2021-22. There were five selected semi determinate tomato lines viz., SL0419, SL0420, SL0504, SL0507, GT017 and BARI Tomato-14 (as check) included for this study for selecting superior semi determinate tomato lines. All the lines showed statistically significant difference in all the parameters studied. Days to first harvest showed 104.0-113.0 DAS (days after sowing). The tomato lines were harvested up to 24.00 to 33.00 days. The harvesting duration revealed that the line SL0419 may be harvested almost one month while GT017 may be harvested more than one month (33.00 days). Plant height was varied ranged from 124.10 to 175.33 cm. As the lines are semi determinate nature, therefore, plants have attained such height. The highest number of fruit was counted in SL0507 (52.67). The largest average fruit weight was harvested from the line SL0419 and SL0504 which were 81.94g and 78.69g respectively. The maximum fruit yield per plant was obtained from the lines SL0419 (3.05kg) while other lines exhibited more than 2.0 kg fruit. 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/ha. It indicated all lines were good yielding tomato lines. Keeping quality attributes good keeping quality (shelf life) was recorded and it was marketable up to 9.0-15.67 days under ambient condition prevailing 27-28ºC 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. The magnitude of virus infection indicated that tomato lines were comparatively virus tolerant. Based on different traits, all the lines found to be promising. All these tomato lines may be selected for conducting regional yield trial in the next year to assess the yield performance and regional adaptability at different AEZs of Bangladesh.

Regional yield trial of insect and disease resistant tomato lines

M.A. Goffar, M. M. R. Salim, 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 HRC, BARI, Gazipur, Bangladesh along with four regional stations (RHRS-Akbarpur, RARS-Burirhat, RARS-Rahmatpur and RARS-Jamalpur) of BARI during the winter season of the year 2021-22 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 were 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 line SL0413 exhibited the highest (10.0 days) shelf life at the ambient temperature of 26-27^{O}C. Number of seeds per fruit showed significantly difference among the lines studied which was ranged from 79.0 to 100.0. In respect of pest and disease reaction, it was revealed that all the lines showed resistant against bacterial wilt (BW), fusarium wilt (FW), root knot nematode (RKN), tomato bacterial spot (TBS), southern blight (SB), early blight (EB) while other diseases like late blight (LB), black leaf mold (BLM) infection was recorded which observed to be very negligible percent. Very insignificant number (1.83/plant) of white fly counted at later stage of crop in SL0411. In the case of leaf miner and fruit borer reaction, on an average 3.0 leaves per plant and 2.83 fruit per plant were infested, respectively. Regarding other qualitative traits, Vitamin C was varied which was ranged from 21.00-30.00 mg/100g, while the highest vitamin C exhibited from the SL0411 and SL0413 (30.00 mg) and the lowest was recorded from the line SL0405 (21.00mg). The highest total acidity was measured in the line SL0405 (1.37 %) and the lowest percent of total acidity exhibited in SL0413 (1.02 %). The highest viscosity was recorded from the line SL403 (660 Cp) that indicated high processing attribute, and the lowest viscosity was obtained from the line SL0405 (172.0 Cp). The magnitude of beta-carotene revealed that 65.00 ppm was obtained in SL0411 and the lowest was recorded in the line SL0403 and control which was 12.88 ppm. 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 TYLCV disease tolerant tomato lines

M. S. Alam, M. A. Goffar and M. M. R. Salim

Regional yield trial of two selected advance disease tolerant tomato lines with BARI Tomato -14 was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur Bangladesh and four regional stations viz. Jamalpur, Burirhat, Jashore, Ishurdi during the winter season of 2020-21to assess the regional yield performance of the selected lines. Significant variation was observed among the lines in respect of different characters studied. Days to 50 % flowering was ranged from 50 to 57 days. Fruit number per plant was varied from 21 to 43.0. The highest (43) number of fruits was counted in AVTO-

1317 followed by AVTO-1229 (37). Average fruit weight was ranged from 81 to 94 g among the studied lines, where the highest (94 g) weight was measured in the line AVTO-1317 the lowest fruit weight was observed in check variety BARI Tomato-14 (81 g). The highest fruit length (6.01 cm) and diameter (6.25 cm) was recorded from the line AVTO-1317. The maximum fruit yield per plant was obtained from the line AVTO-1317 (3.28 kg) followed by AVTO-1229 (2.95 kg) while the lowest fruit yield per plant was recorded from the check variety BARI Tomato-14 (1.74 kg). Corresponding per hectare yield showed the similar trend. The maximum yield per hectare was obtained from the line AVTO-1317 (98.76 t) followed by AVTO-1229 (86.25 t) while the lowest yield was recorded from the check variety BARI Tomato-14 (53.28 t). The low yield of check varietie may be due to virus infection and low population of plant/per unite area. Plant height ranged from 114.5 cm to 128.6 cm. The line AVTO-1317 exhibited the highest shelf life (22 days) in ambient condition at the temperature of 24-27^{0}C. It was revealed that none of the tomato lines under evaluation was infected by bacterial wilt. The magnitude of TYLCV infection indicated that no virus infection found to be occurred in the lines AVTO-1317 and AVTO-1229 except control BARI Tomato-14 which was 45 %. The causes of virus tolerance may be due to genetic potentiality of the tomato lines. The result revealed that considering high yield and disease tolerance the tomato line AVTO1317 found to be promising and may be recommended to release as variety.

Heterosis study of winter tomato hybrids

A.K.M. Quamruzzaman, F. Islam and L. Akter

A study was conducted in tomato to estimate the magnitude of heterosis for yield and yield related components at the Olericulture Division of HRC, BARI during the winter season of 2021-22. Appreciable heterosis was found over better parents for all the traits studied in a desirable direction. Significant negative better parent heterosis was expressed for days to first flowering (4 combinations), days to 50% flowing (6 combinations), days to first harvest (7 combinations), and days to fruit maturity (8 combinations), while significant positive better parent heterosis was noticed in seven and three cross combinations for number of fruits per plant and single fruit weight, respectively. In our study, five cross combinations, viz., F1 203 (25.65%), F1 1501 (14.34%), F1 2101 (14.32%), F1 2301 (15.62%) and F1 2501 (16.22%) showed significantly positive better parent heterosis for higher yield. Six combinations were found to have significant positive heterosis with higher values in F1 1903 (21.95%), F1 2001 (19.62%), F1 2101 (12.84%) for TSS, while the significant negative better parent heterosis for TYLCV infection and leaf sucking pest infestation varied from -100% to 0.00%. Thus, it is evident from the data that, based on better parent heterosis of different yield and yield contributing traits, the cross combinations viz., F1 203, F1 1501, F1 2101, F1 2301 and F1 2501 may be investigated further for developing better hybrid tomato varieties.

Performance of heat tolerant tomato hybrids

A.K.M. Quamruzzaman, F. Islam and L. Akter

The study was conducted at Olericulture Division, HRC, BARI, Gazipur during summer season of 2021 to see the performances of yield and yield related components of twelve heat tolerant tomato hybrids. Significant variation was expressed for days to first flowering (62.1-68.1 days), days to 50% flowing (67.1-73.1 days), days to first harvest (101.0-108.0 days), days to fruit maturity (32.1-36.1 days), while maximum number of fruits per plant was calculated in F1 2101 and F1 2201 (9.5), followed by F1 203, F1 2001, F1 2303, F1 2401 (9.0). The highest single fruit weight was estimated in F1 2501 (195.5g), followed by F1 2101 (119.0g), F1 2201 (113.8g), F1 203 (92.8g), while the range was 33.1-195.5g. The range of fruit yield was 7.9-38.7 t/ha, while higher yielding hybrids were viz., F_1 203 (27.7t/ha), F_1 2001 (25.8t/ha), F_1 2101 (35.5t/ha), F_1 2201 (33.9t/ha), F_1 2303 (25.1t/ha) and F_1 2501 (28.7t/ha). Maximum TSS was produced by F_1 2501 (5.9%), followed by BARI Hybrid Tomato-8 (5.1%), F_1 1101, F_1 1903 (5.0%), with a range of 4.0-5.9%, while TYLCV infection and leaf sucking pest infestation varied from 0.0-10.0% and 3.3-16.7%, respectively. Thus, it is evident from the study that based on the performances of different yield and yield contributing traits, the hybrids, viz., F_1 2101, F_1 2201, F_1 2501, F_1 203, F_1 2001, and F_1 2303, may be selected for further trial to develop heat tolerant tomato hybrid varieties.

Evaluation of virus tolerant summer tomato hybrids

M. N. Uddin, G.A. Rob and M. A. Goffar

Temperatures above 32°C and 21°C at day and night, respectively are the limiting factors for fruit

setting due to an impaired complex of physiological process in the pistil, which results in floral or fruit abscission. Fruit setting in tomato is reportedly interrupted at temperature above 26/20°C day/night, respectively. Thereby, heterosis is study was caried out in the previous year and after evaluation 9 varieties were identified as virus tolerant with expected yield. Therefore, seeds of the 10 hybrids (including BARI Hybrid tomato 8) were sown at the olericulture division of HRC, BARI 8 May 2021. The seedlings were transplanted in the main field in plastic houses on 12 June 2021. 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 best crosses for yield per plot and fruit number per plant was fruit ripening stage and soluble solid content, lycopene was 3125-O-19x3324 A 3125-O-19xWP7 3150-A-5xWP7 3250-A-5x3324 A were selected RYT.

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 four semi determinate hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at four RARS *viz*.- Akbarpur, Burirhat, Jamalpur and Rahmatpur during the winter season of 2021-22 to assess the regional adaptability and yield potentiality. In this study, selected five semi-determinate type hybrids lines like- P_4xP_8 (SD), P_5xP_8 (SD), P_6xP_8 (SD), P_7xP_8 (SD) were included and BARI Hybrid Tomato-9 was used as check. In this report, results of Gazipur experiment have been mentioned. Most of the parameters significantly differed among the tomato entries. The treatment P_7xP_8 (SD) 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 P_5xP_8 (SD). The Maximum marketable yield per ha was obtained from the treatment P_6xP_8 (SD) (96.66 t) followed 94.80 t contributed by the hybrid line P_5xP_8 (SD). Tomato fruit may be harvest about 45.0 days from the most of the entries. Considering the adaptability, yield performance, uniformity and other attributes, the entries P_5xP_8 (SD) and P_7xP_8 (SD) found to be promising. The average yield per hector over locations indicated that the treatment P_5xP_8 (SD) was exhibited the highest yield (62.19 t) followed by statistically identical yield 58.18 t and 58.10 t were recorded from the treatment P_4xP_8 (SD) and P_7xP_8 (SD) respectively. The lowest yield (54.24 t) was recorded from the treatment P_6xP_8 (SD) that indicated satisfactory commercial yield. Considering the level of adaptability, yield potential and other desirable horticultural traits, the entries P_5xP_8 (SD) and P_7xP_8 (SD) found to be promising. The main feature of these entries is harvestable for prolonging period for making long time available fresh tomato in the consumer's market. As this is third year result, therefore the experiment may be repeated in different agro-ecological zones of Bangladesh for confirming the results and shortening the number of entries.

Regional yield trial of determinate tomato hybrids

M. A. Goffar and M. M. R Salim

A study on regional yield trial with three determinate hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at four other RARS/RHRS *viz*.- Akbarpur, Burirhat, Jamalpur and Rahmatpur during the winter season of 2021-22 to assess the regional adaptability and yield potentiality of these entries. In this study, selected four determinate type hybrids lines like P_1xP_2 (D), P_1xP_5 (D) and $P1xP_6$ (D) were included and BARI Hybrid Tomato-5 was used as check. In this report, results of Gazipur experiment have been mentioned. The most of the parameters were significantly differed among the tomato entries. The treatment P_1xP_2 (D) produced the largest average fruit weight (67.00g). The P_1xP_5 (D) 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 P_1xP_5 (D) (69.58 t) followed 63.77 t contributed by the treatment P_1xP_6 (D). Considering the adaptability, yield performance, uniformity and other attributes, the entries P_1xP_5 (D) and P_1xP_6 (D) found to be promising. The average yield per hector over locations indicated that the treatment P_1xP_5 (D) was exhibited the highest yield (60.92 t) followed by

50.0 t were recorded from the remaining treatments. Considering the level of adaptability, yield potential and other desirable horticultural traits, the entries P_1xP_5 (D) and P_1xP_6 (D) 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 third year result, therefore the experiment may be put into as repeated trial at different agro ecological zones of Bangladesh in the next year to confirm the results.

Regional yield trial of saline tolerant tomato hybrids

M. A. Goffar, M. S. Alam, A.F.M.S. Ahsan and A.K.M. Ariful Hoque

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 RARS/RHRS/ARS viz., Patuakhali, Shatkhira and Rahmatpur during the winter season of 2021-22 to assess the regional adaptability and yield potentiality. The lines- P_1xP_2, P_1xP_3, P_1xP_6, P_5xP_6 were considered to be relatively saline tolerant (tested at physiology Division, BARI in 2019). Therefore these lines along with BARI Hybrid Tomato-5 as check were treated as materials. The most of the parameters were significantly differed among the tomato entries. The largest average fruit weight (56.12 g) was produced by the control. The P_5xP_6 hybrid exhibited maximum yield per plant (2.31kg) followed by 2.29 kg fruit harvested from the treatment P_1xP_3. The Maximum marketable yield per ha was obtained from P_5xP_6 hybrid (67.33 t) followed 66.43 t contributed by the control. 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. The average yield per hector over locations indicated that the treatment P_1xP_3 was exhibited the highest yield (59.41 t) followed by above 58.00 t were recorded from the treatment P_1xP_2 and P_1xP_6. The yield of another entry was 51.68 t that indicated satisfactory commercial yield. Considering the level of adaptability in saline prone soil (during harvesting, soil salinity was 10.18 ds/m), yield potential and other desirable horticultural traits, all the hybrids found to be promising. Therefore, the experiment may be repeated as regional yield trial at different saline prone agro ecological zones of Bangladesh for confirming the findings and shortening the number of lines.

Regional yield trial of tomato hybrids (set-I/ winter)

M. A. Goffar, M. R. Ali And M. M. R Salim

A study on regional yield trial with three tomato hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at four outer RARS *viz*., Akbarpur, Burirhat, Jamalpur and Rahmatpur during the winter season of 2021-2022 to assess the regional adaptability and yield potentiality. In this study, selected three hybrids lines like P_1xP_5, P_1xP_6 and P_2xP_7 were included while BARI Hybrid Tomato-5 was used as check. The most of the parameters were significantly differed among the tomato entries. The treatment P_2xP_7 produced the largest average fruit weight (57.78g). The same entry exhibited maximum yield per plant (2.31 kg) followed by 2.29 kg fruit harvested from the treatment P_1xP_5. The Maximum marketable yield per ha was obtained from P_2xP_7 (69.73 t) followed 69.03 t contributed by the hybrid line P_1xP_5. 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. The average yield per hector over locations indicated that the treatment P_1xP_6 was exhibited the highest yield (76.95 t) followed by 75.20 t were recorded from the treatment P_2xP_7. The yield of another entry was 65.35 t that indicated also satisfactory commercial yield. Considering the level of adaptability, yield potential and other desirable horticultural traits, all the entries (hybrid) found to be promising. As this is 2nd year result, therefore, the experiment may be repeated at different agro ecological zones of Bangladesh for confirming the findings and shortening the number of lines.

Regional yield trial of summer tomato hybrids (Set-I)

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 2021. There were eight selected hybrids viz.: P_1xP_3 (S-I); P_1xP_4 (S-I); P_4xP_6 (S-I); P_5xP_6 (S-I); P_1xP_8 (S-II); P_2xP_8 (S-II),

P_5xP_8 (S-II), P_7xP_8 (S-II) and one local check (BARI Hybrid Tomato-8) was included in this study. All the parameters were found to be significantly differed. Average fruit weight was varied significantly which was ranged from 45.00-56.00 g as the fruit size was different. The fruit yield per hectare was obtained the highest in P_7xP_8 (S-II) (37.92 t) while the second highest yield was recorded in control (37.66 t) and the lowest yield was contributed by the entry P_1xP_3 (S-I) (18.01 t). The fruit length, fruit diameter, TSS (2.83-5.29 ^{o}brix) and their shelf life (5.0-6.0 days) also varied significantly. The incidence of wilt infection was the highest in P_1xP_4 (S-I) (10.0%). The other entries were confined between 6.0-8.0% only. The highest virus infection was recorded in treatment P_5xP_6 (S-I) (12.0%), while other treatments comprise between 8.0-10.0% virus. There were four hybrid combinations (P_4xP_6 (S-I), P_1xP_8 (S-II), P_5xP_8 (S-II) and P_7xP_8 (S-II) showed good yield which was confined to 33.00-38.0 tones. Considering the horticultural attributes and pest and diseases reactions, the hybrid tomato entries – (P_4xP_6 (S-I), P_1xP_8 (S-II), P_5xP_8 (S-II) and P_7xP_8 (S-II) found to be promising during summer/rainy season. The trial may be conducted further for confirming the results and for studying adaptability in the different agro-ecological zones of Bangladesh.

Development of year round production packages of cherry tomato under protective culture

M.A. Goffar, M.S. Alam and P. Hanson

A yield trial of one selected cherry tomato line (selected for releasing) of WVC with check BARI Tomato-11 was conducted at the experimental field of Olericulture Division, Horticulture Research Centre (HRC) during the summer and winter season of the year of 20221-22 under net house to assess the adaptability, yield potentiality, pest and disease reaction. The fruit number per plant varied from 173.0 to 147.0. The yield potentials revealed that in winter season contributed the line SL0068 (84.42t/ha) and control (63.77t/ha) while in summer season exhibited the line SL0068 (63.75t/ha) and control (48.43t/ha). No virus and bacterial wilt found to be infected in the field. The line SL0068 may be suggested to release as year round cherry tomato variety for growing different AEZs- of Bangladesh. This line/variety may also be suitable for school gardening too.

Hybridization in tomato for developing hybrid tomato variety

M.A. Goffar, M.S Alam and M.R. Salim

A hybridization work was done among eight parents of tomato inbreeds at the experimental field of Vegetable Division, HRC.BARI, Gazipur during the winter season of 2021-22 to produce F_1 tomato seeds for evaluating GCA, SCA and heterosis in next season to develop new summer and winter hybrid tomato varieties. One set of inbred having eight variability in respect of earliness, fruit size, number of fruits, fruit yield per plant, heat tolerant, tolerance to bacterial wilt (BW) and root-knot nematode (RKN) were included in this crossing program. Seedlings of female line at 30 days were transplanted in 3rd week of November, 2021 while; male parent was transplanted 10 days ahead of female one. There were 20 plants for each combination transplanted for making crosses. Plant protection, irrigation and other intercultural operations were done as and when necessary as normal crop production. Crossing work was done maintaining half diallel fashion as mentioned by B. Griffing, 1956. As maximum as possible number of cross were made for producing hybrid seeds. Fruits of 36 crosses (F_1) along with parents were harvested at full ripen stage and allowed two days storage for postharvest ripening. Then seeds were extracted, washed, dried, weighed and stored properly and preserved for assessing combining ability and heterossis during summer and winter season of 2022-23 and 2023-24.

Maintenance of BARI released open pollinated and parents of hybrid tomato varieties

M.A. Goffar

A study was carried out at the experimented field of Olericulture Division of HRC, BARI, Gazipur during winter season of 2021-22. 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 (open pollinated) tomato varieties (BARI Tomato-2, BARI Tomato-14 and BARI Tomato-15) were included. The seeds of these tomato entries were sown in the seedbed on October 25, 2021. Thirty days old seedlings were transplanted in the main plot on November 24, 2021. There were 50 plants of each inbred and variety transplanted in individual plot (plot size-10.0X1m). The crop was fertilized with

cow dung 10 ton, N-253kg (urea- 550kg), P- 90kg (TSP-450kg), K-125 (MoP-250kg), S- 21kg (Gypsum-116kg), Zn-4.9kg (Zinc Sulphate-14kg) and B-2kg (12kg) per ha, respectively. Half of the quantity of cow dung, entire P and half of the K, entire zinc and boron were applied during land preparation. The remaining half of the cow dung was applied during pit preparation. The rest of K and entire N were applied at three equal installments at 15, 30 and 45 days after transplanting. Gap filling, plant protection, irrigation and other intercultural operations were done as and when necessary. As maximum as possible number of crosses were done for producing selfed seeds maintain proper emasculation and pollination techniques as has been stated in the hand book by WVC (The World Vegetable Centre). Pruning, roughing of off-type and other management was done properly. Fruits were harvested at full ripen stage and allowed two days storage for postharvest ripening. After that seeds were extracted, washed, dried, weighed and preserved in the cold storage at 8^0C temperature.

Regional yield trial of hybrids of tomato in summer

M.A.T. Masud and Tuhina Hasan

The study consisted of four hybrids derived from breeding lines of World Vegetable Center (WVC) and two check varieties BARI Hybrid Tomato 8 and 11. It was conducted at two locations of BARI which included Joydebpur and Jashore in the summer season of 2021. The experiment was established for the 2nd year in RCB design with three replications. Crop was grown under transparent poly tunnels. Data was recorded on 12 characters in each location of which, four major yield contributing characters were combined for interpretation of the result. Result of the study demonstrated marketable fruits per plant of the test hybrids ranged from 7-31 while it was 9-30 in the check varieties across the locations. It was maximum in hybrid-75 (31/ plant) at Joydebpur location. Similarly, average fruit weight (AvFwt.) of the test hybrids varied from 53.2-78.2g while it was 60.4-74.8 in the check varieties over the locations. It was higher in Hybrid-76 (78.2g) at Joydebpur location. Marketable yield per hectare (MY/ha) ranged from 12.8-75.5 t/ha in the test varieties and it was 15.9-60.9 t/ha in the check varieties across the locations. MY/ha was maximum in Hybrid-76 at Joydebpur location. Two hybrids (Hybrid-75 and -76) performed better (Fruits/plant: 20-21, AvFwt: 67-73.6g and MY/ha: 42.9-48.4 tons) over the check varieties ((Fruits/plant: 17-20, AvFwt: 61.5-72.0g and MY/ha: 35.9-38.4 tons) at combined data. No virus and bacterial wilt (BW) disease incidence was recoded in these two Hybrids while the checks had 2-3% virus and 0.8-4.3% BW incidence. Considering major yield contributing characters and disease reaction, two hybrids Hybrid-75 and -76 were consistently found promising for the 2nd year for release as summer hybrid tomato varieties.

Regional yield trial of hybrids of tomato in winter

M.A.T. Masud and Tuhina Hasan

The study consisted of four hybrids derived from breeding lines of World Vegetable Center (WVC) and two check varieties BARI Hybrid Tomato-5 and commercial Hybrid Unnayan (Lal Teer Seeds). It was conducted at four locations of BARI which include Joydebpur, Burirhat, Rahmatpur and Hathazari in the winter season of 2021-22. Crop was grown in open field condition. The experiment was established in RCB design with three replications. Data was recorded on 16 characters in each location of which, three major yield contributing characters were combined for interpretation of the result. Result of the study demonstrated marketable fruits per plant of the test hybrids ranged from 26-72 while it was 28-67 in the check varieties across the locations. It was maximum in hybrid-76 (72/ plant) at Joydebpur location. Similarly, average fruit weight (AvFwt.) of the test hybrids varied from 51.3-141.0g and it was 47.9-138.7g in the check varieties over the locations. It was maximum in Hybrid-53 (141.0g) at Burirhat location. Marketable yield per hectare (MY/ha) ranged from 64.2-123.3 t/ha in the test varieties and it was 46.3-82.9 t/ha in the check varieties across the locations. MY/ha was maximum (123.3 t/ha) in Hybrid-50 at Joydebpur location. All the test hybrids (Hybrid-50, 53, 75 and 76) performed better (Fruits/plant: 43-52, AvFwt: 77.3-95.4g and MY/ha: 80.3-92.7 tons) than the check varieties (Fruits/plant: 36-43, AvFwt: 84.8-85.2g and MY/ha: 68.1-69.4 tons) at combined data. No virus and bacterial wilt (BW) disease incidence was recorded in the test Hybrids. Considering major yield contributing characters and disease reaction, all the four test hybrids Hybrid-50, 53, 75 and 76 were found promising for release as winter hybrid tomato varieties.

Evaluation of promising summer tomato hybrids in wnter

M. S. Alam and M. A. T. Masud

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during the winter season of 2021. Nine summer hybrids with BARI Hybrid Tomato-5 and a commercial variety "Unnoyon" were tested to assess the performance of the selected hybrids. Significant variation was observed among the hybrids in respect of different characters studied. Hybrid genotypes varied significantly for their response to important characters of which days to 50% flowering varied from 49-54 and days to first harvest 98-106 ($P<0.05$). The earliest flowering (49 days) and harvesting (98 days) observed in the hybrid-68 and hybrid-53. The maximum (51%) percent fruit set was found in hybrid-50 and the minimum (38%) in hybrid-10. Harvestable fruits were produced for the longest period (55 days) by hybrid-76. Quite appreciable individual fruit weight was observed in some hybrids. Hybrid-68 produced the heaviest fruits (98.6g) while BARI Hybrid Tomato-5 Produced the minimum (62.5g). All the test hybrids produced higher fruits (32-52 per plant) and yield (2.19-3.74 kg per plant; 56.3-95.2 t/ha). Hybrid -75 produced the highest (95.2 t) per hectare yield followed by hybrid-71 (93.1 t) and hybrid-68 (90.5 t). All the tested hybrids performed better than commercial variety Unnoyon. All the tested hybrids performed better than commercial variety Unnoyon. The experiment may be repeated for confirming the results.

Sweet Pepper

Evaluation of sweet pepper germplasm

A.K.M. Quamruzzaman, L. Akter, F. Islam, and M.A.T. Masud

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during the season of 2021-22 to evaluate the performance of new ten germplasm with a check (BARI Mistimorich-1). The germplasm was AVPP 0912, AVPP 0118, AVPP 0913, AVPP 0301, AVPP 1112, CA0001, CA0002, CA0003, CA0004 and CA0005. The experiment was laid out in RCB design with three replications. Significant variation was found in case of days to 50% flowering among the lines. The line AVPP 0118 responded to flowering at minimum days which was at par to the line AVPP 0301. The line CA0002 was possessed the maximum number of fruit per plant (20.25) followed by AVPP 0912 (16.32). The longest fruit was obtained from the line AVPP 1202 (12.57 cm). Average fruit weight was highest in CA0004 (64.04 g) followed by the line CA0001 (59.25 g). The widest fruits were obtained from AVPP 1202 (7.69 cm). The highest yield/plant was recorded in CA0004 (902.58 kg) and the lowest was obtained by the line AVPP 0118 (609.87 kg). Significant variation in respect to yield among the lines, the line CA0004 gave the highest yield (45.13 t/ha) followed by CA0001 (36.23 t/ha), whereas the lowest yield was obtained from CA0003 (29.66 t/ha). Considering fruit yield, uniform shape and attractive colour the line AVPP 0912, AVPP 0913, CA0004, CA0001 and AVPP 1202 may be selected for advanced yield trial in the next year.

Advanced yield trial of sweet pepper lines

L. Akter, F. Islam, A.K.M. Quamruzzaman and M.A.T. Masud

The experiment was designed at the research field of the Olericulture Division, HRC, BARI, Gazipur during October, 2021 to March, 2022. Six sweet pepper lines (CA 0017, CA 0025, CA 0026, CA 0032, CA 0039, CA 0040) and BARI Mistimorich-1 as check was included in the study to observe the performance of the lines for developing inbred lines as well as to develop the high yielding sweet pepper varieties. Significant variation was found in case of days to 50 % flowering among the germplasm. CA 0039 responded to earliest flowering (11.85 DAP) which was the desired character in this aspect. Earlier harvest was recorded from the line genotype CA 0026 (39.11 DAP). The line CA 0017 was possessed the maximum number of fruits per plant (17.44) followed by CA 0039 (16.07). The highest average fruit weight was in CA 0026 (103.21g) followed by the check variety (79.54 g). The line CA 0039 possessed the highest fruit length (16.21 cm). Per plant yield was highest in CA 0026 (850.05g). Significant variation in respect to yield among the lines, where the line CA 0026 gave the highest fruit yield (42.50 t/ha) followed by CA 0039 (39.46t/ha) and CA 0039 (39.32t/ha). Considering fruit yield and other yield contributing characters, fruit shape, attractive colour the line CA 0026, CA 0017 and CA 0039 may be selected for further evaluation for inbred development in the next year.

Regional yield trial of sweet pepper lines

L. Akter, A.K.M. Quamruzzaman, F. Islam and M.A.T. Masud

An experiment was conducted with four sweet pepper line with a check (BARI Mistimorich- 2) at the central Experimental farm of Olericulture Division, HRC, Gazipur; RARS, Hathazari, Chattogram and RARS, BARI, Jamalpur, Bangladesh Agricultural Research Institute (BARI), from October 2021 to April 2022. The shortest day (64.05) required for harvesting by the line CA 0040. The highest number of fruits/plant obtained from CA 0035 (9.43) followed by CA 0026 (8.76) and the lowest in BARI Mistimorich-2 (7.52). Highest average fruit weight was obtained from the line CA 0035 (106.32g). The per plant yield varied from 0.55 to 0. 83kg. In HRC, Gazipur, the lowest yield per hectare was obtained from CA 0031 (27.43 ton) and highest yield was produced by CA 0035 (41.97 ton) followed by CA 0026 (35.73t) whereas in hathazari, the fruit yield per plant or per hectare was BARI Mistimorich 2 (0.612 kg or 32.6 t/ha) and the genotype CA0035 showed minimum fruit yield (0.325 kg or 17.3 t/ha) and in jamalpur, the line CA 0040 gave the highest fruit yield (24.40 t/ha) which was statistically similar to BARI Mistimorich-2 (23.13 t/ha) and followed by CA 0031 (17.97 t/ha) whereas the minimum yield was recorded from CA 0035 (16.10 t/ha). The mean highest fruit yield was obtained from the check variety BARI Mistimorich-2 (29.09 t/ha) which was statistically similar to CA 0040 (27.91 t/ha). The fruit colour of CA 0026 was orange red which turned into yellowish at mature stage whereas CA 0040 had the red color fruits turned at the mature stage. Only two categories of fruit shape were found among the varieties under study. CA 0026 produced fruits with conical shape while rest of the varieties had the bell shape fruits (Table 3). Very minimum infestation of fruit borer, white fly and mite were observed in tested lines/varieties as the plots were covered by nylon net. this was the first year experiment; it will be continued for next year as RYT.

Performance of sweet pepper hybrids

L. Akter, F. Islam, A.K.M. Quamruzzaman and M.A.T. Masud

Five selected F_1's of sweet pepper (P_1 xP_2, P_1 xP_3, P_2 xP_3, P_1 xP_7 and P_3 xP_4) with a check (F_1 Syam) were evaluated at the farm of Olericulture Division, HRC Gazipur during the winter season of 2021-22 to develop hybrid variety of sweet pepper. The experiment was laid out in a RCB design with three replications. There was significant difference in days to harvest and the duration of harvest was 65-75 days. The P_1 xP_2 was the earliest and it took 65 days to harvest on the other hand *F_1 Syam* took the maximum number of days to harvest (75 days). In case of fruit length and breath, the tallest fruit with the highest breath observed in *F_1 Syam* was 8.90 and 7.02 cm, respectively. The very important character is number of fruits the maximum number of fruits were counted in the P_2 xP_3 (7.95) while the minimum was 5.75 in P_3 xP_4. The heaviest fruits were recorded in the line P_1 xP_2 (176.67 g) while the *F_1 Syam* produced the least weight fruits (120.67 g). The highest amount of fruits was harvested from P_2 xP_3 (1.30 kg) followed by P_1 xP_2, P_1 xP_3 and the lowest amount of fruits harvested from *F_1 Syam* (0.72 kg). The maximum yield per ha were calculated at P_2 xP_3 (36.24 t/ha) which was followed by P_1 xP_7 while the minimum was recorded in *F_1 Syam* (27.93 t/ha). The hybrids P_2 xP_3, P_1 xP_3 and P_1 xP_7 were found promising for earliness, high yield and other characters. So, these lines were recommended for further evaluation for their yield and quality.

Regional yield trial of sweet pepper hybrids

L. Akter, A.K.M. Quamruzzaman, F. Islam and M.A.T. Masud

This study of two selected F_1's of sweet pepper ($F_1$1x2, $F_1$2x3) with a check was conducted at the farm of Olericulture Division, HRC, BARI, Gazipur and RARS Hathazari, Chattogram during the winter season of 2021-22. The experiment was laid out in a Randomized Complete Block Design (RCB) with four replications. The hybrid 2x3 took the minimum days to 1st harvest (66.25 days). In respect of days to 1st harvest the earliest line was $F_1$2x3 (66.25 days), while the other F_1 with the check were at par to this. Significant variation was found in fruit diameter among the hybrid. Fruits of maximum diameter were produced by the check (10.69cm), whereas the minimum was obtained by $F_1$1x2 (6.81cm). The highest number of fruits per plant (28.40) was recorded from $F_1$1x2 which was followed by F_1 2x3 (12.40). The check was remained lowest number of fruit per plant (5.49). The heaviest fruits (114.8g) were obtained from $F_1$2x3 which was statistically followed by the check (105.8g). In Gazipur, the maximum plot yield was obtained from

the hybrid $F_1$1x2 (35.39kg), whereas the lowest yield/plot was obtained from the check (8.20kg). The highest yield was produced by $F_1$1x2 (57.05 t/ha) followed by the $F_1$2x3 (28.37 t/ha). The lowest yield was obtained from the commercial hybrid (17.84t/ha). In case of Hathazari, the highest yield was produced by $F_1$1x2 (27.05 t/ha) followed by the $F_1$2x3 (23.37 t/ha). The lowest yield was obtained from the commercial hybrid (21.84t/ha). The mean highest fruit yield was obtained from the hybrid $F_1$1x2 (47.05 t/ha). These two hybrids $F_1$2x3, $F_1$1x2 were found promising for earliness, high yield, color variation and insect pest reaction. So these two lines may be recommended for further evaluation for their yield and quality.

Year round performance of BARI released sweet pepper varieties

L. Akter, A.K.M. Quamruzzaman, F. Islam, A.K.M.A. Haque and M.A.T. Masud

The study was conducted in the experimental farm of Olericulture Division, HRC, BARI, Joydebpur, Gazipur during the period from June, 2021 to May, 2022.Two BARI released sweet pepper varieties were used as planting materials in this experiment. The factorial experiment was conducted in Randomized Complete Block Design (RCBD) with three replications. Two-factor consist of Factor A: Two sweet pepper varieties (V_1 = BARI Mistimorich-1 and V_2 = BARI Mistimorich-2) and Factor B: six sowing time (S_1 =1st June 2021, S_2 = 1st August 2021, S_3 = 1st October 2021, S_4 = 1st December 2021, S_5 = 1st February 2022 and S_6 = 1st April 2022) for year round cultivation. The two varieties planted in six different time had significant difference among all the nine character studied. Main effect of variety on yield showed that the highest yield obtained from BARI Mistimorich-1(42.22t/ha). Main effect of sowing time on yield showed that the ultimate yield per plant and yield (t/ha) was recorded highest from the sowing time S_3 (918.68g and 45.93 t/ha respectively), whereas the lowest yield was recorded from S_6V_1 (BARI Mistimorich-1) variety with S_3 (1st October sowing) was the best performing combination among all the twelve in aspect of ultimate yield traits. Since, most of the combination performed well in six different time in respect of the yield contributing traits, this study will be continued for next year trial for more confirmation.

Effect of plastic mulch on growth and yield of different sweet pepper varieties

A. K. M. Ariful Hoque, A. K. M. Quamruzzaman and Ferdouse Islam

The study was conducted at Olericulture research field of HRC, BARI, Gazipur during the winter season of 2021-22 to find out the impact of plastic mulch on crop growth and yield of sweet pepper varieties. Two sweet pepper varieties (BARI Mistimorich-1 and BARI Mistimorich-2) and one line (CA 0023) was included in this study. It was clear that number of fruits/plant, individual fruit weight, fruit polar length and equatorial diameter are strongly related to soil moisture content. The effect of plastic mulch on different sweet pepper germplasm showed significant variation. Considering mulching for all three sweet pepper germplasm the highest number of fruits/plant (9.21), individual fruit weight (193.15 g), the highest yield/plant (1.77 kg) and yield (35.57 t/ha) was recorded against BARI Mistimorich-1 compared with other two germplasm. This study would be further investigated in order to recommend the suitability of plastic mulch for sweet pepper production.

Effect of biocher and irrigation level on moisture conservation and yield performance of sweet pepper on rooftop

A. R. Gazi, F. Islam, M. A. Goffer, A. K. M. Ariful Hoque and K.F.I. Murad

An experiment was carried out on the rooftop of the HRC Building of BARI, Gazipur during the year 2021-22 to investigate the different mixture rates of biochar with soil substrate and also to evaluate the yield performance of sweet pepper. The biocher mixer media compositions *viz*., T_1 = 100% soil (control), T_2= 10% biochar + 90% soil, T_3 = 20% biochar + 80% soil, T_4 = 30% biochar + 70% soil, T_5 = 40% biochar + 60% soil and 3 level of irrigation Viz. I_1 = 2-days interval, I_2 = 3-days interval I_3 = 4-days interval, used as factor for yield of sweet pepper. in case of biocher mixture, the highest % moisture conservation (23.12) was obtained in T_4 = 30% biochar + 70% soil. considering the single effect of irrigation level, the highest yield (525.80) was obtained in I_2 = 3-days interval. In interaction effect, the highest yield (596.870) was obtain from 30% biocher +70% soil and 3 days' interval irrigation. Considering all attributes and analyzed findings, it is concluding that from 30% biocher

+70% soil and 3 days' interval irrigation is the best combination for sweet pepper production in rooftop.

Standerization of growing media of sweet pepper in rooftop

A. R. Gazi, M. A. Goffer and F. Islam

An experiment was carried out on the rooftop of the HRC, BARI, Gazipur during the year 2020-21 with a view to standardize the growing media suitable for rooftop gardening of bell pepper. The experiment which was carried out to study the days to 50% flowering, spade value, plant height, no. of fruit, individual fruit weight, yield, fruit length and fruit breadth was laid out in completely randomized block design(RCBD) with 3 replications. The crops were grown in 6 growing medias comprising of different components by volume. The media compositions were T_0 = 60% soil + 40 % Cowdung , T_1= 60 % soil + 30 % Cowdung + 10 % Vermicompost (VC), T_2 = 60 % soil + 30 % Cowdung + 10 % Trichocompost (TC), T_3 = 60 % soil + 30 % Cowdung + 10 % Cocodust (CD), T_4 = 60 % soil + 30 % Cowdung + 10 % Biochar (BC), T_5 = 60% soil + 8 % CM + 8% VC + 8 % TC + 8 % CD + 8 % BC. The highest days to 50% flowering (42.67) SPAD value (72.47), plant height (53.17cm), no. of fruits per plant (7.00), individual fruit weight (89.20 gm), and yield (525.42gm) fruit length (8.07cm) and fruit breadth(7.57cm) was recorded. The media composition of T_2 = 60 % soil + 30 % Cowdung + 10% Trichocompost (TC) could be considered as ideal for rooftop cultivation of Bell pepper.

Broccoli

Regional yield trial of selected broccoli lines

M. Razzab Ali, L. Akter and Ferdouse Islam

A study on regional yield trial of broccoli lines was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur and at outer RARS and Regional Horticultural Research Station viz.- Jamalpur and Narsinghdi during the winter season of 2021-2022 to assess the regional adaptability and yield potentiality. In this study, Broccoli lines like BOI 018 was included and BOI-022 (Local Hybrid) as well as BARI Broccoli 1 used as check The highest marketable curd weight/ plant (1133.3 g) was recorded from the hybrid variety (BOI 022) which was followed by BOI 018 (844.6 g), while the lowest was obtained from BARI Broccoli 1 (476.00 g).On the basis of calculated yield, the highest identical curd yield per hectare (23.13 t) was recorded from the hybrid variety (BOI 022) which was followed by BOI 018 (16.95 t), while the lowest curd yield per hectare (9.28 t) was recorded from the BARI Borccoli-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. Considering earliness, yield potentiality, curd size, curd compactness, and qualitative characters the lines BOI 018 was found promising. As this is first year result, therefore, the experiment may be repeated for confirming the results.

Bottle Gourd

Evaluation of bottle gourd lines in summer

A. Akter, M. A. Hossain, H. Rahman, M. S. Rahman, R. Sultana and H. E. M. K. Mazed

A study was conducted to evaluate bottle gourd (*Lagenaria siceraria*) lines in respect of yield and quality in summer at HRC field, RARS, Jamalpur during the *kharif*-1 season of 2021. Five bottle gourd lines *viz*. LS Jam-001, LS Jam-002, LS Jam-003, LS Jam-004, LS Jam-005 and BARI Lau-4 as check were evaluated to investigate the yield and yield contributing characters. Longer fruit (44.27 cm) was obtained from BARI Lau-4, whereas shorter fruit (31 cm) by LS Jam-003. LS Jam-003 produced wider fruit (12.24 cm) compared to narrower fruit (10.08 cm) from LS Jam-001.The highest number of fruits per plant (12.24) was produced by the LS Jam-003 whereas the lowest number of fruits (8) was noted from the LS Jam-001, LS Jam-003 and LS Jam-005. The higher individual fruit weight (1.61 kg) noted in BARI Lau-4 and lower (1.33 kg) in LS Jam-005. The more fruit yield per plant (15.85 kg) & per hectare (31.71 t) was produced by the LS Jam-002 as against the less 10.64 kg per plant & 21.28 t per hectare in LS Jam-005. The results revealed that the LS Jam-002 and BARI Lau-4 gave higher yield. The study may be continued in the next year for the confirmation of the result.

Advanced yield trial of bottle gourd lines

M.M.R. Salim, A.K.M. Quamruzzaman and L. Akter

The study was conducted at the experimental field of the Olericulture Division, HRC, BARI, Gazipur

during winter season of 2021-22 to assess the yield potential of six bottle gourd lines. Significant variability was observed among the six bottle gourd lines, while the range of number of fruits/plant and average fruit weight was 7–10 fruits and 1.83-2.23 kg, respectively. The range of fruit length and diameter was 18.50 cm (LS209) to 36.50 cm (LS151C) and 10.50 cm (LS226) to 20.33 cm (LS146A1), respectively. The higher fruit yield of bottle gourd was produced by LS146A1 (53.95 t/ha), LS151C (46.80 t/ha), BARI Lau-4 (43.68 t/ha), and LS207 (41.43 t/ha). Considering yield contributing characters, fruit shape and color, the lines LS146A1, LS151C, LS207 were found promising and may be recommended for RYT.

Regional yield trial of winter bottle gourd

A.K.M. Quamruzzaman, M.M.R. Salim and L. Akter

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 (Akbarpur, Hathazari, Jashore, Rahmatpur, Burirhat) of Bangladesh during the winter season of 2021-22 to develop new high yielding OP bottle gourd varieties. Significant variation was observed in average fruit weight, yield /plant, fruit length, fruit yield. The highest number of fruits/ plant was produced in LS 154 (9.7), followed by BARI Lau-4 (9.3), LS 171 (9.2), LS 231 (9.0), while the maximum average fruit weight was produced by LS 154 (2.3 kg), followed by LS 171 (2.2 kg), BARI Lau-4 (2.2 kg). The range of fruit length and fruit diameter were 30.0-37.5cm and 10.0-11.5 cm, respectively. The Highest yield/ plant was produced by LS 154 (50.20 t/ha), followed by BARI Lau-4 (46.04 t/ha), LS 171 (45.54 t/ha), while lowest yield was produced by LS 232 (37.62 t/ha) in Gazipur condition. Incase of mean fruit yield over 6 locations, the lines viz., LS 154, LS 231 and LS 232 performed well, so these three lines can be selected for release of new bottle gourd OP variety.

Heterosis study of Bottle gourd hybrids

A.K.M. Quamruzzaman, M.M.R. Salim and L. Akter

A study was conducted in bottle gourd to estimate the magnitude of standard heterosis for yield and its six yield related components. Seventeen hybrids generated from eight diverged parents were evaluated in a Randomized Block Design with three replications at the Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur Bangladesh during winter season of 2021-22. Appreciable standard heterosis was found over seventeen hybrids for all the traits studied. There was significant variability observed among the seventeen bottle gourd hybrids. The range of significant standard heterosis for number of fruits/plant and individual fruit weight was 11.58 to 12.63 per cent and 11.11 to 22.22 per cent, respectively, while for fruit length and fruit diameter, it was 9.09 to 27.27 per cent and 7.27 to 9.09 per cent, respectively. Eight hybrids showed significant positive heterotic response for fruit yield, and the range was 12.98 to 31.40 per cent. The more significant positive standard heterosis was observed in hybrids F_1 20231 (31.40%), F_1 10154 (28.65%), F_1 40154 (23.98%), F_1 304 (22.22%), and F_1 20232 (19.30%). Considering yield contributing characters, the hybrids F_1 20231, F_1 10154, F_1 40154, F_1 304, and F_1 20232 were found promising and may be recommended for RYT.

Regional yield trial of winter bottle gourd hybrids

A.K.M. Quamruzzaman, M.M.R. Salim and L. Akter

The performance study of five bottle gourd hybrids was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur along with different RARS (Gazipur, Ishwardi, Akbarpur, Hathazari, Jashore, Rahmatpur) of Bangladesh during the winter season of 2021-22 to develop new high yielding bottle gourd hybrid varieties. Significant variation was observed in the number of fruit/ plant, average fruit weight, yield /plant, fruit length, fruit diameter, and fruit yield. In Gazipur, the higher number of fruits per plant was produced by F_1 B3xB4 (10.50), F_1 B4xB3 (9.00) and the average fruit weight was produced by F_1 B3xB4, while the higher fruit yield per hectare was produced by F_1 B3xB4 (50.4), followed by F_1 B4xB3 (40.5 t/ha), and F_1 (B4x231) (33t/ha). The mean fruit yield range of bottle gourd hybrids was 41.71 – 55.87 t/ha, while the highest per hectare fruit yield was recorded in F_1 B4xB3 (55.87 t/ha), followed by F_1 B4x231 (53.80 t/ha), check variety Diana (53.28 t/ha), while the lowest yield was calculated in B4xB2 (41.71 t/ha) over 6 locations. Considering yield potentiality, fruit

color, and acceptable fruit shape, two hybrids, viz., F_1 B4xB3 and F_1 B4x231 were found promising and may be released as a new bottle gourd hybrid variety.

Effect of vine prunning on the growth and yield of bottle gourd

A. Akter, M. A. Hossain, H. Rahman, M. S. Rahman, R. Sultana and H. E. M. K. Mazed

The study was carried out at the HRC, RARS, Jamalpur during the season of 2020-2021 to study the effect of vine prunning on the growth and yield of bottle gourd. The treatments were: T_1= pruning of main vine at 17th nodes; T_2= pruning of primary vine at 10th nodes, T_3= pruning of secondary vine at 10th nodes T_4= Control (No prunning). In consideration of effect of vine pruning on yield of bottle gourd, pruning of primary vine at 10th nodes and pruning of secondary vine at 10th nodes gave higher yield (17.64 kg per plant, 35.30 t/ha and 22.92 kg per plant, 45.83 t/ha respectively) and lowest yield found from no pruning (14.52 kg per plant and 29.05 t/ha). The results revealed that pruning of primary vine at 10th nodes and pruning of secondary vine at 10th nodes gave higher yield. So, we recommended that pruning of vine is beneficial for bottle gourd cultivation.

Pumpkin

Evaluation of pumpkin germplasm

B. Ahmed and M.A.T. Masud

Fifteen pumpkin genotypes were collected from different location of Bangladesh which was evaluated in Olericulture Division, HRC, BARI, Gazipur during the winter season of 2021– 22 to increase the source population of variable pumpkin genotypes. Out of fifteen, the seeds of five genotypes were not germinated and the three genotypes were severely infested by viruses. Only seven genotypes survived and collected seeds and got data from them. The genotypes varied for their response of some characters studied. Days to 1st female flower open and node order to 1st female flower ranged from 52.33 to 61.83 days and 8.41 to 12.20 nodes, respectively. The fruit length and fruit breadth was ranged from 11.50 to 32.33 cm and 13.16 to 20.83 cm, respectively. The flesh thickness, average fruit weight, fruits per plant, yield per plant and yield (t/ha) was ranged from 2.33 to 3.93 cm, 2.50 to 5.66 kg, 2.50 to 5.66, 5.16 to 14.40 kg and 11.73 to 28.80 tons, respectively. The TSS ranged from 6.33 to 12 %. The genotypes were in different shapes such as round, elliptical, high round and oval. The deep orange type flesh color was dominant among the genotypes. Fruit fly infestation and virus incidence was also observed in these genotypes. All the genotypes were not good equally but some of them (CM12, CM15, CM26 and CM28) were good in different aspects. So, these genotypes may be used for breeding purpose.

Inbred development of pumpkin (S_3-S_4)

B. Ahmed and M.A.T. Masud

Seven pumpkin lines were selected from different lines, on the basis of individual fruit weight which was evaluated in Olericulture Division, HRC, BARI, Gazipur during the winter season of 2021 - 22 to developed bigger size pumpkin inbred lines.The lines varied for their response of some characters studied. Most of the lines beard their 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 3.00 to 4.50cm, 4.1 to 5.96 kg, 3.00 to 4.66 node, 14.90 to 21.83 kg and 29.80 to 43.66 ton, respectively. The TSS ranged from 8.83 to 11.30 %. The lines were in different shapes such as round, high round, elliptical and oval. The deep orange type flesh color was dominant among the genotypes. Fruit fly infestation and virus incidence was also observed in these lines. All the lines were above 4 kg and among them one lines (BD10063-1-4) showed more than 5 kg average fruit weight. So, these lines may be used for breeding purpose for developing bigger size pumpkin variety.

Bitter Gourd

Regional yield trial of bitter gourd hybrids

M. A. T. Masud and Tuhina Hasan

Five hybrids of bitter gourd, derived from breeding lines of Vegetable Division, BARI and World Vegetable Center (WVC), were evaluated with one commercial check variety Hybrid Tia (Lal Teer Seeds). The experiment was conducted for the 2nd year at three regional locations of BARI which include Joydebpur, Jamalpur and Ishardi during the summer season of 2021 to select suitable hybrids for release as variety. Fruits/plant of the test hybrids varied from 20-74 over the locations and 39-46 at combined data. Check variety varied from 21-37 over the locations and 29 at combined data for fruits

per plant. In general, the check variety had higher average fruit weight (AvFwt) (142-209g) than the test hybrids across the locations and it was 167.3g at combined data. Performance of three hybrids Hybrid-34, hybrid-35 and Hybrid-39 was good for yield/hectare across the locations (22-29.1, 15-41.7 and 18.6-36.9 tons respectively) and compare to check variety (18.1-29 tons). Among the test hybrids, three (Hybrid-34, 35 and 39) performed better for yield per hectare (25.1-29.8 tons) compare to check variety (23.5 t/ha) at combined data. All the test hybrids were resistant to moderately resistant against virus incidence. No incidence of powdery mildew disease (0.0%) was recorded in the hybrids. Based on the quantitative characters; visual observation of fruit color, shape and size; visitor's choice and virus reactions three hybrids Hybrid-34, Hybrid-35 and Hybrid-39 were found promising for the 2nd year which may be released as hybrid variety of bitter gourd.

Ash Gourd

Regional yield trial of ash gourd lines

M. M. R. Salim

An experiment was conducted at Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the summer season of 2021 to assess yield potentiality and quality of three ash gourd advance lines. The lines were 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. Among three lines, the lines BARI Chalkumra -1 was noted for earliness (42.6 Days) for Days to 1st female flowering. The lines BH-29 exhibited noted for early harvesting i.e. 52.95 Days. Maximum number of fruits per plant (8.45) was recorded in BH-01. Studies revealed that the lines BARI Chalkumra -1 (39.9 t/ha), BH-01(39.9 t/ha), BH-02 (39.9 t/ha) were found to be promising for fruit yield.

Snake Gourd

Advanced yield trial of snake gourd

B. Ahmed and M.A.T. Masud

The study was conducted with eight snake gourd lines *viz.*, TA01-1, TA01-2, TA02-1, TA03-3, TA004-1, TA04-4, TA06-1 and TA07-3 at the farm of Olericulture Division, HRC, BARI Gazipur during the *kharif* season of 2021 to select suitable snake gourd lines. Wide ranges of variability were found in the studied characters among the lines. The line TA06-1 required minimum days for 1st female flower open (42.50 days) and TA004-1 required maximum days for 1st female flower (54.50days). The highest fruit length was observed in TA07-3 (195 cm) whereas, lowest fruit breadth was found in TA04--4 (22.00cm). The average fruit weight was also highest in same lines i.e. TA07-3 (360g). The highest number of fruits per plant, yield per plant and yield (t/ha) was found in TA01-1 (37, 6.63 kg and 36.44t/ha, respectively). The harvest duration was ranged from 26 to 47 days. The fruit fly infestation and downy mildew infection was ranged from 5 to 15% and 5 to 20%, respectively. Considering yield, acceptable fruit size and harvest duration the lines TA01-1 and TA07-3 were best. So these lines may be selected for high yielding snake gourd variety development as well as inbred development for hybridization programme.

Teasle Gourd

Regional yield trial of teasle gourd lines

M. Razzab Ali, A.K.M Ariful Hoque and Ferdouse Islam

A study on regional yield trial with two teasle gourd lines (MD Nar 0020 and MD Nar 0021) with one check (MD Nar 0015) was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at Regional Agricultural Research Stations (RARS) Jamalpur during the summer season of 2021 to assess the regional adaptability and yield potentiality. The maximum days required to harvest was recorded from 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) was recorded from the line MD 0020. The longest fruit was observed from MD 0020 (7.73 cm) followed by MD 0021 while the shortest was from MD 0015 (6.33). The line MD 0020 produced the highest flesh thickness (0.64cm) and the lowest (0.44 cm) was recorded from MD 0015. Maximum exocarp TSS (4.07) was found from the line MD 0020 while the lowest was from MD 015 (3.13). 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, MD 0020 produced green color fruit. Considering yield and yield contributing characheristics, MD Nar 0020 can be recommended for RYT in the next year.

Sponge Gourd

Regional yield trial of sponge gourd hybrids

B. Ahmed, M. A.T. Masud, A. Akter and A Habib

A regional yield trial of four sponge gourd hybrids (*viz*., Hybrid1, Hybrid 2, Hybrid 3 and Hybrid 4) were evaluated with a commercial check variety (Fujian) at different regional locations (Gazipur, Jamalpur and Akbarpur) of BARI during the *kharif* season of 2021 to select suitable hybrids for release as hybrid variety of cucumber. 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 2 which was ranged from 190-240g over the locations and combined data it was 216 g. Maximum yields per plant was also observed in hybrid 2 which ranged from 17.53-36.34kg at different locations and in combined data it was 26.33 kg. The overall performance of three hybrids (hybrid 2, hybrid 3 and hybrid 4) were good for yield across the locations (53.41-72.68, 66.74 and 55.95-71.66 tons respectively) compare to the check variety. Very minimum virus infections (3-5%) were observed in the tested hybrids at later stage but in check variety it was higher (22%). Thus considering the all parameters, visitor acceptance and virus reaction two hybrids (hybrid 2 and hybrid 4) was excellent. Very recently the hybrid 2 was released as new sponge gourd hybrid variety (BARI Hybrid Dhundol -1). So, the hybrid 4 may be released as new sponge gourd hybrid variety.

Cucumber

Regional yield trial of cucumber hybrids

B. Ahmed, M.A.T. Masud, M. N. Uddin, M R Islam and A. Akter

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 (Gazipur, Jamalpur and Rahmatpur) of BARI during the *kharif* season of 2021 to study the regional adaptability and yield potentiality. The hybrids varied significantly for their response of different characters studied. Fruits per plant of almost all the hybrids were higher at individual locations and combined data over the check variety. Maximum individual fruit weight was observed in hybrid 2 which ranged from 205- 221gm in different location and in combined data it was 208gm. Yield per plant was also highest in hybrid 2 in all the locations and in combined data it was 4.14 kg. The highest yield/ha was recorded in hybrid 2 at different locations and also in combined data (36.89 t/ha). Overall performance of the two hybrids (hybrid 1 and 2) were good across the locations (24.76 – 41.82 and 25.56 – 43.73 t/h, respectively) and in combined data it was (34.16 and 36.89 t/ha, respectively). Based on quantative characters, visual observations of fruit color, shape and size, virus and angular leaf spot reactions the two hybrids (hybrid 1 and hybrid 2) was found very promising. Thus considering the all parameters and visitor preference hybrid 1 and hybrid 2 may be released as a hybrid variety of cucumber.

Melon

Regional yield trial of selected melon lines

M. Razzab Ali, M. R. Karim and F. Islam

A study on regional yield trial with two OP muskmelon lines was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur and outer RARS and RHRS *viz*.- Jamalpur and Narsinghdi during the summer season of 2022 to assess the regional adaptability and yield potentiality. The line commercial hybrid produced the highest fruit yield per plant (34.13 kg), while the lowest was produced by CM-15-3-4-2-4-2-3-1-1-1 (22.37 kg).The maximum flesh thickness (3.26 cm) was obtained from CM-15-3-4-2-4-2-3-1-1-1, while the minimum (2.25 cm) was recorded from Commercial hybrid which was statistically at par with CM-11-5-3-4-2-1-1-2-1-1(2.66 cm).The highest (TSS %) was recorded from CM-11-5-3-4-2-1-1-2-1-1 (6.5) which was statistically similar with commercial hybrid (6.36) and the lowest was obtained from CM-15-3-4-2-4-2-3-1-1-1 (4.83). CM-15-3-4-2-4-2-3-1-1-1 line showed light orange

flesh colour and commercial hybrid as well as CM-11-5-3-4-2-1-1-2-1-1 line showed orange flesh colour.In case of texture, one lines showed sandy and 2 lines showed crispy texture. From the study it may be concluded that on the basis of qualitative and quantitative characters two lines found promising.As this is first year result, therefore, the experiment may be repeated for confirming the results.

Watermelon

Evaluation of watermelon lines

A.K.M. Quamruzzaman, F. Islam, L. Akter and M.M.R. Salim

The study was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during summer season of 2021 to assess the yield potentiality of 31 water melon lines/ varieties. There was diverged variability observed among the watermelon lines. The range of TSS was 7.4% to 12.8%, while the number of fruits per plant and single fruit weight was 2 to 7 and 2.52 kg to 7.41 kg, respectively. Wide range of variation was observed in fruit yield per hectare, while the yield range was 21.15 t/ha to 92.04 t/ha. The highest fruit yield per hectare was estimated in CL14 (92.04 t/ha), followed by CL03A (64.63 t/ha), CL21 (58.00 t/ha), CL06 (49.98 t/ha kg), CL15 (49.53 t/ha), CL12B (46.90 t/ha), CL02 (41.33 t/ha), CL08 (41.31 t/ha), CL16 (41.25 t/ha), BARI Tarmuj-1 (41.00 t/ha). Considering vine length, number of fruits per plant, single fruit weight, fruit length, fruit diameter, flesh thickness, rind thickness, TSS (%), fruit yield 11 watermelon lines viz., CL02, CL03A, CL05, CL06, CL07, CL08, CL11B, CL12B, CL14, CL15, CL16 CL21 were selected for next breeding program, like new OP variety development, inbred development and hybridization program.

Heterosis study of watermelon hybrids

A.K.M. Quamruzzaman, F. Islam, L. Akter and M.M.R. Salim

A study was conducted in watermelon to estimate the magnitude of heterosis for yield and its nine yield related components. Sixteen crosses generated from eight diverged parents were evaluated in a RCBD with three replications at the Olericulture Division, HRC, BARI, Gazipur, Bangladesh during the summer season of 2021. Appreciable heterosis was found over better parents for all the traits studied in desirable direction. The range of positive better parent heterosis for number of fruits/plant and individual fruit weight was 4.50 to 30.56 per cent and 7.17 to 21.05 per cent, respectively, while for fruit length and fruit diameter, it was 0.63 to 11.47 per cent and 2.74 to 14.40 per cent, respectively. Nine crosses showed significant positive heterotic response for TSS, while twelve crosses for fruit yield showed positive better parent heterosis and the range was 9.38 to 51.17 %. The higher significant positive better parent heterosis was observed in crosses F_1 104 (51.17%), F_1 105 (44.30%), F_1 801 (29.45%), F_1 102 (23.38%), F_1 401 (19.74%), F_1 103 (19.14%). Considering yield contributing characters, the crossesF_1 102, F_1 103, F_1 104, F_1 105, F_1 401, F_1 801 and F_1 2108 were found promising and may be recommended for RYT.

Profitability analysis of sorjan system and intercropping of 'offseason watermelon–winter vegetables' in tidally flooded saline agro-ecosystem

O.A. Fakir and M.A. Rahman

An experiment was conducted at the ARS, BARI, Binerpota, Satkhira during the *rabi* season of 2021-22 to find out the suitable crop combination for increasing total productivity, return and maximize land utilization through intercropping system. There were 4 treatments *viz*., T_1: BARI Tormuj-2 and BARI Phulkopy-1, T_2: BARI Tormuj-2 and BARI Badhakopy-2, T_3: BARI Tormuj-2 and Local Olkopy, T_4: BARI Tormuj-2 and BARI Broccoli-1. The highest watermelon equivalent yield was recorded from T_4 and it was 20.86 t/ha. The lowest watermelon equivalent yield was obtained from T_1 with the yield of 10.23 t/ha. The lowest soil salinity (2.10 dS/m) was recorded in sowing time and the highest soil salinity (5.30 dS/m) was found during harvesting stage. Considering the highest watermelon equivalent yield, the intercropping of BARI Tormuj-2 along with BARI Broccoli-1 gave the highest profit. However, this is the 1st year experiment, so it needs to consecutive three years trial to draw conclusive comment.

Squash

Hybridization in squash

B. Ahmed and M. S. Alam

A hybridization work was done among the three parents of squash inbreds (CP006-5-4-3, CP004-3-

2-1 and BARI Squash -1) at the experimental filed of Olericulture division, HRC, BARI Gazipur during the winter season of 2021-22. The lines were developed following the crop improvement procedure for 3-4 generations and they are in homozygous condition. Finally, two lines and one variety were considered as inbred lines. Crossing work was done following the full diallel fashion. Six different cross combinations were occurred where total 20 crossed fruits were found and a total number of 199 crossed seeds were found and preserved in cool room. These seed will be used to observe the F_1 performance in winter season of 2022-23.

Country Bean

Advanced yield trial of selected country bean lines

M. S. Alam, B. Ahmed and M. A. Goffar

Advanced yield trial of selected country bean lines was conducted at the Olericulture Division, HRC, BARI, Joydebpur, Gazipur during winter season of 2021-22. The selected superior lines of country bean were DL (St)-024, DL (St)-032 and BARI Sheem-1 as check variety. The lines varied significantly for their response to all the characters studied. Days to flowering ranged from 61 to 72 days after transplanting (DAT). The line DL (St)-024 required minimum days (61) while maximum days (65) required by BARI Sheem-1 (Table 1). Days to first harvest varied from 73 to 85 days. The earliest (73 days) harvest was done in DL (St)-024 where BARI Sheem-1 was harvested at the late (72 days). The line DL (St)-032 produced the maximum number of pods/plant (483) while DL (St)-024 produced the minimum pods (370). The single pod weight was the highest in DL (St)-032 (23.24 g) whereas the lowest in BARI Sheem-1 (11.68 g). The line DL (St)-032 produced the longest pods (15.31 cm) whereas BARI Sheem-1 produced the shortest pods (9.65 cm). The widest pods was recorded from DL (St)-032 (4.17 cm) whereas the narrowest ones from BARI Sheem-1 (2.31 cm). The highest pod yield per plant (8.65 kg) and yield per hectare (35.24 ton) were recorded from DL (St)-032 whereas the lowest yield per plant (5.18 kg) and yield per hectare (24.85 ton) from DL (St)- 024. Several insects and diseases were observed throughout the growing period among all lines. Aphids and jassids infested the crops and no line showed high or moderate tolerance. No mosaic virus infestation was found in the line DL (St)-032. Very low mosaic virus infestation was observed this year in other lines and in check variety. Percent plant infected by mosaic virus ranged from 05 to 10. Based on different yield attributes and qualitative parameters the genotypes DL (St)-024 and DL (St)-032 were found promising which may be recommend for regional yield trial.

Evaluation of country bean germplasm

M. S. Alam and M. A. Goffar

An experiment was conducted at the Olericulture Division, HRC, BARI, Joydebpur, Gazipur during winter season of 2021-22 to select superior lines of country bean. Nine country bean germplasm namely NTR-17, TT-43, TT-70, TT-129, SOQ-2, SOR-1, AZU-1, F-7, NSR-32 are evaluated in the study with BARI Sheem-1 as check variety. The lines varied significantly for their response to all the characters studied. Days to flowering ranged from 56 to 90 days after transplanting (DAT). BARI Sheem-1 produced the maximum number of pods/plant (396) while SOQ-2 produced the minimum pods (279). The single pod weight was the highest in TT-129 (16.0 g) whereas the lowest in NSR-32 (7.2 g). The genotype TT-129 produced the longest pods (17.0 cm) whereas F-7 produced the shortest pods (7.9 cm). The widest pods was recorded from NTR-17 (3.7 cm) whereas the narrowest ones from TT-70 (2.0 cm). The highest pod yield per plant (5.42 kg) and yield per hectare (24. 9 ton) were recorded from BARI Sheem-1 whereas the lowest yield per plant (2.84 kg) and yield per hectare (14.2 ton) from NSR-32. Several insects and disease were observed throughout the growing period among all genotypes. Aphids and jassids infested the crops and no line showed high or moderate tolerance. Percent plant infected by mosaic virus ranged from 0 to 20. Considering yield, no genotypes performed better than BARI Sheem-1. The study may be repeated to confirm the result and to investigate other quality attributes.

French Bean

Regional yield trial of french bean lines

M. S. Alam

The experiment was conducted at the research farm of Olericulture Division, HRC, BARI, Gazipur during the Rabi season of 2021-2022. Three promising lines viz. PV Rai-001, PV Rai-003 and PV Rai-004 along with BARI Jharsheem-2 as check

were included in the trial. French bean genotypes varied significantly for their response to important characters of which days to 50% flowering varied from 38-48 and days to first harvest 48-58 ($P<0.05$). The earliest flowering (38 days) and harvesting (48 days) observed in BARI Jharsheem-2. The maximum number of pods per plant was in BARI Jharsheem-2 (24) and minimum in PV Rai-003 (17). PV Rai-001 produced the larger pod among the genotypes with 15.1 cm length and 1.23 cm width. The highest individual fruit weight (9.64 g) and hundred green seed weight (64 g) were measured from the line PV Rai-001. The maximum (165 g) pod yield per plant was obtained from PV Rai-001 and the minimum (88 g) from PV Rai-003. PV Rai-001 produced the highest (30.25 t) per hectare yield. The plant height was the maximum in PV Rai-001 (125 cm) and its required support system. PV Rai-001 is purple colored bean and may be rich in anthocyanin. Considering pod yield and colour PV Rai-001 may be recommended to release as variety.

Yard Long Bean

Evaluation of yard long bean lines

M.A. Habib, M.A. Sumi and M. H. Hossain

The experiment was conducted at Regional Agricultural Research Station, Akbarpur, Moulvibazar, during the *rabi* season 2021-22 with a view to assessing the yield potentiality of two selected yard long bean lines viz., JSR VU 002 (colored), JSR VU 003 with check BARI Borboti-1. The highest plant height 224.50 cm was observed in JSR VU 003. The highest pods plant^{-1} (15.37) was in JSR VU 002, the lowest pod plant^{-1} (13.63) was in JSR VU 003, check variety BARI Borboti-1 was 14.75. Pod length from three germplasm JSR VU 002, JSR VU 003 and BARI Borboti-1 were 25.16, 28.66 and 35.60 cm, respectively. Fruit yield from the germplasm JSR VU 002 and JSR VU 003 was 12.05 and 18.57 t ha^{-1}, respectively. While Fruit yield from BARI Borboti -1 was 10.41 t ha^{-1}.

Evaluation of yard long bean lines

M. Rahman, M. A. Siddiky, M. A. H. Khan and M. O. Kaisar

The experiment was conducted at the RARS, BARI, Cumilla during *rabi* season of 2021-22 to evaluate the collected germplasm in respect of higher yield and quality of the pods. The test lines including check variety differed for their response to all the traits. The experiment was laid out in RCBD with three replications. The highest number of pods per plant was obtained from the line VS Cum-001 (43.40), while the lowest was from BARI Borboti-1 (19.14). The line VS Cum-001 produced the maximum weight of pods per plant (828.50 g) and BARI Borboti-1 produced the minimum (375.80 g). The highest yield was found from the line VS Cum-001 (53.00 t/ha) and the lowest yield was found from BARI Borboti-1 (15.27 t/ha). Considering yield and other yield contributing characters this can be stated that the line VS Cum-001 performed better regarding yield. It`s a first year experiment. Collection will be continued. So, the study may be repeated to the next year along with check variety for more confirmation of the results.

Advanced yield trial of yard long bean lines

A.K.M. Quamruzzaman, L. Akter and A.K.M. Ariful Haque

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during the summer season of 2021 to evaluate the selected yard long bean lines with a view to searching for a new variety. There was significant variability observed among the six yard long bean lines/variety. The range of fruit length and fruit diameter was 29.8–46.5 cm and 4.9–5.6 mm, respectively. The number of seeds per fruit and seed weight per fruit were significantly varied in this study, which were 9.3–18.3 and 1.34–2.22 g, respectively. The range of the number of fruits per plant and the single fruit weight were 51.4–104.9 and 11.7–16.0 g, respectively. The range of fruit yield/hectare was 13.85–19.94 t/ha, while the highest fruit yield/hectare was produced in BARI Barbati-1 (19.94 t/ha), followed by VS-21 (19.41 t/ha), VS-49 (16.31 t/ha) and BARI Borboti-2, which produced the lowest yield (13.85 t/ha). Considering earliness, yield contributing characters, fruit shape and color, the lines VS 21 and VS 49 were found promising and may be recommended for RYT at different locations for agro-ecological assessment.s

Garden Pea

Preliminary yield trial of garden pea lines

M.M.R salim and A. R. Gazi

A preliminary yield trial of garden pea lines was conducted at Olericulture Division, HRC, BARI,

Gazipur during 2021-22 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 use as check. The production performance was evaluated in RCBD with three replications. Seeds of all treatment were sown in December 28, 2021. The longest green pod was obtained from the BARI Motorshuti-1 (8.7cm) and shortest green pod was obtained from GP-51 (4.3 cm). Significantly highest number of pods/plant was recorded in the genotype GP-01 (13), GP-28 (12), GP-15 (11.7), GP-23 (11.7) compared to other lines. The number of seeds/pod was-significantly highest in BARI Motorshuti-1 (7.9) and lowest was in GP-51 (3.5). The maximum weight of 100 green seed was from BARI Motorshuti-1 (59.4 g) while the minimum was from GP-51 (17.4g). The highest pod yield/hectare was observed with BARI Motorshuti-1 (14.11) followed by GP-35 (10.05 t/ha), GP-01 (9.76 t/ha), BARI Motorshuti-3 (9.47 t/ha), while GP-51 (5.5 t/ha) and GP-28 (4.3 t/ha) showed the lowest pod yield. Therefore, GP-01, GP-28, GP-31 and GP-35 may select for advance yield trial next year.

Okra

Regional yield trial of okra lines

M.M.R Salim

The experiment was conducted with three selected okra lines at Olericulture Division, HRC, BARI, Gazipur to evaluate their fruit yield and reaction to YVMV. The selected three okra lines were AE-18, AE-86, AE -122 and BARI Dherosh- 2 as local check. The experiment was laid out in RCB design with 3 replications from March 2021 to July 2021. The results showed insignificant variation in plant height and days to 50% flowering. Results of analysis of variance showed highly significant ($P<0.05$) differences for average fruit weight and fruit diameter whereas other parameters showed significant difference ($P<0.01$). The maximum plant height (172 cm), No. of fruits/plant (38.6), Fruit yield/plant (1071g), Fruit yield (19.51t) found in BARI Dherosh- 2, while highest average fruit weight (16.0 g) was found in AE -122. The all lines viz BARI Dherosh- 2 (25.07%), AE -122 (27.75%), AE -86 (38.67%) and in AE -18 (38.67%) showed moderately resistant to YVMV in their increasing order of disease infection.

Amaranth

Evaluation of amaranth genotypes grown in winter

M. N. Uddin, A.K.M. Ariful Haque, A. R. Gazi, A. K. M. Quamruzzaman and M.A.T. Masud

Wide variabilities exist among the amaranth genotypes used in the present experiment. Those variabilities could be used for further improvement program of amaranth in our country. It is concluded from the experiment that yield was mainly contributed by plant height, stem weight, and stem dry matter. The stem weight and dry-matter had maximum direct effect on yield. EIS method was used for understand cell orientation and integrity which affect the quality of the materials. Considering the above mentioned characteristics three amaranth genotypes viz. Am (st) 023, Am (st) 028, and Am (st) 030 were found suitable for cultivation in winter season and proposed for RYT.

Regional yield trial of stem amaranth lines

M. Razzab Ali, A.K.M. Ariful Hoque and F. Islam

A study on regional yield trial with six stem amaranth lines was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur and outer RARS and RHRS *viz*.- Jamalpur and Narsinghdi during the summer season of 2022 to assess the regional adaptability and yield potentiality. The heaviest stem was obtained from the line AT Jam-018 (497.0 g), which was statistically similar with AT Jam-008 (430.78 g) and AT Jam-011(408.48 g), whereas the lightest stem was observed from BARI Data 1 (171.0 g).The longest stem length was obtained by AT Jam-018 (135 cm), which was followed by AT Jam-008(122.33 cm), while the shortest stem length by AM-0053 (61.33 cm) which was identical to BARI Data 1.The widest stem breadth (1.83 cm) was obtained by AT-0047 which was statistically identical to AM-0048(1.81 cm), BARI Data 1(1.61 cm), while the shortest stem breadth by AM-0053 (1.42 cm).In case of pigmentation, all lines were showed redish except AT-0047 and AT-0048. On the basis of branching nature, BARI Data 1 showed few branches and rest of the line had all along branches. All the lines showed erect nature, stem were 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 3 was in early fiberness (AT-0047,BARI

Data-1 and AT Jam-008), 2 lines were in mid fiberness (AT-0053, AT Jam-011) and 2 was in late fiberness (AT-0048, AT Jam-018). From the study it may be concluded that on the basis of qualitative and quantitative characters all lines found promising. As this is first year result, therefore, the experiment may be repeated for confirming the results

Lettuce

Advanced yield trial of selected lettuce lines

M. R. Ali, A. R. Gazi and F. Islam

An advanced yield trial was conducted at the Olericulture Division, HRC, BARI, Gazipur during *rabi* season of 2021-22. Three advanced lettuce lines with check (var. BARI Lettuce-1) were included in trial. The highest marketable leaf yield was produced by LS-014 (243.67 g) which was followed by BARI Lettuce 1 (203.33 g), while the lowest at par yield were recorded from LS-010 (90.0 g) which was identical to LS-012 (103.33 g). In case of calculated yield, the highest per hectare marketable yield was recorded from LS-014 (10.56 t) which was followed by BARI Lettuce 1 (8.9 t), while the lowest identical yield was recorded from LS-012 (5.3 t) and LS-010 (4.6 t).The variety BARI Lettuce 1 produced deep green leaves and the line LS-010, LS-012 and LS-014 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 LS-012 and LS-014 were selected for next year trial for further confirmation.

Turnip

Evaluation of turnip germplasm

A.K. M. Ariful Hoque, M. Assaduzzaman and M. R. Ali

The field experiment was carried out at research field of Olericulture Division, HRC, BARI, Gazipur during the winter season of 2021-22. The purpose of the experiment was to evaluate the performance of collected turnip germplasm in Agro-climatic condition of Bangladesh and also to develop new high yielding variety. Five Turnip germplasm viz. BR001, BR002, BR003, BR004, and BR005 were included in this trial. The experiment was laid out in RCBD with three replications. Unit plot size was 2.5 × 2.0 m and plant spacing was maintained 50 × 50 cm. There were significant variations among the germplasm. In case of root polar length, the highest length (11.43 cm) was measured in BR003 germplasm and the lowest (8.21 cm) was in BR001. Root equatorial diameter found maximum (12.25 cm) from germplasm BR002 and minimum (10.12 cm) from BR004. Among five germplasm the highest fresh root weight (615.25 g) was recorded from BR003 germplasm and the lowest (493.18 g) weight was recorded from BR002. Yield per plot found highest (7.38 kg) from BR003 turnip germplasm and lowest (5.92 kg) from BR002 germplasm. Considering growth, yield attributes of different turnip germplasm, BR003 has showed the highest yield compare to other germplasm. As this is second year result, BR003 could be selected for AYT next year.

Drumstick

Advanced yield trial of drumstick lines

M.A. Goffar, M.S. Alam and M. R. Ali

A study on evaluation of selected seven drumstick entries was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur during 2021-22 (plants transplanted six years back). The lines MO 0001, MO 0007, MO 0008, MO 0011, MO 0012 and MO0025 were included in this study. 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 three lines viz MO 0001, 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 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 drumstick lines. Considering flowering and pod setting habit over time, the entry MO0012 may be proposed as off-season and MO0025 as on season drumstick varieties for Bangladesh.

Development of leaf production techniques of drumstick

M.A. Goffar, M. S. Alam and M. R. Ali

An experiment was set up to find out the techniques of leaf production of drumstick at vegetable research field (field-2) of HRC, BARI, Gazipur during the year 2021-22. One drumstick line (MO 007) was used as

material. The stem of three plants of drumstick (5 years old) was cut in one meter height (from soil surface) on 21 may, 2020. Manures and fertilizers were applied as of recommended dose (urea- 200 g, TSP-250 g and MoP-150 g) per plant (Ali *et al.*, 2009). Data on date of stem cutting, date of new flash emergence, number of stem emergence/plant, number of leaf cluster and yield of leaves/plant were recorded. Within a month plant was ready to leave harvest. The leaves of drumstick plants were harvested one month interval which was commenced from 21 June to 21 September of the same year. There were four harvests done. Harvested leaves weight was recorded and mean data have been compiled. The mean results revealed that within 10 to 13 days of stem cutting new leaves or flash started to emerge. There were 8 to 19 stems were counted per plant. The maximum (423) leaves nod was recorded in plant number 2. The mean leaf yield indicated that the higher is the stem and leaf number the higher is the yield. Hence plant number 2 exhibited the highest leaf yield in first year 0.77kg and in 2nd year 1.245 kg. The study has helped to generate primary information and indication on drumstick leaf production such as i. stem to be pruned in alternate year in the month of May; and ii. Leaves have to harvest at tender stage. However, this is the 2nd year results; therefore, the study may be repeated to draw a precession on drumstick leaves production in Bangladesh.

Regional yield trial of pigweed (bothua)

M. A. Goffar, M.S. Alam and M.R. Ali

A regional yield trial of four selected Pigweed lines was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur and at four regional stations *viz.*, Jamalpur, Burirhat, Jashore, Ishurdi during the winter season of 2021-22 to study the adaptability and yield performance. Four Bothua lines of green and purple colour having one short and one tall from each colour were selected for regional yield trial. The experiment was laid out RCB design with three replications having plot size of 3 x 1 sq m providing a spacing of 25 cm x 5 cm. The crop was fertilized with cow dung 5 ton, Urea 200 kg (N-92 kg), TSP 100 kg (P-20 kg) and MoP 150 kg (75 kg). Entire cowdung, TSP and MoP were applied during final land preparation. Data on number of leaves per plant, size of leaves (L & B), days to harvest, green leaf yield/plant (g), plant height at last harvest were recorded. The maximum (253.0) number of leaves was counted in purple coloured tall stature lines and the minimum (95.0) in green coloured short stature lines. The highest leaf length (15.1 cm) and diameter (7.1 cm) were measured from the line purple tall stature line while the lowest leaf length (3.7 cm) and diameter (1.9 cm) were measured from the line green short stature line. The green tall line produced the highest per plant leaf yield (376.0 g) whereas purple tall lines attained tallest height (155.0 cm). However, the experiment may be repeated for confirming the results.

Evaluation 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 2021-22. 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. Considering the growth habit, yield, importance (nutritional & medicinal value- as mentioned in literature) and consumers' acceptance among 28 species, six species such as Bathua (red and green), Chukur (purple and green), Thankuni, Mint/Pudina, Telakuchu and Lafashak were selected for conducting regional yield to release as variety, alongside other species will also be maintained.

Improving productivity and adoption of BARI developed selected vegetable crops through integrated management approaches at char-areas of Bogura and Rangpur districts (IPVC) N.B. This project in funded by KGF, Dhaka

M.A. Goffar and M. S. Alam

A program on improving productivity and adoption of BARI developed selected vegetable crops through

integrated management approaches was conducted under coordinated approach evolving an experienced national NGO. In total, selected 16 HYVs and hybrid vegetables were included for three locations covering two upazilas (Char-areas of two upazilas) of two districts (Shariakandi of Bogura and Kaonia of Rangpur district) and at head quarter of BARI, Gazipur during October 2021 - September 2024. Field trials were conducted by NGO at char areas and on station trial is also being conducted by lead organization at Gazipur (HQ of BARI) for fine tuning of integrated management approaches (IMA). This season six vegetables viz-Cauliflower, Cabbage, Garden pea, Tomato, Pumpkin and Brinjal were included and a base line was conducted to identify problem and socio-economic scenario. The results revealed that in the survey report, percent of commercial vegetable production was higher at Shariakandi area than that of the Kaunia area. The use of hybrid vegetable variety was less than HYV and local one. The nutritional awareness was very poor. The vegetable consumption was also poor and they didn't quantify their daily vegetable consumption. Char dwellers are consumed vegetable during season period (mainly winter season). There is less consumption in other month of the year. Practically, there exists seasonal nutritional hunger. The untrained farmers were not familiar with modern vegetables production technology. Farmers of all location used fertilizer but they didn't maintain recommended dosages. Irrigating water scarcity exists at char area and little bit problem due to land alleviation. Considering above scenario, BARI released vegetable variety along with more other HYV of different seed companies may be included providing more training comprising integrated crop management practices for farmers that may conducive for increasing productivity of vegetables production in the project areas.

The yield performance of selected crops under IMA contributed the highest yield compared to Non-IMA. The MBCR was also higher in IMA than Non-IMA, which was above 2.0 (2.2-2.9) in all locations. Specially, Garden pea possess yield 22.0 to 31.0 kg with high MBCR (2.8-2.9). It's a very short duration crop that requires only 60-65 days. Virtually, this crop was unfamiliar to char areas of Shariakandi and Kaunia. Now it is being popular in these areas too. It was revealed that in some cases Non-IMA exhibits higher yield and MBCR due to use of indiscriminate insecticides and fertilizers. However, this is the first year results; the experiments will be repeated next year to confirm the findings.

Net House/ Hydroponic

Effect of different net houses on growth and quality of high value vegetables

A.K.M. Quamruzzaman, F. Islam, L. Akter and S.R. Mallick

The study was conducted at the research farm of the Olericulture Division, HRC, BARI, Gazipur from Mar 2021 to Feb 2022. In this study, we evaluated the effects of two types of vegetables *viz*., tomato, sweet pepper on the growth, yield, as well as the incidence of pests under four different conditions viz., (1) UV stabilized transparent polyethylene film with 60 mesh insect net along with green shade net, (2) UV stabilized transparent polyethylene film with 60 mesh insect net, (3) 60 mesh insect net, and (iv) open field conditions. The cultivation of vegetables in protected conditions using transparent polyfilm net houses can play a better role in improving quality, advancing maturity, increasing fruiting span, as well as fruit size and yield. Under protected conditions, high light, optimum humidity, high soil moisture and temperature give the best performance of quality parameters. If the protected net house conditions are prepared with UV stabilized transparent polyethylene film with 60 mesh insect net, the tomato, sweet pepper production (95.04, 31.27 t/ha, respectively) produced higher yields with good horticultural traits. The average BCR of these vegetables was 3.13, 6.88, respectively. The product will be safe and of good quality due to the absence of pesticide use. Considering yield and yield contributing traits, pest infestation and BCR, these two types of vegetables performed better in all aspect. These can be selected under the net house condition, which will be prepared with UV stabilized transparent polyethylene film with 60 mesh insect net to ensure year-round production in Bangladesh.

Effect of different net houses on the incidence of insect on vegetable crops

A.K.M. Quamruzzaman, F. Islam, L. Akter, M.S. Hossain and S.R. Mallick

In this study, the effects of different types of net houses viz., NH1, NH2, and NH3, were investigated at the research farm of the Olericulture Division, HRC, BARI, Gazipur from Sep 2021 to Mar 2022 and compared to control (open field) in terms of the incidence of white fly, aphid, leaf miners, mites, and eggplant shoot and fruit borer (ESFB). This study

included six vegetables [i) tomato, ii) eggplant, iii) sweet pepper, iv) broccoli, v) cucumber, and vi) okra, as well as four nethouse treatments [i) UV stabilized transparent polyethylene film with 60 mesh insect net along with green shade net (NH1); ii) UV stabilized transparent polyethylene film with 60 mesh insect net (NH2); iii) 60 mesh insect net (NH3); and iv) open field infestation of white fly, aphid, leaf miners, mites, and ESFB was observed under open field conditions followed by NH1 conditions, while the lower infestation was observed in NH2 and NH3 for all vegetables. From the study, we found the use of stabilized transparent polyethylene film with a 60 mesh insect nethouse provided a negative effect on the presence of different types of notorious insects on vegetables. So, this type of protected nethouse will provide a new dimension to producing safe and quality vegetables in Bangladesh.

Effect of maturity indices on growth and quality of high value vegetables

A.K.M. Quamruzzaman, F. Islam, L. Akter and S.R. Mallick

The research was carried out from March 2021 to February 2022 at the Olericulture Division, HRC, BARI, Gazipur. We tested the impact of four different types of vegetables, including tomato, broccoli, sweet pepper, cucumber on various maturity stages in a protected net house. Vegetables grown in a transparent polyfilm nethouse under protected conditions can improve quality, maturity, fruit size, and yield. When fruits and vegetables are picked before they are fully grown, they may stay green for longer, but they may not ripen to an acceptable color and flavor, resulting in a loss of consumer confidence. Furthermore, because fruit growth continues until harvest, immature fruit will be smaller than mature fruit, resulting in a reduction in harvest yield. In our research, we attempted to find the appropriate maturation stages in order to prevent product loss. At the 5 week stage, the tomato was found to be an appropriate size (6.5 cm length and 6.2 cm diameter), weight (84 g), TSS (4.5 percent), pH (4.3), turning red' and 'tasty', while the broccoli was found to be an appropriate size (12.0 cm length and 13.0 cm diameter), weight (360 g), and 'green' color. At the 6 week stage, while cucumber was found to be of appropriate size (8.8-10.8 cm length and 2.2-2.9 cm diameter), weight (61-88 g), TSS (3.8-4.1 percent), pH (6.3), 'less powdery' with sweet peppers that were found to be of appropriate size (9.2-9.5 cm length and 6.0-6.2 cm diameter), weight (131-142 g), TSS (4.5-4.8 percent), pH (5.6-5.65), 'Shiny green' fruit color, and 'pleasant flavored taste' at week 5-6 stage, quickly lose their attractiveness and shininess, and become slimy in texture. Therefore, determining the optimum maturity of our study will benefit both the consumers and the growers.

Upscaling of protective nethouse technology at farmers' field

A.K.M. Quamruzzaman, F. Islam, L. Akter, S.R. Mallick, M.O. Kaiser and S.M.M. Rahaman

The study was conducted at two farmers' fields, Narshingdi and Cumilla, during Oct 2021 to Sep 2022. In this study, we evaluated the effects of five types of vegetables, *viz*., tomato, sweet pepper, cucumber, netted melon, and okra, under protected nethouse. The cultivation of vegetables in protected conditions using transparent UV poly nethouses played a better role in improving quality, advancing maturity, fruit size, yield and reducing pest and disease infestation. Protected poly nethouses allow a better utilization of sunlight due to the manipulation of the spectra of radiation reaching the crops, thus promoting physiological responses in plant and fruit development, including leaf area index, chlorophyll and carotenoid content, tissue structure, fruit ripening, and physiological disorders. Under this evaluation, cultivation under UV Poly nethouse was found better in the Cumilla area compared to Narshingdi. It might be differences in management operations by different growers. For all crops, *viz*., tomato, sweet pepper, cucumber, netted melon, and okra, the production of the Cumilla area was very significant and higher. So, with UV poly nethouse technology, high value thermos-sensitive vegetables can be commercially grown year-round successfully to produce a safe and quality product, while greater fruit yield/unit area will be achieved in a protected nethouse than in a field.

Standardization of hydroponic nutrient solution for growing vegetables

M. Asaduzzaman, F. Islam and M. Rezaul Karim

A study was conducted in the Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, HRC, 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 plant growth bioassay using six leafy vegetables of variety were done during November 2021 to March 2022. Physical properties of the test nutrient solution were determined as tap water having no flammability and toxicity. In Modified Cooper's solution-2, the growth performance of the test leafy vegetables showed significantly similar performance in term of growth as in Modified Cooper's solution-1. Nutrient solution samples were sent to Soil Science Division for chemical analyses including N, P, K, Ca, Mg, S, Fe, Mn, B, Cu, Na, Zn and Mo (Data to be reported). Upon receiving the chemical composition report the proposed nutrient solution will be recommended for standardization as BARI Hydroponic Solution-2. Future research recommendation should be given for developing commercial grade hydroponic nutrient solution for commercialization and wider extension of hydroponic technology throughout the country.

Development of year round production packages of cherry tomato under protective culture

M.A. Goffar, M.S. Alam, A.K.M. Ariful Hoque and P. Hanson

A yield trial of one selected cherry tomato line (selected for releasing) of WVC with check BARI Tomato-11 was conducted at the experimental field of Olericulture Division, HRC during the winter season of the year of 20221-22 under net house to assess the yield potentiality, pest and disease reaction and adaptability. The fruit number per plant varied from 173.0 to 147.0. The highest fruit yield per ha obtained from SL0068 (63.75 tons), while BARI Tomato-11 gave 48.23 tons per ha. No virus and bacterial wilt found to be infected in the field.

Electrical conductivity and ion selective electrode based nutrient management for growing tomato in recycled hydroponics

M. Asaduzzaman and F. Islam

A study was conducted in the Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, HRC of BARI, Gazipur, Bangladesh to investigate the performance of EC (Electrical Conductitivity) and ISE (Ion Selective Electrode) based nutrient management in tomatoes gorwn in recycled hydroponics. Three types of hydroponic nutrient solution management were used in this experiment. These include ① Standard Nutrient solution culture (50% Enshi-shoo) ② EC based management (1.5 dS/m Enshi-shoo) and ③ ISE based management (50% Enshi-shoo). Deep water culture (DWC) hydroponic system with scheduled recyleing was used. The EC of each working solution was maintained as around 1.5 dS/m throughout the growing period. Results indicated that growth and yield of tomato varieties were increased about 1.5 times in EC based nutrient management and 2.0 times in ISE based nutrient management compared to standard nutrient solution management. Among the tomato varieties used, BARI Tomato-14 showed better results compared to BARI Tomato-2. Combined effect showed greater plant growth and yield performances in BARI Tomato-14 when grown under ISE based nutrient solution. This trial uses the sensor based nutrient management and IoT enabled applications and thus directely address the 4.0 IR challenges in Bangladesh Agriculture.

Development of micro-garden model for medium-size urban-family through soilless culture

M. Asaduzzaman, A.K.M. Ariful Hoque and F. Islam

A trial was conducted in the net house of Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, HRC, BARI, Gazipur, Bangladesh to produce fresh and nutritious vegetables and herbs throughout the year at 3-4 members family level consumption. A number of vegetables and herbs including sweet pepper, tomato, cauliflower, squash, maize 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 spear mints can be grown successfully having optimum yield (about 110.0 g in BARI Pudina-1 and 441.0 g in BARI Pudina-2) for several cycles. On the other hand, fruit vegetable such as sweet pepper (280.0-386.0 g/ plant), table type tomato (1292.8-1884.0 g/ plant) and cherry type tomato (626.0 g/plant) can be obtained from this micro-garden model. Therefore, results of this trial indicate that micro-model has great potential of supplying fresh, nutrient and antioxidant rich vegetables for individual family level consumption toward nutritional security of the country.

Production of micronutrient fortified leafy vegetables providing human health benefits through hydroponic cultivation

M. Asaduzzaman and F. Islam

Gimakalmi, lettuce and spinach were grown in five different levels of $ZnSO_4$, Fe-EDTA and Na_2SeO_4 to evaluate their influence on its growth and mineral uptake through hydroponics. The experiment was conducted under glasshouse condition at Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, HRC, BARI, Gazipur during winter season of 2022-21. The experimental design was CRBD with three replications. The selected leafy vegetables were cultured in hydroponics using 50% 'Enshi' nutrient solution with an average electrical conductivity (EC) of 1.50 dS/m and pH of 7.15. The 50% standard 'Enshi' nutrient solution with increased concentration of Zn (as $ZnSO_4$), Fe (as Fe-EDTA) and Se (as $NaSeO_4$) were prepared to ×1, ×2, ×3, ×4, and ×5 times nutrient solution. There were no significant differences sin growth parameters of gimakalmi grown in elevated concentrations of Fe and Se but Zn. It was found that, shoot fresh weight was highest in control plants and also in plants grown in nutrient solution with ×5 Zn and it was decreased considerably above this concentration. In this report, research results of gimakalmi were presented. Considering the yield, gimakalmi can be grown in ×5 Zn while elevated concentration of Fe and Se until ×15 can be considered. Final calculation will be made after receving the mineral analyses data by Atomic Absorption Spectrophotometer (data to be obtained). The outcome of this research will help producing mincronutrient fortified vegetables providing human helath benefits. However, clinical validation of the developed produce should be conducted for final recommendation.

Development of hydroponic nutrient solution based on commercial grade chemical fertilizers available in Bangladesh

M. Asaduzzaman, A. K. M. Ariful Hoque and F. Islam

A study was conducted in the Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, HRC, BARI, Gazipur, Bangladesh to standardize the commercial grade hydroponic solution developed by Olericulture Division. Research activities such as nutrient solution preparation, analysis for physical properties determination and plant growth bioassay using 6 types leafy vegetables of 11 varieties were done during November 2021 to March 2022. In experiment I, three hydroponic solution such as Enshi-shoo, BARI Hydroponic solution-1 and Commercial grade solution were used while in experiment II, full, ¾ and ½ strength of commercial grade solution were compared with two standard solution such as Ensi-shoo and BARI Hydroponic solution-1. Physical properties of the test nutrient solution were determined as tap water having no flammability and toxicity. In experiment I, Enshi-shoo nutrient solution and BARI Hydroponic solution-1 produced greater performance compared to Commercial grade solution. Greater yield in terms of shoot fresh weight of the leafy vegetables were recorded when grown in BARI Hydroponic solution-1 followed by Enshi-shoo nutrient solution. In experiment II, among the three concentrations of commercial grade solution, ¾ strength solutions produce greater yield in terms of shoot fresh and dry weight of lettuce compared to either full or ½ strength solution. However, ½ strength commercial grade solution also produced significantly similar yield to standard solution such as Enshi-shoo and BARI Hydroponic solution-1. It is recommended that, further trials needs to be designed in order to standardize the composition of the nutrient solution based on commercial grade fertilizer availale in Bangladesh.

Standerization of growing media of sweet pepper in rooftop

A. R. Gazi, M. A. Goffar and F. Islum

An experiment was carried out on the roof top of the HRC, BARI, Gazipur during the year 2020-21 to standardize the growing media suitable for rooftop gardening of bell pepper. The experiment which was carried out to study the days to 50% flowering, SPAD value, plant height, no. of fruit, individual fruit weight, yield, fruit length and fruit breadth was laid out in RCBD with 3 replications. The crops were grown in 6 growing medias comprising of different components by volume. The media compositions were T_0 = 60 % soil + 40 % Cowdung , T_1= 60 % soil + 30 % Cowdung + 10 % Vermicompost (VC), T_2 = 60 % soil + 30 % Cowdung + 10 % Trichocompost (TC), T_3 = 60 % soil + 30 % Cowdung + 10 % Cocodust (CD), T_4 = 60 % soil + 30 % Cowdung + 10 % Biochar (BC), T_5 = 60% soil + 8 % CM + 8% VC + 8 % TC + 8 % CD + 8 % BC.

The highest days to 50% flowering (42.67) SPAD value (72.47), plant height (53.17cm), no. of fruits per plant (7.00), individual fruit weight (89.20 gm), and yield (525.42gm) fruit length (8.07cm) and fruit breadth(7.57cm) was recorded. The media composition of T2 = 60 % soil + 30 % Cowdung + 10 % Trichocompost (TC) could be considered as ideal for rooftop cultivation of Bell pepper.

Organic and Safe Vegetables

Evaluation of magic population of tomato under organic practices

M. N. Uddin, M. Ariful Haque, A.K.M. Quamruzzaman and M.A.T. Masud

The study was carried out at organic field of Olericulture Division under HRC, BARI, Gazipur during winter 2021-22 in order to develop self-population of MAGIC lines. A total 20 sets generation tomato lines namely, T_1 (New 9), T_2 (New 10), T_3 (CLN 31-25-0-19), T_4 (CLN 3150-A-5), T_5 (AVTO 1201), T_6 (New 13), T_7 (CLN 3324A), T_8 (CLN 3241AA), T_9 (New 9 X New 10), T_{10} (CLN3125-0-19X 3150-A-5), T_{11} (AVTO 1201 X New 13), T_{12} (3324A X 3241AA), T_{13} (New 9XNew 10) X(3125-0-19X3150-A-5), T_{14} (AVTO 1201 * New 13) X (3324A * 3241AA), T_{15}- F1, and a total 200 plants were evaluated from F2 population and out of these T_{16} (F2 V1) , T_{17} (F2 V2), T_{18} (F2 V4), T_{19} (F2 V5), and T_{20} (F2 V6) were evaluated with three replications. Seeds were sown for seedling in a seedbed on 20 November 2021MAGIC breeding is an effective approach for improving the genotypes upto desired goal and in this study positive improvement was made to identify suitable lines for further evaluation in terms of horticultural traits under organic condition. Considering the performance F_2 V_1, F_2 V_2, F_2 V_4, F_2 V_5, F_2 V_6 were identify for further evaluation.

Effect of trellis on the yield and profitability of vine crops under organic condition

M. N. Uddin, M. A. R. Gazi, A. K. M. Quamruzzaman and M.A.T. Masud

The study was carried out to find the suitable trellis and its production method on the yield and profitability of vine vegetables crop. The experiment was carried out at organic field under olericulture division, HRC, BARI, Gazipur during winter 2020-21 to find out the suitable trellis considering the yield and profitability. Four types of trellis i.e., Without support, Flat Macha, Bamboo stick support, String support were used in this experiments with three replications. Seedlings of BARI Sheem-1 were raised in pot and at 4 leaf-stage transferred to different types of trellis at main field August 2021. Bamboo stick support after 1 m distance planting produced the maximum amount of fresh pods of country bean. The infestation in pod was less and infection of virus was nil. Yield per ha (t) was found maximum in bamboo stick support (8 t/ha) and the minimum was in without support (3.36 t/ha) (fig 1). The flat macha yield was also 5.35 t/ha which was significantly lower than bamboo stick support and string support (6.13 t/ha). Number of infested plants and increased number of plants per unit area were the main reason for contributing in the significant variation. Considering the yield and yield contributing characters bamboo stick support might be considered for creepy type vegetables for the small holder. This experiment should be continued next year.

Effect of mulching and growing conditions on the growth and yield of organic lettuce

M. N. Uddin, G.A. Rob, A.K.M. Quamruzzaman and M.A.T. Masud

The experiment was conducted at organic field of olericulture division, HRC, BARI from October, 2021 to January, 2022 to assess the effect mulching on the growth and yield of different lettuce varieties in the open filed and plastic house under organic condition. The experiment was conducted in RCBD with five varieties and five treatments. The varieties were LSO-002, LSO-003, LSO-005, LSO-006, and BARI Lettuce-1. On the other hand, the treatments were open field (OF) and no mulching -NM (OF+NM), Plastic house-PH and plastic mulch -PM (PH+PM), OF and water hyacinth mulching-WHM (OF+WHM), OF and PM (OF+PM) and PH and NM (PH+NM. Given overall performances, it can be stated that LSO-006 was an effective, and high yielding variety using plastic house and plastic mulching under organic conditions and BARI Lettuce-1 was most effective on growth using shade and plastic mulching under organic conditions. LSO-002 and BARI Lettuce were the second-highest yielding variety using plastic house and plastic mulching under organic conditions. Moreover, if consider the environmental point of view under plastic house without mulch and in the open field water hyacinth mulch might be recommended with LSO 006 variety.

Research carried out by different sections of HRC

Entomology Section

On-farm validation and upscaling of biorational integrated pest and disease management packages for quality and safe country bean production

A. Mohammad, L. Yasmin, M. M. Rahman 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 2021 to March 2022. BARI Seem-1 was used as test crop. Total three IPM + IDM packages viz, Package1= Seed treatment with Bordeux mixture @10g per kg of seeds + Application of Tricho-compost in pit + Foliar spray of Tricho-leacete (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 5 SG) and Clorantraniliprole (Coragen18.5SC) + Spraying of Amistertop 325 SC and Tilt 250 ECand Package 3= Untreated control were evaluated against major insect pests of country bean following RCB design with ten replications. Results revealed that P_2 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 in respect of reduction of insect pest and disease infestation (60.84% and 67.41 %), increase of marketable yield (47.71%) and marginal benefit cost ratio (9.53).

Field screening of different BARI released brinjal varieties against major insect pests

A. Mohammad and M. I. Islam

Twelve BARI released Brinjal varieties were screened against major insect pest infestation during 2021-22 at research field of Entomology Section, HRC, BARI, Gazipur. Among, twelve varieties namely, BARI Begun-1 and BARI Begun-12 were found as less susceptible against major insect pests like Aphid, Jassid, whitefly and BSFB and high yielding varieties as well.

Survey and monitoring of insect pests of roof garden

A. Mohammad and M. I. Islam

The experiment was carried out at the roof gardens of HRC and Soil Science Division, BARI, Gazipur during 2021-22. Guava, mango, papaya, lemon, hog plum were the available crop at HRC roof garden where plant and leaf infestation data were collected from visual observation. It was observed that 30-80 % guava plant, 0 to 25 % mango plant, 16.67-41.67% papaya plant of the HRC roof garden were infested by mealy bug. 30-80% mango and lemon leaves were also infested by mealy bug. Spiraling whitefly, spiraling whitefly, mealy bug complex were observed at guava plant but infested plants were less than 20 percent. Fruit fly population was observed at roof garden of soil science division by using pheromone trap. Bactocera cucurbitae and Bactocera dorsalis population were found though out the observation period ranged from 13.67 to 36.33 per trap and 12.33 to 44.33 per trap, respectively.

Soil and Water Management Section

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 Soil & Water Management Section, HRC, BARI, Gazipur during summer seasons of 2021 and 2022 to identify the best planting time for better flowering, fruit setting and yield of summer tomato under plastic mulch condition and to develop an off-season low cost production technology with plastic mulch under the prevailing agro-climatic conditions of Bangladesh. The experiment was laid out in factorial RCBD with three replications. Four transplanting dates *viz*., 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 *viz.*, PM_1: Black plastic

mulch, PM_2: Yellow plastic mulch, PM_3: Double layer (black +Yellow) plastic mulch and PM_4: Transparent plastic mulch (control) was tested in the experiment. From this study it was observed that both planting time and plastic mulch had significant effects on summer tomato production. Although double layer plastic mulch under October planting (T_3PM_3) followed by black plastic mulch (T_1PM_3) showed the maximum yield, August planting with double layer plastic mulch performed the best in terms of both yield and economic profitability. Maximum tomato yield of 84.56 ton ha^{-1} was recorded with the treatment T_4PM_3 followed by T_4PM_3 (82.87ton ha^{-1}), respectively. Also the maximum fruit setting (46.0 and 44.7 fruits $plant^{-1}$) was found with the same treatment. But, maximum gross margin (Tk. 4318133) with the highest BCR 14.25 was found in August planting with double layer plastic mulch (T_3PM_3) treatment followed by T_3PM_1 (Tk.4166400) with the BCR 13.78, respectively. Therefore, August planting with double layer (black + yellow) plastic mulch followed by black plastic mulch was more profitable than yellow and transparent plastic mulch in respect of yield as well as economic profitability of summer tomato which could be recommended as an off-season low cost plastic mulch based production technology under the climatic condition of Bangladesh to make availability of tomato in the market round the year.

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 Soil & Water Management Section, HRC, BARI, Gazipur during winter seasons of 2020-21 and 2021-22 to evaluate the effects of boron (B) on seed and pod yield of different bush bean varieties and to develop a boron fertilizer recommendation for BARI bush bean varieties. The experiment was laid out in factorial in RCBD with three replications. Three varieties of bush bean namely, V_1: BARI Jharshim-1; V_2: BARI Jharshim-2 and V_3: BARI Jharshim -3 and four levels of boron *viz*., B_1: 0 kg B (control), B_2: 1 kg B, B_3: 2 kg B and B_4: 3 kg B ha^{-1} were used in the experiment. From two years, study it was observed that application of B had significant effects on bush bean production. Maximum pod yield was recorded from BARI Jharshim-2 followed by BARI Jharshim-1 with 2 kg B ha^{-1} followed by 1 kg B ha^{-1}. Maximum seed yield was obtained from BARI Jharshim-1 followed by BARI Jharshim-3 with 2 kg B ha^{-1} followed by 1 kg B ha^{-1}. Similar results were also observed in other parameters of bush bean. Highest plant boron content in plan perts was found with 3 kg B ha^{-1} under BARI Jharshim-3. From two years, study it was observed that the variety BARI Jharshim-2 followed by BARI Jharshim-1 was more productive with 2 kg boron ha^{-1} for quality seed and pod yield of bush bean.

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 Soil & Water Management Section, HRC, BARI, Gazipur during 2020-21 and 2021-22. The experiment was laid out in a split plot design with three replications. Three levels of vermi-compost as factor A were VC_1= 3 ton ha^{-1}, VC_2 =4 ton ha^{-1}, and VC_3 = 5 ton ha^{-1} and four levels of NPK fertilizer as factor B: F_1 = Control (0-0-0 kg), F_2 = 50% of recommended N: P: K @ 160 : 80 : 70 kg ha^{-1}, F_3 = 75% of recommended N: P: K @ 245 : 115 : 105 kg ha^{-1}, and F_4= 100% of recommended N: P: K @ 330 : 150 : 140 kg ha^{-1} were considered as treatment. From two years' study it was found that all the parameters showed better performance in vermi-compost 5 ton ha^{-1} with 75% recommended N: P: K fertilizer @ 245 : 115 : 105 kg ha^{-1}. Maximum fruit yield (94.44 ton ha^{-1}) was recorded with 75% recommended N: P: K fertilizer under 5 ton ha^{-1} vermi-compost application. Therefore, vermi-compost @ 5 $tonha^{-1}$ with 75% recommended N: P: K fertilizer @ 245: 115: 105 kg ha^{-1} could be suggested as an organomineral fertilizer recommendation for netted melon production under the prevailing agro-climatic condition of Bangladesh.

Growth and yield of tomato varieties influenced by soil properties under different plastic mulch

M. A. Rahman, M. J. Hussain, M. A. Quddus and K. K. Sarker

The experiment was conducted at the research field of Soil & Water Management Section, HRC, BARI, Gazipur during 2020-21 and 2021-22 followed by factorial RCBD with 3 replications. Two varieties of tomato as factor A: V_1: BARI Tomato-18 and V_2: BARI Tomato-21 and four types of plastic mulch as factor B: PM_1: Control,

PM_2: Black PM, PM_3: Yellow PM and PM_4: 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. From this study, results showed that yield was found maximum in black polythene mulch with the variety BARI tomato-18 (92.71 ton ha^{-1}) and BARI Tomato-21 (83.56 ton ha^{-1}) for the two years, respectively followed by yellow polythene mulch. Both the tomato varieties were equally responsive to plastic mulch although the yield was little higher in BARI Tomato-18. Among the plastic mulch treatments black polythene mulch gave the best result in terms of fruit setting, fruit size and yield. Highest TSS was also found in black polythene mulch with the variety BARI tomato-21 (5.0) and BARI Tomato-18 (4.9) followed by yellow polythene mulch, respectively. After two years' study it was found that black polythene mulch followed by yellow polythene mulch was more suitable to produce higher amount of tomato in winter season and variety BARI Tomato-18 performed better than BARI Tomato-21.

Integrated nutrient management to improve productivity of sweet pepper (*Capsicum annum* L.)

M. J. Hussain, M. A. Rahman, M. A. Quddus and K. K. Sarker

The experiment was conducted at the research field of Soil & Water Management Section, HRC, BARI, Gazipur during the winter season of 2021-22 followed by in split plot design with 3 replications. Two levels of cow dung as factor A: CD_1: 5 ton CD/ha and CD_2: 10 ton CD/ha and Factor B: Five levels of chemical fertilizer as T_1: Recommended fertilizer dose on the basis of FRG, 2018; T_2: STB fertilizer recommendation followed by FRG, 2018; T_3: 25% higher dose of STB recommendation; T_4: 50% higher dose of STB recommendation and T_5: Control was used to form treatment combination. It was observed that maximum fruit yield (73.72 ton ha^{-1}) was found in 50% higher dose of STB recommendation with 10 tons CD ha^{-1} followed by 25% higher dose of STB recommendation with 10 tons CD ha^{-1}, respectively. The higher growth and other yield contributing characters were also found with same treatment combination. The experiment will be repeated for the next year for further evaluation for recommendation.

Integrated effect of different sources of organic manures and chemical fertilizers on growth, yield and quality of tomato

M. A. Quddus, M. Ataur Rahman, K.K. Sarker, M. A. Siddiky and M. S. Arfin

Tomato (*Solanum lycopersicum* L.) is responsive to organic and inorganic fertilizers. An experiment was conducted at the research field of Soil and Water Management Section of HRC, BARI, Gazipur during 2021-22 to evaluate the effect of organic and inorganic fertilizers on growth, yield and quality of tomato. The experment consisted of eight treatments *viz*., T_1 = control (untreated), T_2= 100% RDF ($N_{140}P_{40}K_{90}S_{18}Zn_3B_2$ kg ha^{-1} as per FRG, 2018), T_3 = vermicompost 3 t ha^{-1} + recommended dose of inorganic fertilizer (RDF), T_4= poultry maure 3 t ha^{-1} + RDF, T_5= vermicompost 5 t ha^{-1} + RDF, T_6 = cowdung 5 t ha^{-1} + RDF, T_7 = poultry manure 5 t ha^{-1} + RDF, T_8 = Cowdung 10 t ha^{-1} + RDF including blanket dose of 12 kg Mg ha^{-1}. The experiment was set up in RCB design with 3 replications. The highest tomato marketable fruit yield (94.5 t ha^{-1}) was produced fromT_5 treatment followed by T_3 treatment. The highest percent increment of fruit yield (69.3%) over control was achieved in the same (T_5) treatment. Growth, yield and quality attributes were more pronounced in T_5 treatment. So, the result suggests that application of vermicompost 5 t ha^{-1} +100% RDF along with blanket dose of Mg 12 kg ha^{-1} was optimum for getting maximum yield of tomato.

Effect of boron and magnesium on growth, yield and quality of cauliflower

M. A. Quddus, M. Ataur Rahman, K. K. Sarker and M. S. Arfin

Cauliflower (*Brassica oleracea* L. *var*. *botrytis*) is very responsive to applied boron and magnesium fertilizers when soil is deficit or minimum in boron and magnesium. An experiment was conducted at the research field of Soil and Water Management Section of HRC, BARI, Gazipur during winter season of 2021-22 to evaluate the effect of boron and magnesium application on growth, yield traits and yields of cauliflower. The experiment comprised 16 treatment combinations involving four levels each of boron (0, 1, 2 and 3 kg ha^{-1}) and magnesium (0, 4, 8 and 12 kg ha^{-1}) following factorial RCB design with 3 replications .The result indicated that application of B @ 2 kg ha^{-1} and Mg @ 12 kg ha^{-1} produced highest number of leaves $plant^{-1}$ (23.2) and maximum fresh

curd yield (20.20 t ha^{-1}) with higher individual curd weight (1078 g). The interaction effect of boron and magnesium was superior to single effect. Regression analysis indicates that the application of optimum B dose @ 1.66 kg ha^{-1} and Mg dose @ 11.7 kg ha^{-1} could be expected maximum curd yield of cauliflower in the experimental field condition. The result suggests that combined application of B @ 2 kg ha^{-1} and Mg @ 12 kg ha^{-1} can increase curd yield and quality of cauliflower. The present findings might have potential in improving the yield and production of cauliflower in the areas where soils are deficit in boron and magnesium.

Response of sponge gourd to zinc, boron and magnesium application

M. A. Quddus, K.K. Sarker, M. Ataur Rahman and M. S. Arfin

A study was conducted at the research field of Soil and Water Management Section of HRC, BARI, Gazipur during 2021 to determine the effective doses of zinc (Zn), boron (B) and magnesium (Mg) for yield maximization of sponge gourd (*Luffa cylindrica* L.).The experiment consisted of 9 treatment combinations *viz.*, $T_1 = Zn_0B_0Mg_0$ kg ha^{-1}, $T_2 = Zn_3B_{1.5}Mg_4$ kg ha^{-1}, $T_3 = Zn_3B_2Mg_4$ kg ha^{-1}, $T_4 = Zn_4B_{1.5}Mg_4$ kg ha^{-1}, $T_5 = Zn_4B_2Mg_4$ kg ha^{-1}, $T_6 = Zn_3B_{1.5}Mg_8$ kg ha^{-1}, $T_7 = Zn_3B_2Mg_8$ kg ha^{-1}, $T_8 = Zn_4B_{1.5}Mg_8$ kg ha^{-1} and $T_9 = Zn_4B_2Mg_8$ kg ha^{-1} along with the blanket dose of $N_{100}P_{30}K_{80}S_{20}$ kg ha^{-1} and cow dung 10 t ha^{-1}.The experiment was laid out in RCB design with 3 replications. Maximum marketable yield of sponge gourd was highest (55.2 t ha^{-1}) inT_9 treatment followed by T_8 treatment. The percent yield increment over control was achieved highest (26.0%) in the same T_9 treatment. Most of the yield attributes were performed better in T_9 treatment followed by T_8 treatment. The highest net return (Tk. 889229 ha^{-1}) was obtained from T_9 treatment followed by T_8 treatment. The highest benefit cost ratio (BCR) (5.14) was also recorded from T_9 treatment followed T_8 treatment. Considering the yield and BCR the combination $Zn_4B_2Mg_8$ kg ha^{-1} including $N_{100}P_{30}K_{80}S_{20}$ kg ha^{-1} might be suggested for sponge gourd cultivation.

Impact of organic and inorganic fertilizers on growth, yield and quality of bitter gourd

M. A. Quddus, K.K. Sarker, M. Ataur Rahman and M. S. Arfin

A study was conducted at the research field of Soil and Water Management Section of HRC, BARI, Gazipur during 2021 to determine the effective combination of organic and inorganic fertilizer dose for yield maximization of bitter gourd (*Momordica charantia* L). The experiment was consisted of 9 treatments *viz.*, T_1 = Control, T_2 = 100% RDF ($N_{120}P_{40}K_{85}S_{20}Zn_3B_2$ kg ha^{-1}), T_3 = 50% RDF + vermicompost 5 t ha^{-1}, T_4 = 50% RDF + poultry manure 2.5 t ha^{-1}, T_5 = 75% RDF + vermicompost 5 t ha^{-1}, T_6= 75% RDF + poultry manure 2.5 ha^{-1}, T_7 = 75% RDF + cowdung 5 t ha^{-1}, T_8 = 50% RDF + vermicompost 5 t ha^{-1}+ cowdung 5 t ha^{-1}, T_9 = 25% RDF + vermicompost 5 t ha^{-1}+ cowdung 5 t ha^{-1} including blanket dose of 8 kg Mg ha^{-1} following RCB design with 3 replications. The results showed that the highest marketable bitter gourd yield (13.5 t ha^{-1}) was obtained from the treatment T_8 (50% RDF+ vermicompost 5 t ha^{-1}+ cowdung 5 t ha^{-1}). Most of the yield attributes of bitter gourd exhibited the best performance in T_8 treatment. Vitamin C content (45.1 mg/100g) was the maximum in T_8 treatment. The gross return was also highest (Tk.405000 ha^{-1}) in T_8 treatment. The results suggest that the combination 50% RDF + vermicompost 5 t ha^{-1}+ cowdung 5 t ha^{-1} with blanket dose of 8 kg Mg ha^{-1} can be the best fertilizer combination for bitter gourd cultivation under experimental field condition.

Evaluation of alternate furrow irrigation and irrigation interval with supplemental every-furrow irrigation for eggplant

K.K. Sarker, M. A. Quddus and M. Ataur Rahman

Alternate furrow irrigation (AFI) is an ideal improvement of traditional every-furrow irrigation (EFI) for saving water and is relatively easy to apply in small-scale farming system. Therefore, the present study was conducted at the research field of Soil and water Management Section of HRC, BARI, Gazipur during 2021-22 to evaluate the effects of AFI with 10 and 15 days intervals with supplement one EFI at critical growth stage (flowering/1st fruiting stage) on eggplant yield, water saving, water productivity (WP) and benefit cost ratio as compared with AFI without supplement EFI and EFI with 10 and 15 days intervals. The field experiment was laid out in RCB design with 6 treatments replicated thrice. Irrigation water was applied through two ways of furrow: AFI and traditional EFI. AFI indicates that one of the two neighboring furrows was alternately irrigated during consecutive irrigation event. The results of the study showed that plant height and SPAD value of the eggplant at

different growth stages were not significantly different among the treatments. The SPAD value at 92 days after planting (DAP) was significantly ($P<0.001$) different but the AFI with 10 and 15 days interval had no significant difference. The marketable yield of eggplant was significantly ($P<0.001$) different among the treatments but the yield did not differ between the treatments of AFI with or without supplement and one EFI at 10 days intervals. The most important result was that AFI saved irrigation water by 35% compared to the traditional EFI without significantly reduction in yield at 10 days intervals. AFI significantly improved WP by around 50% compared to EFI when irrigation was applied at 10 days intervals. Net return from AFI technique was found nearly similar compared to EFI at 10 days intervals and more than EFI at 15 days intervals. The benefit cost ratio (BCR) was higher in AFI by 1.7 and 1.5 when irrigation water was applied at 10 days interval with supplement one EFI than the EFI at 10 and 15 days interval, respectively. Unit production cost was obtained lower in AFI by around 15.10 Tk./kg compared to the traditional EFI by 16.60 Tk./kg at 10 days irrigation interval. However, AFI with 10 days intervals with supplement one EFI at flowering or fruiting stage could be an alternative option in the areas where water and supply methods are limited to irrigation in Bangladesh.

Plant Physiology Section

Effect of plant growth regulators on the performance of lady's finger

M. Moniruzzaman and R. Khatoon

A field experiment on lady's finger was conducted at the Plant Physiology Field of Horticulture Research Center, Bangladesh Agricultural research Institute, Gazipur during the summer season of 2021 to study the effect of plant growth regulators on growth and yield of the crop. The experiment consisted of seven plant growth regulator (PGR) treatments *viz.*, two naphthalene acetic acid (NAA) concentrations (100 and 200 ppm), two gibberellic acid (GA_3) concentrations (100 and 200 ppm), two chlorocholine chloride (CCC) concentrations (200, and 400 ppm) and tap water as control, and two okra varieties, namely BARI Dheros-2 and OK-1820. The experiment was conducted in split-plot design with three replications. Among all foliar agents, the response of GA_3 was found better. The results revealed that plant height, number of leaves/plant and number of branches/plant at 50 days after sowing and at harvest, biomass production (fresh weight/plant, dry weight/plant, dry matter (%) and dry matter production), fruit length, fruit diameter, individual fruit weight and number of fruits/plant were found maximum from100 ppm GA_3 followed by 200 ppm GA_3. Maximum fruit weight/plant was obtained from the application of 100 ppm GA_3 (546.0 g in BARI Dheros-2 and 739.5 g in OK-1820) followed by 200 ppm GA_3 (515.0 g in BARI Dheros-2 and 689.0 g in OK-1820) and 200 ppm NAA (709.0 g in OK-1820). The result indicated that the highest fruit yield per hectare (21.10 t in BARI Dheros-2 and 21.74 t in OK-1820) was recorded with the application of 100 ppm GA_3 which was followed by 200 ppm GA_3 (19.88 t in BARI Dheros-2 and 20.87 t in OK-1820) and 200 ppm NAA (16.77 t in BARI Dheros-2 and 19.63 t in OK-1820). Average yield of two varieties revealed that maximum gross margin was found from GA_3 @ 100 ppm (Tk. 3, 60,112/ha) followed by NAA @ 200 ppm (Tk. 3, 16,612/ha), whereas NAA @ 200 ppm gave the highest BCR of 3.29 and GA_3 @ 100 ppm BCR of 3.05.

Response of tomato to gibberellic acid application under salinity stress at lab condition

M. Moniruzzaman and R. Khatoon

A lab study was conducted to explore the interactive amendment effects of exogenous gibberellic acid (GA_3) and salinity on seed germination and seedling growth of tomato at the laboratory of Plant Physiology Section, Horticulture Research Centre, BARI during 16 March-27 March, 2022. Seeds were presoaked in different levels of GA_3 solutions (100, 200 and 300 ppm) and then after drying in shade, seeds were subjected to NaCl solutions (0.0, 8.0 and 12.0 dS/m). The experiment was laid out in completely randomized design (CRD) with three replications. The effects of salinity and external GA_3 application alone and in presence of 8 and 12 dS/m salinity levels on germination percentage (GP), germination characteristics such as germination index (GI), germination rate of index (GRI), germination value (GV), mean germination time (MGT), seedling growth characters *viz.*, shoot length, root length, seedling fresh weight, seedling dry weight, seedling vigour index-I (SVI-I) and seedling vigour index-II (SVI-II) were investigated. Salt stress at 8 and 12 dS/m reduced FGP, GRI, GI, CVG and GV, the length of shoots, dry weights,

while 8 dS/m increased root length but 12 dS/m decreased root length in tomato. Salt stress levels 8 and 12 dS/m increased MGT by 41.38% and 115.52%, respectively. Compared with control (hydro-priming), only GA_3 @ 100 ppm increased GRI (1.18%), GI (0.48%), CVG (6.95%), GV (7.70%), shoot length (28%), root length (79.50%), seedling length (41.94%), seedling fresh weight (120%), seedling dry weight (50%), SVI-I (42% and SVI-II (50%) but decreased MGT (6.68%) under salt stress (8 dS/m). These results indicated that GA_3 @ 100 ppm could be used as an effective tool for improving tomato seed germination and seedling growth in salt-contaminated soils.

Evaluation of hyacinth bean varieties for drought tolerance through yield-based selection indices

M. Moniruzzaman and R. Khatoon

Identification of drought-tolerant crop genotypes/varieties 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 during 31 August 2021–02 March 2022. The study was carried out using a 9 × 2 factorial experiment following split-plot design 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 5.43 and 7.34 kg/plant, respectively. Drought stress reduced fruit yield by 26.52% on average. The three varieties BARI Shim-4, BARI Shim-6, and BARI Shim-10 were identified as drought tolerant varieties for drought tolerance breeding or direct cultivation in drought prone areas.

Screening of bottle gourd genotypes against salinity at germination and early seedling growth stages

M. Moniruzzaman and R. Khatoon

The impact of two levels of sodium salt (NaCl) (0.0 and 8.0 dS/m) was tested on 40 bottle gourd genotypes/varieties at the laboratory of Plant Physiology Section, HRC, BARI from 24 February to 04 March 2022. Among 40 bottle gourd lines five were BARI released varieties, nine open pollinated (OP) and twenty six hybrid lines. The experiment was laid out in completely randomized design (CRD) under lab condition. 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. Genotypes were evaluated in terms of relative percentage of shoot length, root length, shoot fresh weight, root fresh weight, total fresh weight, total dry weight, final germination percentage, germination index, germination rate of index and germination value. Results of this study showed a decrease in germination, other germination parameters and growth criteria (shoot length, root length, shoot and root fresh weight, seedling fresh and dry weight and seedling vigour index) at 8 dS/m salinity levels. Among 40 lines 11 lines/genotypes G_8 (LS 171), G_{12} (BARI Lau-3), G_{17} (LS 154 x LS 231), G_{19} (LS 171 x BARI-4), G_{20} (LS 171 x LS 232), G_{25} (LS 232 x LS 254), G_{26} (BARI-1 x BARI-2), G_{28} (BARI-1 x LS 232), G_{29} (BARI-1 x LS 231), G_{32} (BARI -3 x BARI-4) and G_{39} (BARI x LS 154) showed better performance at 8 dS/m in respect of all the parameters studied and these genotypes were identified as salt tolerant (8 dS/m) genotypes. Based on the performances six genotypes G_7 (LS 154), G_9 (LS 146A1), G15 (BARI-2 x LS 231)), G_{18} (LS 171 x BARI-1), G_{31} (LS 146A1 x LS 232) and G_{37} (LS 232 x LS 231) were considered as moderately salt tolerant and two genotypes G_{13} (BARI Lau-4) and G_{16} (BARI-4 x LS 154) as salt susceptible ones.

Germination and growth of brinjal 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 18 November 2021 to 30 November 2022 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., T_1 = 289 µM GA_3, T_2 = 0.25% KNO_3, T_3 = 50 µM H_2O_2, T_4 = 1 µM TRIA , T_5 = 5 ppm NAA, T_6 =40 mM NaCl, T_7 = Hydro priming by Distilled water with

no priming as control (T_8). 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 of index (germination speed index), coefficient velocity of germination, germination value, were enhanced significantly in both the varieties at 0.25% KNO_3 and 50 µM H_2O_2. Seedling growth (shoot length, seedling dry weight, seedling vigour index-I and seedling vigour index-II) were also increased at 0.25% KNO_3 and 50 µM H_2O_2. Root length was negatively affected by priming with all chemicals.

Screening of bitter gourd genotypes against salinity at germination and early seedling growth stage

R. Khatoon, M. Moniruzzaman and M. A. T. Masud

A lab experiment was carried out at the Plant Physiology Laboratory of HRC, BARI, Gazipur during 9 June to 22June, 2022 to find out the salinity tolerant bitter gourd genotypes during germination and early seedling growth stages. The response of 10 bitter gourd genotypes (G_1 = BARI Karala-1, G_2 = BARI Karala-2, G_3 = BARI Karala-3, G_4 = BARI Karala-4, G_5 = AVBG-1308, G_6 = AVBG-1310, G_7 = AVBG-1320, G_8 = AVBG-1324, G_9 = MC-117-1-2-3 and G_{10} = MC-25-2-6-3-1-5-4) against three levels of salinity (0, 6 and 10dS/m) were studied. The experiment was laid out in completely randomized design (CRD) with three replications. The germination percentage and seedling vigour index along with seedling growth attributes viz., shoot length, root length, shoot dry weight, root dry weight and total dry weight were reduced with increasing the salinity levels. *Among 10 bitter gourd genotypes* G_2, G_8, G_9 and G_{10} performed better at 10 dS/m during germination and early seedling stage in respect of studied characters. Based on relative final germination percentage, relative seedling vigour index, relative shoot length, relative root length, shoot dry weight, root dry weight and total dry weight, total rank score was calculated and according to overall rank score, the genotypes G_2, G_9, G_{10} and G_8 ranked 1st, 2nd, 3rd and 4th, respectively among the genotypes studied. Therefore, it might be concluded that G_2, G_8, G_9 and G_{10} might be salt tolerant at germination and early seedling growth stage.

Response of seed priming by gibberellic acid and potassium nitrate to germination and seedling growth of sweet pepper (*Capsicum annuum* L.)

R. Khatoon and M. Moniruzzaman

A lab experiment was conducted at the Laboratory of Plant Physiology Section of HRC, BARI from 4 November 2021 to 18 November 2021 to determine the suitable concentration of GA_3 and KNO_3 used as seed priming agents for higher germination and seedling growth of sweet pepper seeds. The experimental treatment consisted of 4 concentrations of GA_3 *viz*., 0, 250, 500 and 750 parts per million (ppm)) and 5 concentrations of KNO_3 *viz.*, 0, 0.25, 0.50, 0.75 and 1%. The experiment was laid out in completely randomized design (CRD) with four replications. Germination percentage (GP) and other germination properties *viz*., Mean Germination Time (MGT), Germination Rate of Index (GRI), Germination Index (GI), Coefficient of Velocity of Germination (CVG), Germination Value (GV), Germination energy (GE) and days required for 50% germination (T_{50}), and seedling growth characters *viz*., shoot length, root shoot length and seedling dry weight were measured. The higher values of FGP, GRI, GI, CVG, GE, and GV, and shoot length and seedling dry weight of sweet pepper seeds were recorded from seeds treated with 250 ppm GA_3 compared to control treatment. The sweet pepper seeds priming with 0.25% KNO_3 also gave the better results in respect of GP, GRI, GI, CVG, GE and GV, and seedling dry weight compared to control and other treatments. On the contrary, the lowest values of MGT and T_{50} were obtained from 250 ppm GA_3 and 0.25% KNO_3 compared to control treatment. It might be concluded that 250 ppm GA_3 and 0.25% KNO_3 would be suitable for seed priming of sweet pepper seeds for the higher germination and seedling growth of sweet pepper.

Postharvest Technology Section

Maturity determination of broccoli (*Brassica oleracea* var. *italica)*

M. S. Arfin, M.N. Islam, T. A. A. Nasrin, M. F. B. Hossainand M. M. Rahman

The experiment was conducted at the field and laboratory of Postharvest Technology Section of HRC, BARI, Gazipur during the winter season of 2021-22 to find out the suitable maturity stage

(harvest stage) of broccoli (*Brassica oleracea* L. var. *italica*). The experiment consisted of 5 maturity stages *viz.*, heads harvested 50 days after transplanting (DAT), 55 DAT, 60 DAT, 65 DAT and 70 DAT. Thirty days old seedlings of the broccoli variety 'BARI Broccoli-1', sown in 1st week of October 2021 were transplanted on 1st week of November 2021 in the field. The experiment was laid out in RCBD with three replications. The broccoli heads were harvested according to treatment and were immediately transported to the laboratory where they were cleaned and washed for further analysis. This study reports the changes in the colour, chlorophyll and vitamin C content of harvested broccoli florets after harvest under ambient temperatures of 19 ± 2°C and a relative humidity of 60%. The above parameters were measured at initially and then at daily intervals for up to 3 days. The florets of broccoli heads harvested at 65 DAT showed the slower change in colour (L* 37.98 on day 1 to 44.06 on day 3, a* -2.92 in day 1 to -4.48 in day 3, b*7.76 on day 1 to 16.20 on day 3) compared to other treatments. The amount of chlorophyll content increased with the maturity (harvest) date but decreased with storage time. This change in chlorophyll level was slower in 65 DAT (21.62 µg/mg on day 1 to 6.18 µg/mg on day 3). Decrease of vitamin C content with storage time was also slower in 65 DAT (64.62 mg/100g on day 1 to 50.41 mg/100g on day 3) among all treatments. This was the first year's trial and more trial is needed to generate additional information and further confirmation of the results.

Standardization of blanching time of broccoli using boiling water and microwave techniques and quality studies during frozen storage

T. A. A. Nasrin, M. S. Arfin and M.N. Islam

The experiment was conducted at the laboratory of Postharvest Technology Section, HRC, BARI, Gazipur to standardize the blanching time of broccoli florets using boiling water blanching (BWB) and micro wave blanching (MWB) techniques with non-blanched florets as control. BWB and MWB techniques were compared in this study in order to determine their effects on some quality characteristics of broccoli florets (colour indices, peroxidase activity, ascorbic acid, total sugar, reducing sugar, beta carotene and TSS) just after blanching and during frozen storage (-20°c) every 30 days later for 6 months. Broccoli heads were harvested at marketable stage from the field and then they were immediately transported to the laboratory where they were cleaned and washed for further analysis. Florets were then separated from heads. Broccoli florets were blanched for 1.0, 1.5, 2, 2.5, 3 and 3.5 min. Blanched broccoli florets were then cooled and packed in high density polyethylene (HDP; 0.10 mm thickness) bag and stored at -20°c. The effectiveness of each blanching process was investigated measuring the loss of peroxidase activity which resulted more rapidly in MWB (1.5 min) than in BWB (2 min). After blanching the colour values, lightness and chroma were increased and hue angle was decreased. As a result broccoli florets showed brighter green colour. Ascorbic acid, total sugar, reducing sugar and TSS of broccoli were reduced whereas beta carotene content was raised after blanching. In MWB, reduction of ascorbic acid, total sugar, reducing sugar and TSS were lower than in BWB. During frozen storage, the quality attributes were reduced significantly in non-blanched broccoli florets whereas in blanched broccoli florets it was less especially in MWB technique. MWB was suitable for blanching of broccoli heads to retain the nutritional quality of broccoli florets in frozen storage (-20°c) as less time as well as water was needed to blanch broccoli florets in microwave than in boiling water.

Impact of sodium lauryl sulfate and saponin as safe sanitizing agent on postharvest quality of tomato

M. S. Arfin, M.N. Islam, T. A. A. Nasrin, M. F. B. Hossain and M. M. Rahman

An experiment was conducted at the field and laboratory of Postharvest Technology Section, HRC, BARI, Gazipur during 2020-21 to find out the effectiveness of three washing materials [Sodium Lauryl Sulfate, Saponin **(**triterpene glycosides) and Calcinated Calcium] at different concentration on tomato. Thirty days old seedlings of tomato variety 'BARI Tomato-21', sown in 1st week of October 2021 were transplanted on 1st week of November 2021 in the field. Tomato fruits were harvested at breaker stage after 125 days after transplanting, transported to the laboratory and randomly divided into eight treatment groups for sanitization. Fresh tap water was taken in seven buckets and sanitizing materials were dissolved in it. Tomatoes of each group were dipped in the preselected buckets as per treatment for five minutes and dried in air. The sanitized tomato fruits were kept in plastic tray at a mean room temperature of 22 ± 2^0 C and a relative

humidity of 70%. This study was conducted following CRD with three replications. After washing with the chemicals, tomato fruits were arranged according to design and treatments for 30 days. The sanitizing agents were evaluated in terms of shriveling percentage and shelf life. These parameters were measured on day 1 and then at daily intervals for up to 30 days. Findings of the present study revealed that sanitizing agents for washing had positive effect on shelf life and shriveling of tomato. Sodium Lauryl Sulfate and Saponin reduced the shriveling percentage and prolonged the shelf life of tomato by 20 days, while the shelf life of non-washed one was 12 days only. This was the first year's trial. Therefore, more trial needs to generate additional information and further confirmation of the results.

Plant Pathology Section

Screening eggplant germplasm for resistant against bacterial wilt

M. afroz, L. Yasmin and M. M. Rahman

Twenty-eight eggplant varieties/accessions were evaluated for resistance to *Ralstonia solanacearum* grown under artificial epiphytotic conditions during 2021-22 cropping season. Among them, 22 accessions of eggplant, SM-01, SM-310A, SM-12, SM-467, SM-312, SM-02, BARI Hybrid Begun-4, SM-11, BARI Hybrid Begun-5, SM-05, BARI Hybrid Begun-3, SM-04, EG-203, SM-407, SM-489, SM-323, SM-312A, SM-20, SM-14, SM-314, SM-13, BARI Hybrid Begun-2 and BARI Begun-8 showed resistant reaction. Three accessions *viz*., SM-018, SM-23A and SM-465 showed moderately resistant reaction. Only one accession, BARI Hybrid Begun-6 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 varieties/accessions were screened to find out bacterial wilt resistant source grown under artificial epiphytotic field conditions during 2021-22 cropping season. Among the accessions, 16 accessions, AVTO-1229, AVTO-1316, AVTO-1317, SL-0416, SL-0403, SL-0411, SL-0406, BARI Tomato-19, SL-0413, SL-0405, SL-0038, SL-0310, SL-0003, SL-0311, SL-0009 and BARI Tomato-11 showed resistant reaction against bacterial wilt. BARI Tomato-14 and BARI Tomato-15 showed moderately resistant reaction to *Ralstonia solanacearum.*

Screening eggplant germplasm against root-knot nematode

L. Yasmin, M. afroz and M. M. Rahman

Twenty seven eggplant varieties/accessions were tested in a nematode infested sick bed for their resistance to root-knot nematode during 2021-22 cropping season. Among them, two accessions BARI Hybrid Begun-3 and SM-467 were found resistant, nine accessions BARI Hybrid Begun-5, SM-11, SM-05, BARI Hybrid Begun-4, SM-01, SM-310A, SM-314, SM-323 and SM-465 showed moderately resistant and five accessions SM-312, SM-018, BARI Hybrid Begun-6, BARI Hybrid Begun-2 and EG-323A, showed moderately susceptible; six accessions SM-20, SM-312A, SM-12, EG-203, SM-489 and SM- 407 were found susceptible and five accessions SM-14, SM- 13, SM-23A, SM-02 and SM-04 were found highly susceptible to root knot nematode.

Screening tomato germplasm against root-knot nematode

L. Yasmin, M. afroz and M. M. Rahman

Nineteen tomato varieties/accessions were tested in a nematode infested sick bed for their resistance to root- knot nematode during 2021-22 cropping season. Among them, three accessions (BARI Tomato-11, SL-0405 and SL-0310) showed resistant, two accessions (SL-0009 and SL-0405) showed moderately resistant, three accessions (BARI Tomato-19, SL-0403 and AVTO-1316) showed moderately susceptible, six accessions (SL-0038, BARI Tomato-14, SL-0406, SL-0411, AVTO-1317, SL-3119) showed susceptible, five accessions (BARI Tomato-15, SL-0416, SL-0413, AVTO-1229, SL-0403) showed highly susceptible reaction to root knot nematode.

Screening okra germplasm resistance to *okra yellow vein mosaic virus*

L. Yasmin, M. afroz and M. M. Rahman

Twenty-two okra germplasm were evaluated for resistance to okra yellow vein mosaic virus (OYVMV) grown under natural conditions during 2022 cropping season. Among them, 11 accessions

of okra *viz.*, BD-12109, BD-12112, BD-12114, BD-12116, BD-12117, BD-12119, BD-12120, BD-12123, BD-12126, BD-12118 and BARI Okra-2 showed highly resistance reaction. Six accessions showed resistant reaction. Four accessions showed moderately resistant reaction. Only one line showed tolerant reaction.

Screening tomato germplasm for resistance to Tomato Yellow Leaf Curl Virus

M. M. Rahman, L. Yasmin, M. afroz and M. S. Nahar

The experiment was conducted at the research field of Plant Pathology section of HRC, BARI, Gazipur during winter season of 2021-22 with some promising varieties and accessions of tomato to find out resistant sources against Tomato Leaf Curl Virus (TYLCV) disease. A total of 31 tomato varieties/ accessions were evaluated including susceptible check. Seventeen accessions were showed resistant and twelve accessions were found moderately resistant to disease. The highest yield was observed in GP-0089 (31.67 t/ha) with 20% disease incidence followed by SL-3119 and AVTO-1316 with 10% and 14% disease incidence, respectively. No accessions were found immune to TYLCV in tomato.

Screening country bean germplasm for resistance to bean yellow mosaic virus

M. M. Rahman, L. Yasmin and M. afroz and M. S. Nahar

The experiment was conducted at the research field of Plant Pathology section of HRC, BARI, Gazipur during winter 2021-22 cropping season with some promising varieties and accessions of country bean to find out resistant sources against country bean yellow mosaic virus (YMV) disease. A total of 22 country bean varieties/accessions were evaluated including susceptible check. Two accessions have been performed highly resistance to the mosaic virus disease. Eight accessions were showed moderately susceptible and the rest of the accessions were susceptible to disease. the germplasm BD 10518 produced the highest yield (12.4 t/ha) with 50% disease incidence followed by LD 0025 (10.13 t/ha), NTR17 (9.60 t/ha) and BARI Sheem-1 (10.40 t/ha) with disease incidence 33.33, 33.33 and 16.66%, respectively.

Survey on bacterial wilt of solanaceous vegetable crops

M. afroz, L. Yasmin, M. M. Rahman, Z. H. Prodhan and A. K. M. Khorsheduzzaman

A comprehensive survey was conducted during July 2021-June 2022 cropping season throughout three major eggplant and tomato growing districts namely, Bogura, Thakurgaon and Gazipur to record the incidence of bacterial wilt of eggplant and tomato. During reporting period, three districts were surveyed that covered 50 farmers' fields and trial sites. Data on area surveyed, variety grown, wilt incidence (%), etc. were recorded at the time of survey. Previously, a total of 110 wilt infected plant samples of eggplant and tomato were collected from Narsingdi, Bogura and Thakurgaon districts during January-May 2021. A total 143 isolates *Ralstonia solanacearum* were isolated from eggplant, tomato, chili and potato. Biochemical tests such as Gram reaction/Potassium hydroxide test, Kovac's oxidase test, Catalase test, urease test and biovar test were performed for biochemical characterization of the isolates. All biochemical tests were found positive, which confirmed identification of those isolates.

Development of IPM package for gummy stem blight disease management of bottle gourd

M. Afroz and L. Yasmin

The experiment was conducted at the research field of Plant Pathology Section of HRC, BARI, Gazipur during the winter 2021-22 cropping season. Three treatments *viz*., T_1= 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, T_2= IPM package II: Soil application of Talc base d *Trichoderma* @ 50 kg/ha + Mustard oil extract cake @ 600 kg/ha + Foliar spray of Tricho-leachate @ 0.2% at 15 days interval and T_3= Control (regular practices) were used. Among the treatment, IPM package II: Soil application of Talc based *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 (MBCR), the highest value was obtained from T_2 (5.51) which was followed by T_1 (2.37).

Management of Tomato Yellow Leaf Curl Virus of tomato through chemical and cultural means

M. M. Rahman, L. Yasmin and M. afroz and M. S. Nahar

The experiment was conducted at the research field of Plant Pathology Section of HRC, BARI, Gazipur during winter 2021-22 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. Four treatments *viz.*, yellow polyethylene mulch, black polythene mulch, neem oil and control (Insecticide Admire) were evaluated. Among them, yellow polyethylene mulch reduced the disease incidence and increased yield of tomato. Therefore, yellow plastic mulch may be recommended for controlling whitefly population and management of TYLCV disease in tomato**.**

Management of bacterial wilt of tomato through biological agents

M. Afroz, L. Yasmin, M. M. Rahman, Z. H. Prodhan andA. K. M. Khorsheduzzaman

The experiment was conducted at the research field of Plant Pathology Section of HRC, BARI, Gazipur during November 2021 to May 2022. Five treatments *viz.*, T_1= *Pseudomonas* spp. 1, T_2= *Pseudomonas* spp. 2, T_3= *Bacillus* spp. 38, T_4 = *Bacillus* spp. 18 and T_5 = Control were used. Among the treatment, *Bacillus* spp. 38 reduced the maximum wilt incidence followed by T_1 (*Pseudomonas* spp. 1), T_4 (*Bacillus* spp. 38) and T_2 (*Pseudomonas* spp. 2). Yield of tomato was significantly increased due to application of biological agents.

Management of bacterial wilt of eggplant through chemicals

M. Afroz, Z. H. Prodhan, L. Yasmin, M. M. Rahman and A. K. M. Khorsheduzzaman

The experiment was conducted at the research field of Tuber Crops Research Sub Centre, BARI, Seujgari, Bogura during 2021-22 to observe the performance of different chemicals for the management of bacterial wilt disease of eggplant. There were nine treatments *viz.*, (T_1) Stable bleaching powder @ 25 kg/ha, (T_2) Bleaching powder @ 100 kg/ha, (T_3) Ulka 35 SC (Azoxystrobin 20% + Tebuconazole 15%) @ 0.5ml/L, (T_4) Timsen-TM (N-alkyl dimethyl benzyl ammonium chloride 40%) + Stabilized urea 60% @ 2 g/L, (T_5) Sunvit 50WP (Copper Oxychloride 50%) @ 6.8 g/L, (T_6) Bactaf 50 SP (Chloroisobromylcyanuric Acid 50%) @ 1.5 g/L, (T_7) Bactroban 20 WP (Bismerthiazol) 2g/L, (T_8) Sunpuma 54 WP (Kasugamycin Hydrochloride Hydrate 4% + Carbendazim 50%) 1.5 g/L and (T_9) Untreated control. The lowest percent of wilt was observed in Stable bleaching powder @ 100 kg/ha which was statistically similar with Ulka 35 SC @ 0.5ml/L.

Management of bacterial wilt of eggplant through cultural practices

M. afroz, Z. H. Prodhan, L. Yasmin, M. M. Rahman and A. K. M. Khorsheduzzaman

The experiment was conducted at the research field of Tuber Crops Research Sub Centre, BARI, Seujgari, Bogura during 2021-22 to observe the performance of different cultural practices for the management of bacterial wilt disease of eggplant. There were five treatments *viz*., (i) Biochar @ 2 t/ha, (ii) Biochar @ 3 t/ha, (iii) Burning of Rice husk @ 10 t/ha (iv) Rice Ash @ 2 t/ha and (v) Control. All the treatments reduced bacterial wilt disease incidence over control. Among them, burning of rice husk @ 10 t/ha had the lowest wilt incidence and higher yield followed by Biochar @ 3 t/ha.

Management of bacterial wilt of eggplant through biological agents

M. afroz, Z. H. Prodhan, L. Yasmin, M. M. Rahman and A. K. M. Khorsheduzzaman

The experiment was conducted at the research field of Tuber Crops Research Sub Centre, BARI, Seujgari, Bogura during 2021-22 to observe the performance of different biological agents for the management of bacterial wilt disease of eggplant. There were five treatments *viz*., (i) *Pseudomonas* spp. 1 (ii) *Pseudomonas* spp. 2 (iii) *Bacillus* spp. 38 (iv) *Bacillus* spp. 18 and (v) Control. All the biological agents reduced the incidence of the disease. Reduction of wilt incidence over control was maximum in *Pseudomonas* spp. 1 followed by *Bacillus* spp. 38, *Bacillus* spp. 18 and *Pseudomonas* spp. 2.

Management of bacterial wilt of eggplant through chemicals in the farmer's field

M. afroz, Z. H. Prodhan, L. Yasmin, M. M. Rahman and A. K. M. Khorsheduzzaman

The experiment was conducted at the farmer's fields of ChotoFulbari, Sherpur, Bogura during 2021-22 to observe the performance of different chemicals for the management of bacterial wilt disease of eggplant. There were nine treatments *viz*., (T_1) Stable bleaching powder @ 25 kg/ha, (T_2) Bleaching powder @ 100 kg/ha, (T_3) Ulka 35 SC (Azoxystrobin 20% + Tebuconazole 15%) @ 0.5ml/L, (T_4) Timsen-TM (N-alkyl dimethyl benzyl ammonium chloride 40%) + Stabilized urea 60%) @ 2 g/L, (T_5) Sunvit 50WP (Copper Oxychloride 50%) @ 6.8 g/L, (T_6) Bactaf 50 SP (Chloroisobromylcyanuric Acid 50%) @ 1.5 g/L, (T_7) Bactroban 20 WP (Bismerthiazol) 2g/L, (T_8) Sunpuma 54 WP (Kasugamycin Hydrochloride Hydrate 4% + Carbendazim 50%) 1.5 g/L and (T_9) Untreated control. Among the treatments, reduction of wilt incidence over control was maximum in T_1 followed by T_3 and T_4.

Management of bacterial wilt of eggplant through cultural practices in the farmer's field

M. Afroz, Z. H. Prodhan, L. Yasmin, M. M. Rahman and A. K. M. Khorsheduzzaman

The experiment was conducted at the farmer's field of ChhotoFulbari, Sherpur, Bogura during 2021-22 to observe the performance of different cultural practices for the management of bacterial wilt disease of eggplant. There were five treatments *viz.*, (i) Biochar @ 2 t/ha, (ii) Biochar @ 3 t/ha, (iii) Burning of rice husk @ 10 t/ha (iv) Rice Ash @ 2 t/ha and (v) Control. All the treatments reduced bacterial wilt disease incidence over control. Among them, burning of rice husk @ 10 t/ha showed the lower wilt incidence and higher yield of eggplant.

Management of bacterial wilt of tomato through biological agents

M. Afroz, Z. H. Prodhan, L. Yasmin, M. M. Rahman and A. K. M. Khorsheduzzaman

The experiment was conducted at the research field of Tuber Crops Research Sub Centre, BARI, Seujgari, Bogura during 2021-22 to observe the performance of different biological agents for the management of bacterial wilt disease on tomato. There were five treatments *viz.*, (i) *Pseudomonas* spp. 1 (ii) *Pseudomonas* spp. 2 (iii) *Bacillus* spp. 38 (iv) *Bacillus* spp. 18 and (v) Control. All the biological agents reduced the incidence of the disease. Reduction of wilt incidence over control was maximum in *Bacillus* spp. 38 followed by *Pseudomonas* spp. 1, *Bacillus* spp. 38 and *Pseudomonas* spp. 2.

Management of bacterial wilt of tomato through chemicals

M. afroz, Z. H. Prodhan, L. Yasmin, M. M. Rahman and A. K. M. Khorsheduzzaman

The experiment was conducted at the research field of Tuber Crops Research Sub Centre, BARI, Bogura during 2021-22 to observe the performance of different chemicals for the management of bacterial wilt disease of tomato. The experiment comprised 9 treatments *viz*., (T_1) Stable bleaching powder @ 25 kg/ha, (T_2) Bleaching powder @ 100 kg/ha, (T_3) Ulka 35 SC (Azoxystrobin 20%+Tebuconazole 15%) @ 0.5ml/L, (T_4)Timsen-TM (N-alkyl dimethyl benzyl ammonium chloride 40% + Stabilized urea 60%)@ 2 g/L, (T_5) Sunvit 50WP (Copper Oxychloride 50%) @ 6.8 g/L, (T_6) Bactaf 50 SP (Chloroisobromylcyanuric Acid 50%) @ 1.5 g/L,(T_7) Bactroban 20 WP (Bismerthiazol) 2g/L, (T_8) Sunpuma 54 WP (Kasugamycin Hydrochloride Hydrate 4%+Carbandazim 50%) 1.5 g/L and (T_9) Untreated control. The lowest percent of wilt was observed in T_1 which was statistically similar with T_3 and T_4

Management of bacterial wilt of tomato through cultural practices

M. afroz, Z. H. Prodhan, L. Yasmin, M. M. Rahman and A. K. M. Khorsheduzzaman

The experiment was conducted at the research field of Tuber Crops Research Sub Centre, BARI, Bogura during 2021-22 to observe the performance of different cultural practices for the management of bacterial wilt disease of tomato. The experiment comprised 5 treatments *viz*., (i) Biochar @ 2 t/ha, (ii) Biochar @ 3 t/ha, (iii) Burning of Rice husk @ 10 t/ha (iv) Rice Ash @ 2 t/ha and (v) Control. All the treatments reduced bacterial wilt disease incidence over control. Among them, burning of rice husk @ 10 t/ha and Biochar @ 3 t/ha showed the lower wilt incidence and higher yield of tomato.

Management of bacterial wilt of tomato through chemicals

A. K. M. khorsheduzzaman, M. Afroz, L. Yasmin, M. M. Rahman and M. Z. H. Prodhan

Effect of different chemicals on bacterial wilt management in tomato was carried out at the research field of Agricultural Research Station and farmers' field of Thakurgoan during 2021-22 cropping season. The eight chemical treatments along with an untreated control were evaluated against bacterial wilt disease in BARI Bomato-15. The chemicals treatments were: T_1= Stable bleaching powder @ 25 kg/ha just before planting; T_2=Bleaching powder @ 100 kg/ha just before planting; T_3=Ulka @ 0.5g/l water just before flowering; T_4=Timsen @ 2g/l water at 7 days interval; T_5=Sunvit @ 6.8 g/l water at 7 days interval; T_6= Bactaf 50 EC @ 1.5g/l water at 7 days interval; T_7= Sunpuma 54WP; T_8= Bactroban 20WP and T_9= Untreated control. The study was laid out in a RCB design with three replications. Unit plot size was 3.0 m x 2.5 m maintaining 50 cm for plant to plant and 40 cm for row to row, where 36 plants were accommodated. From the study, it is clearly evident that the plots treated with Stable bleaching powder @ 25.0 kg/ha (T_1) received the lowest (11.50%) mortality of the plants, the highest mortality reduction (73.86%) and the highest yield (81.50 t/ha) and found most effective for bacterial wilt management in both research and farmers' field compared to untreated control and other treatments. Further trial needed for confirmation of the results.

Monitoring of post harvest diseases in common vegetables

L. Yasmin, M. Afroz and M. M. Rahman

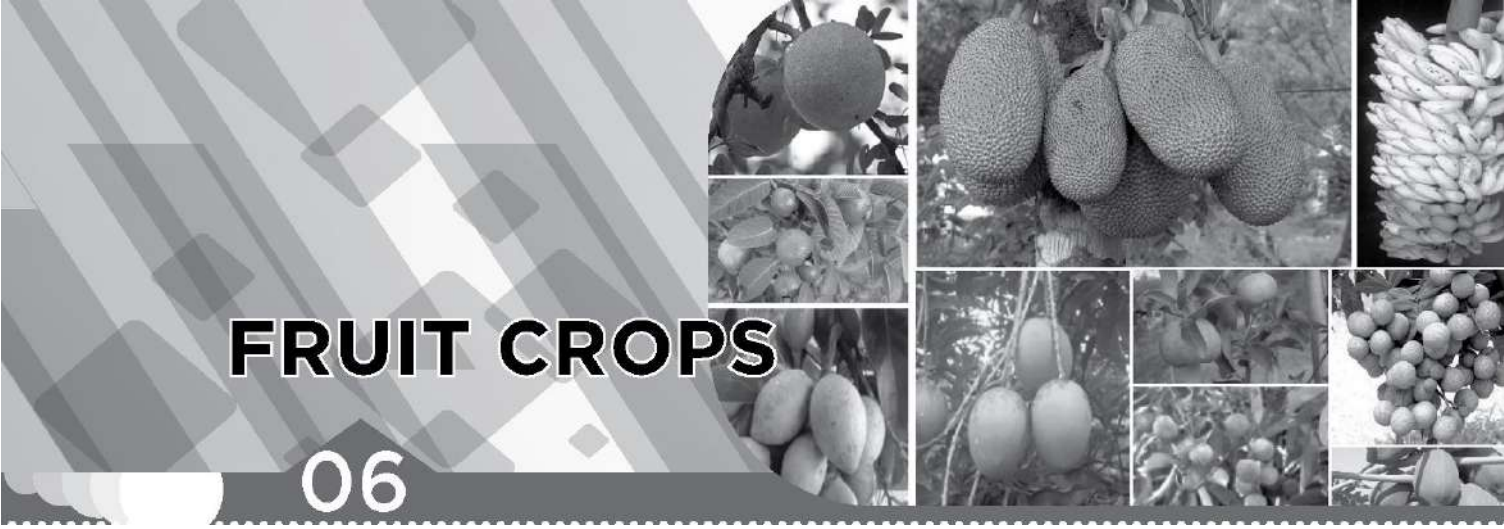
Disease samples of sweet pepper, brinjal, tomato, cauliflower, cucumber and country bean were collected from vegetable research field of HRC, BARI, Gazipur during October 2021 to May 2022. Disease symptoms appeared on fruits. *Fusarium* sp. and *Alternaria* sp. were identified from sweet pepper; *Fusarium* sp., *Alternaria* sp. and *Diplodia* sp. were identified from brinjal; *Chladosporium* sp.,*Odiodendron* sp., *Candida* sp. and *Alternaria*sp were identified from cauliflower; *Fusarium* sp. was identified from cucumber; *Colletotrichum* sp. was identified from country bean .

Agricultural Economics & Statistics Section

Price variation and cost-return analysis of BARI Hybrid Tomato-8 at farm level

S. M. A. Shiblee and R. Islam

This study was carried out to know the real situation of BARI Hybrid Tomato-8 at farm level e.g. how the farmers accepted this variety, how much benefit they received, what was their problem in cultivating this variety. Data were collected from 27 sample farmers from Ramrail and Mojlishpur union of Sadar upazilla of Brahmanbaria district. Respondent farmers' summer tomato land was found 28.12% of total cultivated land. Transplanting started at the 3rd week of June (1st Ashar) and last transplanting time was 3rd week of September (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 continued up to mid-April. The average yield was calculated at 79 t/ha. The price of tomato varied over the season ranging from 90 Tk./kg to 10 Tk./kg. At the beginning, the price was high and gradually it declined and the declining rate was 3.35 Tk./kg. Gross return was found Tk. 39.50 lakh/ha. Farmers incurred on full cost basis a total of Tk. 22.30 lakh/ha. Therefore, farmers earned net return of Tk. 17.17 lakh/ha with BCR 1.77. Switching over from rice to BARI Hybrid Tomato-8 farmers gained a net return of Tk. 15.6 lakh/ha and societal gain was Tk. 37 lakh/ha. There was another hybrid tomato variety named 'Raja F_1' found in the study area. Farmers opined that they found BARI Hybrid Tomato-8 better than 'Raja' in terms of yield and taste. However, the price of 'Raja' was higher than that of BARI Hybrid Tomato-8 because of its attractive colour and size though being less taste. Farmers apprised to have received higher profit from BARI Hybrid Tomato-8 than 'Raja' due to its high yield though being less price. Farmers informed that they did not get adequate seed of BARI Hybrid Tomato-8 as per requirement. If they get adequate seed of BARI Hybrid Tomato-8, they will not cultivate 'Raja' F_1. Because of being highly profitable and well acceptance in the farmers' field, adequate seed of the BARI Hybrid Tomato-8 should be made available to the farmers through BADC and different seed companies.



FRUIT CROPS

06

Project I: Varietal Development

Evaluation of jackfruit germplasm

M. J. Rahman, M. Z. Rahman and M. A. Islam

Twelve jackfruit germplasm *viz*., AH Joy-078, AH Joy-084, AH Joy-099, AH Joy-115, AH Joy-203, AH Joy-204, AH Joy-209, AH Joy-210, AH Joy-215, AH Joy-217, AH Joy-218 and AH Joy-219 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 9.1 m in AH Joy-203 and minimum plant height in AH Joy-078 (3.8 m). Base girth ranged from 78 cm (AH Joy-115) to 120 cm (AH Joy-203). Trunk height varied from 0.80 m to 1.46 m. Number of fruits ranged from 12 to 32. The fruit weight ranged from 3.48 kg to 10.28 kg. Fruit length varied from 23.8 to 33.4 cm whether diameter varied from 11.7 to 23.5 cm. Maximum bulb weights were recorded to be 5.40 kg in AH Joy-099 and minimum bulbs weight was observed 1.93 kg in AH Joy-078. Number of bulb per fruit varied from 52 in AH Joy-204 to 366 in AH Joy-219. Maximum and minimum edible portions were manifested to be 59.7 and 46.1 % in AH Joy-209, respectively. TSS content was noticed to vary from 16.0 to 25.0 ^{o} Brix. With respect to the number of fruits per plant, fruit weight, edible portion, TSS content and pulp quality, the germplasm AH Joy-099, AH Joy-115, AH Joy-204, AH Joy-215, AH Joy-218 and AH Joy-078 were found auspicious.

Hybridization in jackfruit

M. A. Islam, M. J. Rahman and M. M. Khatun

Hybridization in jackfruit was carried out at the Fruit Research Firm, HRC, BARI, Joydebpur, Gazipur to incorporate some important characters like colour, off-season, year-round and regular heavy bearing habit in the desired variety. Cross combinations for hybridization were: AH Joy-105 x Hazari Kanthal and AH Joy-105 x BARI Kanthal-2. Initial fruit set was found 3, AH Joy-105 x Hazari Kanthal (1) and AH Joy-105 x BARI Kanthal-2 cross combinations and finally number of fruits was harvested 1 fruit. From the cross combinations AH Joy-105 x Hazari Kanthal and AH Joy-105 x BARI Kanthal-2, 2 fruits were harvested and seedlings have been raised, which will be planted in the main field. In this year, number of complete inflorescence of jackfruit was medium. As a result, percent fruit set was good. In the next year, huge number of female flowers of Jackfruit will be pollinated in Joydebpur to have more fruits.

In-situ evaluation of some selected profuse Bearing jackfruit germplasm

M. J. Rahman and M. A. Islam

Six jackfruit germplasm *viz*., AH Joy-261, AH Joy-266, AH Joy-271, AH Joy-272, AH Joy-273, AH Joy-274 and AH Joy-275 were evaluated to identify the superior ones as profuse bearer and family size jackfruit in the jackfruit growing areas of Gazipur and Tangail. Number of fruits varied from 70 to 443. Age of tree ranged from 18 to 32 years. Fruit weight ranged from 1.75 to 4.80 kg. Fruit length varied from 18.3 to 30.2 cm while diameter varied from 15.0 to 18.5 cm. Maximum and minimum individual bulb weights were recorded to be 40.0 g in AH Joy-275 and 14.6 g in AH Joy-273, respectively. Number of bulbs per fruit varied from 20 in AH Joy-271 to 165 in AH Joy-273. Maximum and minimum edible portion were manifested to 65.5% in AH Joy-273 and 52.2 % in AH Joy-275, respectively. TSS was noticed to vary from 19.0 to 29.0 ^{o} Brix. With respect to the number of fruit per plant, fruit weight, edible portion, TSS and pulp quality, the germplasm AH Joy-272, AH Joy-266, AH Joy-274 and AH Joy-274 were noticed auspicious.

Evaluation of jackfruit germplasm

A.S. M. Yousuf Ali, M. K. Islam and M. M. Rahman

An experiment was carried out with two jackfruit germplasm namely AH Cha-001 and AH Cha-002 at RHRS, Chapainawabganj. Between two jackfruit germplasm, maximum tree volume was recorded in AH Cha-002 (300 m^3) and minimum was recorded in AH Cha-001 (264 m^3). Fruits did not ripe yet. So, all the data have not been taken. Maximum number of fruits (60) per plant was recorded from AH Cha-001 while minimum (32) fruits were noted in AH Cha-002. Diseases and insect-pests were absent in two jackfruit germplasm. The maximum number of fruits (60) per plant was recorded from AH Cha-001 while the minimum (32) was from AH Cha-002. Others data will be collected after harvesting the fruits. As it was the 4th year observation, the experiment should be continued.

Evaluation of off-season jackfruit germplasm

M. A. Habib, M. A. Sumi, M. S. Alam and M. H. Hossain

Two off-season jackfruit germplasm were evaluated at the RARS, Akbarpur, Moulvibazar. 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. Maximum number of fruits was observed in AH Akb-001 (190). AH Akb-008 produced 140 fruits. Maximum percentage of edible portion was observed in AH Akb-001 (52.4%) followed by AH Akb-08 (38. 3%). Maximum TSS was found in AH Akb-001 (27%). Considering the earliness, yield and yield contributing characters the line AH Akb-001 performed better. This line can be suggested for further evaluation to release as a variety.

Collection and evaluation of year-round (off-season) jackfruit germplasm in Cumilla region

M. M. H, Bhuiyan, M. H. Rahman and M. O. Kaisar

Four identified year-round and off-season jackfruit germplasm *viz*., AH Cum-101, AH Cum-102, AH Cum-103 and AH Cum-104 were evaluated through RASR, Cumilla. Data on yield and yield contributing characters of two germplasm were collected. It was observed that 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 yield and yield contributing attributes, the germplasm AH Cum-102 exhibited superior results. The identified jackfruit germplasm were characterized with some yield and yield contributing attributes. Two germplasm were prominent considering yield and yield contributing characters. Other two newly identified germplasm will be evaluated in this year. Moreover, new germplasm will be identified to evaluate and develop off-season jackfruit variety to extend the availability of jackfruit throughout the year.

Evaluation of jackfruit germplasm in the hill region

M. G. Rahman, M. A. A. Malek and M. R. Ahmad

Ten jackfruit germplasm were evaluated at the fruit farm of HARS, Khagrachari to identify superior small sized jackfruit germplasm with high yield potentiality and edible qualities. Yield and yield components of the jackfruit germplasm were studied. 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.TSS content of the fruits varied from 16 to 24.5% where AH Kha-007 produced the highest TSS (24.5 %). The highest fruit yield (kg/plant) was found in AH Kha-006 (387.6 Kg). The edible portion varied from 36.65% to 52.67% where AH Kha-005 showed the highest (52.67 %) edible portion. 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 superior small sized jackfruit germplasm with high yield potentiality and edible qualities.

Comparative performance of BARI released jackfruit varieties in Narsingdi region

M. J. Rahman, M. A. Islam, S. M. M. Rahman, Akmm Rahman, M. H. Rahman and R. Akter

Comparative performance of BARI released three Jackfruit varieties (e.g., BARI Kanthal-1, BARI Katnhal-2 and BARI Kanthal-3) were evaluated at the RHRS, BARI, Shibpur, Narsingdi. Wide range of variation was observed in plant height, base girth, trunk height, plant spreading and number of main

branch/plant. Plant height varied from 2.56 to 3.50 m, whereas trunk height ranged from 0.52 m to 0.66 m. Base girth ranged from 23.66 cm to 25.92 cm. Plant spreading varied to a large extent. Minimum N-S spreading was found in BARI Kanthal-3 (1.81 m) and maximum spreading was noted in BARI Kanthal-2 (2.08 m). The E-W spreading ranged from 1.77 to 2.14 m. The highest number of main branch was found in BARI Kanthal-1 (5.8). It was second year result. So, only growth parameters were recorded. Further study is needed to evaluate more precisely.

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 studied at the Fruit Research Farm, HRC, BARI, Joydebpur. Plant height, base girth, plant spreading and 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. The exotic jackfruit germplasm (AH Exo-05) and (AH Exo-10/AH Joy-270) produced red and light pink coloured pulp, respectively. Texture of pulp of both germplasm were firm. Experiment will be conducted in the next year for further evaluation.

Hybridization in mango

M. S. Uddin and B. C. Sarker

The popular mango varieties *viz*., 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, HRC, BARI, Gazipur to develop superior hybrids with desirable characters of mango. Harivanga X BARI Aam-4, Langra x BARI Aam-3 and Langra x BARI Aam-4, BARI Aam-3 x BARI Aam-4 and BARI Aam-4 x BARI Aam-3. A total of 1250 flowers from 170 panicles were emasculated and pollinated. Seventeen fruits were obtained from BARI Aam-3 x BARI Aam-4 and BARI Aam-4 x BARI Aam-3. These mango hybrid fruits were harvested at mature 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 subsequent seasons for further variety improvement programme.

Hybridization in mango

Y. Abida, M. H. Waliullah, Kh. H. Alam and M. A. Uddin

A hybridization programme was conducted at the Fruit Research Station (FRS), Binodpur, Rajshahi. Total 8 cross combinations were included (BARI Aam-4 x BARI Aam-11, BARI Aam-4 X BARI Aam-14, Catimon X BARI Aam-14, Gopalbhog X BARI Aam-4, BARI Aam-14 X BARI Aam-4, Langra x BARI Aam-14, BARI Aam-3 x BARI Aam-14, BARI Aam-3 x BARI Aam-7) where 2069 flowers were emasculated and 2042 flowers pollinated from 286 panicles. Finally, only one hybrid fruits were obtained from the cross BARI Aam-3 x BARI Aam-7. This mango hybrid fruit was harvested at mature stage and stones of the fruits will be sown in soil for germination in the hybrid seedling plot. After germination, this one-year old hybrid seedling will be transplanted in the main field.

Hybridization in mango

S. Sultana, M. H. Rahman and M. O. Kaisar

A hybridization program was conducted at RARS, BARI, Cumilla during February to July of 2022 to develop superior hybrids combining better fruit quality with profuse bearing nature in mango. There were two cross combinations: ♀ MI Cum 006 × ♂ MI Cum 015 & ♀ MI Cum 001 × ♂ MI Cum 015. A heavy bearing line, MI Cum 015, was used as a male parent to be crossed with two other female parents containing high TSS and very low fibre content, namely MI Cum 006 which was early & MI Cum 001 which was a late bearing line with firm pulp texture. A total of 912 flowers from 85 panicles were emasculated and pollinated. Fifteen fruits from the crosses were set initially but all fruits dropped before getting matured. The program will be continued in the next year.

Inter-varietal hybridization of mango

A. S. M. Yousuf Ali, M. K. Islam and M. M. Rahman

A hybridization programme was conducted at RHRS, Chapai Nawabganj. A total of 2900 flowers from 550 panicles were emasculated and pollinated. Three hybrid fruits were obtained from the cross combination of BARI Aam-3 x Quzai. Five hybrid fruits were obtained from the crossess between BARI Aam-2 x Palmer. Four hybrid fruits were obtained from the crossess between Langra x Palmer. These mango hybrid fruits were harvested at mature stage and stones of the fruits will be sown in soil for germination in the hybrid seedling plot. After germination, these one year hybrid seedlings will be transplanted in the main field after khasi and will be evaluated in the following seasons.

Inter-varietal hybridization of mango

M. O. Hoque, M. Z. Uddin, Md. Razzab Ali, M. M. Hossain and A. K. Saha

A hybridization program was conducted at the RARS, Burirhat, Rangpur. Cross combinations were BARI Aam-3 X BARI Aam-4, BARI Aam- 3 x BARI Aam-11, Harivanga x BARI Aam-4 and Harivanga x BARI Aam-11. A total of 2715 flowers from 146 panicles were emasculated and pollinated. One hybrid fruit was retained in the plant upto 70 days of pollination from the crosses between BARI Aam-3 x BARI Aam-4. On the other hand, no fruit set was observed from the crosses between BARI Aam-3 x BARI Aam-11.

Hybridization of mango at Chattogram region

S. M. K. H. Chowdhury, M. G. Azam, A. S. M. H. Rashid

A hybridization program was conducted in mango orchard of Agricultural Research Station, Khulshi, Chattogram to develop premium quality mango variety with year-round production. A reciprocal cross was made between BARI Aam-3 and BARI Aam-11. Seven inflorescences of five plants from BARI Aam-3 and five inflorescences of five plants of BARI Aam-11 were selected for crossing. Considering female of BARI Aam-3 and male of BARI Aam-11; four, six, three, five, eight, seven and six flowers were emasculated from Inflorescence-1, inflorescence-2, inflorescence-3, inflorescence-4, inflorescence-5, inflorescence-6 and inflorescence-7, respectively. In inflorescence-1, one fruit was set and dropped. Three fruits were set and dropped in inflorescence-2. One fruit was set and is being developed in inflorescence-3. Three fruits were set and dropped in inflorescence-4. Five fruits were set and dropped in inflorescence-5. Three fruits were set and dropped in inflorescence-6. Three fruits were set and dropped in inflorescence-7. On the other hand, female of BARI Aam-11 and male of BARI Aam-3 were selected. Here four, two, four, six and five flowers of BARI Aam-11 were emasculated from inflorescence-8, inflorescence-9, inflorescence-10, inflorescence-11 and inflorescence-12, respectively. In inflorescence-8, two fruits were set; and one fruit was dropped and another is being developed. One fruit was set and dropped in inflorescence-9. No fruit was set on inflorescence-10, inflorescence-11 and inflorescence-12.

Evaluation of mango germplasm at Jamalpur region

M. A. Hossain, M. S. Rahman, H. Rahman, A. Akter, R. Sultana and H. E. M. K. Mazed

An experiment was conducted to identify suitable mango germplasm at HRC, Fruit Orchard, RARS, Jamalpur. The highest plant height was recorded from MI Jam-021 (4.30 m) and the lowest was in MI Jam-031 (1.00 m). The maximum base girth was obtained from MI Jam-021 (62.00 cm) and the minimum in MI Jam-031 (6.0 cm). The highest canopy spread was observed in MI Jam-021 (4.10 m x 3.90 m) and the lowest was in MI Jam-031 (0.32 m x 0.27 m). The maximum tree volume was obtained from MI Jam-021 (36.00 m^3) and the lowest was in MI Jam-031 (0.05 m^3). The highest individual fruit weight (340 g) was observed in MI jam-003 and the lowest (145 g) was in MI Jam-026. The highest fruit length (14.1 cm) was obtained from MI Jam-007 and the lowest (7.00 cm) was in MI Jam-026. The highest yield per plant (13.5 kg) was noted in MI Jam-021 and the lowest was in MI Jam-026 (0.73 kg).The maximum TSS (21%) was observed in MI Jam-021 and the lowest was in MI Jam-001 (16%). Considering plant growth, yield and yield contributing characters, it could be concluded that the line MI Jam-021 performed better. The experiment would be continued.

Evaluation of kancha-mitha mango germplasm in Chattogram region

M. G. Azam, S. M. K. H. Chowdhury and A. S. M. H. Rashid

The experiment was conducted at Mango orchard of Agricultural Research Station (ARS), Khulshi,

Chattogram to asses mango genotypes to release as a kancha-mitha mango variety. This study comprised three genotypes of mango, namely MI Pah 007, MI Pah 010, and MI Pah-020, as well as BARI Aam-9 as a control. The plant height ranged from 3.15 m to 5.9 m; the base girth ranged from 37 cm to 96 m; the plant canopy ranges from 2.5 m to 8.1 m east-to-west and 3.6 m to 8.8 m north-to-south; and the number of fruits per plant ranged from 70 to 284. 5. February was the flowering month for all genotypes. Mid-February was the 50% blooming date for MI Pah-007, the first week of February for MI Pah 010 and MI Pah-020, and the end week of February for BARI Aam-9. The fruit weighs between 147.20 and 252.80 g. MI Pah-010 produced the largest fruit (11.48 cm ×6.82 cm). MI Pah-007, on the other hand, produced the smallest fruit (9.30 cm × 5.97 cm). The fruit with the greatest thickness was acquired from MI Pah-020 (6.26 cm) and the fruit with the smallest thickness was recorded from BARI Aam-9 (5.06 cm). The thickness of the stone ranged from 1.48 cm to 1.98 cm, while the weight of the skin ranged from 24.20 g to 36.80 g. The edible component of each genotype was nearly identical. The MI Pah 007 sample yielded the highest TSS (9.90%), and its flavor was excellent. The TSS content of MI Pah-010 is quite low at 7.34 percent, but the flavor is very good. MI Pah-010 and MI Pah-020 reached maturity first, followed by MI Pah-007. BARI Aam-9 reached maturity much later than other genotypes. It can be concluded that MI Pah-007 and MI Pah-010 can be selected as promising lines to release as kancha mitha variety based on their fruit size, TSS (%), edible portion, organoleptic test and yield performance. Though, it was the first year experiment collection, further evaluation is needed in the next consecutive years.

Evaluation of early mango germplasm

A. S. M. Yousuf Ali, M. K. Islam and M. M. Rahman

An experiment on evaluation of some mango germplasm was conducted at the RHRS, Chapainawabganj. Three genotypes were collected (MI ChaE-01, MI ChaE-03, MI ChaE-04) from five Upazilas of Chapainawabganj district and one from Chuadanga District. BARI Aam-1 was uesd as check variety. Individual fruit weight (227.5 g) was recorded maximum in BARI Aam-1 while minimum (115) fruit weight was found in MI ChaE-03. Harvesting time varied from 1st week of May to last week of May. Harvesting time was 1st week of May in MI ChaE-01 while it was the last week of May from both BARI Aam-1 and MI ChaE-04. BARI Aam-1 produced maximum edible portion (69.2%) whereas minimum (55.3%) edible portion was obtained from MI ChaE-03. Cosidering harvesting time and edible portion, Both MI ChaE-01 and MI ChaE-02 were found better. This is the 1st year observation. So, this experiment will be continued.

***In-situ* evaluation of a late mango germplasm**

A. S. M. Yousuf Ali, M. K. Islam and M. M. Rahman

An experiment on '*In-situ* evaluation of a late mango germplasm' was carried out at RHRS, Chapai Nawabgonj to know the detailed information on plant growth, fruit characteristics and yield. Maximum tree volume was recorded in MI ChaL-01 (28 m^3) and the minimum tree volume was recorded in BARI Aam-12 (17.5 m^3). The fruits of both the gemplasm were not ripen yet. So, all the data were not taken. The identified mango germplasm were characterized with plant growth characters. Fruits were not harvested from both of the germplasm. So, no data regarding yield and yield contributing attributes were taken. This is the 1st year observation. So this experiment will be continued

Characterization and evaluation of late mango germplasm

M. H. Waliullah, Kh. H. Alam,Y. Abida and M. A. Uddin

An experiment on 'characterization and evaluation of late mango germplasm' was conducted at the Fruit Research Station, Rajshahi. 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 in 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 main season and 182 g in the late season (May-September, 2021). TSS of main season fruit was 17% while it was 21% in late season fruit. The overall performance of the germplasm MI Raj-002 was satisfactory. The germplasm had the capability

of two times production in a year. Fruit quality in terms of TSS% and flavor was good though it had some fibers in pulp but it was palatable. Considering two times production and good flavor it can be considered as a promising germplasm. The experiment should be carried out in the next year for further investigation.

Characterization and evaluation of mango chance seedlings obtained from MI Chal-001

A. S. M. Yousuf Ali, M. K. Islam and M. M.Rahman

Four mango chance seedlings obtained from MI ChaL-001 were characterized and evaluated at the RHRS, Chapainawabganj. All chance seedlings tress produced flowers and fruits in 2021-22. All the genotypes had the capability of late season fruit production. The individual fruit weight of MI ChaCS-01 was noted 543.5 g and MI ChaCS-02 gave the lowest fruit weight (252 g). MI ChaCS-01 and MI ChaS-02 produced greenish yellow colour but MI ChaS-01 produced attractive and good quality fruits. MI ChaCS-02 having pleasant pulp flavour like 'Langra' variety. Fruits were not harvested yet. So, data will be recorded for final conclusion.

Evaluation of local mango cultivars

O. A. Fakir

An experiment was conducted at the Agricultural Research Station, Benerpota, Satkhira to improve the local mango cultivars. Five mango germplasm namely MI Sat-001, MI Sat-002, MI Sat-003, MI Sat-004 and MI Sat-005 were included in this study. Among them, earlier flowering and harvesting was recorded in MI Sat-003. The largest fruit (129 g) was recorded in MI Sat-003 and the lightest fruit (115 g) was observed in MI Sat-004. Higher edible portion (63%) was recorded from MI Sat-003 and the lower edible portion (52%) was noted from MI Sat-004. Maximum total Soluble Solids (TSS 19.00%) was recorded in MI Sat-004 and minimum (17.00 %) TSS was recorded in MI Sat-003. The germplasm MI Sat-004 produced 5.05 kg fruit and the germplasm MI Sat-003 produced 1.65 kg fruit in this year. Growth condition and fruit yield and quality were quite satisfactory. This is first year experiment. It needs successive three year results to draw final conclusion.

Evaluation of local elite mango germplasms

O. A. Fakir

An experiment was conducted at the Agricultural Research Station, Benerpota, Satkhira to identify promising local mango lines with desirable characteristics. Three mango germplasm namely MI Sat-006, MI Sat-007 and MI Sat-008 were included for evaluation. Earlier flowering was observed in MI Sat-006 and MI Sat-007 but earlier harvesting was recorded from MI Sat-006. Maximum number of fruits per plant (22) was produced by MI Sat-008 and minimum number of fruits per plant (08) was produced by MI Sat-007. Maximum fruit weight (1250 g) was recorded in MI Sat-007. The highest edible portion (78%) was achieved from MI Sat-007 and the lowest edible portion (71.77%) was achieved from MI Sat-006. Maximum total Soluble Solids (TSS) (18.00%) was observed in MI Sat-006 and minimum (14.00 %) TSS was observed in MI Sat-007. Yield (20-22 t/ha) was noticed maximum in MI Sat-006 and the minimum yield (15-20 t/ha) was recorded from MI Sat-007. On the basis of fruit yield, MI Sat-006 might be considered as a promising germplasm but in consideration of quality MI Sat-008 ranked first. However, this was the results of first year experiment, it needs successive three year results for drawing final conclusion.

Evaluation of exotic mango germplazm

M. O. Hoque, M. Razzab Ali, A. K. Saha and M. Z. Uddin

The experiment was conducted at the RARS, Burirhut, Rangpur with a view to find out a suitable mango germplasm for releasing as variety. The germplasm (MI Exo-Bur-001, MI Exo-Bur-002, MI Exo-Bur-003, MI Exo-Bur-004, MI Exo Bur-005, MI Exo-Bur-006) were collected from local fruit fair and the saplings were planted in June 2018. The age of the tree was around 5 years and 3rd year fruit bearing occurred in 2022. Maximum number of fruits per plant (38) was recorded from MI Exo-Bur-004, which was followed by MI Exo-Bur-002 (15), whereas minimum number of fruits (5) was found in MI Exo-Bur-005. No fruit was set was observed in MI Exo-Bur-006. The average fruit weight was found higher (580.00 g) from MI Exo-Bur-003, followed (490.00 g) by MI Exo-Bur-002, while the lowest (280.00 g) fruit weight was found in MI Exo-Bur-004. The highest fruit yield was found (10.64 kg) in MI Exo-Bur-004, followed (7.35 kg) by MI Exo-Bur-002, while the lowest (1.95 kg) fruit yield was found in MI Exo-Bur-005. Considering maximum number of fruits (38) as well as fruit yield (10.64 kg) per plant that the line MI Exo-Bur-004 was found promising. However, this was 3rd year trial. So, the trial should be continued for next year.

Performance of some mango hybrids

A. S. M. Yousuf Ali, M. K. Islam and M. M.Rahman

An experiment on performance of some mango hybrids was carried out with 3 mango hybrids namely Hy-010, Hy-030 and Hy-111 at RHRS, Chapai Nawabgonj to investigate the detailed information on plant growth, fruit characteristics and yield. Maximum tree volume was recorded in Hy-030 (152 m^3) and noted minimum tree volume was recorded in Hy-010 (33 m^3). Fruit weight was noticed maximum in Hybrid-111 (532 g) while minimum fruit weight was manifested in Hybrid-030 (268 g). The highest yield of fruit was recorded in Hy-030 (40.2 kg) while the lowest yield was recorded in Hy-111 (16 kg). Hy-111 had maximum edible portion (75%) followed by Hy-010 whereas minimum (63%) was recorded in Hy-030. The highest TSS (21%) was recorded from Hy-111 while minimum (15%) was in Hy-010. The highest fruit fly infestation was recorded in Hy-010 (14%), while low fruit fly infestation was found in Hy-030 (11.1%). The mango hybrid Hy-058 showed the highest disease incidence (15.20%) while the lowest incidence was found in Hy-107 (14.20%) in natural condition. Stem end rot was absent in all the mango hybrids. Maximum shelf life was found both in Hy-010 and Hy-111 (7 days) and minimum shelf life was found in Hy-030 (6 day). Considering overall performances especially, fruit weight and edible portion, colour, eating quality and total soluble solids (TSS) Hy-010 and Hy-111 were found best. This experiment should be continued.

Evaluation of mango germplasm for green consumption at hill valley in Chattogram hill tracts

S. P. Chakma, M. Islam and M. A. Hossain

An experiment was conducted at hill valley of Hill Agricultural Research Station of Raikhali, Rangamati Hill District to find out the best green mango germplasm. The experiment was conducted in RCBD maintaining 6 m × 6 m spacing with five existing germplasm (MI Rai-005, MI Rai-006, MI Rai-007, MI Rai-008 and MI Rai-009). The highest number of fruits per plant (186) was found in MI Rai-008 and the lowest number of fruits per plant (4) was in MI Rai-009. The heaviest individual fruit weight (207 g) with edible portion (78%) were recorded in MI Rai-008, on the other hand, the lowest fruit weight (111.0 g) was found in MI Rai-007. Maximum TSS (9%) was found in germplasm MI Rai-006 and MI Rai-008. The germplasm MI Rai-006 and MI Rai-006 were 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 were noticed superior among all other germplasm under study in Chattogram Hill Tracts.

Performance of green unripe mango (kanchamitha) germplasm at hilly region

M. A. A. Malek, M. G. Rahman and M. R. Ahmad

An experiment was conducted for the evaluation of one Kanchamitha mango germplasm (MI Kha-001) at Hill Agricultural Research Station, Khagrachari. The full blooming period was the end of January. The tree habit was spreading to intermediate type. Harvesting period was 14 to 19 May, 2022. Total Soluble Solids (TSS%) was recorded 10.0. Edible portion was found (78.12%). 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 for being used as unripe condition. The 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 for using at unripe condition. The experiment will be continued for final recommendation.

Clonal selection of banana cv. 'Sabri'

M. S. Islam, M. F. Hossain and M. S. Islam

Ten 'Sabri' banana lines (MS Isd-001, MS Isd-002, MS Isd-003, MS Isd-004, MS Isd-005, MS Isd-006, MS Isd-007, MS Isd-008, MS Isd-009 and MS Isd-010) were evaluated at the RARS, BARI, Ishwardi, Pabna to evaluate and identify the suitable lines. The highest bunch weight (18.66 kg) was found in MS Isd-003 and MS Isd-010. The highest number of fingers per hand (17) was found in MS Isd-002 and MS Isd-003, whereas, MS Isd-001 got the lowest (14.67) fingers per hand. However, the highest fruit yield (46.66 t/ha) was obtained from MS Isd-003 which was statistically similar to that of MS Isd-010 (46.52 t/ha) and the lowest yield (34.09 t/ha) was recorded at MS Isd-001. The line MS Isd-008 exhibited the highest edible portion (80.34%). TSS percent ranged from20.50-22.87. Based on the results, it may be concluded that the accessions MS

Isd-0032, MS Isd-007, MS Isd-008, and MS Isd-010 performed better in terms of yield and yield contributing characters. This is the first year trial. Selected superior lines will be more precisely evaluated next year.

Evaluation of banana 'Sabri' germplasm

M. Islam, E. Mahmud, N. Akter and M. I. A. Howlader

An experiment on 'the evaluation of banana (Sabri) germplasm in southern region of Bangladesh was conducted at the experimental field of Regional Horticultural Research Station (RHRS), Lebukhali, Dumki, Patuakhali. Seven germplasm (MSLebu-004, MS Lebu-005, MS Lebu-006, MS Lebu-007, MS Lebu-008, MS Lebu-009 and MS Lebu-012) were collected from farmer's orchard and household. The collected germplasm were transplanted at experimental field of RHRS, Lebukhali, Patuakhali soon after collection. This experiment is on-going. Some plants are at vegetative stage and some are at bearing stage. The experiment will be continued. After completion of the experiment, superior banana varieties will be developed.

Clonal selection of banana cv. 'Amritsagar'

S. M. M. Rahman, M. M. Rahman, Akmm Rahman, M. H. Rahman and R. Akter

More than five hundred 'Amrit Sagar' germplasm was collected from ten different locations and planted at the research field of RHRS, BARI, Shibpur, Narsingdi to evaluated and identify the suitable lines/variety and to know regional adaptability of banana. This is third year evaluation with 5 accessions (MS Nar-001, MS Nar-005, MS Nar-010, MS Nar-022 and MS Nar-030) were considered. Selected germplasm will be evaluated more precisely. Maximum number of leaves were obtained from MS Nar-005 (13.55) whereas MS Nar-030 produced minimum leaves (11.02). MS Nar-005 got the highest bunch weight (18.25 kg), number of hands/bunch (8.52) and the heaviest hands (3.16 kg). MS Nar-022 got the highest number of fingers per hand (17.40) whereas, MS Nar-010 got the lowest (14.94). MS Nar-005 produced the highest fruit yield (45.63 t/ha) closely followed by MS Nar-030 (43.22 t/ha) and MS Nar-001 produced the lowest yield (38.79 t/ha). MS Nar-005 exhibited the highest edible portion (73.83%). TSS was noted maximum in MS Nar-005 (21.49%) followed by MS Nar-001 (20.07%). MS Nar-005 exhibited the highest shelf life (7.92 days) as compared to the lowest shelf life in MS Nar-030 (6.88 days). Based on the results obtained from the experiment, it may be concluded that the accessions MS Nar-005 and MS Nar-030 performed better in terms of yield and yield contributing characters.

Evaluation of banana cv. 'Sabri' germplasm at Jamalpur region

A. Akter, M. A. Hossain, H. Rahman, M. S. Rahman, R. Sultana and H. E. M. K. Mazed

An experiment was carried out for fruit characteristics of banana cv. 'Sobri' kola at the HRC, RARS, BARI, Jamalpur. Six local germplasm *viz*., MS Jam-001, MS Jam-002, MS Jam-003, MS Jam-004, MS Jam-005, and MS Jam-006 were included in the study. The line MS Jam-005 exhibited the highest bunch weight (4.35 kg) and the line MS Jam-002 had maximum number of hands per bunch (6). The highest average weight of individual hand (795 g) was found in MS Jam-005. Number of fingers per hand was noted the highest in MS Jam-003 (10.70). MS Jam-006 exhibited the biggest finger (85.40 g) as against the smallest finger in MS Jam-003 (70 g). Considering number of fingers, individual bunch weight, edible portion, TSS content and shelf life, all the lines were found promising. This is the first-year result. So, this experiment should be continued for the next year for getting detail information of the germplasm and confirmation of the result.

Advanced yield trial of banana cv. 'Sabri' (MS Jai-024)

S.M.L. Rahman, M. H. M. B. Bhuyan, J. C. Sarker and F. Ahmed

The experiment was conducted at the Citrus Research Station, Jaintapur, Sylhet with an advanced 'Sabri' banana line MS Jai-024 with a local check MS Jai-021. A wide variation was observed regarding growth characteristics where MS Jai-021 was found superior with plant height, base girth, leaf size and growth condition compared to MS Jai-024. Maximum bunch weight was obtained from MS Jai-024 (11.5 kg) while minimum from MS Jai-021 (6.4 kg). Variation was also found in other characters. Maximum number of hands bunch^{-1} (13), hands weight (1.6 kg), number of fingers hand^{-1} (16), finger size (13.1×3.7 cm) and finger weight (96.5 g) was found from the advanced

line MS Jai-024. In a similar way, maximum yield was found in MS Jai-024 (28.75 t ha^{-1}), while minimum (16.00 t ha^{-1}) yield was observed in MS Jai-021. Furthermore, the advanced genotype MS Jai-024 exhibited the highest TSS (25.5%) and edible portion (89%). Considering all the parameters MS Jai-024 could be further investigated with RYT for releasing as variety.

Hybridization in litchi

M. J. Rahman, M. A. Islam and M. M. Khatun

Hybridization in litchi was carried out at the Fruit Research Farm of HRC (HRC), BARI, Joydebpur, Gazipur to incorporate some important characters like earliness, lateness, colour, regular heavy bearing habit in the desired variety or cultivar. Cross combinations for hybridization were: BARI Litchi-2 x BARI Litchi-3, BARI Litchi-2 x BARI Litchi-4, BARI Litchi-2 x Kadmi, BARI Litchi-2 x Bedana and Kanthali x BARI Litchi-3. Initial fruit set was found 20, 15, 25, 21, 06 in BARI Litchi-2 x BARI Litchi-3, BARI Litchi-2 x BARI Litchi-4, BARI Litchi-2 x Kadmi, BARI Litchi-2 x Bedana and Kanthali x BARI Litchi-3 cross combinations and finally number of fruits was harvested 1, 0, 4, 1, 0, respectively. From the cross combinations BARI Litchi-2 x BARI Litchi-4 and Kanthali x BARI Litchi-3 the initial fruit set was recorded to be 25, 09 but unfortunately all the fruits were dropped at the marble stage and finally no fruit was harvested. But from the cross combinations BARI Litchi-2 x BARI Litchi-3, BARI Litchi-2 x Kadmi and Litchi-2 x Bedana 6 fruits were harvested and 4 seedling have been raised, which will be planted in the main field. In this year, number of complete flowers of litchi was medium. As a result, percent fruit set was good. In the next year, huge number of female flowers of Kanthali will be pollinated in Joydebpur and Debiganj to have more fruits. In 2021, 2 seedlings were raised from the cross between BARI Litchi-2 × BARI Litchi-4. The seedlings will be planted in the field.

Evaluation of local and exotic litchi germplasm

M. J. Rahman, M. M. Khatun and M. A. Islam

An experiment was carried out to evaluate nine local and two exotic litchi germplasm at the Fruit Research Farm of HRC, BARI, Gazipur with BARI released varieties namely BARI Lichu-1, BARI Lichu-2, BARI Lichu-3, BARI Lichu-4 and BARI Lichu-5, 5 local varieties *viz*., Bombai, Kadmi, Bedana, Madraji and Kanthali and two exotic grafted litchi germplasm *viz*., LC Exo-031 and LC Exo-032. Local litchi germplasm were planted during 2007 to 2014. Exotic litchi germplasm were collected in 2018 from China. Scions of exotic litchi germplasm were used for grafting on seeded litchi rootstalk raised from seed of BARI Lichu-1. Grafted plants were planted in 2019. Local litchi germplasm were maintained in the Fruit Research Farm, Gazipur and evaluated every year against climatic condition because litchi is very sensitive to temperature. Harvesting time of litchi is very short and it differs from year to year. Harvesting time of litchi germplasm was recorded from 2nd week of May to 2nd week of June, 2022. The average fruit weight was observed 22.3 g. Maximum weight of aril was observed in BARI Lichu-4 (21.20 g) followed by BARI Lichu-1 (17.40 g), BARI Lichu-3 (18.55 g) and Kadmi (17.23 g). Minimum aril weight was recorded in Madraji (14.50 g). The average seed weight was observed to be 3.50 g. Maximum seed weight was found in BARI Lichu-2 (5.78 g) followed by BARI Lichu-1 (5.02 g) and minimum seed weight was found in BARI Lichu-3 (1.54 g). TSS ranged from 12.4 to 19.2^{o}Brix. Exotic litchi germplasm was harvested first in 8th May, 2022 and quality in respect to taste and sweetness having TSS 18.0 ^{o}Brix, it could be a new early variety. So, for further evaluation, the experiment will be continued**.**

In-situ evaluation of litchi germplasm

M. J. Rahman, M. A. Islam and M.M.Khatun

One litchi germplasm (LC Joy-21) was identified at Ispahani Agro Limited, Robertsonganj, Rangpur. Fruits were collected and evaluated in the fruiting season of 2022. The age of tree was 100 years. It was exceptional and regular bearer with the habit of profuse bearing intensity. Fruits were harvested during the last week of May to first week of June. Fruit colour is pinkish red and oval shaped. Number of fruits was about 30000. The weight of individual fruit was 22.20 g and aril weight was 16.18 g. Length and diameter were 3.63 cm and 3.2 cm, respectively. The aril colour was waxy white. The flavour of aril was intermediate. It was sweet and juicy. Weight of pericarp and seed were 3.14 g and 2.88 g, respectively. On the basis of fruit bearing habit, number of fruits/plant, fruit weight and fruit taste, the germplasm was auspicious.

Hybridization of local guava with BARI and exotic guava varieties

M. R. Karim, Babul C. Sarker, M. T. Islam and M. A. Islam

A study was initiated at HRC, BARI, Gazipur on varietal improvement of guava through hybridization with local, BARI 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 (BARI Payara-2 x Sowrupkathi) were harvested after successful crosses. Seedlings raised and planted for evaluation with closer spacing during last year. During this year i.e. 2021-22; average plant height, base girth, East-West spreading and North-South spreading of F_1 hybrid plants were recorded 191.85 cm, 8.37 cm, 108.85 cm and 144.35 cm, respectively. Both quantitative and qualitative characteristics of the fruit obtained from the hybrid plant were also noted; which were 196 g fruit weight, 6.5 cm fruit length, 7.3 cm fruit breadth, 2.2 cm mesocarp thickness, 2.3 cm core length, 11% TSS, subglobose type fruit shape, greenish colored and smooth textured skin, crispy and creamy white colored flesh, finally less seeded and rose flavoured fruit, respectively. Considering the primary objective of the experiment i.e. to incorporate taste and flavour of local guava into the commercial and exotic varieties; it seems that, we can incorporate the taste and flavour of Sowrupkathi payara into the BARI Peyara-2. So, the experiment will be continued to attain the final goal of the hybridization process.

Evaluation of colour fleshed guava germplasm in off season

A. S. M. M. Uddin

Ten colour fleshed guava germplasm *viz*., PG Joy-001, PG Joy-002, PG Joy-003, PG Joy-004, PG Joy-005, PG Joy 006, PG Joy-007, PG Joy-008, PG Joy-009 and PG Joy-010 were collected and planted at the Fruit Research Farm of HRC. BARI Joydebpur, Gazipur in July 2019. Wide variation was observed in quantitative and qualitative growth and yield contributing characteristics. The tallest plant was found in PG Joy-003 (2.63 m) and the shortest plant was recorded in PG Joy-001 (2.17m) and PG Joy-010 (2.17m). Maximum base girth was found in PG Joy-002 (18.00 cm) and minimum base girth was noted in PG Joy-010 (14.07 cm). Fruit characteristics of 10 colour fleshed guava lines varied widely. The largest fruit was produced by PG Joy-002 (438.38 g). PG Joy-010 produced the smallest fruit (101.13 g). Maximum number of fruits per plant was recorded in PG Joy-002 (32). The highest mesocarp TSS was found in PG Joy-002 (8.43%). Endocarp TSS was found maximum in PG Joy-002 (11.17%) and minimum TSS was noticed in PG Joy-007 (6.87%) and PG Joy-007 (7.2%). Wide variation was found in growth, yield and yield contributing and qualitative characters among the colour fleshed guava germplasm in off season the evaluation indicates the ample scope of crop improvement through selection as well as hybridization. So, the experiment needs to be continued emphasizing immediate hybridization.

Evaluation of 'Kanchan Nagor' guava germplasm

M. G. Azam, S.M.K.H. Chowdhury and A.S.M.H. Rashid

The study was conducted in the fruit orchard of Agricultural Research Station (ARS), Khulshi, Chattogram to assess the genotypes based on qualitative characters, quantitative characters and chemical contents for releasing as variety. The height of the plant ranged from 3.00 m- 6.20 m. There were huge variations in the case of base girth and plant canopy. There was great variability in fruit weight. The fruit weight ranged from 54 g- 174 g. The TSS of the 'kanchan nagor' guava was usually very high ranged from 9.07 % - 14. 40%. There were variability in fruit shape of studied genotypes such as globose shape (70%), sub globose shape (15%) and pear shape (15%). There were three types of fruit surface of studied genotypes. Among these, 65% had smooth, 20% had bumpy and 15% had ridge fruit surface. There were less seeded (35%), medium seeded (55%) and high seeded (10%) genotypes of guava. All the genotypes were greenish white in skin color except PG Pah-009, which had yellowish white skin color. There was no variation in pulp color. Pulp texture was soft for all the genotypes except PG Pah-012, which had medium pulp texture. There were variations in fruit taste. Among the studied genotypes, 35 % genotypes were less sweet, 35 % genotypes were medium sweet and 30 % were very sweet. Based on quantitative, qualitative and chemical characters, the lines, namely, PG Pah-001, PG Pah-003, PG Pah-004, PG Pah-005, PG Pah-006, PG Pah-008, PG Pah-009, PG Pah-010, PG Pah-011, PG Pah-015 and PG Pah-025 might be selected for further evaluation in the next consecutive years.

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 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 S_8 progeny of CP Joy-005, CP Joy-009; BC_6 progeny and S_3 progeny of CP Joy-022 were included in the study. Among the four sets; S_8 progeny of CP Joy-005 produced 75, 15 and 10 percent andromonoecious, female and male plants, respectively; S_8 progeny of CP Joy-009 produced 65, 30 and 5 percent andromonoecious, female and male plants; the BC_6 progeny produced 55, 45 and 0 percent andromonoecious, female and male plants, respectively and S_3 progeny of CP Joy-022 produced 75, 25 and 0 percent andromonoecious, female and male plants, respectively. Considering the number of fruits per plants, 26, 25, 24 and 27 fruits were recorded in S_8 progenies of CP Joy-005 and CP Joy-009; BC_6 and finally S_3 progeny of CP Joy-022, respectively. The results of the study revealed that, we are very much near to develop a gynodioecious papaya variety with 100% productive plant. After obtaining the positive result (i.e. no male plant in the advanced population) in the S_9 generation we will propose the germplasm CP Joy-005 to release as a gynodioecious papaya variety in the next year.

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 HRC, BARI, Joydebpur, Gazipur to purify the 'Shahi' papaya variety. Seedlings of purified sib-mated seeds were transplanted in the main field on the second week of March 2022 and the sib-mating process (selfing of five flowers from each plant) for this year was started on 12 May 2022 and being continued. From May to June 2022, a total of 150 flowers were sib-mated, among those flowers 114 fruits have been set. By comparing standard 'Shahi' papaya characters and our last ten (10) year's experiment results, we can conclude that the original 'Shahi' papaya characters have almost regained and we need to maintain it through sib-matting every year to retrieve the original characters and also to maintain the varietal purity. Otherwise, the original characters will be degenerated again.

Purification of 'Shahi' papaya

M. H. Waliullah, Kh. H. Alam,Y. Abida and M. A. Uddin

An experiment was carried out of the fruit research station, BARI, Binodpur, Rajshahi to purify the 'Shahi' Papaya variety. Seedlings of purified selfed seeds were transplanted in the main field on 08 March 2021 and 10 flowers in each plant were selfed (Sib mating) from June to August 2021. The results showed that the plant and fruit characteristics of 'Shahi' papaya (BARI Pepe-1) under this experiment were almost similar to that of the original 'Shahi' Papaya in the characters under consideration. It was found that the plant and 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 regained and need to maintain it through sib-matting every year to retrieve the original characters also to maintain the varietal purity. Otherwise, the original characters will be degenerated again.

Evaluation of ber germplasm

A. Akter, M. A. Hossain, H. Rahman, M. S. Rahman, R Sultana and H E M K Mazed

An experiment was conducted to identify suitable ber germplasm (*Zizyphus mauritiana*) at HRC Fruit Orchard, RARS, Jamalpur. Forty six germplasm were included in the study. Wide range of variation was noted regarding quantitative and qualitative fruit characters. ZM Jam-124 had maximum individual fruit weight 22.16 g and ZM Jam-188 got minimum fruit weight 3.77 g. Yield per plant varied from 6 kg (ZM Jam-200) to 52 kg (ZM Jam-123). Edible portion varied from 86.60 (ZM Jam-227) to 95.66% (ZM Jam-122). Percent TSS varied from 10 (ZM Jam-227) to 22 % (ZM Jam-122). The germplasm ZM Jam-122, ZM Jam-124, ZM Jam-127, ZM Jam-196, ZM Jam-202, ZM Jam-223, ZM Jam-244 and ZM Jam-287 showed better performance in terms of individual fruit weight, yield per plant, edible portion, TSS, crispiness, sweetness, and taste. Some germplasm viz. ZM Jam-122, ZM Jam-124, ZM Jam-127, ZM Jam-140, ZM Jam -151, ZM Jam-174, ZM Jam-196, ZM Jam -205, ZM Jam -223, ZM Jam-244 and ZM Jam-287 showed promising characters regarding

sourly sweet taste which was our target. Some germplasm like ZM Jam-124 showed promising characters regarding late bearing habit and ZM Jam-287 showed early bearing habit. Some germplasm *viz*., ZM Jam-122, ZM Jam-188, ZM Jam-223, and ZM Jam-244, showed superior performances regarding organoleptic taste.

Collection and evaluation of sour type ber germplasm

M. H. Waliullah, Kh. H. Alam,Y. Abida and M. A. Uddin

A study was conducted at the Fruit Research Station, Binodpur, Rajshahi with sour ber lines. Fruit weight was recorded highest in ZM Raj-002 (10.63 g) followed by ZM Raj-005 (10.43 g) and ZM Raj-006 (10.43 g) whereas, the lowest fruit weight was observed (6.17 g) in ZM Raj-008. Total soluble solids (TSS) of different ber varied from 14.33-19.67 %. TSS was recorded the highest in ZM Raj-002 (19.67 %) followed by ZM Raj-010 (16.67 %). The highest edible portion was found in ZM 002 (89.59 %) followed by ZM 005 (89.16 %) and ZM 007 (89.02 %). Yield was recorded the highest in ZM Raj-002 (13.53 t/ha) and the lowest yield was recorded in ZM Raj-010 (10.40 t/ha). Among the ten sour type ber lines, ZM Raj-002, ZM Raj-005 and ZM Raj-006 were found to be promising lines for releasing as a sour type ber varieties.

Evaluation of local ber germplasm

M. H. Waliullah, Kh. H. Alam,Y. Abida and M. A. Uddin

A study was conducted at the Fruit Research Station, Binodpur, Rajshahi with seven local and exotic ber varieties. Fruit weight was recorded the highest in BARI Kul-3 (38.8 g) followed by BARI Kul-2 (34.5 g) whereas, the lowest fruit weight was observed in Umboli Kul (15.7 g). Total soluble solids (TSS) were recorded the highest in Umboly Kul-1 (17.3 %) followed by Apple Kul and BARI Kul-1, while that was noted the lowest in BARI Kul-2 (12.2%). BARI Kul-3 gave the highest yield (25.47 t/ha) and it was noticed the lowest in Chapai Kul (10.92 t/ha). Among the other lines, Local Kul (Late) was found to be very promising for late season (up to Mid-April). Among the lines, ZM Raj-012 (Local Kul Late) was found to be very promising line for releasing as a ber variety for late season.

Evaluation of exotic ber germplasm

A. S. M. Mesbah Uddin and B. C. Sarker

The experiment was carried out at the Fruit Research Farm of HRC, BARI Gazipur to identify suitable exotic ber germplasm. Nine exotic germplasm were included in the study. Wide range of variation was noted regarding quantitative and qualitative fruit characters. Maximum number of fruits was harvested from ZM Joy (Ex)-005 (1038.80) and minimum number of fruits was counted in ZM Joy (Ex)-002 (795.83). ZM Joy (EX)-003 had maximum individual fruit weight (33.43 g) and ZM Joy (EX)-005 got minimum fruit weight (22.03 g). The largest fruit was obtained from ZM Joy (EX)-008 (4.06 cm x 3.63 cm) and the smallest fruit obtained from ZM Joy (EX)-005 (3.72 cm x 3.16 cm). ZM Joy (Ex)-007 exhibited the best yield per plant (31.48 kg) and ZM Joy (EX)-005 gave the lowest yield per plant (22.90 kg). Edible portion of the fruits varied from 95.60 % in ZM Joy (EX)-005 to 96.71 % in ZM Joy (EX)-007. Percent TSS ranged from 13.82 % in ZM Joy (EX)-002 to 16.85 % in ZM Joy (EX)-005. Wide variation was existed among the exotic ber germplasm in quantitative and qualitative growth, yield and yield contributing characteristics. ZM Joy-07 was found superior in terms of yield and yield contributing characters. ZM Joy-03 and ZM Joy-08 also exhibited promising result to be further evaluation.

Evaluation of indegenous 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. Average individual fruit weight ranged from 6 g to 18 g. The germplasm ZM Kha-013 produced the highest individual fruit weight (18 g) and lowest in ZM Kha-021 (6 g). Fruit weight (12 fruits) of different ber genotypes ranged from 66-178 g. The germplasm ZM Kha-023 produced the highest fruit weight (178 g) and the lowest fruit weight in ZM Kha-021 (6 g). Edible portion ranged from 64.89% (ZM Kha-005) to 79.85% (ZM Kha-023). TSS of ber genotypes 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-021, ZM Kha-024, and ZM Kha-030 were found promising which can

be used for processing of pickeles and ZM Kha-013 and ZM Kha-017 were almost sweet in taste.

Evaluation of pineapple germplasm

S. M. L. Rahman, F. Ahmed, J. C. Sarker, and M. H. M. B. Bhuyan

Three pineapple germplasm (AC Jai-011, AC Jai-012 and AC Jai-013) were evaluated at CRS, Jaintapur, Sylhet to identify the suitable ones for the high rainfall area. The design was set in RCBD factorial arrangement with three replications. There was no significant variation among the genotypes regarding plant height. Maximum number (30) of leaves plant^{-1} was recorded in AC Jai-011, while the lowest number (20) of leaves plant^{-1} in AC Jai-013. All the genotypes produced statistically similar leaf length but leaf breadth varied significantly. The widest leaf (4.16 cm) was recorded in AC Jai-011 but the narrowest leaf (3.26 cm) was noted in AC Jai-013. All the germplsm are now in vegetative stage. AC Jai-011 showed better growth performance among them. So, after flowering and fruiting the final evaluation and conclusion could be made within 4 to 5 years.

Evaluation of exotic jamun germplasm

M. M. Khatun and B. C. Sarker

An exotic jamun germplasm (SC Ex-001) was evaluated at the HRC, BARI, Gazipur. Plant height, base girth and number of primary branches were 5.18 m, 57.10 cm and 4, respectively. The plant produced 5.50 kg of fruits. Individual fruit weight was 7.57 g, edible portion was 86.13% having TSS 13.16%. The fruit was black in colour. The growth condition of the plant, fruit quality as well as yield was quite satisfactory and the experiment will be continued for final recommendation.

Evaluation of jamun germplasm

M. H. Waliullah, Kh. H. Alam,Y. Abida 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 on different areas in Rajshahi, Natore and Pabna). Wide variations were observed among the germplasm. The highest fruit weight (15 g) was obtained from SC Raj-014 followed by SC Raj-013 (13 g). Maximum edible portion (86.67 %) was obtained from SC Raj-014 and SC Raj-016 followed by SC Raj-005 and SC Raj-015 (85 %), whereas minimum edible portion (72.50%) was found in SC Raj-004. The highest TSS 18 % was obtained from SC Raj-013. Maximum yield per plant was recorded form SC Raj-005 (50 kg) followed by SC Raj-001 (47 kg). Minimum yield per plant was recoded in SC Raj-006 and 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 than those of other lines. This is 4th year experiment. So, this survey should be continued to collect superior germplasm for evaluation.

Evaluation of jamun germplasm

M. F. Hossain, M. S. Islam, K. U. Ahamed and M. M. Uddin

Eight jamun germplasm (SC 001, SC 002, SC 003, SC 004, SC 005, SC 006, SC 007 and SC 008) were evaluated at the RARS, BARI, Ishwardi, Pabna during 2022 to evaluate their overall performance and to find out the superior lines for releasing as variety. The biggest fruit and highest individual fruit weight were found in SC Ish-007 and the smallest fruit and lowest individual fruit weight were found in SC Ish-006. Maximum TSS (14.56%) was found in SC Ish-006 and the highest edible portion (82%) was found in SC Ish-001. However, the highest fruit weight (30 kg/plant) was obtained from SC Ish-001. The biggest fruit and the highest individual fruit weight were found in SC Ish-007. Maximum TSS (14.56%) was found in SC Ish-006 and the highest edible portion (82%) was found in SC Ish-001. However, the highest fruit weight (30 kg/plant) was obtained from SC Ish-001. This was the first year evaluation. The trial should be continued for confirmation of the results.

In-situ evaluation of jamun germplasm

H. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

In-situ evaluation of two jamun germplasm (*Syzygium cumini* Skeels.) was performed at a farmer's field, Jamalpur to develop a suitable variety of jamun for the agro-climatic condition of Bangladesh and to enrich and conserve the germplasm. Higher individual fruit weight of 9.25 g was obtained from SC Jam-002 and lower individual fruit weight of 8.10 g was obtained from SC Jam-001. The fruit length varied from 3.08-3.40 cm. The fruit breadth varied from 2.06-2.54 cm. More edible portion (82.70%) was obtained from

SC Jam-002, whereas less edible portion (77.78%) was found in SC jam-001. Higher TSS (8.60%) was obtained from SC Jam-002 and lower TSS (7.68%) was noted from SC Jam-001. According to organoleptic test, both the Jamun germplasm were noted good. Considering fruit characteristics, quality, percent TSS, and edible portion, SC Jam-001, and SC Jam-002 were found good. This is a first-year experiment. So, this experiment should be continued to collect more superior germplasm for evaluation.

Evaluation of dwarf coconut in hilly area of Rangamati

S. P. Chakma, 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 fruit orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District with five coconut germplasm (CN Rai-001, CN Rai-002, CN Rai-003, CN Rai-004 and CN Rai-005). The average plant height was recorded 594 cm and 671 cm in Vietnam Xiem Blue and Kerala hybrid, respectively, after five years of plantation. The vegetative growth rate was noted higher in Kerala hybrid coconut than Vietnam Xiem Blue coconut. Both lines started fruiting but fruits were dropped down at baseball size. Most of the plants are at vegetative stage, so this experiment will be continued.

Evaluation of lemon germplasm

M. A. H. Khan, M. Rahman and M. O. Kaisar

An experiment with thirty germplasm of lemon was conducted to evaluate the superior lemon germplasm at the RARS, BARI, Cumilla. The saplings of the germplasm were collected from different upazilas of Cumilla district and planted on 2017 and 2020. Among the germplasm, 11 were in fruit bearing stage and 19 were in growth stage. The highest number of fruits/plant (335) and weight of fruits/plant (52.99 kg) were observed in CL Cum-008. The highest individual fruit weight (186.6 g) was found in CL Cum-033 followed by (176.80 g) CL Cum-034. The line CL Cum-008, CL Cum-013 and CL Cum-019 were performed better than other lines. This experiment is going on and after completion of the experiment suitable lemon varieties will be developed.

Morphophysiological characterization and evaluation of seedless lemon germplasm

M. H. M. B. Bhuyan, M. M. Rahman F. Ahmed, J. C. Sarker and S. M. L. Rahman

An effort was made for the morphological characterization and evaluation of collected seedless lemon germplasm. Variability was observed in different characters among the germplasm studied. Among the germplasm, CL Jai-102 was noticed superior with maximum individual fruit weight, large fruit size, highest number of fruits plant^{-1}, fruit yield plant^{-1} as well as ha^{-1} yield followed by Cl Jai-101. On the other hand, the genotype CL Jai-105 produced the lowest yield. The fruit quality attributes also varied among the gremplasm tested. Interestingly the genotype CL Jai-101 was found with no seed. But in the other genotypes, not all but some fruits were found with one or two seeds. In this study, seedless lemon genotypes showed wide variation both in qualitative and quantitative characteristics. Therefore, it can be concluded that these germplasm could further be used for varietal development programs. This is the first year of study. Next year this study will be focused on the yield potential of the germplasm to find out the superior genotypes.

Evaluation of lime germplasm

M. A. H. Khan, M. Rahman, M. H. Rahman and M. O. Kaisar

An experiment with six lime germplasm was conducted to evaluate the superior lime germplasm at the RARS, BARI, Cumilla. Among the genotypes two genotypes were in bearing stage and 4 genotypes were in growth stage. The highest number of fruits/plant (275) and weight of fruits/plant (15.89 kg) were observed in CA Cum-001. The highest individual fruit weight (60.8 g), fruit length (6.1 cm), fruit diameter (4.2), juice% (4107%) and thickness of rind were observed in CA Cum-002. This experiment is going on and after completion of experiment suitable lime variety will be developed.

Evaluation of Kaghzi lime (*Citrus aurantifolia*)

M. R. Islam, S. D. Setu, S. Hasna, M. G. Kibria and M. R. Uddin

The experiment was conducted at the RARS, Rahmatpur. Six germplasm (CA Rah-01, CA Rah-02, CA Rah-03, CA Rah-04, CA Rah-05 and CA Rah-06) of Kaghzi lime were collected from different areas of

the southern part of the country and planted on July 2013. Wide variations in growth characteristics among the germplasm were found. Among the germplasm, the highest plant height was attained in CA Rah-01 (6.2 m) and the lowest plant height was recorded in CA Rah-06 (2.78 m). The highest base girth was found in the germplasm CA Rah-01 (31cm) and the lowest base girth was noted in CA Rah-04 (14 cm). The maximum total number of fruits was found in CA Rah-02 (860) and the lowest one was noted 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). The highest yield was found in the germplasm CA Rah-02 (40.19 kg/plant) and the lowest yield was recorded in CA Rah-04 (6.31 kg/plant). Wide variation in quantitative and qualitative growth characteristics among the Kaghzi lime germplasm indicates the ample scope of crop improvement through selection. The highest yield was found in the germplasm CA Rah-02 (40.19 kg/plant). To confirm the findings as well as to determine the yield performance the experiment should be continued.

Evaluation of sweet orange (Kata malta) line

M. R. Islam, M. M. Rahman and Z. A. Firoz

An experiment was conducted at the citrus orchard of RARS, Hathazari, Chattogram in order to assess the yield potentialities of Katamalta. The plants were seven years old and same tree shape was obloid. Differences were observed in all the quantitative parameters studied. The plant height and canopy size were higher in Katamalta (2.88m and 1.58x3.47 m^2) than those of BARI Malta-1 (2.7m and 1.34 x 2.28 m^2) accordingly. Number of fruits/plant and individual fruit weight were higher in Katamalta (234, 191 g) than that of BARI Malta-1 (150, 117 g respectively). The yield of fruits was higher in Katamalta (27.9 t/ha) which was higher than that of BARI Malta 1 (11.0 t/ha). The Juice content was higher in Katamalta (60 ml) than that of BARI Malta-1 (46.2 ml). The TSS was higher in Katamalta (8.5%) than that of BARI Malta-1 (7.1%). From the results, it can be concluded that the Katamalta was higher yielder as compared to BARI Malta-1.

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 Chattogram Hill Trach 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 ranges from February to March. Harvesting time was late November-December in case of CS Kha-001. All the germplasm produced profuse fruits. No. of fruits per plants was the highest (220) in BARI Malta-1 while the lowest (135) was in CS Kha-002. Individual fruit weight was also varied from 135.33-165.67g. The biggest (165.67g) fruit was recorded in CS Kha 002 and the smallest (135.33) was observed in BARI Malta-1. Weight of fruits per plant was the highest (27.53 kg) in BARI Malta-1while in case of CS Kha-001 it produced yield of 29.98 kg/plant and the lowest (22.67 kg) was in CS Kha-002. Number of seed ranged from 10-22. TSS ranged 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.

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 performances 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. Maximum fruit weight (460.1 g) was recorded in CS Jai-051 while minimum (152.2 g) in CS Jai-209. Fruit size also attained maximum (9.9 cm ×9.8 cm) in CS Jai-051. High juice content and the highest TSS (13.6%) were recorded in CS Jai-003, while CS Jai-209 attained the lowest TSS (10%). Edible portion was recorded maximum (78.67%) in CS Jai-051 which was followed by CS Jai 003 (77.13%) and CS Jai-209 (76.74%). Fruit color at maturity of exotic sweet orange germplasm were found pale green and greenish yellow CS Jai-051 and BARI Malta-1, respectively whereas, others were found bright yellow. Pulp colors of studied germplasm were found off white to orange, whereas BARI Malta-1was light yellow. Among the

germplasm, CS Jai-003 and CS Jai-051 were found promising and can be released as new sweet orange (Malta) variety.

Hybridization in mandarin

S. M. L. Rahman, F. Ahmed, M. S. Zaman and M. H. M. B. Bhuyan

A hybridization program was conducted at the Citrus Research Station (CRS), Jaintapur, Sylhet and RARS, Akbarpur, Mouluvibazar. A total of 250 flowers were emasculated and pollinated. Finaly 2 hybrid fruits were obtained from different crosses. These hybrid fruits will be harvested at ripen stage and seeds of the fruits will be sown in soil for germination. After germination, seedlings of hybrid fruits will be transplanted in the main field and will be evaluated. Developed hybrid fruits will be harvested at proper mature stage and kept in the laboratory. After collecting seeds it will be sown in the soil for germination in the hybrid seedling plot. After germination one year old hybrid seedlings will be transplanted in the main field and will be evaluated in the following season.

Evaluation of mandarin germplasm under north-eastern hilly area of Bangladesh

F. Ahmed, J. C. Sarker, M. H. M. B. Bhuyan and S. M. L. Rahman

The experiment was conducted to study the performance of mandarin germplasm at the Citrus Research Station (CRS), Jaintapur, Sylhet to identify suitable genotypes for this high rainfall areas. BARI Komola-1 and BARI Komola-3 were used as check. Plant height ranged from 101.33 cm to 60.67 cm. The tallest plant was recorded at CR Jai-303 while the shortest plant was recorded in CR Jai-302. BARI Komala-1, BARI Komola-3 and CR Jai-303 had maximum base girth (2 cm) but CR Jai-302 had the lowest base girth (0.9 cm). Maximum leaf lamina length was found in CR Jai-304, whereas the shortest leaf was found at CR Jai-303. Wider leaf was noticed at CR Jai-305 but narrower leaf was noted at CR Jai-303. Leaf length breadth ratio found maximum at CR Jai-304 but lowest at BARI Komola-3. All the plants are now in vegetative stage and showed better growth performance. So, after flowering and fruiting the final evaluation and conclusion can be made within 4 to 5 years.

Evaluation of pummelo germplasm

M S Rahman, M A Hossain, H Rahman, A Akter, R Sultana and H E M K Mazed

The experiment was conducted at HRC, RARS, Jamalpur. Seven germplasm were evaluated in this study. A wide variation was observed regarding plant growth and fruit characteristics among the Pummelo germplasm tested. CG Jam-001 was found superior with large canopy size (3.58 m x 3.80 m), the highest tree volume and fruit number. The highest yield per plant was recorded in CG Jam-001(30.72 kg) and the lowest was in CG Jam-006 (2.73 kg). The highest TSS was found in the line CG Jam-001 (9.2 %). Considering growth and yield contributing characters it could be concluded that the line CG Jam-001 performed better. The experiment would be continued.

Evaluation of pummelo germplasm

MA Alam, MR Alam and KU Ahammad

The study was undertaken to identify suitable germplasm of pummelo with 19 accessions of 14-18 years old plants along with a locally collected germplasm at RARS, Jashore. The heaviest fruit (2850 g) was collected from CG Jas-025 whereas the lightest fruit (693 g) was found in CG Jas-019. The highest edible portion (63.8%) was observed in CG Jas-004 while the lowest edible portion (36.8%) was observed in CG Jas-011.The highest TSS (9.5%) was recorded in CG Jas-015 whereas the lowest TSS (6.0%) was found in CG Jas-025. Maximum number of fruits per plant (122) was observed in CG Jas-023 followed by CG Jas-017 (92) whereas minimum number of fruits per plant (18) was found in CG Jas-025. Excellent eating quality was observed in CG Jas-007, CG Jas-013, CG Jas-018, CG Jas-023 and CG Jas-029 with bitterless pulp. Based on the number of fruits per plant, edible portion, total soluble solids, absence of bitterness and organoleptic test the germplasm CG Jas-007, CG Jas-013, CG Jas-018, CG Jas-023 and CG Jas-029 were found superior germplasm. However, further investigation should be carried out for the next few years.

Evaluation of pummelo germplasm

M A H Khan, M H Rahman and M O Kaisar

An experiment with eighteen germplasm of pummelo was conducted to evaluate the superior pummelo germplasm at the RARS, BARI, Cumilla.

The plants are now in growth stage. The maximum plant height was found in CG Cum-009 (1.80 m) and the minimum plant height was found in CG Cum-017 (0.70 m). This experiment is going on and after completion of the experiment suitable pummelo variety will be developed.

Evaluation of local pummelo germplasm

M. Islam, E. Mahmud, N. Akter and M. I. A. Howlader

An experiment with three genotypes of pummelo was conducted at the pummelo orchard at the experimental field of RHRS, Lebukhali, Dumki, Patuakhali for the evaluation of superior pummelo lines in southern region of Bangladesh. Most of the plants are in vegetative stage. Only one germplasm (CG Lebu-001) is in fruiting stage. This is an on-going experiment and after completion of the experiment superior pummelo varieties will be developed.

Evaluation of local pummelo germplasm

J. C. Sarker, F. Ahmed, M. H. M. B. Bhuyan and S. M. L. Rahman

Evaluation of local pummelo germplasm was conducted at Citrus Research Station, Jaintapur, Sylhet to study their performance. All the germplasm showed significant variation in respect of plant height, base girth and canopy spreading attributes. The highest plant height (4.45 m) was recorded in CG Jai-061 followed by CG Jai-055 (4.19 m) as well as CG Jai-054 (4.12 m) and the lowest in CG Jai-064 (3.15 m). Maximum base girth was also found from CG Jai-053 (23.23 cm) followed by CG Jai-061 (21.34 m) and CG Jai-054 (20.12 cm). Canopy size was recorded maximum (62.33x44.64 cm) in CG Jai-054 minimum (27.67 x 27.27 cm) in CG Jai-062. The plants are at vegetative stage and the growth is satisfactory. Final conclusion can be made after 3-5 years of fruit quality evaluation.

Evaluation of pummello germplasm 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, Khulshi, Chattogram for the evaluation of twenty-five pummello genotypes. Among these genotypes, sixteen genotypes, namely CG Pah-001, CG Pah-002, CG Pah-003, CG Pah-005, CG Pah-006, CG Pah-008, CG Pah-011, CG Pah-012, CG Pah-014, CG Pah-015, CG Pah-016, CG Pah-020, CG Pah-021, CG Pah-022 and CG Pah-023 produced fruits. The heaviest fruit (2050 g) was recorded from CG Pah-001 followed by CG Pah-003 that weighted 1670 g. The lightest fruit (620 g) was observed in CG Pah015 followed by CG Pah-021 that weighted 730 g. The largest fruit size (16.54 cm x 18.72 cm) was obtained from CG Pah-001 and the smallest fruit size (10.12 cm x 10.54 cm) was recorded from CG Pah-015. The heaviest segment (108.80 g) was recorded from CG Pah-01 and the lightest segment (31.00 g) was recorded from CG Pah-022 followed by CG Pah-012. Maximum edible portion (82.05 %) was calculated from CG Pah-008 and minimum edible portion (41.30 %) was calculated from CG Pah-022. The highest total soluble solid (12.53%) was counted from CG Pah-008 and the lowest total soluble solid (7.93%) was counted from CG Pah-001. CG Pah-001 produced maximum amount of fruit (61.5 kg) and CG Pah-014 produced minimum amount of fruit (3.88 kg). All the genotypes were bitter in taste except CG Pah-003, CG Pah-005 and CG Pah-006. Considering the quantitative and qualitative characters especially the bitterness, CG Pah-001, CG Pah-003, CG Pah-005, CG Pah-006, CG Pah-014 and CG Pah-020 might be considered as promising lines. Further evaluation is needed next consecutive years.

Evaluation of pummello germplasm in hilly region of Rangamati

S. P. Chakma, M. Islam, M. E. Hoque and M. A. Hossain

An experiment with thirteen germplasms of pummelo was conducted at the existing thirteen years old orchard of pummelo plants collected from different parts of Chattagong Hill Tracts at hill valley of Hill Agricultural Research Station of Raikhali in Rangamati Hill District for the evaluation of superior pummelo genotypes in hilly region. The performance of the germplasm can be concluded after the harvest of the fruits. The performance of the pumelo germplasm can be concluded after the harvest of the fruits.

In-situ evaluation of year-round pumello 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

year 2017-2018, 2018-2019, 2019-2020, 2020-2021 and 2021-2022. One off-season pummel germplasms (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 (37) and immature (62) fruits were found in the month of October and June, respectively. Average fruit weight was 1.50 kg. The maximum edible portion was obtained (40.73%) and the highest TSS (10.8%). The average number of fruits per month (19.58) was collected from CG Kha-001. Considering of fruit characteristics, edible quality, TSS, percent edible portion and yield potentialities, the germplasm CG Kha-001 was found promising. The number of fruits per month, fruit weight, edible portion and TSS were found satisfactory. Flesh of the line CG Kha-001 was soft, juicy, bitter less and very sweet in organoleptic taste. Therefore, CG Kha-001 was found promising for year round cultivation of pummelo at the hilly region.

Hybridization in Satkara

S. M. L. Rahman, F. Ahmed, M. S. Zaman and M. H. M. B. Bhuyan

A hybridization program of satkara was conducted at Citrus Research Station (CRS), Jaintapur, Sylhet and RARS, Akbarpur, Mouluvibazar. A total of 350 flowers were emasculated and pollinated. Four hybrid fruits were obtained from different crosses. These citrus fruits will be harvested at mature stage and seeds of the fruits were sown in the soil for germination. After germination, seedlings of hybrid fruits will be transplanted in the main field and will be evaluated. Developed hybrid fruits will be harvested at proper mature stage and kept in the laboratory. After collecting seeds it will be sown in the soil for germination. After germination one year old hybrid seedlings will be transplanted in the main field and will be evaluated in the following season.

Evaluation of bael germplasm

M. O. Hoque, M. Razzab Ali and A. K. Saha

An experiment was conducted at RARS, Burirhat, Rangpur with a view to developing high yielding variety of bael. Seventy two germplasm of bael were evaluated in this study. Out of 72 germplasm, 35 germplasm produced flowers and fruits during this season and all germplasm data were reported. Rest of the genotypes did not produce fruit. Flowering time of different genotypes was observed in all genotypes from 1st week of May to 1st week of June. Early flowering (1st week of May) was observed in germplasm AM Bur-012, AM Bur-013, AM Bur-017, AM Bur-045 and AM Bur-052 and late flowering (1st week of June) was observed germplasm AM Bur-046, AM Bur-047, AM Bur-054, AM Bur-055, AM Bur-057, AM Bur-058, AM Bur-061and AM Bur-071. Harvesting was done from 2nd week of March to 1st week of May. Maximum number of fruits per plant (80) was obtained from AM Bur-031, which was followed (60) by AM Bur-056, whereas minimum number of fruits (1) was found in AM Bur-007 and AM Bur-009. The genotypes AM Bur-031 produced the highest fruit yield (32.28 kg/plant), while minimum fruits yield (0.54 kg/plant) was recorded from genotypes AM Bur-055. Considering weight of pulp, color, flavor, stickiness, texture, grittiness, bitterness and sweetness it can be concluded that the germplasm AM Bur-001, AM Bur-007, and AM Bur-037 was found promising.

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, BARI, Jaintapur, Sylhet. 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 case of different characters of the germplasm tested. Among the germplasm the highest number of fruits (139) was recorded in AM Jai-001 with maximum TSS (37.2%). The heaviest fruit was found in AM Jai-002 (830.6 g) with largest size (13.2×12.3 cm^2). Maximum edible portion (82.56%) was recorded in AM Jai-001 while minimum (55.77%) was in AM Jai-002. From the above study it was found that AM Jai-001 was the best in terms of TSS (%), number of fruits $plant^{-1}$ and edible portion with no bitterness. It may be released as new variety.

***In-situ* evaluation of bael germplasm**

A.S.M. Yousuf Ali, M. K. Islam and M. M.Rahman

An experiment was evaluated at Chapainawabganj Sadar and Shibganj Upazila. The study consisted of one bael germplasm. BARI Bael-1 was used as check. Age of the germplasm, AM Cha-001 was 34 years while BARI Bael-1 was 15 years. Maximum individual fruit weight (1020 g) was found in AM Cha-001, while the minimum fruit weight (860 g)

was in BARI Bael-1. Considering TSS (38%), pulp percentage (71.87%) and yield /plant (117.3 kg), the germplasm AM Cha-001 was found better. Considering TSS (38%), pulp percentage (71.87) and yield (117.3 kg/plant), the germplasm AM Cha-001 was found better under this study. This experiment will be continued.

In-situ evaluation of bael germplasm

R Sultana, M A Hossain, H Rahman, A Akter and H E M Khairul Mazed

An experiment was conducted at different villages of Nandina upazila of Jamalpur Sadar. The study consisted of five bael germplasm to find out a superior germplasm of beal for the commercial cultivation. The maximum individual fruit weight (1500 g) was found in AM Jam-005, while the minimum (850 g) in AM Jam-003. Considering TSS (42.5%), pulp percentage (80.21), fiber percentage (1.02), and eating quality (Excellent), the germplasm AM Jam-005 was found superior. Considering TSS (39.9%), pulp percentage (70.23), fiber percentage (1.27), grittiness (absent) and eating quality (Excellent), the germplasm AM Jam-004 was also found superior. Considering TSS (42.5%), pulp percentage (80.21), fiber percentage (1.02), grittiness (absent) and organoleptic taste (Very Excellent), the germplasm AM Jam 005 was observed superior.

Evaluation of existing bael germplasm

A. S. M. Yousuf Ali, M. K. Islam and M. M. Rahman

An experiment was conducted at the RHRS, Chapainawabganj including 22 bael genotypes to find out a good germplasm of bael for the commercial cultivation. Germplasm were collected from different places of Chapainawabganj and Rajshahi district. A wide variation was observed among the germplasm regarding growth, fruit and tree characteristics. Only sixteen germplasm among 22 were produced fruits for this year. Among the fruit characteristics, fruit weight varied from 345 to 2260 g, fruit length 9.2 to 15 cm, fruit breadth 8.3 to 17.4 cm, pulp weight 171 to 1605.8g, fibre weight 14 to 80 g, seed weight 14 to 33 g and TSS 28-37 %. No of fruits per plant was recorded the highest from AM Cha-006 (65) and the lowest from AM Cha-015 (10). Considering over all assessment, 5 germplasm AM Cha-02, AM Cha-004, AM Cha-013, AM Cha-014 and AM Cha-015 were found as promising. Sixteen germplasm produced flowers and fruits this year. Among the germplasm, in consideration of fruit characteristics and edible portion, flavor and TSS%, the germplasm AM Cha-002, AM Cha-004, AM Cha-006, AM Cha-013, AM Cha-016 and AM Cha-014, AM Cha-015 were found superior. This experiment will be continued.

Evaluation of wood apple germplasm

A. Anwari, A. S. M. Mesbah Uddin and B. C. Sarker

Six wood apple germplasm were evaluated at the Fruit Research Farm of HRC, BARI, Gazipur which were planted in June 2009. Date of flowering ranged from 2nd week of February to March-April, June-August/ 2021-22. Date of fruit set varied from March to April, July and September in the germplasm. Three times fruit setting was observed in FL Joy-003 and FL Joy-004. There were no significant differences in case of fruit weight, length, diameter, weight of rind and rind thickness. But significant differences were found in TSS (%). The biggest fruit was recorded in FL Joy-005 (405.43g) followed by FL Joy-004 (386.83 g). The smallest fruit was obtained from FL Joy-006 (303.50g). FL Joy-005 had maximum TSS (16.00 %), followed by FL Joy-004 (15.70 %) and minimum (12.57 %) TSS content was noted in FL Joy-007. Fruit colour of most of the germplasm was grayish white and fruit shape of the germplasm was round to oval. Pulp colour of the germplasm was light brown to dark brown and intermediate to excellent in taste. The fruits of all the germplasm were harvested from 1st week of September/2021 to mid of January/2022, which produced fruits for economic benefits. All the germplasm gave fruits up to last of February- 1st of May and 3 sizes of fruits were observed: marble, medium and matured. Number of fruits per plant ranged from 142.00 to 17.33 at mature stage. The highest number of fruit per plant was obtained from FL Joy-004 (142.00) as against the lowest number of fruits in FL Joy-002 (17.33). Yield per plant (52.78 kg) and yield per ha (32.99 t/ha) was recorded highest in FL Joy-004, followed by FL Joy-005 (yield per plant (21.84 kg/plant) and (13.65t/ha). The lowest fruits weight per plant and yield per plant were obtained from FL Joy-002 (8.96 kg/plant and 5.60 t/ha, respectively). Biochemical analysis was done by sending samples of 5 germplasm (FL Joy-003, FL Joy-004, FL Joy-005, FL Joy-006 and FL Joy-007) to Post Harvest Division and Soil Science Division of BARI, Gazipur. FL Joy-004 had the

highest content of fat (%), total sugar (%), reducing sugar (%) and pH i.e. 5.83%, 10.60%, 4.30% and 3.80, respectively. FL Joy-005 had low content of total sugar (8.15 %) and reducing sugar (3.30%), low pH was obtained from FL Joy-007. Vitamin-C content was recorded as the highest in FL Joy-003 (21.16 mg/100 g), followed by FL Joy-005 and FL Joy-004 (20.42 mg/100 g and 18.82 mg/100 g, respectively). Total acidity (%) was found high in FL Joy-007 (3.22 %) and lower in FL Joy-006 (1.42 %).100 g of raw wood apple of FL Joy-007 contained the highest Ca i.e. 560 mg, followed by FL Joy-006 (540 mg) and FL Joy-003 (530 mg), where FL Joy-004 contained the lowest Ca (230 mg). Fe and Mn were recorded as the highest in FL Joy-003 (5.15 and 2.72 mg/ 100 g, respectively) and the lowest was perceived from FL Joy-007 (2.84 and 1.50 mg/ 100 g, respectively). There was no insect infestation and disease infection among the germplasm in 2021-22. Individual fruits were covered by polyethylene bag at marble stage played a vital role for controlling fruit borer and diseases. It also enhanced the outer attractiveness of fruits. Harvesting time of BARI Kodbel-1 and BARI Kodbel-2 was Oct-Nov and Feb-Mar, respectively. Germplasm of this experiment will be able to extend availability to the market from September to 1st week of March, which will compensate periodic gap of production of BARI Kodbel-1 and BARI Kodbel-2. Considering the quantitative and qualitative characteristics and yield components of fruits the germplasm FL Joy-003, FL Joy-004 and FL Joy-005 were noticed promising and may be released as variety.

Hybridization in golden apple

M. M. Khatun, M. A. Islam and B. C. Sarker

Hybridization in golden apple was carried out at the Fruit Research Farm of HRC, BARI, Joydebpur, Gazipur to incorporate some important characters like year round bearing habit and dwarfness, fruit size and sweetness in the desired golden apple variety. Cross combinations for hybridization were: BARI Amra-2 x BARI Amra-1 and BARI Amra-1 x BARI Amra-2 and number of fruit set was recorded in 6 and 1 from the cross combination of BARI Amra-2 x BARI Amra-1 and BARI Amra-1 x BARI Amra-2, respectively. Six hybrid fruits from the cross combination of BARI Amra-2 x BARI Amra-1and 1 hybrid fruit from the cross of BARI Amra-1 x BARI Amra-2 was recorded. These fruits will be harvested at maturity stage and seeds of the fruits will be sown in the soil for germination. After germination, seedlings of hybrid fruits will be transplanted in the main field and will be evaluated.

Evaluation of golden apple germplasm

M. H. M. B. Bhuyan, J. C. Sarker, F. Ahmed and S. M. L. Rahman

The present study was conducted at CRS, Jaintiapur, Sylhet to evaluate one golden apple germplasm. Plant height was observed 7.5 m where as base girth was found 90.0 cm. Canopy size was (8.7×7.6 m). Number of fruits was 560, which yielded 51.8 kg fruit plant $^{-1}$ and 14.34 t ha $^{-1}$ with 6 m spacing. In case of fruit weight average 92.5 g of each fruit was obtained with 5.78×4.98 cm size. Rind weight was 13.5 g while stone weight and pulp weight was 11.8 g and 67.0 g respectively. On an average total soluble solid (TSS) and edible portion was recorded 11.64% and 72.43% respectively for each fruits. This is the first year study. Further detailed study is required for releasing this accession as a variety for north eastern region of Bangladesh.

In-situ evaluation of six Burmese grape germplasm

A. S. M. M. Uddin and M. T. Islam

An experiment was conducted at Joynagar, Shibpur, Narsingdi. The study consisted of 6 (six) Burmese grape (*Baccaurea sapida*) germplasm to find out a suitable high yielding, late and promising germplasm of Burmese grape for releasing as variety. Out of six germplasm, the highest plant height, base girth, canopy spreading (N-S and E-W) was noted from BS (N)-004. Maximum individual fruit weight (27.33 g) was found in BS (N)-001 while minimum fruit weight (17.23 g) was recorded in BS (N)-004. The biggest fruit (3.47 cm x 3.60 cm) was noticed in BS (N)-001 and the smallest fruit was observed in BS (N)-004. TSS (17.00 %) was recorded maximum in BS (N)-004 and minimum TSS (13.33 %) was recorded in BS (N)-005. Maximum edible portion (61.45 %) was noted in the germplasm BS (N)-001 and minimum edible portion (43.93 %) was recorded in the germplasm BS (N)-006. The highest yield (5.52 t/plant) was noticed in BS (N)-001 and the lowest yield was calculated in BS (N)-006. Total soluble solids content was measured the highest in BS (N)-004 (17.00 %) and the lowest TSS content was registered in the germplasm BS (N)-005. Taste and eating quality of

all the germplasm were excellent but BS (N)-001 exhibited superiority to all of the germplasm under evaluation. Burmese grape is a potential fruit. Considering the growth, yield and yield contributing characteristics like fruit size and shape, fruit retention, juiciness, color and appearance, edible portion, TSS content, etc. the germplasm BS (N)-001 was found very much superior to all the germplasm evaluated. Therefore, the germplasm BS (N)-001 can be released as a promising and excellent Burmese grape variety.

In-situ evaluation of superior burmese grape germplasm

M. H. Rahman, Syed M. Mizanurrahman, A.K.M. Mahbub Ur Rahman

In-situ evaluation of Burmese grape was conducted at the farmer's field, Shibpur, Narsingdi with ten Burmuse grape germplasm. Variation was observed in case of yield and yield contributing characters. The highest fruit size (34.27 mm x 38.60 mm) was observer in BS Nar-009. Maximum edible portion (57.2%) was recorded from BS Nar-009. Maximum percent TSS (17.4%) was noticed from BS Nar-008. Maximum number of fruits and yield per plant was observed in BS Nar-010. Among the germplasm, on the basis of yield and yield contributing characters BS Nar-009 and BS Nar-010 showed better performances. The experiment should be continued for the next year to release a variety at the farmer's field.

Evaluation of Burmese grape germplasm

M. H. M. B. Bhuyan, S. M. L. Rahman, F. Ahmed and J. C. Sarker

The experiment was conducted at CRS, Jaintiapur, Sylhet, with five Burmese grape germplasm. A wide variation was observed in case of growth, yield contributing characters, yield and fruit quality of the germplasm studied. The highest plant height, base girth, canopy spreading was found from BS Jai-005. Leaf size was also maximum in this line. Maximum number of fruits plant^{-1}, yield plant^{-1} and yield ha^{-1} were obtained from BS Jai-001. BS Jai-001 was also free from disease where as the others suffered from powdery mildew and sooty mould. Chaper beetle was common in case of all the germplasm and only BS Jai-001 was free from fruit borer. Fruit size was highest in BS Jai-003 (3.4 cm ×3.4 cm) followed by BS Jai-001 (3.35 cm × 3.14 cm). Flesh color and texture for all germplasm was off white and juicy. Maximum edible portion (47.5%) and per cent TSS (13.6%) was found from BS Jai-001. Considering all the parameters studied BS Jai-001 performed best among the germplasm and could be released as a variety for farmers cultivation.

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. Eleven germplasm of sapota were collected from different areas of the southern part of country and planted on July 2012. Wide variations in growth characteristics among the germplasm were found. As regards to plant height, it was observed that it varied significantly and ranged from 8.23 m to 9.45 m with the mean value of 8.93 m. The tallest plant was observed in accession number AS Rah-01 (9.45 m) which was followed by AS Rah-05, AS Rah-07, AS Rah-10 (9.35 m) and smallest plant in accession number AS Rah-11 (8.23 m). The height maximum number of fruits per plant was found in AS Rah-01 (524) and the lowest one was AS Rah-02 (356). As regards to average fruit weight, it was observed that it varied significantly and ranged from 69.20 g to 92.80 g with the mean value of 81.12 g. The heaviest fruit was harvested from AS Rah-11 (92.80 g) and the lightest average fruit weight was obtained from AS Rah-10 (69.20 g). In respect of total soluble solids (TSS), significant variations were seen among the fruits of accessions. The highest TSS (24 °Brix) was obtained from the accession number AS Rah-01 followed by accession number AS Rah-06 (19 °Brix). On the other hand, the lowest TSS (16 °Brix) was recorded from the accession number AS Rah-04 and AS Rah-05. In this trait the mean value was 16.71. Among 11accessions the yield of fruit per plant was varied significantly (and ranged from 28.51 kg to 46.03 kg. The fruit of accession number AS Rah-11 produced the highest yield of 46.03 kg followed by accession number 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 accession number AS Rah-04. In this trait, the mean value was 36.23 kg. Among 11 accessions the yield of fruit per plant was varied significantly and ranged from 28.51 kg to 46.03 kg. The fruit of accession number AS Rah-11 produced the highest yield of 46.03 kg followed by accession number 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 accession number AS Rah-04. In this trait, 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 germplasm 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, Khulshi, Chattogram for the evaluation of ten aonla germplasm. Only four of the ten germplasm were able to produce fruits. The most fruits were obtained from EO Pah-007, which was documented as 1480, followed by EO Pah- 008 (497). The least number of fruits were found in EO Pah-009. The edible portion of EO Pah-009 was greater (94.03 %). EO Pah-009 yielded the greatest fruit length (3.65 cm) and fruit breadth (3.84 cm), while EO Pah-007 yielded the smallest fruit length (2.21 cm) and fruit breadth (2.54 cm). The highest TSS (10.92 %) was found in EO Pah-007, while the lowest TSS (9.4 %) was found in EO Pah-010. EO Pah-008 produced the best yield (16.60 kg/) plant, followed by EO Pah-007 (14.73 kg). Considering yield, fruit size, TSS, edible portion EO Pah-007, EO Pah-008 and EO Pah-010 can be considered as promising line of aonla. Though it was third year data collection, evaluation will be needed for next consecutive years.

Evaluation of bullock's heart germplasm

M. A. Alam, M. R. Alam and K. U. Ahammad

A study was carried out at RARS, Jashore to find out the superior germplasm of bullock's heart (*Annona reticulata* L). Ten germplasm were identified of 4 to 10 years old plants 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 yield per plant. The heaviest fruit (576 g) was recorded in AR Jas-013 whereas the lightest fruit (296 g) was found in AR Jas-010. The highest edible portion (75.8%) was observed in AR Jas-007 while the lowest edible portion (64.1%) was found in AR Jas-011. The highest TSS (26.2%) was recorded in AR Jas-012 whereas the lowest TSS (18.3%) was found in AR Jas-010. Maximum number of fruits per plant (78) as well as the highest yield per plant (36.5 kg) was found in AR Jas-007. Organoleptic teste as well as eye appeal of fruits was excellent in AR Jas-002, AR Jas-006, AR Jas-007 and AR Jas-012. Considering fruit weight, total soluble solids, edible portion, Organoleptic teste, flavour, sweetness and eye appeal, the germplasm AR Jas-002, AR Jas-006, AR Jas-007 and AR Jas-012 were found superior and further investigation should be continued.

Evaluation of bullock's heart germplasm

M S Rahman, M A Hossain, H Rahman, A Akter, R Sultana and H E M K Mazed

Six germplasm of bullock's heart (*Annona reticulata*) such as AR Jam-001, AR Jam-002, AR Jam-003, AR Jam-004, AR Jam-005 and AR Jam-006 were evaluated at the RARS, Jamalpur. The highest plant height (6.30 m) was recorded in AR Jam-006 and the lowest (2.80 m) in AR Jam-003. Base girth was maximum (52.2 cm) in AR Jam-006 and minimum (33.5 cm) in AR Jam-003. The highest canopy spreading was observed in AR Jam-006 and the lowest in AR Jam-005. The highest tree volume was observed in AR Jam-006 (79.93 m^3) and the lowest was in AR Jam-005 (9.23 m^3). The highest number of branches (5.60) was observed in AR-Jam-006 and the lowest in AR Jam-002 (3.3). The highest number of fruits per plant was observed in AR-Jam-006 (92) and the lowest was in AR Jam-005 (6.0). The highest yield per plant was recorded in AR Jam-006 (22.26 kg) and the lowest was in AR Jam-005 (0.91 kg). The highest TSS was observed in AR Jam-006 (24.5%) and the lowest was in AR Jam-004 (21.5 %). The highest edible portion was recorded in AR Jam-006 (72.9 %) and the lowest was in AR Jam-003 (66.6 %). Considering plant and fruit characters it can be concluded that the line AR-Jam-006 performed better. The experiment will be continued.

Evaluation of custard apple germplasm

M. H. Waliullah, Kh. H. Alam, Y. Abida and M. A. Uddin

Fruit characteristics of seven custard apple germplasm were studied in the laboratory of Fruit Research Station, BARI, Binodpur, Rajshahi. The result indicated that wide range of diversity existed in fruit weight, seed weight, TSS content, pulp content and skin weight etc. The weight of a matured fruit varied from 122 g to 180 g. The highest fruit weight (180 g) was observed in AS Raj-005 followed by AS Raj-007 (171.3 g) and the lowest

fruit weight was noted in AS Raj-003 and AS Raj-004 (122 g). Maximum (56.96%) edible portion was measured in AS Raj-007 followed by AS Raj-005 (48.17%). TSS varied from 23.3 to 25 but there was no significant difference in TSS among the lines. This was the first-year result. The germplasm AS Raj-005 and AS Raj-007 showed better performance on the basis of fruit weight, skin weight, no. of seeds/fruit, edible portion and TSS value. Further study is needed to select the superior germplasm for developing variety.

Evaluation of custard apple germplasm

A. S. M. Yousuf Ali, M. K. Islam and M. M. Rahman

An experiment on collection and evaluation of some custard apple germplasm was conducted at the RHRS, Chapainawabganj. Sixteen germplasm were collected from five Upazilas of Chapainawabganj district. Seeds were sown into seed bed and after germination all of the germplasm were transferred into main field between 2015 and 2016. Twelve germplasm produced fruits among 16 germplasm in this year. The genotype AR Cha-07 gave maximum TSS (22%), edible portion 58.5% and yield per plant (1.4 kg). Considering single fruit wt. (200 g), TSS (22), edible portion (58.5%) and yield per plant (1.4 kg), the germplasm AR Cha-07 was found better. This experiment will be continued.

Evaluation of Indian dillenia germplasm

M. R. Alam, M. A. Alam and K. U. Ahammad

A study was carried out at HRC, RARS, to evaluate the Indian dillenia (chalta) germplasm available in Jashore region. Two promising germplasm *viz*., DI Jas-001 and DI Jas-002 were evaluated at HRC, RARS, Jashore for developing as a variety. The germplasm were collected from Jashore region and planted in 2009. The recorded plant height of the two genotypes was 8.7 m and 8.3m. Flowering was started from 15 May 2021. DI Jas-001 produced total 980 fruits in the fourth year of reporting. DI Jas-002 produced total 435 fruits in the first year of reporting. Individual fruit weights were 610.5 g and 522.67 g respectively. Total yield of the plants were 597.8 kg and 230.55 kg respectively. Though only two germplasm had been evaluated, DI Jas-001 was an excellent germplasm in respect of yield and quality. However, this is the fifth year of the experiment. Therefore, the germplasm can be proposed as a variety.

Evaluation of some pomegranate germplasm

A. S. M. Yousuf Ali, M. K. Islam and M. M. Rahman

Seventeen germplasm of pomegranate were evaluated for their performance at RHRS, Chapai Nawabganj. 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 (40) was recorded in PG Cha-002 followed by PG Cha-004 (23) whereas the lowest number of fruits per plant (1) was produced in PG Cha-003, PG Cha-005, PG Cha-011, PG Cha-014 and PG Cha-015 followed by PG Cha-006 (2), PG Cha-007 (5), PG Cha-012 (3) & PG Cha-013 (4). The fruits were not harvested yet. After ripening fruits, data on all the germplasm will be recorded . This experiment will be continued for drawing conclusion.

Evaluation of cowa germplasm

M. Islam, E. Mahmud, N. Akter and M. I. A. Howlader

An experiment was conducted at RARS, BARI, Rahmatpur, Barishal. Ten germplasm of cowa were included in this study. These were 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. Wide variations in growth characteristics among the germplasm were found. Among the germplasm, the highest plant height was attained in GC Rah-04 (7.55 m) and the lowest plant height was attained in GC Rah-018 (1.0 m). The highest number of fruits per plant was found in GC Rah-09 (2864) and the lowest was in GC Rah-18 (25). The highest individual fruit weight was found in GC Rah-03 (65.61 g) and the lowest was in GC Rah-02 (35.61 g). The highest number of bulbs per fruit was found in GC Rah-02 (7.40) and the lowest number of bulbs per fruit was in GC Rah-05 (5.60). The height edible portion was in GC Rah-03 (70%) followed by GC Rah-02 and GC Rah-09 (69%). The highest yield was found in the germplasm GC Rah-09 (166.86 kg/plant) followed by GC Rah-03 (147.29 kg/plant) and the lowest was in GC Rah-18 (1.16 kg/plant). Wide variation in quantitative and qualitative growth characteristics among the cowa germplasm indicated the ample scope of crop improvement through selection. The highest yield was found in the germplasm GC Rah-09 (166.86 kg/plant) followed by GC Rah-03 (147.29 kg/plant). To confirm the findings as well as to determine the

yield performance, the experiment will be continued.

Evaluation of star gooseberry germplasm 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, Khulshi, Chattogram to evaluate five-star gooseberry germplasm. The largest fruit (16.02 mm × 21.87 mm) was observed in PD Pah-003 whereas the smallest fruit (13.40 mm × 17.10 mm) was found from PD Pah-005.The highest individualfruit weight (4.21 g) was attained from PD Pah 003 and the lowest individual fruit weight (2.35 g) was obtained from PD Pah-005. The maximum edible portion (97.12 %) was recorded in PD Pah-003 followed by PD Pah-002 (96.54%) and the minimum edible portion (94.04 %) was noted from PD Pah-005.The highest fruit yield was obtained from PD Pah-001 (66.28 kg) whereas PD Pah-005 gave lowest yield (7.40 kg). Maximum TSS was found in PD Pah-003 (9.20 %) followed by PD Pah-001 (9.16%), which were very good in organoleptic taste as there was no bitterness in the sap. The minimum TSS (7.92 %) was recorded from PD Pah-005. Based on the TSS (%), fruit size, fruit yield and organoleptic taste, PD Pah-001 and PD Pah-003 were supposed to be superior and might be considered as promising line for variety.

Performance of advanced star apple germplasm in hilly region

S. P. Chakma, M. Islam, M. E. Hoque and M. A. Hossain

An observation was done on star apple at the Hill tracts Agricultural Research Station, Ramgarh, with a view to investigation the performance of star apple germplasm. The leaf colour was brown at ventral surface and green at dorsal surface. The shape of leaf was oblong. Base girth and plant height of CC Ram 006 were 151.5 cm and 12.98 m, respectively (Table 1). Profuse bearing was observed in the line PC Ram 006 which gave 2150 fruits in this year. The mean single fruit weight was 106 g and yield was 225.50 kg/plant. The length of fruit was 5.86 cm and diameter was 5.62 cm. All the fruits had a moderate storage quality (7 days) in perforated poly bag or paper packet but skin was shrinked within three days if keeping in room temperature. It also remained very good up to one month if kept under low temperature and moderate high humidity. Fruits had moderate edible portion (61.12%) and TSS (8.50 %). Number of seeds per fruit was 4.12 weighing 2.47g. The skin colour of the fruits was attractive green with off white flesh with pleasant flavor. A well ripen fruits seems to be soft enough like a rubber ball and tasty like tender coconut pulp but sweet in taste. From previous year's data it is concluded that the line CC Ram-006 could be released as variety.

In-situ evaluation of bilimbi germplasm in Cumilla region

M A Siddiky, T Tasmima, M. O. Kaisar, M H Rahman, M M H Bhuyian, M Rahman

Andm A H Khan

The experiment was conducted at the RARS, BARI, Cumilla. The study comprised two bilimbi germplasm AB Cum-001 and AB Cum-002. Age of the germplasm was 8 years old. Maximum individual fruit weight (24.83 g), fruit/plant (8125) and yield/plant (195.34) was found in AB Cum-001 while minimum in AB Cum 001. The line AB Cum-001 was selected as superior between two germplasm in terms of yield, fruit quality and tolerant to diseases and insects. The line AB Cum-001 was selected as superior one between two germplasm in terms of yield, fruit quality, attractiveness and tolerant to diseases and insects. The fruit of the selected line can be harvested all the year round (January to December). So, this line has been proposed for releasing as a year round bilimbi variety.

Evaluation of water chestnut germplasm

M S Rahman, M A Hossain, H Rahman, A Akter, R Sultana and H E M K Mazed

Three germplasm of water chestnut (*Trapa bispinosa* Roxb) such as TB Jam-001, TB Jam-002 and TB Jam-003 were evaluated at the RARS, Jamalpur. The highest stem length (2.48 m), leaf length (5.64 cm), leaf breadth (7.57 cm), petiole length (12.52 cm), individual fruit weight (18.9 g), and pulp weight (7.9 g) were recorded in TB Jam-001 and the lowest in TB Jam-003. The highest yield per hectare (97.2 t) was observed in TB Jam-001 and the lowest (79.6 t) in TB Jam-003. Considering growth, yield and yield contributing characters it could be concluded that the line TB Jam-001 performed better. The experiment will be continued.

Evaluation of water chestnut germplasm

O. A. Fakir

Water chestnut (*Eleocharis dulcis*) is commonly known as ''Singhara'' or ''Paniphal'' in Bangladesh. The experiment consisted of two germplasm *viz*., red type and green peeled chestnut and it was evaluated at RARS, Jamalpur. The aim of the study was to evalute the germplasm in respect of fruit characters. There was marked variation in fruit length. Maximum fruit length was recorded in red type (4.48 cm) followed by green type (3.77 cm). Besides, maximum breadth (2.72 cm) and single fruit weight (18.80 g) obtained from red type water chestnut. But, highest TSS (5.32%) was recorded from green peeled chestnut. Among two genotypes red type water chestnut gave the most satisfactory performance over green one. It was first year experiment, so it needs to successive two years trial for final conclusion.

Evaluation of eggfruit in hilly area

S. P. Chakma, M. Islam, M. E. Hoque and M. A. Hossain

Eggfruit (*Pouteria campechiana*) is belonged to the family Sapotaceae. It is native to southern Mexico and Central America. It is also widely known as canistel or chesa or tiesa. Because of its diverse usage potentialities, it needs to be evaluated, characterized and released as a new variety in Bangladesh. An experiment on the evaluation of eggfruit or tiesa in the hill valley was conducted at the Hill Agricultural Research Station, Raikhali, Rangamati Hill District. Based on maximum number of fruits per plant (150), individual fruit weight (182 g), fruit size (8 cm x 6.6 cm), pulp thickness (1.5 cm), edible portion (80%) and yield (27 kg/plant), PC Rai-001 found as superior line. PC Rai-001 should be released as a new crop variety in Bangladesh.

Evaluation of jabuticaba in hilly area

S. P. Chakma, M. Islam, M. E. Hoque and M. A. Hossain

Jabuticaba (*Plinia cauliflora*) is a slow growing tree under the family of myrtaceae and native in Central/South/Southeast Brazil. As it can be successfully grafted and has economic value, Jabuticaba variety can be released in Bangladesh. An experiment on the evaluation of jabuticaba in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District. Maximum individual fruit weight (8.3 g), fruit size (26 mm x 25 mm) and yield (14 kg/plant) were observed in PC Rai-005 which had a good taste and TSS (15%). Based on all the fruit yield characteristics, PC Rai-005 was the superior jabuticaba line and should be released as a new variety in Bangladesh.

Evaluation of minor fruits germplasm

F. Ahmed, M. H. M. B. Bhuyan, J. C. Sarker and S. M. L. Rahman

The experiment was conducted at Citrus Research Station, BARI, Jaintapur, Sylhet to find out superior lines suitable for the acidic soil of the northeastern region of Bangladesh. False mangosteen recorded plant height (200 cm), spreading E-W (80 cm), N-S (76 cm), and base girth (1.9 cm). Monkey jack recorded plant height (215 cm), spreading E-W (90 cm), N-S (74 cm) and base girth (1.4 cm). Flacourtia recorded plant height (215 cm), spreading E-W (163 cm), N-S (128 cm) and base girth (3.3 cm).These three germplasm show relatively better growth performance than other minor fruits germplasm. On the other hand, wood apple is slow growing than all the other fruits germplasm. Wood apple attained the lowest plant height (58 cm), lowest spreading E-W (20 cm), N-S (18 cm), and lowest base girth (0.5 cm). Considering the parameters it can be concluded that false mangosteen, monkey jack, and Flacourtia have better growing habit than other minor fruits in nursery condition. On the other hand, wood apple is slow growing compared to all other fruits. These plants will be planted in the fruit orchard of Citrus research station, BARI, Jaintapur, Sylhet in this rainy season to know the performance and suitability of these fruits in this region.

Evaluation of dragon fruit germplasm

J. C. Sarker, M. H. M. B. Bhuyan, F. Ahmed and S. M. L. Rahman

The study was conducted at Citrus Research Station (CRS), Jaintapur, Sylhet with three germplasm of dragon fruit *viz*., HC Jai-001, HU Jai-002 and HM Jai-003. The highest canopy spreading (315 cm × 227 cm) as well as number of side branches (43) were recorded in HU Jai-002 while the lowest (214 cm × 189 cm) in HM Jai-003. The earliest flowering was recorded in HC Jai-001 on 11 May followed by HU Jai-002 (10 May) while HM Jai-003 flowered last (25 September). The highest number (54) of

fruits was recorded in HU Jai-001 and lowest (10) in HM Jai-003. The highest yield per plant (3.42 kg) in HU Jai-002 while the lowest in HM Jai-003 (2.2 kg). The heaviest fruit (356.3 g) was recorded in HU Jai-002 while the lightest (135.5 g) was produced in HM Jai-003. The largest fruit (8.2×7.3 cm^2) was recorded in HU Jai-001 whereas the smallest (7.8×5.6 cm^2) in HM Jai-003. Maximum TSS (12.8%) was recorded in HM Jai-003 while minimum (11.2%) in HC Jai-001. The highest edible portion (81.75%) was recorded in HU Jai-002 whereas the lowest (56.45%) was in HM Joy-003. HU Jai-002 found best regarding fruit weight, fruit size and yield but in consideration of edible portion (%), TSS (%) as well as extraordinary yellow-skinned white fleshed, HM Jai-003 was best. Further evaluation should be done for releasing it as a variety.

Evaluation of cashew nut germplasm in north-eastern hilly region of Bangladesh

J. C. Sarker, F. Ahmed, M. H. M. B. Bhuyan and S. M. L. Rahman

An experiment was conducted at CRS, Jaintapur to find out the promising genotype for commercial cultivation in the region. All the genotypes differed in their growth characters. Among the five genotypes, maximum tree height was recorded in AO Jai-003 (2.08 m) whereas, minimum tree height was reported in AO Jai-004 (1.49 m). Similarly, maximum stem girth was reported in AO Jai-003 (13 cm) while the minimum reported in AO Jai-001 (10.33 cm). Maximum canopy spread in the east-west as well as north-south direction was furthermore reported in AO Jai-005 (85.67 and 83 cm respectively). The plants are at vegetative stage and the growth is satisfactory. Final conclusion can be made after 3-5 years of fruit quality evaluation.

Evaluation of promising cashewnut germplasm in hill tract

S. M. Faisal and Pabitra Sutradhar

Twenty promising cashewnut germplasm were evaluated at Hill Tracts Agricultural Research Station, Ramgarh. Twenty cashew nut germplasm were aged 1.5 to 3 years. Among these twenty plants, data were recorded from three germplasm in respect of flower and fruit. The line AO Ram-012 produced the maximum number of fruits (55/plant) while bigger nut (7 g) was obtained from the line AO Ram-047. Maximum nut yield (0.253 kg/plant) obtained from the line AO Ram-012, and maximum edible portion of nut (35.29 %) was recorded from the same line. Considering nut yield and yield contributing characteristics AO Ram-012 was found the best. The study will be continued.

Evaluation of cashew nut germplasm

S.P. Chakma, S. Marma, M. Islam, M.E. Hoque and M. A. Hossain

An experiment on the evaluation of cashewnut in the hill valley was conducted at the Hill Agricultural Research Station, Raikhali, Rangamati Hill District. The exotic germplasms showed the superiority over local germplasms among all the growth parameters and cashew nut characters. Based on cashew characters AO Rai-034, AO Rai-024 and AO Rai-020 was found as superior lines among all the lines.

Evaluation of coffee germplasm in north-eastern hilly region of Bangladesh

J. C. Sarker, F. Ahmed, M. H. M. B. Bhuyan and S. M. L. Rahman

Evaluation of coffee germplasm was conducted at the Citrus Research Station, Jaintapur, Sylhet to study their performance. Among the three germplasm, the maximum tree height was recorded in CA Jai-002 (1.50 m) whereas, minimum reported in CA Jai-001 (1.41 m). Similarly, maximum stem girth was reported in CA Jai-003 (7 cm) while the minimum reported in AO Jai-001 (6.33 cm). The maximum canopy spread in the east-west as well as north-south direction was furthermore reported in CA Jai-001 (67.67 and 63.67 cm, respectively). The plants are at vegetative stage and the growth is satisfactory. Final conclusion can be made after 3-5 years of fruit quality evaluation.

Evaluation and adaptability of promising coffee germplasm at Ramgarh

S. M. Faisal and Pabitra Sutradhar

The experiment was carried out at the existing plantation of Hill Tracts Agricultural Research Station (HTARS), Ramgarh to identify high yield potentiality and better quality of coffee beans. Twenty genotypes of *Coffea canephora* (syn. *Coffea robusta*) commonly known as *robusta* coffee from the existing coffee orchard of HTARS, Ramgarh was selected for the study. Average plant base girth was 3.46cm. Maximum base girth (4.14cm) was recorded from CC Ram-001, CC Ram-003 and CC Ram-009, respectively. Maximum primary branch/plant was 3, recorded from CC Ram-017.

Average plant height was 2.04m. Average leaf length was 16.32 cm. Average leaf width was 7.18 cm. Average leaf petiole length was 1.76 cm. The line CC Ram-003 showed better adaptability and tolerant to diseases and insect in our climatic conditions. The present finding shows the great genetic potentialities of the studied germplasm. The study should be continued.

Evaluation of coffee germplasm

S.P. Chakma, S. Marma, 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. Maximum plant height (180 cm), base girth (13 cm), canopy size (170 cm x 160 cm) and leaf size (16 cm x 8 cm) were observed in CC Rai001. The lowest plant height (110 cm), base girth (8 cm), canopy size (120 cm x 100 cm), and leaf size (10 cm x 4 cm) was found in CARai002. This is 3rd 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. A. A. Malek, M. G. Rahmanand M. R. Ahmad

The experiment was carried out at the existing plantation of Hill Agricultural Research Station at Khagrachari to identify high yield potentiality and better quality coffee beans. 20 (twenty) germplasm of Coffea canephora (syn. *Coffea robusta*) commonly known as robusta coffee from the existing coffee orchard of HARS, Khagrachari was selected for the study. The average height of evaluated line (CC Kha 001) was medium (4.27 m) and regular bearing evergreen shrub or small tree. The average length and width of leaf was 21.72 cm & 9.99 cm respectively with 1.22 cm of leaf petiole length. The average length and width of individual fruit was 1.36cm & 1.19 cm respectively. Harvesting duration of fruit was mid January to March. The seed colour of evaluated coffee plant (CC Kha-001) was greenish brown with roundish shape. The average length and width of individual seed was 1.11cm & 0.97 cm respectively. Average weight of 100 been was 905g. Average fruit weight (kg) per plant was 8.13.The line CC Kha-001 showed better adaptability, yield, fruit quality, attractiveness and tolerant to diseases and insect is satisfactory in our climatic condition. The present finding shows the great genetic potentiality of the studied germplasm. So this line has been proposed for releasing as a coffee variety.

Performance of coffee germplasm in young brahmaputra and jumuna floodplain

M. T. Islam, B. C. Sarker, M. S. Uddin and M. A. Islam

An experiment on the performance of coffee germplasm in Young Brahmaputra and Jumuna Floodplain region was conducted the Fruit Research Farm of HRC, BARI, Gazipur. The higher plant height and base girth (116.17 cm and 5.35 cm) was recorded in *Coffea robusta* germplasm. Maximum tree volume (141.07 m^3), canopy spread (55.83 × 53.83 cm^2) and number of main branch (20.00) were found in *Coffea arabica* germplasm. This is 1st year experiment. Some plants are at vegetative stage and some are at flowering stage. The experiment will be continued.

Evaluation of fig (*Ficus carica*) germplasm

M. M. Khatun and B. C. Sarker

The edible fig (*Ficus carica*) is a small deciduous tree which has been under cultivation since antiquity in the eastern Mediterranean region. Six fig germplasm were planted in 2019 and evaluated to select the superior ones at the Fruit Research Farm of HRC, BARI, Gazipur. Variation was noticed in number of fruits per plant, fruit characters and pulp characters of fig. Maximum plant height was recorded to be 2.90 m in FC Joy-003 and minimum plant height in FC Joy-005 (1.10 m). Base girth ranged from 11 cm in FC Joy-001 and FC Joy-003 to 12.30 cm in FC Joy-004. The fruit weight ranged from 32.40 to 49.20 g. Fruit length varied from 4.35 to 5.98 cm whether fruit width varied from 3.80 to 5.02 cm. TSS content was noticed to vary from 9.20 to 12.00 ^{o} Brix. Maximum number of fruit was recorded from FC Joy-005 (47). Oblong and globose shape of fruit was observed with light purple to purple colour having light pink to pink colour of pulp. Considering yield and yield contributing characters all the germplasm showed better performance. This is first year result; further evaluation is needed for final conclusion.

Study on floral biology and pollen preservation of avocado

A Anwari and B C Sarker

An experiment to gather vast 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 HRC, BARI, Gazipur. There were 8 germplasm in the fruit research farm, among them the germplasm PA Joy-006 **(**Perseaamericana**),** PA Joy-003, PA Joy-004 and BARI Avocado-1were used as material in this experiment. This is 2nd year experiment. 0-53 unopened flower buds of PA Joy-006, some unopened flower buds of PA Joy-003, PA Joy-004 and BARI Avocado-1of different inflorescences were tagged for observation and data were collected from 02.02.2022 to mid of March/ 2022. Data on the following parameters such as flower type, 1st flower initiation, time of female flower opening- closing, time of male flower opening- closing, pollen number, pollen viability, length of anther, number of anther per flower, length of flower, number of petal, temperature etc. were collected on daily basis. Avocado has structurally perfect or complete or bisexual flower 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. But, this year some male and female flowers were opened at the same time due to low temperature, as it delayed female flower opening and called as synchronization and anther dehiscence was found delayed some cases. Flowers grow in terminal panicles or clusters composed of 200-300 small, yellowish green, light green and yellowish cream color A- type flowers. Stigma of female flower was white and sticky when receptive and shriveled and brown at male stage. Stigma of female flowerof BARI Avocado-1 was white,curvy style and sticky when receptive. Dissected parts of male and female flower, ovary, stigma and anther were observed under microscopes of Plant Pathology Division and Pomology Division of BARI, Gazipur. PA Joy-006, PA Joy-003, PA Joy-004 and BARI Avocado-1 had A-type flower which played role as functional female and male at different time of a day followed by next day. But, this year, flowering pattern similar to type B flower was observed for 4-5 days. Only one true dwarf type avocado variety is named Little Cado, which has both type A & B flower. PA Joy-006 had shown the similar pattern of flowering. Further study is needed for PA Joy-006 to confirm the flower type, either its varietal effect or effect of temperature which might affect synchronization. Female (♀) flower started to open from 10.00-10.30 a.m. and within 11.30 a.m. stigma becomes receptive, receptivity remains up to 12.30 p.m. and then it's starts 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. At 12.30 pm ♂ flowers opened and within 3.00-5.00 p.m. ♂ flowers dehisced and closed for ever, some male flowers were observed active after 6.15 pm. Synchronization of male and female flowers of avocado is far most difficult. This is 2nd year experimental observation. The floral biology study of avocado will be continued, except PA Joy-006 and the study on pollen preservation techniques will be continued to gather exact knowledge about preservation for proper hybridization.

Evaluation of avocado germplasm

S.P. Chakma, M. Islamand M. A. Hossain

The avocado (*Persea americana*), a tree likely originating from south-central Mexico, is classified as a member of the family Lauraceae. Avocados do contain very high fat (about 26%), but it is mostly the unsaturated kind (67% of total fat) as oleic acid which is harmless making it very beneficial for health who have limited access to other fatty foods (high fat meats, fish and dairy products). An experiment on the evaluation of avocado in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2021-22. PA Rai-008 had two fruit set. This is 3rdyear experiment. The growth of all the germplasm was noted satisfactory. The experiment will be continued for further investigation.

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, HRC, BARI, Gazipur. 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, BARI Kanthal-2 and BARI Kanthal-3). 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 January grafting with BARI Kanthal-2 (82.3%). Considering grafting success, January was the suitable time for cleft grafting in jackfruit.

Micro propagation of papaya (*Carica papaya* l.)

M. K. Jamil

For the development of a suitable and reproducible protocol for micro propagation of papaya, shoot tips of BARI papey-1 were cultured on MS medium supplemented with different concentrations of BAP with 4% sugar. The responses of explant were varied at different concentrations of BAP. Among the treatments, BAP at 3.0 mg/l (T_4) and 4.0 mg/l (T_5) along with 4% sugar were found better for shoot induction of the explants. But shoot multiplication and elongation were found better in another treatment (T_5) which consisted of 0.25 mg/l BAP + 0.4 mg/l GA_3.

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 HRC, BARI, 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 on May and September; 4 times on May, August, November and February ; 6 times on May, July, September, November, January and March; NPK fertilizers 6 times on 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 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

Effect of canopy management on growth and yield of mango

Babul C. Sarker and M. Sorof Uddin

The experiment was conducted at the Fruit Farm of HRC, BARI, Gazipur with three BARI released varieties, namely BARI Mango-3, BARI Mango-4 and BARI Mango-8 to standardize canopy architecture of mango plants planted at closer spacing. The experiment was set following RCBD with 5 replications. Immediately after fruit harvest of previous season the 9 years old plants of BARI Mango-3, BARI Mango-4 and BARI Mango-8 were pruned by 30 cm from the tip. Adequate care and management of the plants in the experiment were taken as per requirement. Maximum canopy spread (3.67 m and 3.85 m, respectively) as well as tree volume (33.49 m^3) was recorded in BARI Mango-8 and minimum canopy dimension was noticed in BARI Mango-4. Maximum number of fruits per plant (108.66) was recorded in BARI Mango-3 and minimum number of fruits per plant (48.50) was counted in BARI Mango-8. The highest yield (47.00 kg) was recorded from BARI Aam-4 and the lowest yield (14.45 kg) from BARI Aam-8. The highest average individual fruit weight (520.0 g) was recorded from BARI Aam-4 while the lowest fruit weight (220.0 g) from BARI Aam-3. The highest TSS 23% was recorded from BARI Aam-3 while the lowest from BARI Aam-8. The relation between the yield and the tree volume indicates that tree size management by tip pruning can give higher yield from per unit area of a closer spaced mango orchard. Thus, pruning at appropriate level could be one of the most important tools of structuring mango orchard to a desired canopy architecture as well as yield. The experiment will be continued for confirmation of the result.

Effect of cocodust as growing media for mango sapling production

M. K. Islam, A. S. M. Y. Ali and M. M. Rahman

The experiment was conducted at RHRS, BARI, Chapainawabganj to develop soilless mango sapling production and to facilitate transport/export. The treatments were T_1: Coco dust 100%, T_2: Coco dust 75% + Cow dung 25%, T_3: Coco dust 50% + Cow dung 50% and T_4: CD 50% + Soil 50% (control). Healthy seeds were sown into the pots filled with medium on 16 July 2021. At one year after seeding, the highest plant height (78.65 cm), number of branch per plant (3.00), internode length (11.28 cm),

stem diameter (0.98 cm), number of leaves per plant (54.00) and leaf area was found in the treatment T_4: CD 50% + Soil 50% (control), which was statistically on par with treatments having cocodust plus cowdung i.e. T_2 and T_3 but significantly higher than T_1, the cocodust only. The result indicated that the mango sapling can be grown without soil in cocodust medium in addition with organic manure cowdung to facilitate transport or export. This is the 1st year result and needs to be repeated in next year.

Effect of irrigation on mango fruit cracking in Chattogram region

M. P. Haque, Z. A. Firoz, M.A. Hossain, and S.K. Biswas

The study was conducted at RARS, Hathazari, Chattogram) to explore the optimum period of irrigation to mitigate mango fruit cracking. Five treatments were applied: T_1: rain-fed i.e. local practice, T_2: irrigation at full bloom, T_3: irrigation at fruiting setting, T_4: irrigation at full bloom and fruit setting and T_5: irrigation at 2 weeks interval. The highest yield (76.5Kg 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 dropped fruits (21 and 19) was occurred in irrigation at full bloom and fruit setting (T_4). The lowest number of cracked fruits (15 and 13) as well as the highest TSS (24%) occurred irrigation at fruit setting (T_3) and the benefit-cost ratio was also higher in this treatment.

Effect of ultra high density plantation of mango at varying spacing on yield and profit

M. K. Islam, A. S. M. Y. Ali and M. M. Rahman

The experiment was conducting at RHRS, BARI, Chapainawabganj to find out the optimum spacing for ultra-high density plantation of mango. The treatments were T_1: Traditional spacing 8 m×8 m, T_2: UHDP spacing 3 m×3 m, T_3: UHDP spacing 3 m×2 m, T_4: UHDP spacing 2.5 m×2.5 m and T_5: UHDP spacing 2 m×2 m. One year old saplings were planted on 01 September 2021. No significant difference was found regarding growth parameters after one year of planting. The experiment is in the field and this is first year. The experiment will be continued.

Effect of length of heading back in ultra high density plantation on growth, stature and yield of mango

M. K. Islam, A. S. M. Y. Ali and M. M. Rahman

The experiment was conducted at RHRS, BARI, Chapainawabganj to find out the suitable length of heading back in ultra-high density planting for short stature, balanced branching to cope with the space and higher yield of mango. The treatments comprising two times heading back were T_1: at 60+30 cm heights, T_2: at 60+45 cm heights, T_3: at 60+60 cm heights, T_4: at 60+75 cm heights T_5: at 60+90 cm heights and T_6: No heading back. One year old saplings were planted on 01 September 2021. The first heading back was done on 28 February, 2022. After 4 months of 1st heading back, the highest plant height (1.65 m), number of branch per plant (5.00), stem diameter (2.00 cm), east west canopy (1.10 m) and north-south canopy (1.27 m) and tree volume (1.21m^3) were found in no heading back treatment which were significantly higher than all heading back treatments. Heading back treatments were identical with each other in studied parameters as because heading back at 60 cm height is common to all treatments and 2nd heading back is yet to be done. The experiment will be continued.

Effect of different doses of diquat 20% (Weedout SL) for controlling weed in banana field

M. M. Khatun and B. C. Sarker

A field trial was conducted at the Fruit Research Farm of BARI, to find out the optimum dose of herbicide to control weed in the banana field. Five treatments i.e. T_1: spraying of Diquat 20% @ 6 ml/litre of water, T_2: spraying of Diquat 20% @ 8 ml/litre of water, T_3: spraying of Diquat 20% @ 10 ml/litre of water, T_4: Two hand weeding at 25 and 50 DAE (Days After Establishment) and T_5: No spray (control) were included in this study. Number of weed/m^2 and weed control efficiency (WCE) was influenced by different treatments. Maximum (208 and 269) weeds/m^2 was recorded in control plot at 25 and 50 DAE, respectively. Minimum 70 weeds/m^2 were recorded in T_2 followed by T_3 treatment (74 weeds/m^2), respectively after 25 days of application. The highest weed control efficiency 73.24% was found in T_2 treatment at 25 DAE followed by T_3 treatment (72.24%). The results revealed that spraying of herbicide (Diquat 20% @ 8 ml /litre of water) was the 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 different doses of glufosinate-ammonium 20% (vanish 200sl) for controlling weed in banana field

M. M. Khatun and B. C. Sarker

A field trial was conducted at the Fruit Research Farm of BARI, Gazipur to find out the optimum dose of herbicide to control weed in the banana field. Five treatments i.e. T_1: spraying of glufosinate-ammonium 20% @ 5 ml/litre of water, T_2: spraying of glufosinate-ammonium 20% @ 7 ml/litre of water, T_3: spraying of glufosinate-ammonium 20% @ 9 ml/litre of water, T_4: Two hand weeding at 25 and 50 DAE (Days After Establishment) and T_5: no spray (control) were included in this study. Number of weed/m^2 and weed control efficiency (WCE) was influenced by different treatments. Maximum (201 and 302) weeds/m^2 was recorded in control plot at 25 and 50 DAE, respectively. Minimum 61 weeds/m^2 were recorded in T_2 followed by T_3 treatment (63 weeds/m^2), respectively after 25 days of application. The highest weed control efficiency 74.83% was found in T_2 treatment at 25 DAE followed by T_3 treatment (73.49%). The results revealed that spraying of herbicide (Glufosinate-ammonium 20% @ 7 ml/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 girdling on flowering, fruiting and yield of litchi

M. A. Islam, M. M Khatun and M. J. Rahman

An investigation on girdling practices of litchi was carried out at HRC, BARI, Gazipur, Bangladesh (at 24º 0´ North latitude and 90º 25´ East longitude). Girdling was performed in BARI Lichu-1, BARI Lichu-3 and BARI Lichu-4 having 2 to 3 cm diameter with hardened flush of December/2021. Girdling was done on primary branches of three litchi varieties. Few differences in respect of flowering and fruit characteristics were observed in girdled and non-girdled branches. Bud break of girdled branches was observed on 22 January, 2022 in BARI Lichu-1, 27 January 2022 in BARI Lichu-3 and 02February, 2022 in BARI Lichu-4 where in non-girdled branches on 25 January 2022 in BARI Lichu-1, 28 January 2022 and 5 February 2022 in BARI Lichu-4. First M_1 flowers in girdled branches of BARI Lichu-1, BARI Lichu-3 and BARI Lichu-4 were observed on 3 March, 27 February and 28 February, respectively. Female flowers of those varieties in girdled branches were found on 12th , 8th and 5rd March, respectively where in non girdled branches of female flowers of three varieties were 15th March, 11th March and 10th March, respectively. Last M_2 flowers of BARI Lichu-1, BARI Lichu-3 and BARI Lichu-4 were observed on 16th, 10th and 8th March, respectively. Non girdled branches delayed to produce M_2 flowers. No of initial fruit set per panicle was 45, 32 and 37 in BARI Lichu-1, BARI Lichu-3 and BARI Lichu-4, respectively. The number of initial fruit set per panicle in non girdled branches was observed to be 30, 25 and 28, respectively. Number of flowers, number of fruits, and fruit yields increased in girdled branches than non-girdled branches. The reason of improvement in girdled branches might be due to rapid translocation of photosynthates and minerals from other part of the plants to developing fruits and reduced flow of carbohydrates to the roots. Initial fruit set of girdled branches of BARI Lichu-1, BARI Lichu-3 and BARI Lichu-4 was 52, 40 and 32, respectively whether the number of initial fruit set of those varieties in non-girdled branches was 30, 28 and 25, respectively. The number of fruits harvested from BARI Lichu-1, BARI Lichu-3 and BARI Lichu-4 was 24, 13.2 and 17.6, respectively whether the number of fruit harvested from those varieties in non-girdled branches was 11.3, 8.0 and 9.0, respectively. The experiment will be conducted next year for more confirmation of the results.

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, M. Islam and M. S. Arfin

An experiment was carried out at HRC, 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. The experiment was laid out in a two factor randomized complete block design with 3 replications. There were six levels of organic and inorganic fertilizer doses as T_1: control or farmer's practice, T_2: 100% Recommended dose/plant, T_3: 10 kg vermicompost + 10 kg cowdung + 50% Recommended dose/plant, T_4: 10 kg vermicompost +

10 kg cowdung + 25% Recommended dose/plant, T_5: 10 kg vermicompost + 75% Recommended dose/plant, T_6: 10 kg cowdung + 75% Recommended dose/plant and three types of sapacing as S_1: (1.5 x 3.0) m, S_2: (2.0 x 3.0) m and S_3: (2.5 x 3.0) m. Results revealed that the highest fruit yield (17.51 kg plant^{-1}) due to highest individual fruit weight (287.02 g) and maximum number of fruits per plant (61.00) was recorded from the treatment T_5 (10 kg vermicompost + 75% Recommended dose/plant) and the lowest fruit yield (12.79 kg plant^{-1}) was noted in T_1 (control or farmer's practice). The highest fruit yield (16.07 kg plant^{-1}) was noted in S_2 (2.0 m x 3.0 m) compared to that of S_3 (2.5 m x 3.0 m) (14.21 kg plant^{-1}).The highest fruit yield (19.40 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 (S_2T_5) treatment, which was statistically on par to that of S_2T_3 (2.0 m x 3.0 m spacing and 10 kg vermicompost + 10 kg cowdung + 50% Recommended dose/plant) (18.19 kg plant^{-1}) and the least yield (12.05 kg plant^{-1}) was recorded from S_1T_1 (1.5 m x 3.0 m spacing and control or farmer's practice) treatment combination. Maximum vitamin C (mg/100g) content (370.00) was obtained in S_2T_5 (2.0 m x 3.0 m spacing and 10 kg vermicompost + 75% Recommended dose/plant) and minimum (210.00) vitamin C (mg/100g) content was noted in S_1T_1 (1.5 m x 3.0 m spacing and control or farmer's practice) treatment combination. Maximum TSS (10.77 %) was recorded from S_2T_5 (2.0 m x 3.0 m spacing and 10 kg vermicompost + 75% Recommended dose/plant) treatment combination compared to minimum TSS (8.47%) in S_1T_1 (1.5 m x 3.0 m spacing and control or farmer's practice). This is the third year trial. The experiment will be continued to confirm the outcome of the study.

Effect of split application of fertilizer on the harvesting time, yield and quality of ber

A Akter, M A Hossain, H Rahman, M S Rahman, R Sultana, H E M K Mazed and F Sultana

The study was carried out at RARS, Jamalpur. The treatments were: Factor-A: fertilizer dose: F_1: Recommended dose (1222 g urea, 1000 g TSP, 1000 g MOP, 281 g gypsum, 15 g boron and 30 kg cowdung), F_2: 150% of the recommended dose and F_3: 200% of the recommended dose; Factor-B: split application of fertilizer: S_1: Total amount of fertilizer in one installment (at vegetative stage), S_2: Total amount of fertilizer in two installments (at vegetative stage + just after fruit set) and S_3: 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 variation was observed in the treatments in terms of parameters studied. 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) gave the highest yield (71.50 kg/plant). Application of 150% of the recommended fertilizer dose (1222 g urea, 1000 g TSP, 1000 g MOP, 281 g gypsum, 15 g from and 30 kg cowdung and total amount of fertilizer in two installments (at vegetative stage and just after fruit set) can be recommended for higher yield of BARI Kul-2).

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 HRC, BARI, Gazipur to develop a recommendation of fertilizer for coconut. 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 RCBD with four replications. BARI Narikel-2 was taken for the experiment. Age of palm tree was 12-14 years at Gazipur. The highest number of initial female flowers was observed in T_3 (17.7) and the lowest number of female flowers was obtained from T_5 (9.5). Fruit set differed significantly among different treatments. The highest number of fruit per bunch was noticed in T_3 (11.0) followed by T_2 (10.6) and T_1 (8.5). The lowest number of fruit set per bunch was recorded in T_1 i.e., control (6.0). Number of fruits per plant differed significantly among the treatments. The highest number of fruits per year was observed in T_3 (121.0) and the lowest in T_5 (38.4). The highest water content was found in T_3 (905 ml) followed by T_2 (780 ml) and T_1 (750 ml). The lowest water content in green coconut was observed in T_5 (520 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 the rest 50% NPK applied at April/May is recommended. Gypsum, boron, zinc

and cowdung would be applied as blanket doses at September/October. Before use of fertilizer, sanitation i.e., cleaning 2 times at September/October and April/May were done.

Effect of fertilizer on prevention of flower and fruit drop in coconut

M. R. Islam, M. J. Rahman, S. D. Setu, S. Hasna and M. R. Uddin

The present study was conducted at RARS, Rahmatpur, Barishal to evaluate effect of fertilizer to reduce on flower and fruit drop in coconut. The experiment was laid out in a RCBD with three replications and five treatments. T_1 (RD): $N_{450}P_{100}K_{1000}S_{63}Zn_{21}B_5$ g/tree/year, T_2 (RD + 25% more): N_{562} $P_{125}K_{1250}S_{79}Zn_{26}B_{6.25}$ g/tree/year, T_3 (RD+ 50% more): $N_{675}P_{150}K_{1500}S_{93}Zn_{32}B_{7.5}$ g/tree/year, T_4: PF (20 kg cowdung) and T_5: Control. The highest plant height was observed in the treatment T_4 (19.15 m) whereas the lowest one was treatment T_5 (17.44 m). The highest base girth was found in the treatment T_2 (1.31 m) and lowest one was T_4 (1.12 m). There was a significant difference in the number of leaves per plant. The height number of leaves per plant was 30.33 in treatment T_2 and the lowest one was treatment T_2 (23.67). There was a significant difference in the number of bunch per plant. The highest bunch per plant was count in the treatment T_2 and T_3 (10) where the lowest one was treatment T_1 and T_5 (7.67). The length of spadix was a significant difference. The height length was treatment T_2 (95.91cm) and the lowest one was Treatment T_1 (70.95cm). The highest number of fruit per bunch was observed in the treatment T_2 (10.54) followed by T_3 (9.87). The lowest number of fruit per bunch was observed in the treatment T_5 (5.35). There was a significant difference in the number of nut per plant. The higher nut number was found treatment T_2 (105.73) and the lowest one was treatment T_5 (41.20). Application of RD + 25% more (N_{562} $P_{125}K_{1250}S_{79}Zn_{26}B_{6.25}$ g/tree/year), was noticed beneficial in respect of maintaining nutritional status of coconut and improving coconut yield over a period of time.

Effect of organic fertilizers for safe lemon production

M. H. M. B. Bhuyan, M. M. Rahman, F. Ahmed, J. C. Sarker and S. M. L. Rahman

The experiment was conducted on five years old BARI Lebu-5 at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a RCBD with six treatments, each replicated three times. The total number of plant units subjected to the study was eighteen (18). The treatments include T_1: Native nutrients (soil without manures and fertilizers), T_2: Farmers practice (RDF according to FRG from chemical fertilizers), T_3: Farmyard manure (10 t ha^{-1}), T_4: Vermicompost (6 t ha^{-1}), T_5: Poultry manure (5 t ha^{-1}), T_6: Mustard oil cake (4 t ha^{-1}). Although from the experiment it was found that T_2 (farmers practice) performed best compared to the organic treatments, but the organic treatments are very closer to the farmers practice. Among the organic treatments T_4 (Vermicompost) performed best regarding growth, yield contributing characters, yield and fruit quality attributes of BARI Lebu-5**.** The experiment should be repeated for further confirmation of the result.

Evaluating beneficial microorganisms for safe and quality lemon production

M. H. M. B. Bhuyan, M. M. Rahman, F. Ahmed, J. C. Sarker and S. M. L. Rahman

The study was executed with the aim of evaluating beneficial microorganisms (BM) on growth and yield of BARI Lebu-5. The experiment was conducted on five years old BARI lebu-5 orchard planted in 3m×3m spacing at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a RCBD with four treatments, each replicated three times. The treatments include T_1: Control (water spray), T_2: Spray of effective microorganism, T_3: Soil application of *Bacillus* sp., T_4: Spray of Clybio (Japanese formulation). The results illustrated significant differences among the treatments. Maximum increament in plant height was found in T_3 (14.45%), highest increament in base girth and canopy spreading was found in T_4 (4.4% and 22.5×22.8 % respectively). On the other hand maximum yield plant^{-1}, and yield ha^{-1} was found in T_2 (22.30 kg and 24.53 t ha^{-1} respectively) followed by T_3 (21.93 kg and 24.13 t ha^{-1} respectively). This is the first year study. The experiment should be repeated for the confirmation of the 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 in RARS, Rahmatpur to

investigate the effect of vermicompost on growth and fruit yield of sweet orange. There were four treatments comprising T_1: 100 % of the recommended dose per plant (FRG, 2018); T_2: 100 % of the recommended dose plus 10 kg vermicompost; T_3: 100 % of the recommended dose plus 20 kg vermicompost; T_4: 100 % of the recommended dose plus 30 kg vermicompost. All the treatments were significantly different from the control on all the growth and yield parameters. Data revealed that, vegetative characters plant height was recorded maximum in plants treated with treatment T_1 (335.00 cm) and maximum base girth was noticed in plants treated with T_1 and T_2 simultaneously. The highest number of fruits per plant was counted in plants treated with T_4 (105.67) which was statistically followed by T_3 (103.33) and lowest on T_1 (96.33). Individual fruit weight was maximum in plants treated with T_4 (151.00 g) and lowest on T_2 (134.47g). Highest yield and TSS was observed in plants treated with T_4 (17.36 kg/plant) and (11.75%), respectively. Minimum number of fruits per plant and yield (96.33 and 12.13 kg/plant, respectively) were recorded in plants treated with T_1, only 100 % of the recommended dose per plant where no vermicompost was added. From this experiment, it was observed that applying 100 % of the recommended dose plus 30 kg vermicompost exhibited best results.

Effect of gibberellic acid (GA_3) on seedlessness of latkan (*Baccaurea sapida*)

A. S. M. Mesbah Uddin and M. T. Islam

An investigation was carried out at HRC, BARI, Gazipur. The investigation was done to know the effect of GA_3 on seedlessness of latkan. GA_3, was applied at before full bloom stage. Treatments were varying with six concentration of gibberellic acid i,e T_1: 0 ppm (control), T_2: 50 ppm, T_3: 100 ppm, T_4: 150 ppm, T_5: 200 ppm and T_6: 250 ppm. Harvested fruit shape was roundish, skin colour of fruits was yellowish and surface texture of fruits was smooth. Pulp and albedo colour was off-white and the texture of pulp was observed soft. A wide range of variation was observed with respect to fruit weight, fruit breadth, inflorescence length and number of fruits per inflorescence among the treatments. The highest individual weight of fruit was recorded from T_6 (15.07g), whereas the lowest individual fruit weight was noted in T_1 (12.91g). The largest fruit was observed in T_6 (3.23 x 3.40 cm) and the smallest in T_1 (2.86 x 3.08 cm). Inflorescence length varied from 18.53cm to 22.37 cm, the highest was found in T_4 (20.75 cm) followed by T_6 (20.75 cm) and minimum inflorescence length was recorded in T_3 (117.47cm). Number of fruits significantly varied among the treatments. Maximum fruits were observed in T_6 (18.08) and the least number of fruits per inflorescence was recorded in T_2 (14.58). Rind weight varied from 5.63g to 6.85g in T_1 and T_6 respectively. The highest rind thickness was recorded in T_4 (0.35 cm) and the lowest rind thickness was observed in T_2 (0.29 cm). In case of number of segments per fruit and percent edible portion, maximum segments was manifested in T_6 (3.81, 54.41) and minimum number of segments was recorded in T_1 (3.11) and T_1 (51.81), respectively. Number of seeds varied from 3.11in T_1 to 3.81in T_6. The largest seed was observed in T_1 (1.22x .97 cm) and the smallest seed was noticed in T_6 (1.02 x 0.84 cm). Weight of 100 seeds was found maximum in T_1 (25.177g) and minimum value was recorded in T_6 (22.88g). TSS varied from 15.92 in T_6 and 18.03 in T_1. According to the objective no expected output was found. It might be due to heavy rainfall after applying hormone (GA_3). GA_3 250 ppm gave bigger fruits with more edible portion. When we applied more concentration of i.e. GA_3 500 ppm or more seedlessness occurred without any flesh.

Effect of fertilizer dose on growth, yield and quality attributes of wax apple

M. T. Islam, M. A. Quddus, B. C. Sarker, M. Islam 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 HRC, BARI, 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 (cowdung 10 kg, Urea 304 g, TSP 300 g, MoP 400 g, gypsum 100 g, zinc sulphate 19 g and boric acid 18 g), T3: 125 % Recommended dose per plant (cowdung 12.5 kg, Urea 380 g, TSP 375 g, MoP 500 g, gypsum 125 g, zinc sulphate 24 g and boric acid 23 g) and T4: 150

% Recommended dose per plant (cowdung 15 kg, Urea 456 g, TSP 450 g, MoP 600 g, gypsum 150 g, zinc sulphate 29 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 (4.84 m, 58.50 cm, 60.16 m^3, 4.65 m and 5.10 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 (73.93 kg plant-^{1}) due to the highest individual fruit weight (61.00 g) and maximum number of fruits per plant (1212) 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) (56.65 kg plant-^{1}). Maximum TSS (%) was noted from the treatment T_4 (5.50) and the minimum TSS (%) was recorded in T_1 (4.73). The highest increase in terms of all the growth parameters of BARI Jamrul-3 over control was noted from the treatment T_4 (150 % Recommended fertilizer dose per plant). Increase of fertilizer might increase plant growth as well as yield and quality of wax apple. The experiment should be continued in the next year for further evaluation.

Effect of stem prunning on the growth and yield of dragon fruit

A Akter, M A Hossain, H Rahman, 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: T_1: Only Mother stem allowed up to trellis; T_2: Two stems allowed up to trellis (with mother stem); T_3: Three stems allowed up to trellis (with mother stem); T_4: Four stems allowed up to trellis (with mother stem); T_5: Five stems allowed up to trellis (with mother stem) and T_6: 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 (245 g, 249 g and 241 g, respectively). Maximum edible portion (64.56 %) was found from two stems allowed up to trellis (with mother stem). The experiment will be continued in the next year for the confirmation of the result.

Effect of bud thinning on quality and yield of dragon fruit

M.G. Azam, S.M.K.H. Chowdhury and A.S.M.H. Rashid

The study was conducted in the dragon fruits orchard of Agricultural Research Station, Khulshi, Chattogram to assess the effect of bud thinning on quality fruit production of dragon fruit. There were six treatments namely T_1: 10% bud thinning, T_2: 20% bud thinning, T_3: 30% bud thinning, T_4: 40% bud thinning, T_5: 50% bud thinning and T_6: no bud thinning (control) in this experiment. The experiment was laid down in RCBD, which was replicated thrice. The highest number of fruit (72.33) was obtained from T_6 treatment and the lowest number of fruit (52.00) was obtained from T_5 treatment. The largest size fruit (9.75 cm × 7.67 cm) was obtained from T_5 treatment followed by T_4, T_3, T_2 and T_1 treatment. On contrary, the smallest size fruit (9.19 cm × 7.50 cm) was obtained from T_6 (control) treatment. The highest fruit weight (317.45 g) was obtained from T_5 treatment and the lowest fruit weight (265.09 g) was obtained from T_6 (control) treatment. Skin thickness (cm), skin weight (g), TSS (%) and edible portion (%) were statistically insignificant. The highest yield/pillar (19.18 kg) was obtained from T_6 (control) treatment and the lowest yield/pillar (15.84) was recorded from T_5 treatment but in term of quality the largest fruit and maximum weight was obtained from this treatment. So, it can be concluded 50 % bud thinning can ensure the production of highest quality of dragon fruit. It is first year experiment, further evaluation is needed for next year for the confirmation of this result.

Identification of suitable light for enhancing day leangth for off season dragon fruit production

M.G. Azam, S.M.K.H. Chowdhury and A.S.M.H. Rashid

The study was conducted in the dragon fruit orchard of Agricultural Research Station, Khulshi, Chattogram to identify the economically suitable light for off season dragon fruit production. There were four treatments namely T_1: 100 W Incandescent Bulb (IB), T_2: 20 W warm LED, T_3: 18 W warm LED and T_4: 15 W warm LED in this experiment. The experiment was laid down in RCBD, which was replicated thrice. The day temperature was higher than the night temperature during the experimental period. The relative

humidity ranged from 29 to79% in the morning (10 am). On the other hand, at night (10 pm) the relative humidity ranged from 61 to 99%. The highest number of bud/ pillar (60.44) and the highest number of fruits/pillar (32.78) were attained from T_1 treatment. On the other hand T_4 treatment provided the lowest number of buds/pillar (33.89). T_3 treatment provided the lowest number of fruits/ pillar (20.45), which is statistically identical with T_4 treatment (20.56). The highest fruit length (9.75 cm) was observed in T_2 treatment and the lowest fruit length was recorded from T_4 treatment (8.89 cm). The fruit breadth ranged from 7.93 cm-8.13 cm, fruit weight ranged from 311.92 g-333.80 g, edible portion ranged from 58.10-61.52% and the TSS ranged from 10.27 %-11.29%. The highest fruit yield/ pillar was obtained from T_1 treatment (9.99 kg). On contrary, the lowest fruit yield was recorded from T_4 treatment (6.36 kg). Highest BCR (2.80) was obtained from T_3 treatment and the lowest BCR (2.23) was recorded from T_4 treatment. Considering yield, yield contributing characters and BCR, it can be concluded that artificial lighting with 18 W warm LED for 6 hrs from 6 pm-12 am is more beneficial for off-season dragon fruit production. Though the experiment was conducted for the first time, further evaluation is needed in next year.

Project VI: Urban Horticulture

Development of production package of some selected fruit crops for rooftop gardening

M. Islam, A. Anwary, B. C. Sarker and M. T. Islam

An experiment was conducted on the rooftop of HRC, BARI, Gazipur to develop production package for selected fruit crops on the roof. The experiment was laid out in a RCBD with three replications. Each of fruit plants were selected as a treatment. The fruit crops such as dragon fruit, guava and golden apple were selected for performance trial on the roof. In respect of all tested parameters such as the plant height, number of brunches per pillar, numbers of fruits per pillar, edible portion (%), TSS (%) and yield/ pillar (kg) were found higher in BARI Dragonfal-1 by 201.18 cm, 14.7, 20.33, 83.00 %,15.79 % and 5.17 kg, respectively compared to BAU Dragonfal-2. First flower initiation was 15 days earlier in BARI Dragonfal-1 (351 days) compared to BAU Dragon fral-2 (366 days). In terms of fruit weight, length and breadth (243.9g, 8.60 cm and 6.81 cm respectively), the larger fruits were obtained from BARI Dragonfol-1 than BAU Dragonfal-2. Considering plant height, stem diameter and canopy spread from the North to the South BARI Amra-2 (V_2) performed better than BARI Amra-1(V_1) by 180 cm, 18.7 cm and 153.2 cm respectively. But, in terms of yield BARI amra-1(V_1) showed better performance (158 fruits/ plant) than BARI Amra-2 (V_2). In case of guava, considering plant height, number of branches / plant and canopy spread in both N-S and E-W directions (159.0cm, 21 branches per plant, 163.8 cm and 185.3 cm, respectively), BARI Peyara-2 performed better than BARI Peyara-4. Higher stem diameter (7.73 cm) and number of leavesper plant (203 leaves) were observed in BARI Peyara-4 compared to BARI Peyara-2. Minimum days were required to 1st flower initiation in BARI Peyara-4 (58 days) and maximum were in BARI peyara-2 (74 days). Number of fruits per plant was collected higher from BARI Peyara-2 (4.00). The highest individual fruit weight (185.33 g) and total yield (737.00 g) were found from BARI Peyara-2 in comparison with BARI Peyara-4. Further study is highly desired to confirm the result.

Standerdization of soil media for roof gardening of guava

M S Rahman, M A Hossain, H Rahman, A Akter, R Sultana, H E M K Mazed and M Yasmin

An experiment was conducted at HRC field, 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 (5.02 m^3) was found in 50% soil + 50% vermicompost followed by 50% soil + 50% cowdung (4.377 m^3) and the lowest tree volume (1.84 m^3) was obtained from 100% soil (control). The maximum number of fruits per plant (88.57) was observed in T_4 treatment whereas the minimum number of fruits per plant (55.63) was observed in T_7 (control) treatment. The highest yield per plant (32.57 kg) was found in T_4 treatment (50% soil + 50% vermicompost) followed by T_1 (28.41 kg) and the lowest yield (17.81 kg) was in T_7 (control) treatment.

Effect of different growing media for dragon fruit production on the roof

M. Islam, A. Anwary, B. C. Sarker and M. T. Islam

An experiment was carried out on the rooftop of HRC, BARI, Gazipur to evaluate the different growing media for dragon fruit production on the roof. The experiment was laid out in a RCBD with three replications. The experiment had been divided into two sets. In set-1, the different combinations of growing media including soil had been applied whereas, in set-2, different soilless media had been used. BARI Dragonfal-1 was selected for both sets of the experiment. There were four treatments in set-1 *viz.*, T_1 (100 % loam soil), T_2 (50 % loam soil + 50 % coco dust), T_3 (50 % loam soil + 50 % bio-char) and T_4 (40% Loam soil + 30 % coco dust + 30 % bio-char) and in set-2, there were three soilless media as treatment such as T_1 (100 % Coco dust), T_2 (100 % Bio-char) and T_3 (50 % coco dust + 50 % bio-char). By considering most of the growth and yield parameters in set-1 (soil media) experiment, the treatment T_2 (50 % loam soil + 50 % coco dust) performed the best and in the case of set-2 (soilless media) the treatment T_1 (100 % Coco dust) showed the best result. Further study is highly needed for the confirmation of the result.

Standardization of soil media for roof top gardening of dragon fruit

M S Rahman, M A Hossain, H Rahman, 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 (4.62 m^3) was found in T_4 treatment and the lowest tree volume (2.06 m^3) was obtained from T_7 (control) treatment. The maximum number of fruits per plant (11.17) was observed in T_4 followed by T_1 treatment (10.00) whereas the minimum number of fruits per plant (3.5) was observed in T_7 (control) treatment. The highest yield per plant (3.08 kg) was found in T_4 treatment (50 % soil + 50 % vermicompost) followed by T_1 (2.74 kg) and the lowest yield (0.74 kg) was in T_7 (control) treatment.

Evaluation of strawberry production in different growing methods on the roof

M. Islam, A. Anwary, B. C. Sarker and M. T. Islam

An experiment was conducted on the rooftop of HRC, BARI, Gazipur. The experiment was laid out in a RCBD with three replications. BARI Strawberry-3 was selected for the experiment. The experiment was divided into three sets of research activities. There were four treatments in set-I *viz.*, T_1 (Column system), T_2 (Vertical wall mount system), T_3 (Horizontal bed system) and T_4 (Pot culture). In set-II there were two treatments such as T_1 : column system (Iron) and T_2 : column system (plastic). There were also two treatments in set-III viz; T_1: Bed system (Geobag) and T_2: Bed system (cocksheet). By considering the growth and yield parameters the horizontal bed system performed the best (Set-I) and between different bed systems the cocksheet bed performed better (set-III). However, in between two column systems the performance of plastic column was found better considering growth and yield of strawberry. Further study is needed for the confirmation of the result.

Project V: Adaptive Trial

Performance of BARI developed jackfruit varieties at Joydebpur

M. J. Rahman, S. M. M. Rahman and M. A. Islam

An experiment was performed at the Fruit Research Farm, HRC, BARI, 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 1m x 1m x1m. The experiment was laid out in RCBD with 12 replications. Plant heights in June, 2021 of BARI Kanthal-1, BARI Kanthl-2 and BARI Kanthal-3 were recorded 4.03 m, 4.00 m and 3.96 m, respectively and in June, 2022 plant heights of BARI Kanthal-1, BARI Kanthl-2 and BARI Kanthal-3 were recorded 4.40 m, 4.21 m and 4.18 m, respectively. From June, 2021 to June, 2022, plant height increased 9.10 % in BARI Kanthal-1, 5.25% in BARI Kanthl-2 and 5.60% in BARI Kanthal-3, respectively. At the same time, base girth increased from 30.9 cm in June, 2021 to 44.20 cm in June,

2022 in the case of BARI Kanthal-1; 35.7 cm in June, 2021 to 49.4 cm in June, 2022 in the case of BARI Kanthal-2 and 34.0 cm in June, 2021 to 47.2 cm in June, 2022 in the case of BARI Kanthal-3. From June, 2021 to June, 2022, base girth increased 43.0 % in BARI Kanthal-1, 54.4 % in BARI Kanthal-2 and 38.8 % 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 all the varieties of jackfruit i.e., BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3 in June, 2022 and matured fruits were harvested from all the varieties. BARI Kanthal-2 and BARI Kanthal-3 didn't show their off-season and year round behaviour. The experiment will be continued for desired characters.

Performance of BARI developed jackfruit varieties at Narsingdi

S. M. M. Rahman, M. J. Rahman, M. A. Islam, R. Akter and M. H. Rahman

Comparative perfomance of BARI released three Jackfruit varieties (BARI Kathal-1, BARI Kathal-2 and BARI Kathal-3) were evaluated at the RHRS, BARI, Shibpur, Narsingdi. Wide range of variation was observed in plant height, base girth,trunk height, plant spreading and number of main branch/plant. Plant height varied from 2.56 m to 3.50 m, whereas trunk height ranged from 0.52 m to 0.66 m. Base girth ranged from 23.66cm to 25.92 cm. Plant spreading varied to a large extent. The minimum N-S spreading was found in BARI Kanthal-3 (1.81 m) and the maximum in BARI Kanthal-2 (2.08 m). The E-W spreading ranged from 1.77 m to 2.14 m. The highest no. of main branch was found in BARI Kanthal-1 (5.8). It was second year result. So, only growth parameters were recorded. Further study is needed to evaluate more precisely.

Adaptive trial of selected crops at farmer's field

M. Islam, A. Anwary, B. C. Sarker and M. T. Islam

An adaptive trial was conducted at the farmer's field of Nalitabari and Jhenaigati upazilla in Sherpur district. In this trial BARI Dragonfal-1 and BARI Peyara-4 were selected for both locations. From the study it was found that in every case the performance of BARI dragon fol-1 and BARI Peayara-4 was found comparatively better in Jhenaigati Upazilla than in Nalitabari Upazilla. In case of dragon fruit, results showed that BARI Dragonfal-1 produced 172 % more brunches and 216 % more fruits/pillar than in Nalitabari Upazilla. In Jhenaigati Upazilla, individual fruit weight, fruit size (length and breadth) were 220.7 g, 7.47 cm, 7.13 cm respectively, whereas, in Nalitabari they were 130.3 g, 5.60 cm and 5.45 cm respectively. BARI Dragonfal-1 yielded 437.8 % higher in Jhenaigati than in Nalitabari. Higher edible portion (66.32 %) and TSS (10.89 %) was also found in Jheanaigati. The growth performances of BARI Peyara-4 in Jhinaigati upazilla was found better than in Nalitabari Upazilla. In Jhenaigati Upazilla plant height, number of branches/plant, canopy spread (N-S and E-w), number of leaves/plant and no. of fruits/plant were 264.5cm, 78.33, 238.2 cm, 218.5 cm.5 cm, 1542 and 27 respectively, which is 87 %, 144 %, 92 %, 116 %, 104 % and 125 % higher than the performance of BARI Peyara-4 in Nalitabari respectively. Considering growth and yield characteristics, performance of BARI Dragonfal-1 and BARI Peayara-4 was found better in Jhenaigati Upazilla than in Nalitabari Upazilla may be due to soil and climatic condition and proper management practices. However, further study is required for the confirmation of the results.

Adaptive trial of BARI released lemon varieties

A. K. M. M. Rahman, S. M. M. Rahman, M. H. Rahman and R. Akter

The experiment was conducted to evaluate the suitable lemon variety for Narsingdi region at the research field of RHRS, BARI, Shibpur, Narsingdi with two BARI released lemon variety with one local variety. Significant variation was observed in case of growth, yield contributing characters, yield and fruit quality of the variety studied. The highest plant height (4.08 m) and base girth (0.27 m) was recorded from BARI Lebu-5. The maximum canopy spreading (3.37× 2.96 m^2) were noted form local variety followed by BARI Lebu-4 (3.16x2.95 m^2). Maximum yield (16.41 t/ha) was obtained from BARI Lebu-5. On the other hand minimum yield (9.91t/ha) was recorded in local variety. Among the variety BARI Lebu-5 and BARI Lebu-4 was found to free from disease whereas local suffered from gummosis. Leaf miner was common in case of all of the variety. Fruit size was the highest in BARI Lebu-5 (13.50 × 7.73 cm^2) followed by local variety (12.14 × 6.08 cm^2). The highest edible portion (73.33 %) and TSS (8.00 %) was noticed in BARI Lebu-5. This is first year evaluation, further studies is needed to evaluate more precisely.

Research carried out by different sections of HRC

Project VI: Postharvest Technology Section

Postharvest storage and value addition of mango through semi solid mesocarp

M. S. Arfin, M.N. Islam, T. A. A. Nasrin and M. F. B. Hossain

The experiment was conducted at the laboratory of Postharvest Technology Section, HRC, BARI, Gazipur to investigate the effectiveness of different preservatives (citric acid, potassium metabisulphite, calcium chloride, table salt and ascorbic acid) on semi solid mesocarp of mango at three drying conditions (50, 60 and 70%). Full ripe mango fruits of variety 'Langra' were procured from contact grower /local market. Mangoes were washed with Aqua's solution of 200 ppm sodium hypochlorite. Fruits were peeled carefully by prewashed stainless steel knife and mesocarp were cut into pieces and kept in prewashed stainless steel trays. Then a fixed amount of mango slices were treated with desired preservatives and subjected to the three drying conditions. Findings of the present study revealed that preservatives had positive effect on drying of semi-solid mango mesocarp and positive changes occurred in colour and shelf life of mango slices. In 50% drying, lightness (L*) were reduced, redness (+a*) increased and yellowness (+b*) decreased and the rate were higher in control and ascorbic acid treated slices and lower in citric acid and potassium metabisulphite treated slices at 12th month of storage. L* value (lightness) decreased, +a* value (redness) and +b* value (yellowness) increased after 60% and 70% drying. Changes in lightness was low in potassium metabisulphite and high in salt, in redness, was lower in potassium metabisulphite and higher in calcium chloride and in yellowness, was low in citric acid and high in potassium metabisulphite at 12th month of storage. In all drying conditions, ascorbic acid treated mango slices showed the highest vitamin C content at 12th month of storage and it was 13.31 mg/100 g at 50% drying, 11.68 mg/100 g at 60% drying and 9.87 mg/100 g at 70% drying. Vitamin C decreased with the drying condition and it was maximum in 70% drying and minimum in 50% drying. In potassium metabisulphite and citric acid treated slices, the changes in vitamin C were minimum in 50% drying (11.68 mg/100 g in potassium metabisulphite and 11.60 mg/100g in citric acid). In 60% drying this vitamin was 9.87 mg/100 g in potassium metabisulphite and 9.60 mg/100 g in citric acid and in 70% drying, it was 7.28 mg/100 g in potassium metabisulphite and 6.60 mg/100 g in citric acid. This is the first year's trial. Therefore, more trial is needed with other varieties to generate additional information and further confirmation of the results.

Standardization of ethylene dose for uniform and safe bulk ripening of banana using developed low-cost ethylene generator

M. S. Arfin, M.N. Islam, T. A. A. Nasrin, M. F. B. Hossain and M. M. Rahman

An experiment was carried out at the laboratory of Postharvest Technology Section, HRC, BARI, Gazipur to find out the effective concentration of ethephon (2-chloroethylphosphonic acid) with newly developed simple 'Ethylene Generator' on safe ripening and quality of banana. Bananas (var. Sobri) were harvested at proper maturity (matured green) stage and exposed to ethylene gas generated from ethephon (48 SL) by low-cost simple 'Ethylene Generator'. Ethephon solutions were prepared at desired concentration (100 and 400 ppm) for ethylene gas generation. Quantity of ethephon containing the desired level of active ingredient was suspended in 10 ml of distilled water and 5 ml of 39% potassium hydroxide solution. The prepared solution was then poured into a small plastic container containing some cotton. This container was the newly developed low cost ethylene generator. Two concentrations of ethephon i.e. 100 and 400 ppm were used as source of ethylene gas. Bananas were exposed to ethylene gas for 24 hours at ambient storage (27±1°C and 70±5% RH) condition in a large polythene bag (used as ripening chamber) and the small plastic container (newly developed low cost ethylene generator) was placed inside it for uniform ripening. Treatment with ethylene gas resulted in 99% fruit ripe with uniform yellow colour, desirable firmness and acceptable quality after the end of storage. Lightness (L* 51.12), greenness (a* -9.98) and yellowness (b*35.57) increased after 24 hours in 400 ppm ethephon treated fruits which indicated the change of skin colour from green to yellow. Banana treated with 400 ppm ethephon was softer than 100 ppm ethephon treated fruits and firmness was 2.13 kg

after 48 hours and 1.89 kg at 72 hours of storage time. This is the first year's trial. Therefore, more trial needs with bulk volume of banana fruits and different concentrations of ethephon to generate additional information and further confirmation of the results.

Selection of suitable cutting size and cultivar for semi solid dry mango

M. S. Arfin, M.N. Islam, T. A. A. Nasrin, M. F. B. Hossain and M. M. Rahman

An experiment was carried out at the laboratory of Postharvest Technology Section, HRC, BARI, Gazipur to find out the effectiveness of three cutting sizes (2 slices per mango, 4 slices per mango and cubes from mango) for semi solid dry mango at two drying percentages (70 and 80%). From the findings obtained from a previous study on effectiveness of different preservatives (citric acid, potassium metabisulphite, calcium chloride, table salt and ascorbic acid) on semi solid mesocarp of mango at three drying percentages (50, 60 and 70%), potassium metabisulphite as preservatives was selected for this study.

Full ripe mango fruits of variety 'Harivanga' were procured from contact grower /local market. Mangoes were washed with Aqua's solution of 200 ppm sodium hypochlorite. Fruits were peeled carefully by prewashed stainless steel knife and mesocarp were cut into desired pieces and kept in prewashed stainless steel trays. Then a fixed amount of mango slices were subjected to the two drying conditions. Findings of the present study revealed that cutting size had positive effect on drying of mango. Lightness decreased, redness and yellowness increased after 70% and 80% drying in three cutting sizes. The change was higher in cubes and lower in two slices per mango cutting size. This is the first year's trial. Therefore, more trial is needed with quality parameter analysis to generate additional information and further confirmation of the results.

Project VII: Plant Pathology Section

Monitoring of post harvest diseases in common fruits

L. Yasmin, M. Afroz and M. M. Rahman

Disease samples of banana, straw berry, bael, grape and orange were collected from fruit research field of HRC, BARI, Gazipur during October 2021 to May 2022. Disease symptoms appeared on fruits. *Fusarium* sp.,*Chladosporium* sp and *Colletotrichum* sp. were identified from banana; *Fusarium* sp., *Chladosporium* sp, *Pestalotia* sp. and *Aspergillus* sp., *Penicillium* sp. and *Rhizopus* sp. were identified from straw berry and *Fusarium* sp., *Chladosporium* sp., *Diplodia*sp., *Aspergillus* sp. *and Penecilium* sp. were identified from grape and orange.

Project VIII: Agricultural Economics & Statistics Section

Adoption and profitability of BARI Dragonfal-1 at farm level in the Chattogram hill tracts of Bangladesh

R. Islam and S. M. A. Shiblee

The study was carried out to gain an in-depth understanding on the adoption and profitability of BARI Dragonfal-1 at the farm level in Khagrachari and Rangamati Hill district of Chattogram hill tracts of Bangladesh. A total of 60 Dragon fruit farmers were selected by taking 30 farmers from each district. Agriculture was the main source of livelihood income. Data were analyzed through tabular method and Cobb-Douglas production model. Most of the farmers cultivated BARI Dragonfal-1 as their high value crop. BARI Dragonfal-1 as considering a new fruit variety, it was mostly cultivated in the study areas. Farmers' consciousness about BARI Dragonfal-1 cultivation was found increasing. Gross margin were Tk. 2279124/ha and Tk. 3300268/ha for Rangamati and Khagrachari areas, respectively on cash cost basis. Net return from dragon fruit cultivation were Tk. 2229524/ha and Tk. 3245268/ha for Rangamati and Khagrachari areas, respectively. Major reasons in favour of dragon fruit cultivation were higher yield, regular fruit bearing, high demand and better price due to attractive colour and size. The dragon fruit adopting farmers faced problems like shortage of quality saplings, high price of inputs, lack of irrigation facility, lack of quality fertilizers and insecticides. Non availability of alternative variety was recorded as one of the major problems to dragon fruit cultivation.

FLOWER CROPS

07

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 research field of floriculture division, HRC, BARI, Gazipur during 2021- 2022. 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 (88.02cm). The longest rachis (43.47cm) was recorded by TR-004. The maximum number of flower sticks/ha (2,65,000 sticks) was 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.

Evaluation, characterization and maintenance of lilium

F.N. Khan, K. Ambia, A. Naznin, Mmr. Bhuiyin and Mt. Rashid

Twenty genotypes of lilium along with BARI Lilium-1 and BARI Lilium-2 were evaluated under lilium shade at floriculture division, HRC, BARI during 2021-22. Previously collected 15 promising and 5 newly collected germplasms along with BARI Lilium-1 and BARI Lilium-2 as check were planted under UV polyfilm structured shade house and agro shade net house on 20 to 25 November, 2021. Lilium genotypes showed wide variation in all qualitative and quantitative parameters studied. Among the newly collected lilium germplasm, two have double type of petals. The longest stalk and rachis (93.8cm and 34.0cm, respectively) were produced by the genotype Lil-036. The maximum number of florets per stalk (10.0) was produced by BARI Lilium-1. Maximum vase life was observed in BARI Lilium-2 (11.0 days).

Evaluation and maintenance of rose

A. Naznin, K. Ambia, M. M. R. Bhuyin, F. N. Khan and M. T. Rashid

Rose belongs to the family Rosaceae, is one of the natures beautiful creations and is universally known as the Queen of Flowers. The present investigation was carried out at the research field of floriculture division, HRC, BARI, Joydebpur, Gazipur. Ten different types of roses were collected from different nurseries and at the time of data recording, the age of plants was three years. 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 with where ten genotypes of rose were evaluated that showed wide range of variation for all vegetative and floral traits under study.

Evaluation of chrysanthemum genotypes

K. Ambia, A. Naznin, M.M.R. Bhuyin, M. T. Rashid and F.N. Khan

Thirty chrysanthemum genotypes with BARI Chrysanthemum-2 as check variety were evaluated at the research field of floriculture division, HRC, BARI, Gazipur during winter season of 2021-22. There was significant variation among the genotypes in respect of plant height (35.0-64.0 cm), number of

flowers per plant (15.0-75.0), diameter of flower (2.6-8.5 cm), stalk length (4.2-12.5 cm) and vase life of flowers (5.0-13.0 days). Among the genotypes, CM-004 and CM-022 were found superior for cut flower production as well as CM-012, CM-018, CM-019 and CM-021 for pot culture.

Collection and maintenance of cactus and succulents

K. Ambia, M. T. Rashid, A. Naznin, M.M.R. Bhuyin and F.N. Khan

Thirty cactus genotypes and twenty-three genotypes of succulents were collected and maintained at the research field of floriculture division, 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. Succulent genotypes showed wide variation in different growth characters.

Evaluation and maintenance of gerbera

A. Naznin, K. Ambia, M. M. R. Bhuyin, F. N. Khan and M. T. Rashid

Twenty-nine genotypes of gerbera with BARI Gerbera-1 were collected and 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.

Evaluation and maintenance of heliconia

A Naznin, M. M. R. Bhuiyin, K. Ambia, F. N. Khan and M. T. Rashid

A study on the performance of seven heliconia germplasm was conducted at the research field of floriculture division, HRC, BARI, Gazipur during 2021-2022. The experimental material comprised seven genotypes heliconia, H-001, H-002, H-003, H-004, H-005, H-006 and H-007. Wide ranges of variations for all qualitative and quantitative characters were observed. Based on flower colour, erect habit, shoot number and vase life, H-004, H-005 and H-007 were identified as good genotypes.

Evaluation of gladiolus germplasm

M. M. R. Bhuyin, F. N. Khan, A. Naznin, K. Ambia and M. T. Rashid

A study was conducted at the research field of floriculture division, HRC, BARI, Joydebpur, Gazipur during the period from November 2021 to May 2022 for evaluation of ten gladiolus genotypes. Genotypes were collected from different places and nurseries of Jessore and Dhaka and were given the accession numbers, GL-001 (V_1), GL-002 (V_2), GL-003 (V_3), GL-012 (V_4), GL-018 (V_5), GL-025 (V_6), GL-037 (V_7), GL-040 (V_8), GL-042 (V_9) and BARI Gladiolus-1 (V_{10}) was used as check. These were maintained at the Landscape, Ornamental and Floriculture Division of the Horticulture Research Centre, BARI, Joydebpur. It was revealed from the study that GL-002, GL-012, GL-025 and GL-037 found as promising genotypes for selection on the basis of its flower characters such as attractive color, early flowering, maximum number of florets, longest spikes and rachis, highest weight of spike, longest shelf life, etc.

Evaluation and maintenance of dendrobium orchids

A. Naznin, M. M. R. Bhuiyin, K. Ambia, F. N. Khan and M. T. Rashid

The present investigation was carried out to study the performance of some collected genotypes of Dendrobium orchid. Twelve genotypes of Dendrobium orchid were used as planting material and collected from different sources for this investigation. These are Dendrobium Alba (V_1), Dendrobium Red Alba (V_2), Dendrobium Candy Stripe Alba (V_3), Dendrobium Sharifa Fatema Alba (V_4), Dendrobium Sonia Alba (V_5), Dendrobium Thong Chai Gold Alba (V_6), Dendrobium Malay Alba (V_7), Dendrobium Jenny Denny Alba (V_8), Dendrobium Bicolour Alba (V_9), Dendrobium Yellow Alba (V_{10}), Dendoribum Paradise Alba (V_{11}) and Dendrobium Asian Beauty (V_{12}) under shade net house conditions. Vegetative and flowering characters varied significantly among the genotypes. Longest plant (40.0 cm) and maximum grith of pseudobulb (15.2 mm) was found in 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 cm^2), 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).

Evaluation of foliage and ornamental plants

M. M. R. Bhuyin, F. N. Khan, A. Naznin, K. Ambia and M. T. Rashid

Houseplants are domesticated wild plants that have, over the years, been cultivated and bred to thrive in an indoor environment. Though they different in appearance and cultural needs, they have one essential feature in common adaptability. A study on the evaluation of foliage and ornamental was conducted at the research field of floriculture division, HRC, BARI, Gazipur during 2021-22. The collected germplasm showed wide range of variation for the traits under studied.

Evaluation and maintenance of climbers and creepers

A. Naznin, M. M. R. Bhuiyin, K. Ambia, F. N. Khan and M. T. Rashid

A study was carried out at Floriculture Research Field of HRC, BARI, Gazipur during 2021-22 to collected and evaluated different climbers and creepers. Eleven genotypes of climbers and creepers were collected and data on different parameters were recorded. Variation was found in respect of flower and foliage colour, flowering period, days to flowering and sunlight requirement.

Evaluation and maintenance of water lily

F.N. Khan, Mt. Rashid, K. Ambia, A. Naznin and Mmr. Bhuiyin

A study on the performance of twenty water lily germplasm was conducted at Floriculture Research Field of HRC, BARI, Gazipur during 2021-22. Wide variations were observed in respect of flower diameter, flower durability in tub/chari and number of flowers/plant for 3 months. However, a greater number of genotypes should be collected for continuing the study in order to improve the depository of this flower.

Collection and maintenance of cactus and succulents at Jamalpur region

R Sultana, F.N.Khan, M A Hossain, A Akter and H.E.M Khairul Mazed

Thirteen cactus and nine succulent genotypes were collected and maintained at the Regional Agricultural Research Station, Jamalpur during the year 2021-2022. Thirteen lines of cactus and nine lines of Succulents were collected from different nurseries and accession numbers were given to each entry. A large variation was found in shape, size and colour among the observed genotypes. Among the genotypes, Cac Jam-005 and S Jam-001exhibited distinctly vigorous.

Performance of commercial cultivars of gerbera collected from various sources under protected condition

A. Naznin, K. Ambia, M. M. R. Bhuyin, F. N. Khan and M. T. Rashid

The experiment was carried out at Floriculture Research Field of HRC, BARI, Joydebpur, Gazipur during *rabi* season of 2021-22. Tissue cultured seedlings of some commercial cultivars of gerbera were collected from different available sources and evaluated to see the performance in respect of quality and yield potential. The sources were S_1= GETCO, S_2= RARF, S_3= KF-Bioplants, S_4= Apex agriscience limited, S5= Krishan Botanics.Variation was observed for all quantitative and qualitative characters under study. Based on the studied characteristics, Gerbera collected from KF-Bioplants (S_3) performed better and produced good quality flowers. Therefore, KF-Bioplants can be considered as a good source of seedlings for commercial cultivation. However, more number of quality parameters will be included for continuing the experiment in order to recommend a good source of gerbera seedlings for commercial cultivation.

Influence of foliar application of BA, GA_3 and NAA on vegetative growth and flowering of chrysanthemum (*chrysanthemum morifloium*)

M. T. Rashid, K. A. Ara, F. N. Khan, K. Ambia, A. Naznin and M. M. R. Bhuiyin

The pot experiment was conducted at the Floriculture Research Field of HRC, BARI, Gazipur during August 2021 to May 2022 to evaluate the foliar spray of gibberellic acid (GA_3), benzyl adenine (BA) and naphthalene acetic acid (NAA) on growth and flowering traits of chrysanthemum (*Chrysanthemum morifolium*). The experiment was laid out in RCBD with three replications. Four weeks old seedlings of chrysanthemum genotype CM-019 (flower class: Pompon and flower colour: orange yellow) were

transplanted in pot keeping under natural sunlight. The aqueous solution of GA_3, BA and NAA @ 100 and 200 ppm of each were sprayed on the flower plants at monthly interval starting after one month of transplantation of seedlings along with control (water). The results revealed that vegetative growth and flowering parameters were significantly influenced by plant growth regulators. Maximum number of leaves per plant (50.0) and leaf area per plant (7.5 cm^2) were recorded from the spraying of BA @ 100 ppm closely followed by BA @ 200 ppm (48.0 and 7.0 cm^2/plant) and GA_3 @ 100 ppm only for number of leaves (47.0/plant). Spraying of GA_3 @ 100 ppm produced the tallest plant (70.0 cm) and the highest plant spread (23.0 cm). Number of flowers (26.0/plant), flower size (7.8 cm), average weight of stalk (37.0 g) and vase life (15.0 days) were also found maximum from the application of GA_3 @ 100 ppm, closely followed by GA_3 @ 200 ppm (23.5/plant, 7.2 cm, 36.0 g, 14.0 days) and NAA @ 100 ppm (18.5/plant, 7.0 cm, 36.0 g, 13.0 days) and irrespective of concentrations, BA failed to improve these characters. GA_3 @ 100 ppm recorded maximum length of stalk (37.5 cm) and rachis (29.0 cm), which was identical with GA_3 @ 200 ppm (34.6 cm and 25.0 cm), and BA @ 100 ppm gave the lowest length of stalk and rachis. GA_3 also caused faster initiation of flowering, whereas NAA and BA delayed it. GA_3 @ 100 ppm took the minimum days to flowering (50.0 days) was observed when plants were sprayed with GA_3 @ 100 ppm whereas it was maximum (69days) from BA @ 100 ppm treatment. It can be concluded that GA_3 @ 100 ppm provided the best results for obtaining better vegetative 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

M.T. Rashid, K. A. Ara, M.M.R. Bhuiyin, F.N. Khan, A. Naznin and K. Ambia

An experiment was conducted at the Floriculture Shade Net House of Floriculture Division, HRC, BARI, Gazipur during 2021-22 to evaluate the effect of different potting media on growth and quality of ornamental foliage plant, Aglaonema. Six treatments T_1-Soil (Control), T_2-Vermicompost + perlite (1:1), T_3- FYM + perlite (1:1), T_4 Cocodust + perlite (1:1), T_5-Cocodust + perlite + FYM (1:1:1) and T_6-Cocodust + perlite + Vermicompost + (1:1:1) were laid out in CRD and replicated five. 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 (T_6) treatment containing cocodust + perlite + vermicompost in 1:1:1, (v/v) combination. Poor performance of all characteristics of Aglaeonema was exhibited in only soil (T_1). This finding can support to the urban people and commercial entrepreneurs for successfully cultivation of Aglaeonema.

Effect of substrates on growth, yield and quality of anthurium in soilless culture

M.T. Rashid, K. A. Ara, M.M.R. Bhuiyin, F.N. Khan, A. Naznin and K. Ambia

An experiment was conducted at the Floriculture Shade Net House under Horticulture Research Centre of Bangladesh Agricultural Research Institute, Gazipur during 2021-22 to evaluate the effect of different substrate on growth, flowering, yield and quality of anthurium. Six treatment combinations were T_1: Soil (control), T_2: Cocodust, T_3: Perlite, T_4: Sawdust, T_5: Cocodust + Perlite (1:1), and T_6: Cocodust + Sawdust (1:1). The experiment was laid out in CRD with five replications. Among the treatments, Cocodust+ perlite (1:1) (T_5) followed by Cocodust singly (T_2) was performed best in respect of growth, floral number and quality characteristics of anthurium. Poor performance of all characteristics of anthurium was exhibited in only soil (T_1). Gross return and BCR was highest in T_5 treatment. The result suggests that Perlite + Cocodust (1:1 ratio) followed by Cocodust (100%) could be used for flower yield maximization and quality improvement of anthurium in pot cultivation. This finding can support to the urban people and commercial entrepreneurs for successfully cultivation of anthurium.

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 Research Field of HRC, BARI during 2021-22. The experiment was laid out in CRD 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, T_5- Cocodust + Sphagnum moss (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).

Effect of substrates on the growth and yield of BARI Cactus-1

R. Sultana, F.N. Khan, M. A. Hossain, A. Akter and H.E. M. Khairul Mazed

The present investigation was carried out at RARS, Jamalpur during the period from 2021-22. The basic substrates were Soil, cocodust, perlite, Vermicompost and soil which were used singly and in combinations. All the mixtures were made on v/v basis. Liquid fertilizer was applied for getting best growth. This experiment was conducted to observe the effect of six kinds of potting media (T_1 =100% Vermicompost, T_2 =100% Soil, T_3=100% Cocodust, T_4=50% Soil + 50% Cocodust, T_5=50% Cocodust+ 25% soil+ 25% Perlite, T_6 = 50% Cocodust+ 25% Vermicompost+ 25% Perlite on BARI cactus-1 during the year 2021-22. Data on plant growth characters of BARI cactus-1 like plant height, plant diameter, number of roots, root length, number of baby cactus, number of spines etc. were recorded. Among the various potting media 50% Cocodust+ 25% Vermicompost+ 25% Perlite (T_6) performed the best in respect of growth characteristics of BARI cactus-1. Contrasting to this, the soil medium (T_2) alone performed poor result.

Effect of substrates on the growth and yield of cryptanthus

R Sultana, F.N. Khan, M A Hossain, A Akter and H.E. M Khairul Mazed

The present investigation was carried out at the RARS, Jamalpur during the period from 2021-2022.The basic substrates were cocodust, perlite, vermicompost and soil which were used singly and in combinations. All the mixtures were made on v/v basis. Liquid fertilizer was applied for getting best growth. This experiment was conducted to observe the effect of seven kinds potting media (T_1 =50% Soil + 50% Cocodust, T_2 =50% Cocodust+ 50% Perlite, T_3=50% Cocodust+ 50% Vermicompost, T_4=100% Cocodust, T_5=100% Vermicompost, T_6 =100% Soil on Cryptanthus during the year 2021-2022. Data on plant growth characters like plant height, number of leaves, leaf size, plant spread, number of suckers, survivability % etc. were recorded. Among the various potting media, 50% cocodust + 50% Vermicompost (T_3) performed the best in respect of growth characteristics ofCryptanthus. Contrasting to this, the soil medium (T_6) alone performed poor result.

Response of *Sansevieria* spp. to rooting hormone in propagating substrates

A. Naznin, K. Ambia, M. M. R. Bhuyin, F. N. Khan, K.A. Ara and M. T. Rashid

A pot experiment was conducted at the research field of Floriculture Division of HRC, BARI to find out suitable natural rooting hormone and propagation media for *Sansevieria* cuttings. Combinations of propagation media were M_1= cocodust+sand+ cowdung (1:1:1), M_2= sawdust+ sand+cowdung (1:1:1), M_3 =cocodust+ sawdust+sand+cowdung (1:1:1:1) and the rooting hormones were R_1= Honey, R_2= coconut water, R_3= IBA, R_4= control (without hormone). Among the various treatments, combination of cocodust, sawdust, sand and cowdung with IBA rooting hormones enhanced early shoot emergence, better root formation, increased plant weight and height. This study provided the empirical evidence that rooting hormone and substrate combination influenced root development of *Sanseveria* spp.

Effect of coco-coir based soil less media on yield and flower quality of gerbera

M. M. R. Bhuyin, F. N. Khan, A. Naznin, K. Ambia and M. T. Rashid

A study was conducted at the Floriculture Research Division, HRC, BARI, Joydebpur, Gazipur during the period from November 2021 to May 2022 to find out the effect of different substrates on growth and yield of gerbera was carried out in CRD with 6 treatments and 3 replications. Treatments consisted

of follows: T_0: Fine sand, T_1: Coco-coir: Perlite (0:100), T_2: Coco-coir: Perlite (25:75), T_3: Coco-coir: Perlite (25:75), T_4: Coco-coir: Perlite (75:25) and T_5: Coco-coir: Perlite (100:0). plants were fertilized with a same nutrient solution. Results showed that, the growing medium T_4: Coco-coir: Perlite (75:25) was better than other treatments. In this substrate, flower number, flower diameter, shoot diameter, stem neck diameter, flower height and vase life showed better result among other growing media.

Combination effect of different growing media on the yield and flower quality of gerbera in soil less culture

M. M. R. Bhuyin, F. N. Khan, A. Naznin, K. Ambia and M. T. Rashid

A study was conducted at the Floriculture Research Division, HRC, BARI, Joydebpur, Gazipur during the period from November 2021 to May 2022 to find out the effect of different substrates on growth and yield of gerbera under an open soil-less production system was carried out in a CRD with 6 treatments and 3 replications. Treatments consists of were as follows: T_1: Soil + sand +coco peat + vermicompost (1:1:2:2), T_2: Sand + coco peat + vermicompost (1:2:2), T_3: Sand + coco peat + vermicompost + vermiculite (1:2:2:0.5), T_4: Sand + coco peat +vermicompost + perlite (1:2:2:0.5) and T_5: Sand + coco peat + vermicompost + vermiculite + perlite (1:2:2:0.25:0.25) and T_6: Control(sand). plants were fertilized with a same nutrient solution. Results showed that, the growing medium T_5: Sand + coco peat + vermicompost + vermiculite + perlite (1:2:2:0.25:0.25) was better than other treatments. In this substrate, flower number, flower diameter, shoot diameter, stem neck diameter, flower height and vase life showed better performance among growing media.

Hybridization in gladiolus flower

F.N. Khan, A. Naznin, K. Ambia, M.M.R. Bhuiyin and M.T. Rashid

A hybridization program on gladiolus was conducted in the flowering season November, 2016 to June, 2022 at Floriculture Research Division, HRC, BARI, Gazipur. Eight gladiolus genotypes were included in this study *viz*. Gl-004, BARI Gladiolus-5, BARI Gladiolus-6, GL-037 and GL-039. Parents were selected depending on the attractive criteria of flowers like colour, spike length, number of florets/spike etc. Four crossing were done with attractive parent GL-039 during January, 2017 without following any fashion. Pollination was done in the morning. One day before pollination, emasculation was done. After getting pods the seeds were sown in pot on 29 November, 2017. A large number of cormels were produced from a single cross from first generation. After a successive year of maintenance 4 new gladiolus hybrids have been found.

Bulb and bulblet production of lilium influenced by planting materials and growing condition

F.N. Khan, K. Ambia, A. Naznin, MMR. Bhuiyin and M.T. Rashid

An experiment was conducted at Floriculture Research Field, HRC, BARI during August 2021 to June 2022 to find out the suitable planting materials under optimum growing conditions for quality bulb production. Considering various planting materials and growing conditions, bulblet produced significantly longest root (13.65cm), maximum number of bulbs/hill (0.85), the heaviest and largest bulb (5.42g and 2.0cm, respectively). The plants grown under UV shade house produced the maximum number of roots/plant (8.07), maximum number of leaves/plant at 90 and 120 DAT (12.25 and 17.64, respectively), maximum number of bulbs/hill (1.13), the heaviest and largest bulb (8.34g and 2.82cm, respectively). On the other hand, the plants grown under the plastic shade house produced the longest root (14.18cm) and also longest plant at various date after transplanting (13.50cm to 16.98cm). The plants grown under greenhouse produced the maximum number of bulblets/hill (3.43) and the heaviest bulblet (3.05). The bulblet combined with the plants grown under UV shade house showed better performances at maximum cases.

Influence of planting dates on the production of asiatic lilium under protective condition

F.N. Khan, K. Ambia, A. Naznin, MMR. Bhuiyin and M.T. Rashid

An experiment was conducted at Floriculture Research Field, HRC, BARI during October, 2021 to June, 2022 to find out the optimum planting time for better flower production and to extend the flowering duration of lilium. Lilium bulbs planting at 01 December produced the longest plant (72.0cm). Considering spike length, planting at

November 15 showed better performances and produced the longest spike (72.0cm). Lilium bulbs planted at November 15 produced the maximum number of florets per spike (10.50) followed by all the planting dates except 15 February planting which produced only 7.0 florets/spike. Bulb planting at 15 November produced the heaviest and largest bulbs (25g & 5.11cm, respectively) and the maximum number and weight of bulblets/plant (4.0 & 5.26g, respectively).

Adaptive trial of gladiolus varieties at farmers field

F. N. Khan

A trial was conducted at Gazipur, Rajshahi, Bogura, Rangpur, Khagrachori and Jamalpur during 2021-2022 to evaluate the performance of gladiolus varieties and to popularize among the farmers. 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 variety. 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

F. N. Khan

Trials were conducted at Gazipur, Bogura, Rangpur, Rajshahi, Khagrachori and Jamalpur during 2021-2022 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 varieties at farmers field

F. N. Khan

Trials were conducted at Gazipur, Bogura, Rangpur, Rajshahi, Khagrachori and Jamalpur during 2021-2022 to observe the performance of BARI released Marigold variety under farmer's field condition. BARI Marigold -1 variety showed better performance and produced higher yield over local variety at all locations.

Adaptive trial of lilium variety at farmers field

F. N. Khan

Trials were conducted at Gazipur, Savar, Jashore and Rangpur during rabi season of 2021-2022 to observe the performance of BARI released lilium varieties under farmer's field condition. BARI lilium-1and BARI lilium-2 getting higher yield and better market price at all locations.

Adaptive trial of gypsophila variety at farmers field

F. N. Khan

Trials were conducted at Gazipur, Jamalpur, Rajshahi, Khagrachori, Bogura and Rangpur during Rabi season of 2021-2022 to observe the performance of BARI released Gypsophila variety under farmer's field condition. The variety BARI Gypsophila-1 getting higher yield and better market price at all locations.

Research carried out by different sections of HRC

Post-harvest technology Section

Determining optimum storage temperature and duration for preservation of lilium flower

M. S. Arfin, M. N. Islam, A. Naznin, K. Ambia and T. A. A. Nasrin

An experiment was conducted at the research field of Floriculture Division and Postharvest Technology Laboratory of HRC, BARI, Gazipur during 2021-22 to find out the optimum storage temperature and duration for preservation of lilium flower. Bulbs of BARI Lilium-1 were planted on 1st week of November 2021 in the field. Flower sticks were harvested approximately 120 days after planting when first two florets of a flower stick showed color. Selected stalks were cut with sharp knife from 12 cm apart above the ground in the morning, pulsing for 30 minutes in normal water and immediately transported to the postharvest technology laboratory for investigation. The experiment consisted of two factors- factor A: three levels of temperature *viz.*, 8^0C, 12^0C and room temperature (23 ± 1^0C) and factor B: two storage duration *viz.*, 2 days and 4 days. The experiment was laid out in factorial CRD with three replications. Ten sticks constitute one replication. Among 6 treatment combinations, the

combination of 8^0C temperature with 2 days storage duration performed best in terms of vase life (6 days). Vase life was recorded as the number of days on vase until the flowers showed symptoms of bent neck or advanced signs of fading on all petals. It was calculated when half of florets of the stick became unattractive. Therefore, the optimum storage temperature and duration were 8^o C and 2 days for preservation of BARI Lilium-1 flower. This experiment needs to be continued for confirmation of the result.

Plant Pathology Section

Survey of botrytis blight disease of lilium

L. Yasmin, M. Afroz, M. M. Rahman and F. N. Khan

Survey was conducted at the research field of Floriculture Division, HRC, BARI, Gazipur during December 2021 to March 2022 to record the incidence and severity of botrytis graymold disease of lilium.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 lilium 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' and 'Table damee'. The highest PDI was 80% in Lil-011 and the 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'.

CEREAL CROPS

08

Evaluation of chia germplasm for early and high yield

M.S. Parvin, S. Akter, A.H. Akhi, M.M. Rohman and M.M. Ali

Chia (*Salvia hispanica*) is an annual plant in the mint family that is grown commercially for its seeds. Chia seeds are rich in omega-3 fatty acids the seeds also provide an excellent source of soluble fiber and antioxidants. It contains 25% to 40% oil with 60% of it comprising (omega) ω-3 alphalinolenic acid and 20% of (omega) ω-6 linoleic acid. Both essential fatty acids are required by the human body for good health, and they cannot be artificially synthesized. Currently these is a high demand for chia seeds and seed products (such as oil) which have a much higher value than canola, soybean or flax. The health foods and nutraceutical industries are currently marketing raw chia seeds as a dietary supplement, as well as incorporating the seeds into snack foods, drink mixes, and cereals; milled chia is sold for use as flour. The global market for nutraceuticals is continuing to grow due to an aging population, interest from a broader spectrum of consumers in functional foods that include ingredients like omega-3 fatty acids, and increasing interest. Considering the health benefit and increasing demand of chia seeds in Bangladesh, Plant Breeding Division of BARI undertook this program for characterization and evaluation of chia germplasm to develop early, short and high yielding chia variety. In this experiment six chia lines collected from different sources were evaluated at Gazipur to select better performing early, dwarf and high yielding Chia lines. Significant variation was observed for the trait *viz*., days to heading, days to maturity and plant height among the tested lines. Considering maturity (98days), dwarfness (90cm) and yield (1600 kg/ha) the germplasm was found promising. It should be released as early and dwart variety as soon as possible.

Hybridization in barley

M.M. Rohman, S. S. Alam and M.M. Ali

The experiment was conducted with nine selected parental genotypes of barley including advanced lines, BHL-25 (P_1), BHL-27 (P_2), INBON/L-21/15 (P_3), INBON/L-40/15 (P_4), INBON/L-53/17 (P_5) and IBYT-17/E4 (P_6), Atalpha/12(P_7), Esmarlda (M104/12) (P_8) and BARI Barley-9 (BB-9, P_9) were crossed following 9×9 half diallel fashion to obtain new recombinant for developing early, dwarf, saline tolerant and high yielding hull-less barley crosses. Among the 36 cross combinations, 34 crosses produced seeds successfully. Highest number of seeds (97 seeds) was found in cross $P_7 \times P_9$ followed by $P_4 \times P_9$ (94) and $P_7 \times P_8$ (73) whereas the crosses $P_1 \times P_3$ and $P_6 \times P_8$ produced lowest number of seeds (13). A total of 1378 seeds were harvested from the obtained cross combinations and preserved for next year confirmation trial.

Growing of F_1 generation of barley (Set-I)

H. Z. Raihan, M. M. Rohman and M.M. Ali

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 design during rabi 2020-21.As a result 45 crosses were made but 34 crosses were successfully produced seed. In 2021-22 all the 10 parents and their 34 F_1's progenies were grown in single row following family block design. Variation was observed among the genotypes for most of the traits studied. Based on earliness and yield per plant eight crosses namely $P_5 \times P_6$ (51.25g), $P_7 \times P_{10}$ (42g), $P_2 \times P_4$ (40g), $P_5 \times P_7$ (37.85g), $P_3 \times P_{10}$ (37g), $P_8 \times P_9$ (45.6g), $P_4 \times P_6$ (39g) and $P_4 \times P_9$ (39.2g) were selected for next year experiments.

Growing of F_1 generation of barley (Set-II)

M.M. Rohman, M. M. Ali and R. Sultana

Eight parents, namely BHL-25 (P_1), BHL-27 (P_2), INBYT-19-E4 (P_3), INBYT-19-E5 (P_4), INBYT-18-E9 (P_5), INBYT-20-E85 (P_6), BB-7 (P_7) and BB-9 (P_8) were crossed in 8×8 half diallel design and produced 28 crosses during *rabi* 2020-21.In 2021-22 all the 8 parents and their 28 F_1's progenies were grown in single row following family block designin five-meter-long single row plot during *rabi* 2021-2022. Variation was observed among the genotypes for most of the traits studied. Based on yield per plant eleven crosses namely $P_3 \times P_7$ (35.9g), $P_1 \times P_5$ (31.8g), $P_3 \times P_8$ (31.3g), $P_7 \times P_8$ (28.9g), $P_5 \times P_8$ (25.4g), $P_2 \times P_3$ (24.6g), $P_1 \times P_4$ (25.3g), $P_1 \times P_8$ (22.0g) , $P_4 \times P_8$ (23.5), $P_1 \times P_2$ (21.0g) and $P_6 \times P_8$ (24.8g) were selected for next generation evaluation.

Growing of F_2 generation of barley

M. M. Rohman and M. M. Ali

Twelve F_1s, namely BHL-25 × INBYT/18-E6, BHL-25 × INBON-18-E5, BHL-27 × INBYT/18-E9, BHL-27 × BARI barley-9, INBYT/18-E6 × INBON19-L53, INBYT/18-E9 × INBON-18-E5, INBYT/18-E9 × INBON19-L53, INBYT/18-E9 × BARI barley-7, INBON-18-E5 × INBON19-L53, INBON-18-E5 × BARI barley-7, INBON-18-E5 × BARI Barley-9 and INBON19-L53 × BARI Barley-9, were advanced to F_2 generation for selecting desirable segregates. Based on earliness, tillering and yield (12-81g), 30 individual plants were selected. The seeds of the selected plants were harvested, and threshing was done manually. Finally the seeds were preserved for next year advancing the germplasm.

Growing of F_3 generation of barley

M. M. Rohman and M. M. Rohman

Seeds of two hundred and twenty nine F_3 genotypes were grown for selecting desirable plants. Based on earliness, tillering and yield, 135 individual plants were selected. The seeds of the selected plants were harvested and threshing was done manually and was preserved for next year advancing the germplasm.

Growing of F_4, F_5 and F_6 generation of barley

M.M. Billah, Z.A. Talukder, A.N.M.S. Karim and R. Sultana

One hundred forty two families, 15 families and 3 lines were tested from F_4 F_5 andin F_6 generation, respectively. Fifty five families from F_4 generation, 5 lines from F_5 generation and 3 lines from F_6 generation were selected based on earliness, short stature, hull-less and high yield. The selected lines and individual plants will be grown in the next year to select the promising ones for advancing the generations.

Advancing of F_1, F_2 and F_3 generations for developing saline tolerant barley line

M.M. Rohman and H.Z. Raihan

Twenty eight F_1s from 8×8 diallel crosses of barley were screened hydroponically against 8-10 dS/m equivalent salinity in Hoagland media for one month to select F_2 seeds for further advancing. After one month the salinity level was increased 8 to 10 dS/m. Among the F_1s, 13 were susceptible and died before or during flowering. Remaining 15 F_1s were evaluated based on grain setting, K^+/Na^+, root volume and ROS. Based on the criteria, 8 genotypes were selected as tolerant, 7 as medium tolerant and 13 as susceptible. The seeds will be used for F_2 advancing. On the other hand, 12 F_2 generations were grown on saline soil in green house and advanced for F_3 seeds. 35 segregates were selected. At the same time, 35 F_3 plants were selected from 54 F_3 generations for next generation advancing. In another two experiments, 29 F_2 and 30 F_3 prescreened genotypes were grown in research field of Plant Breeding Division (non-saline condition) for increasing seeds and generation advancing for further screening in native saline soil. Moreover, 100 F_3 genotypes were evaluated in saline soil of Koira, Khulna and 43 genotypes were selected.

Observation trial of promising barley lines

A.N.M.S. Karim, M.M. Billah, A.H. Akhi and M.M. Rohman

Twenty four barley lines along with three check varieties, namely BARI Barley-7, BARI Barley-8 and BARI Barley-9 were used following RCB design to investigate the performance of the lines and also to identify the short duration and high yielding barley lines. Considering yield and yield contributing characters, six genotypes, namely E69 (2.90 t/ha), E84 (2.76 t/ha), E96 (2.70 t/ha), E22 (2.57 t/ha), E28 (2.48 t/ha) and E4 (2.40 t/ha) were found promising and selected for future breeding programme.

Preliminary yield trial of hull-less barley

A.N.M.S. Karim, M.M. Billah, M.M. Rohman, M.S. Kobir, B. Sarker and R. Sultana

Seven barley genotypes along with three check varieties (BARI Barley-7, BARI Barley-8 and BARI Barley-9) of barley were assessed for genotype environment interaction (GEI) and stability to select the best barley genotypes in three different locations, namely Gazipur, Rangpur and Jashore. The analysis of variance revealed that genotype and environment were greatly responsible for the variations of the traits under study while genotypes-environments interaction explained very little variation. Considering yield and stability six genotypes, namely E7 (3.39 t/ha), E10 (2.40 t/ha), E17 (2.52 t/ha), E21 (2.48 t/ha), E111 (2.81 t/ha) and E119 (2.46 t/ha) were found high yielder and stable across locations and need to be further evaluation.

Regional yield trial of hull-less barley

H.Z.Raihan, M. S. Kabir, M. Rahman, O.A. Fakir and M.M. Ali

Nine barley advanced lines including two check varieties (BARI Barley-7 and BARI Barley-9) were evaluated following RCB design with three replications at Gazipur, Panchagarh, Jashore and Satkhira to find out early mature, high yielding stable barley lines. Combined analysis was carried out for five characters of nine barley lines at four environments. Result showed that presence of genetic variability was found for yield. All the traits except yield showed highly significant environment effects indicate high differential genotypic response across the different environments. Considering stability parameter, earliness and yield potentiality of advanced line IBON-HI-19E24 (2.98 t/ha) and IBON-HI- 19 E100 (2.30 t/ha) was the most stable high yielding lines across the environments.

International barley yield trial for arid and semi-arid regions (Ibyt-ASA-22)

M.S. Akter, M. M. Rohman and M .M. Billah

Twenty-five barley lines (received from ICARDA) and two check varieties, namely BB-7and BB-9 were evaluated at Gazipur following RCBD design with 2 replications to select better performing early, dwarf and high yielding barley lines. Significant variation was observed for all the traits among the tested entries except number of tillers per plant and grain per plant. Considering earliness and yield per plant four lines (IBYT-ASA-22/E10 (640g), IBYT-ASA-22/E15 (710g), IBYT-ASA-22/E17 (468g) and IBYT-ASA-22/E18 (946g) were selected for future breeding program.

International barley yield trial for feed forage and malt in favorable environments (Ibyt-FFM-22)

M.S. Akter, M. M. Rohman and M. M. Billah

Twenty-five barley entries (received from ICARDA) along with one check variety BARI Barley-8 were evaluated following RCBD design with 2 replications at Gazipur to select better performing early, short stature and high yielding barley lines. Significant variation was observed for all the traits among the tested entries except number of tillers per plant. Considering yield per plant, six barley lines i.e IBYT-FFM-22/E15 (11.10gm/plant), IBYT-FFM-22/E16 (11.00gm/plant), IBYT-FFM-22/E17(11.60gm/plant), IBYT-FFM-22/E20 (10.40gm/ plant), IBYT-FFM-22/E21 (11.00gm/ plant) and IBYT-FFM-22/E22 (10.00gm/plant) lines were selected for next year trial.

International barley observation nursery (Ibon-22)

M.S. Akter, M. M. Rohman and M. M. Billah

One hundred and twelve (112) barley lines including three check variety, namely BARI Barley-7, BARI Barley-8 and BARI Barley-9 were evaluated at Gazipur. Significant variation was observed for the studied traits. Days to heading and maturity ranged from 57 to 89 days and104 to 127 days, respectively. Plant height ranged from 55 to 93 cm while yield widely varied 0.15 to 2.72 t/ha. Considering short stature and yield, six lines *viz*., eIBON-22/E18m (1.61 t/ha), IBON-22/E32 (0.67 t/ha), IBON-22/E33 (1.92t/ha), IBON-22/E34 (1.56t/ha), IBON-22/E66 (2.04 t/ha) and IBON-22/E80 (1.68t/ha) were selected for future breeding program.

Screening of barley genotypes against spot blotch

A.H. Akhi, M.M. Rohmanand M.M. Ali

Ten genotypes of Barley (*Hordeum vulgare* L.) were screened out following RCB design with three replications against spot blotch disease caused by *Bipolaris* under natural condition to find out resistance genotype. The experiment was monitored regularly to observe the first appearance of disease. Three plants were selected from each treatment and disease severity was assessed in two stages of

development at vegetative and grain filling stage by using 0-5 scale (Rashid, 1997 and this rating scale was modified from Hossain and Schlosser, 1993) and described as 0=no leison (highly resistant), 1=minute leison (resistant), 2= leison covering upto 10% of leaf area (moderately resistant), 3= leison covering upto 25% of leaf area (moderately susceptible), 4= leison covering 50% of leaf area (susceptible), 5= leison covering more than 50% of leaf area (highly susceptible). Among the ten genotype incidence % ranged from 11.9-29.4% at vegetative stage and 16.7-63.3% at grain filling stage indicating plants were infected severely at later stage means grain filling stage. But in two stages incidence% highest in BB-8. In case of disease reaction, infection was severe at later stage and most of the genotype showed susceptible reaction against spot blotch. Only one genotype i.e Atalpha showed resistant reaction and one genotype (E3) showed moderately resistant reaction among the ten tested genotypes. Resistant and moderately resistant genotype will be further screened out in artificial condition.

Induced mutagenesis in foxtail millet (*Setaria italica* L.) to develop variable population

M.M. Billah, A.N.M.S.Karim and M.M. Ali

Foxtail millet (*Setaria italica*) is one among the less utilized crop in family of Poaceae. This plant has relatively high tolerance to drought and extreme conditions of weather and external chemicals or nutrients. Mutation can be defined as a sudden heritable alteration in the structure or sequence of DNA of an organism which is not caused as a result of segregation and recombination of genes. Chemical mutagen such as ethyl methane sulphonate (EMS) can produce single base substitutions with different mutation spectra (Esson *et al*., 2018). These chemicals induce many variations in structural traits in plants (Salim *et al*., 2009). Mutations may be lethal or semi-lethal. Good selection of concentration is prerequisite for successful improvement of certain qualitative and quantitative characters (Kumar *et al.*, 2003). The objective of the present investigation was to identify the response of two foxtail millet genotypes to different doses of EMS and also to create variability in M1 generation. Seeds of two foxtail millet varieties, i.e. BARI Kaon-2 and BARI Kaon-4 were subjected to chemical (EMS) mutagenic agent. This work was done in Plant Breeding Division laboratory, Gazipur. In chemical treatments, seeds of two varieties were presoaked for 6 hrs in distilled water. Later on, these seeds were dried on filter paper for removing of excess water (maintain 12% moisture content). After presoaking seeds were treated with 0.4% EMS for 3 hrs with intermittent shaking every 10 minutes interval for homogeneous emulsion of EMS at room temperature of 25±2ºC. After treatment the seeds were thoroughly washed in running tap water to remove the excess of mutagen. The procedure adopted was similar to that for the 0.6% and o.8% EMS for individual treatment. A set of 200 seeds were taken from each variety for each treatment and control. All seeds were sown at the research field of Plant Breeding Division (PBD), BARI. M_1 plants were evaluated by plants for survival, plant height (cm) (at 7DAS, 21 DAS and at maturity), 50% flowering, total tillers/plant, fertile tillers/plant, spike no/plant and no. of seed/plant from 5 randomly selected plants. All the recorded data were analyzed statistically. Result Showed that there are some mutagenic effects showed in some of the treatment i.e. plant survival percentage, plant height and maturity. Besides, some mutagenic plant showed empty panicle, long plant height. Segregation or discrimination will be done in M_2 generation and plant with desired characters will be selected. So further investigation will be needed for future breeding program.

Regional yield trial of foxtail millet

M.M.Billah, M.B.Sarker, M.I.Riad and M.S.Kobir

Six foxtail millets lines *viz.*, E1 (BD862), E2 (BD922), E3 (BD1041), E4 (BD1063), E5 (BD1105), E6 (BD1116) and two check varieties E7 (BARI Kaon-2), E8 (BARI Kaon-4) were evaluated at four locations, namely Gazipur, Jamalpur, Burirhut and Jashore following RCB design with three replications to select the foxtail millet genotypes having higher yield and other potential attributes. Result of combined analysis showed that significant variation was found in most of the traits regarding genotypes (GEN) and environments (ENV). Considering the stability parameter for grain yield all the genotypes showed different response of adaptability under different environment conditions. Among the tested Foxtail millet lines E1 (2.9 t/ha) showed high yield and E4 (2. t/ha) and E5 (2. 6 t/ha) were more stable and selected for further evaluation and commercialization.

Observation trial of selected proso millet lines

S.H. Omy, M. M. Rohman and M.M. Ali

Twenty two proso millet lines along with one check variety (BARI Cheena-1) were evaluated at Gazipur following RCB design with three replications to select high yielding proso millet germplasm. Result of mean performance showed that wide range of variation was observed among the germplasm for all the traits recorded. Considering earliness (103 days to mature) three lines BD-1405, BD-1408, BD-1413 and for dwarfness BD-1408 (42.9 cm) and for high yield two genotype BD-777 and BD-1442 (2.7 t/ha) were selected for next year trial.

Regional yield trial of proso millet

S. H. Omy, B. Sarker, M. I. Riad, S. Kobir and M. M. Rohman

Eight proso millets lines (BD-1399, BD-1447, BD-777, BD-1411, BD-791, BD-1448, BD-1402 and BD-1446) including check BC-1 (BARI Cheena-1) were evaluated at three locations, namely Gazipur, Burirhut and Jashore following RCB design with three replications to find out the suitable lines having higher yield and other potential attributes. Analysis was carried out for days to heading, days to maturity, plant height, tiller number/plant, panicle length, weight of individual panicle, grain yield/plant, grain yield/plot, thousand grains weight and grain yield. Analysis of variance for all characters showed significant genetic variability among lines except days to maturity and panicle length. The lines BD-1399, BD-1447 and BD-777 (1.8 t/ha) were found more promising for yield and selected for the next year trial.

Preliminary yield trial of finger millet germplasm

M.S. Parvin .M.S. Akter and M.M. Rohman

Five finger millet germplasm were evaluated following RCB design with three replications at Gazipur to find out the suitable genotypes for the development of short stature and early maturing finger millet variety. Statistical 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 five finger millet germplasm. Analysis of variance for different characters among the genotypes showed significance variation for the traits i.e. days to heading, thousand seed weight and yield per plant. The genotype 3392 showed lowest days to heading (87 days), short height (71cm) highest thousand grain weight (3 g) and yield per plant (11.33 g) which was significantly differed from others tested genotypes and selected as promising line.

Population development of pearl millet

A.N.M.S. Karim, M.M. Billah, A.H. Akhi and M.M. Ali

The experiment was conducted with twelve pearl millet germplasm *viz*., ICMV-05555, MC-94C2, ICMV-15111, ICMV-221, ICMV-15222, ICMV-05222, ICMH-1201, ICMH-1301, EEBC-C-1, HHVBC, ICMV-05777 and Dhanshakti received from ICRISAT and were used as base population material following balanced bulk method. Total 300 plants were grown to develop for base population. For the purpose of next generation of selection, 50 panicles were selected separately and preserved carefully. The balanced bulked seeds of these populations would be grown in the next coming season following the same activity.

Development of base population in sorghum

M.Z.A. Talukder, M.M. Billah, A.N.M.S. Karim, A.H. Akhi and M.M. Rohman

Seventy sorghum germplasm selected from ICRISAT and other sources were used for conducting the experiment. Balanced bulk 2^{th} cycle seeds of two groups, each contained 50 selected panicles based on (i) medium height and high yield goal and (ii) dwarf and earliness were planted and random mated in isolation at Gazipur for the development of source populations in sorghum. For the purpose of next cycle of selection, finally 125 panicles were selected separately from the two groups and preserved carefully. The balanced bulked seeds of these two populations would be grown separately in isolation for final selection of the two desirable source populations in the coming rabi season.

Screening of sorghum lines under waterlogging stress condition

Z. A. Talukder, M.M. Billah, A.N.M.S. Karim, A. H. Akhiand M.K. Alam

Waterlogging strongly affects agronomic performance of sorghum (*Sorghum bicolor* L.). In order to investigate the suitable waterlogged tolerant genotypes and identify the most susceptible stage, 41 sorghum genotypes were subjected to successive artificial excess water stress at five leaf

stage (stage 2), flag leaf stage (stage 4) and boot stage (stage 5) was used to screen waterlogged tolerant genotypes. Targeting this issue, an experiment was carried out at Plant Breeding Division, Field Lab, Gazipur with 41 sorghum genotypes during January–May 2022 to screen out the waterlogging tolerance sorghum genotypes. The waterlogging was implemented at the five-leaf stage (stage 2), flag leaf stage (stage 4) and boot stage (stage 5). Waterlogging remarkably declined the growth of all the sorghum genotypes compared to control. Reduced plant height, panicle length, and grain yield per plants were observed under waterlogging stress. The most yield effect of waterlogging stress occurred at the boot stage, followed by the five-leaf stage and flag leaf stages. Among the 41 genotypes, G12, G15, G20, G27, G30, G35 and G39 showed better waterlogging tolerance. These genotypes showed a greater number of adventitious roots in the base of their stem and brace roots, which probably helped plants to thrive under waterlogging conditions. These waterlogged tolerant sorghum genotypes will further be evaluated in waterlogging condition to verify the results.

Evaluation and selection of mutants for desirable traits in M_2 generation of oat (*Avena sativa* L.)

A.H. Akhi, M.M. Rohman Andm.M. Ali

Oat (*Avena sativa*) is a worldwide healthiest crop and popularity of oat is increasing day by day in Bangladesh. As a exotic crop chances of getting germplasm is low. Unfortunately, due to shortage of germplasm, variation for desirable traits lacking in oat. For any crop improvement genetic variation is the pre-requisite and induced mutagenesis is one of the main tool to create variation under current climate changes. Gamma irradiation in physical mutagens and Ethyl methane sulphonate (EMS) in chemical mutagens are most efficient and frequently used for induction of economically desirable mutants in several crops. Seeds of two oat genotypes, i.e BOL-1 and BOL-2 were subjected to physical (Gamma rays), chemical (EMS) and combined treatments (Gamma rays + EMS) to evaluate M_2 generation developed plant from the two oat genotypes of different doses of gamma rays, EMS and combination treatments. This is the second year experiment. In first year the seeds of two genotypes were exposed to five doses of gamma radiation (γ rays) i.e., 200Gy, 250Gy, 300Gy, 350Gy, 400Gy; two doses of EMS chemical concentration i.e. 0.4% and 0.8% concentration and gamma+ EMS combination treatments. M_1 plants were evaluated by comparing with non-irradiated plants for survival, plant height (cm) (at 7 DAS, 21 DAS and at maturity), 50% flowering, total tillers/plant, fertile tillers/plant, spike no/plant and no. of seed/plant from 5 randomly selected plants. In 2^{nd} year (M_2 generation) M_2 seeds from each treatment were sown and M_2 population was evaluated in each dose/treatment along with control. Mutation frequency was estimated for each mutant in each genotype and each treatment as percentage of the total M_2 plants. Result showed that total 447 morphological mutants characterized in 10 categories namely broad leaf mutant, tall mutant, semi dwarf mutant, dwarf mutant, early mutant, late mutant, higher no of tillers, single awn mutant, double awn mutant and basal hairiness mutant were identified with a frequency of 12.9% in M_2 generation of all the two oat genotypes *i.e.*, Bol-1 and Bol-2. Amongst all the identified mutants, the appearance of basal hairiness were highest in frequency (2.9%) and number (102) followed by frequency (%) of semi dwarf (2.1%), early (1.6%) late and single awn mutant (1.3%), dwarf (0.9%), tall(0.8%), double awn (0.6%), higher no of tiller and broad leaf (0.5%).The overall relative frequency of morphological mutations recorded in M_2 generation was the highest in Bol-1 (14.1%) followed by Bol-2 (11.3%). The maximum mean frequency of morphological mutations recorded in gamma radiation (4.5% in Bol-1) followed by gamma + EMS combination (3.6% in Bol-2).The selected morphological mutants suggest the further evaluation and confirmation of these variants in the next generations. Broad leaf, spreading type, tall, flowering, narrow leaf, dwarf and semi-dwarf mutants and late maturity mutants could be indirectly useful in recombination breeding programme for developing high yielding lines particularly dual purpose.

Induced mutagenesis in buckwheat to develop variability

M.S. Akter, M.M. Rohman, A. H. Akhi and S. S. Alam

Buckwheat (*Fagopyrum* spp.) is a broadleaf plant and not a cereal grain, but its seeds are used for flour and many of the same uses as a cereal grain, so it is often referred to as a pseudo cereal. It is an

underutilized highly nutritious crop in our country and almost unfamiliar to Bangladeshi people. But health conscious people are now interested to this crop. So various research program have been initiated in Plant breeding division. But genetic variation is first priority for any type of crop improvement. and unfortunately the variability of available germplasm is very low due to less germplasm in context of our country. It can be increased through physical and chemical mutagens. Chemical (EMS) mutagens are mostly used for induction diversified desirable changes in several crops. Considering all, the present study was undertaken to identify the diverse variation of two buckwheat genotypes with four treatments of Ethyl Methane Sulphonate (EMS). It was also taken for identification and isolation of induced morphological mutations in M_1 generation. In this experiment, two buckwheat genotypes (Bogura-1 and BD-4272) were treated chemically with EMS to induce variability. Result showed that the doses of 0.1% (EMS) and 0.3% (EMS) treatments were proved to be more efficient for most of the characters in M_1 generation in both genotypes. Conversely, 0.5% (EMS) treated plants showed short plant height, low yield and yield contributing characters.M_1 seeds of different treatments were harvested and kept separately for future breeding program.

Regional yield trial of buckwheat

A.H. Akhi, M.I. Riad and R.Sultana

Four buckwheat lines *viz*., BD-4272, BD-4273, BD-4274, BD-4275 and one local check Bog-1 were evaluated at three locations, namely Gazipur, Jamalpur and Debiganj following RCB design with three replications to find out the suitable lines having higher yield and other potential attributes. Results of combined analysis of variance for seven characters of five genotypes at three environments 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. The genotype E2 (BD-4272) and E3 (BD-4273) showed early maturity i.e 80 days and 81 days, respectively than other tested genotypes. Considering earliness, yield potentiality and stability parameter, genotype E2 (0.8 t/ha) and E3 (1.0 t/ha) exhibited higher yield whereas E3 was stable in favorable environment. So, E3 was selected as a candidate for variety release.

Molecular characterization of newly developed barley lines with released varieties

Z.A. Talukder, S.H. Omy, A.N.M.S. Karim, H.Z. Raihan and M.M. Rohman

BARI has developed some new barley varieties and advanced lines. The genetic variation at molecular level of the released barley varieties was not done yet. So, the program was undertaken to select genetically diverse lines for future breeding program.

Twelve barley genotypes were used for polymorphism study through seven SSR markers. A total of 21 alleles with average of 3.45 alleles/locus were observed. Among them, six markers showed distinct polymorphism within the barley genotypes. Major allele frequency varied from 0.33 to 0.67, with mean of 0.52. The polymorphism information content ranged from 0.42 to 0.68 (average 0.54). The mean heterozygosity was 0.06, which indicated attainment of higher levels of homozygosity. Cluster analyses grouped 12 genotypes into three main clusters each having sub-clusters. Genotypes BB-2 and BHK-34 were more diverged compared to other genotypes. The Principal Coordinate Analysis (PCO) showed the spatial distribution of the 12 barley genotypes. The genotypes *viz*., BB-2 and BHL-34 were found far away from centroid of the cluster. The genotypes that placed far away from the centroid were more genetically diverged compared to the genotypes placed near the centroid which were likely to be genetically more similar. The molecular characterization study found that the 12 barley genotypes are in harmony with clustering approaches using the SSR genotypic data and principal components analysis, which identified three cluster group. These results demonstrated genetic diversity among the genotypes.

Modulation of drought induced oxidative stress in finger millet by trehalose and methyl jasmonate

M. M. Rohman

Finger millet (*Eleusine coracana*) is a staple crop in Africa as well as in India. In India it is cultivated mainly in the tarai regions of Himalayas and the southern peninsula. Wheat and rice provide food security, but crops like finger millet promise nutritional security for the world. Being a hardy crop, it is relatively easy to grow finger millet under stressful regimes, without hampering the net

productivity. Due its strong root system, it can tolerate drought. Drought tolerance capacity is associated with ROS and MG detoxification system. This study was undertaken to examine drought induced oxidative stress and its manipulation by Trelahose (Tre) and Methyl Jasmonate (J). Five treatments control (C), drought (D), D+Tre (1 mM), D+J (100 µM) and D+ Tre (0.5mM)+J(50 µM), were applied either as seed treatment or foliar application at 15 days, 22 days and 29 days after emergence (DAE). Drought stress was started at 15 DAE, and maintained approximately 7.5% of field capacity (FC) till harvesting. Biochemical and enzymatic data were taken at flowering stage. Drought stress increased O_2•- and H_2O_2 contents and LOX activity strongly over control in both genotypes. Although SOD activity changed and varied with genotypes and application methods, CAT played important role in H2O2 metabolism by induced activity in drought in presence or absence of Tre and J while APX had vital role in drought. Both MDHAR and DHAR were induced by Tre and J. They also restored GR activity. However, higher GST activity in foliar spray might be associated in leaf senescence or injury for foliar spray. Although drought induced MG concentration, it decreased by Tre and J. However, there was no harmony in the activity of glyoxalases. Importantly, Gly-I activity increased in drought with Tre and J, but the regulation pattern of Gly-II activity had no harmony, and thus, it needs more research to fix the problem.

Nutritional analysis of BARI released minor cereals

M. M. Rohman

Cereal grains feed a large population around the world. They constitute a significant part of daily diet of the consumers. Minor cereals are tangible food source in many parts of the world, having high nutritive values. They play an important role in proving substitute of rice or wheat, the main source of carbohydrates in the harsh environment of the country. BARI released minor cereals are composed of high nutritional components. Determination of protein, moisture, fat, fiber, ash, starch and amylose content of BARI released important varieties and advanced lines was objective of this study. Barley varieties contained almost similar amount of protein, fiber and ash (10.54 to 10.82% protein, 12.14 to 13.38% fiber and 2.05-2.10% ash). However, BARI Barley-8 has higher amylose content. Fiber content in foxtail millet ranged 9.24 to 10.85% and ash 2.44-2.46%. Fat content is higher in BD-777. Sorghum contained the highest amylose than other cereals. BARI oat contains 13.01±0.20% protein and 9.24±0.03% fiber. Buckwheat had higher fiber. In contrast, quinoa line contained higher protein 14.10±0.13% and but fiber content 5.54±0.03% and amylose content comparatively lower (12.0±0.15%). This year few nutrition contents were measured. This program is ongoing. Minerals and other nutrients are under process to analyze.

Starch quality analysis of barley lines and varieties

Z. A. Talukder, S.H. Omy, A.N.M.S. Karim, M.M. Rohman, M.M. Billah and R. Sultana

Barley grain is composed of carbohydrates, proteins, dietary fiber, vitamins and minerals. The present study was conducted to investigate the variability for amylose and amylopectin content in different barley genotypes. The variation in amounts of amylose and amylopectin, are responsible for its unique physical and chemical properties with strong influences on functional properties of flour or semolina and on its specific uses in the food. High amylopectin provides immediate carbohydrate assimilation to boost energy levels among the professional athletes and people of growing age. High amylose improves the product texture of starch and turns it into a source of slowly digestible carbohydrate that is good for diabetes patient. Our results showed that starch content ranged from 62.0 to 72.0% in barley genotypes. Among the barley genotypes, amylose content ranged from 13.0 to 29.0%. The average amylopectin content among barley was 75.98% with the range 71.0-87.0%. Among 44 genotypes, 42 had an average content of amylose (18-30%), none of the genotypes contained more than 30% of amylose content. Among 44 genotypes only two genotypes had more than 85% amylopectin content. Our results indicated that the barley genotypes had considerable variation for amylose and amylopectin. which not only provided some useful information about the difference in the amount of amylose and amylopectin content among these barley genotypes, but also offered some prospects of using selected germplasm for barley quality improvement in respect of preferred amylose and amylopectin content. It is concluded that the amylose and amylopectin ratio in different barley genotypes had only a marginal difference of variation. In this

study, any high amylose and high amylopectin or waxy genotypes was not found. The present results showed means and ranges of amylose and amylopectin content were more or less as expected from the ploidy of the species and their relationships to each other. The ranges are broad enough that it is possible to increase them through a targeted breeding program.

Determination of total arsenic in minor cereals (barley, foxtail millet, proso-millet, finger- millet, pearl -millet, buckwheat. Oat, quinoa and sorghum)

M.S. Parvin and M.M. Ali

Cereal grains are the most important source of the world's total food and also the major source of toxic arsenic. Therefore, it's high time to produce ideal cereals that must contain a lower amount of arsenic and ensure safety for all kinds of lives. Ensuring safe food is one of the objectives of sustainable development goal-2 (SDG-2). With this view in mind, the Plant Breeding Division of BARI currently are working with nine minor kinds of cereal (Barley, Foxtail millet, Proso-millet, Finger-millet, Pearl-millet, Buckwheat, Oat, Quinoa, and BARI-Sorghum 1) were undertaken for biochemical analysis of arsenic on their leaves. The leaves of available nine kinds minor of cereal (Barley, Foxtail millet, Proso-millet, Finger- millet, Pearl-millet, Buckwheat. Oat, Quinoa, and BARI Sorghum-1) were collected from Joydebpur experimental field to their total arsenic accumulation. The acceptable limit of arsenic in the terrestrial plant was determined less than 10 mg kg^{-1} under normal conditions. The biochemical analysis of these nine kinds of minor cereal was found all the cereals have shown a negligible amount of arsenic. Although it showed that BARI Kaon-1 (0.97888) contains an increasing amount of arsenic comparing with others, still it was within acceptable range.

Breeder seed production of barley

M.M. Billah, M.I. Riad, B. Sarker and M.N. Amin

Quality seed is important to maintain the purity of a variety. Research organization has no mandate to produce seeds in large scale. However seed production of released varieties is a pre-requisite for demonstration of the varieties at farmer's level to popularize it to the public. To increase and maintain the purity of the released barley varieties, total 1,252 kg of breeder seed of nine barley varieties *viz*., BARI Barley-1 (62 kg), BARI Barley-2 (57 kg), BARI Barley-3 (35 kg), BARI Barley-4 (56 kg), BARI Barley-5 (58 kg), BARI Barley-6 (131 kg), BARI Barley-7 (370 kg), BARI Barley-8 (266 kg), and BARI Barley-9 (217 kg) were produced at four (Gazipur, Burirhat, Debigonj and Ishwardi) different locations and stored for further use.

Breeder seed production of foxtail millet, proso millet, sorghumand oat varieties

M.M. Billah, A.H. Akhi,M.I. Riad and B. Sarker

Breeder seed is essential for maintaining purity of the variety. Total 1,257 kg breeder seeds of Kaon, Cheena and Sorghum were produced at four (Gazipur, Burirhat, Debigonj and Ishwardi) different locations during *rabi* season 2021-22. BARI Kaon-1 (203 kg), BARI Kaon-2 (123 kg), BARI Kaon-3 (123 kg), BARI Kaon-4 (70 kg), BARI Cheena-1 (101 kg), BARI Sorghum-1 (540 kg) and BARI Oat-1 (97 kg) varieties seeds were produced and stored for further use.

Maintenance and seed increase of barley lines

M. K. Alam and M.M. Billah

Well maintained parental lines are the reason behind getting good seeds. Therefore, the present study was conducted to maintain and seed increase of barley lines for further use. Twenty-five barley lines were grown at BARI, Gazipur during *rabi*, 2021-22. Total 7.76 kg seeds were obtained from 25 lines and stored to use in the breeding program of next *rabi* season.

Maintenance and seed increase of foxtail millet germplasm

M.M.Billah, A.N.M.S.Karim and S.H.Omy

Germplasm are the main building blocks of variety development. Maintaining seed purity by rouging off type, diseased and weak plants is most important in plant breeding. Again, availability of enough seed is prerequisite to conduct various breeding program to develop better variety. Hence, the experiment was conducted with 12 exotic foxtail millet lines. Each line was investigated carefully and off type, diseased and weak plants were rouged out and a total of 3.67 kg seeds were preserved for future breeding program.

Maintenance of proso millet germplasm

S.H. Omy, M.M. Rohman and M.M. Ali

Maintenance of existing germplasm is one of the basic activities in varietal improvement of any crop.

Proso millet seeds were produced at BARI, Gazipur for maintaining 100 proso millet germplasm. Seed increased during the *rabi* 2021-22. Total 19.21 kg seed was produced from these lines this year and stored for next year maintenance cycle.

Maintenance of pearl millet germplasm

A.N.M.S. Karim and M.K. Alam

Pearl millet is a widely grown cereal in the semi-arid regions of Africa and Asia and is historically recognized as a subsistence staple of the poorest people living in the most difficult production environment. Maintenance of available germplasm of pearl millet is the main objective of the experiment. It was conducted at BARI, Gazipur, during *rabi* season 2021-22 to maintenance of 12 pearl millet germplasm. Total 2.5 kg seeds were produced from pearl millet germplasm for next year trial.

Seed increases of oat germplasm

A.H. Akhi, M.K. Alom and R.Sultana

One BARI released oat variety (BARI Oat-1) and four germplasm were used to increase seed. As a self-pollinated crop this line was maintained by natural selfing. Including 65 kg seeds from BARI oat 1, 8 kg BOL-1, 6 kg BOL-3, 8 kg BOL-4 and 8 kg BOL-5 and total of 95 kg seed was produced and preserved for future breeding program.

Seed increase of buckwheat germplasm

A.H. Akhi, M.K. Alom and R.Sultana

Seed is essential for maintaining purity of the variety. Three Buckwheat germplasm *viz*. BD4272, BD4273 and BD4275 were maintained and seeds were increased produced at BARI, Gazipur during 2021-22 cropping season. Each line was grown in 2 rows of 5 m long with row distance of 25 cm and seeds were sown continuously. A Total of 1.95 kg breeder seed of three buckwheat germplasm.

Maintenance and seed increase of quinoa germplasm

H. Z. Raihan and R. Sultana

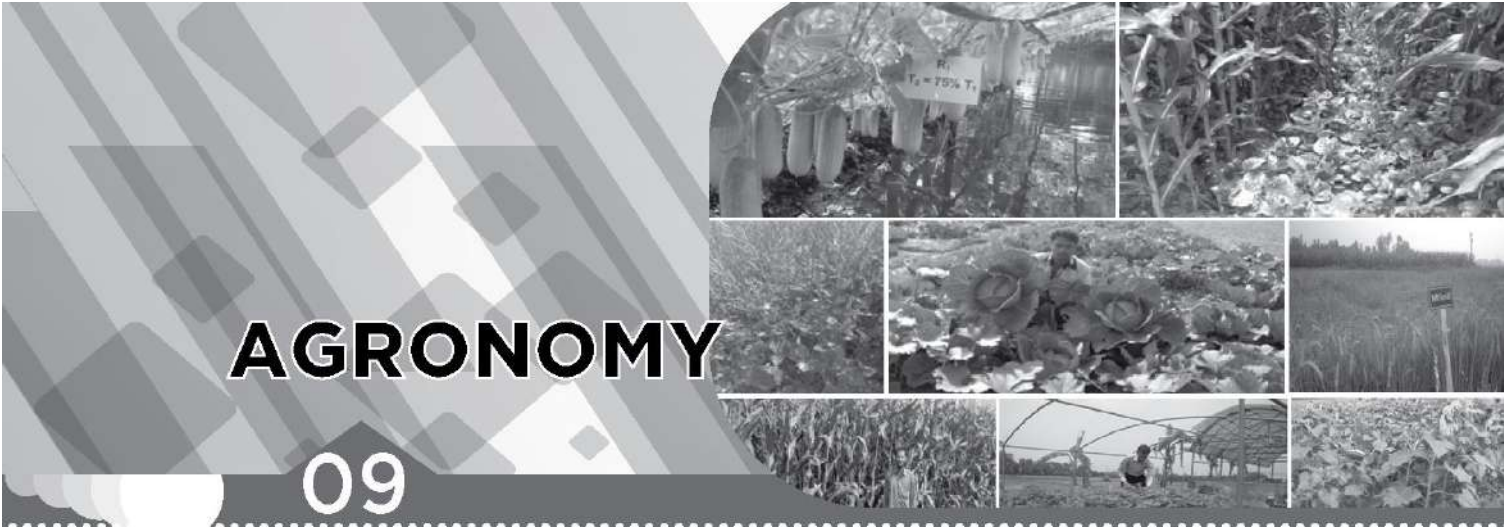
Four Quinoa genotypes *viz*., BARI Quinoa Line-1, BARI Quinoa Line-2, BARI Quinoa Line-3 and SAU Quinoa-1 was maintained and increased by open pollination. A total of 1.36 kg, 0.66kg, 0.605 kg and 0.78 kg seeds were produced from BARI Quinoa Line-1, BARI Quinoa Line-2, BARI Quinoa Line-3 and SAU Quinoa-1 respectively and preserved for future breeding program.

Technology transfer activities

M. K. Alam and M. M. Rohman

Plant breeding division, BARI has been working with ten crops like barley, proso millet, foxtail millet, sorghum, pearl millet, finger millet, buckwheat, quinoa and chia. This division has also given more emphasiz to develop high yielding varieties. Area and production of high value minor cereals can be increased through adopting new varieties and modern technologies. For quick dissemination of new varieties and improved production technologies, a number of technology transfer programs have been initiated during 2021-22 by the plant breeding division. One SA/SSA training with 25 participants on barley, millet, sorghum and other minor cereal production technology was conducted at BARI, Gazipur.

Four farmers training on Crop Production and dissemination of minor cereals were conducted with total 120 farmers at Khulna, Gaibanda, Rangpur and Bogura. Demonstration trials were set at Munshigonj, Rangpur, Tangail, Bogura, Jamalpur, Barishal, Rajshahai, Gaibandha, Faridpur, Manikgonj. Besides, one seminar workshop and 4 field days were arranged by plant breeding division. Twelve varieties were transferred throughout the countries. One Annual report and 1 leaflet were published by the division.



AGRONOMY

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Crop management

Growth and yield of sorghum as influenced by spacing and nutrient management

A.A. Begum, J.A. Chowdhury, M.Z. Ali, M.R. Karim and D.A. Choudhury

A field experiment was conducted at the Research Field of Agronomy Division BARI, Gazipur during *rabi* season of 2021-2022 to find out optimum fertilizer dose and plant spacing (plant population) for better growth and maximum grain yield of sorghum. Three plant spacing viz., S_1=60 cm × 10 cm (1,66,666 plants/ha), S_2=50 cm × 15 cm (1,33,333 plants/ha) and S_3 =40 cm × 20 cm (1,25,000 plants/ha), and four fertilizer doses viz., F_1=N_{120} P_{60} K_{50} S_{27} $Zn_{2.8}$ $B_{1.4}$ kg/ha, F_2=F_1 + 25% NPK (N_{150} P_{75} K_{63} S_{27} $Zn_{2.8}$ $B_{1.4}$ kg /ha), F_3=F_1 + 50% NPK (N_{180} P_{90} K_{75} S_{27} $Zn_{2.8}$ $B_{1.4}$ kg /ha) and F_4=Control (Native fertility) were used as treatments. Seeds of sorghum (BARI Sorghum-1) were sown on 23 November 2021. Fertilizers were applied as per treatments. Three irrigations were done at 30 and 50 DAS and grain development stage. Data on growth parameters like leaf area and dry matter accumulation were measured at different dates with 25 days interval. Leaf area was measured by an automatic leaf area meter (L13100 c, L1COR, 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 SunfleckCeptometer (Model Decagon, Pulman, Washington, USA). Soil-Plant-Analysis Development (SPAD) Value of leaf chlorophyll content was measured using a portable SPAD meter (Model SPAD-502, Minolta crop, Ramsey, NJ) at 30, 45, 60, 75 and 90 DAS. The crop was harvested on 7 April 2021 (135 days after sowing). 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. Higher LAI was observed with higher population of 1,66,666 /ha receiving higher fertilizer N_{180} P_{90} K_{75} S_{27} $Zn_{2.8}$ $B_{1.4}$ kg /ha (F_3), which intercepted higher PAR and contributed to higher DM production as well as higher grain yield (4.68 t/ha) followed by same spacing 60 cm × 10 cm (S_1) with N_{150} P_{75} K_{63} S_{27} $Zn_{2.8}$ $B_{1.4}$ kg /ha (F_2) and N_{120} P_{60} K_{50} S_{27} $Zn_{2.8}$ $B_{1.4}$ kg/ha (F_1). Though S_1F_3 combination gave the maximum gross return (Tk. 117000/ha) but the highest benefit cost ratio (2.28) was recorded in S_1F_1 treatment. The results indicated that plant spacing of 60 cm × 10 cm with fertilizer dose N_{120} P_{60} K_{50} S_{27} $Zn_{2.8}$ $B_{1.4}$ kg/ha might be suitable for higher grain yield and economic return of sorghum cultivation.

Effect of nutrient management and harvesting time on ratooning of sorghum as fodder

A.A. Begum, S. S. Kakon, M.R. Karim, S. T. Zannat and D. A. Choudhury

The experiment was conducted at the Research Field of Agronomy Division BARI, Gazipur during *rabi* season of 2021-2022 to find out the optimum fertilizer dose and harvesting time of ratooning sorghum for higher fodder production. Six fertilizer doses viz., F_1= $N_{120}P_{60}K_{50}$ kg/ha, F_2= $N_{90}P_{45}K_{37}$ kg/ha (75% NPK of F_1), F_3=$N_{60}P_{30}K_{25}$ kg/ha (50% NPK of F_1), F_4=$N_{30}P_{15}K_{12}$ kg/ha (25% NPK of F_1), F_5=N_{90} kg/ha, F_6=Control (Native fertility) and three harvesting times viz., H_1=35 days after grain harvest of main crop (DAGH), H_2=45 DAGH and H_3= 55 DAGH were used as treatments. The experiment was laid out in a piece of land with the area of 32.5 m × 36.4 m. After harvesting of the main or grain crop, ratooning experiment was laid out in a two

factorial randomized complete block design with three replications. Seeds of sorghum (BARI Sorghum-1) were sown on 16 November 2021 with a spacing of 60 cm between rows and 10 cm between the plants. Fertilizers were applied at the rate of 120-60-50 kg/ha of NPK as urea, triple super phosphate (TSP), muriate of potash (MoP) for grain sorghum. Three irrigations were done at 30 DAS, 45 DAS and 85 DAS. Thinning was done at 20 DAS and weeding at 35 DAS. Main crop was harvested at 136 DAS on 31 March, 2022. At harvest, plant was cut 15 cm above the ground level to facilitate regeneration for ratooning of sorghum as fodder purpose. The fodder was harvested as per time of cutting treatment. Green biomass weight of fodder was recorded plot wise immediately after harvest. Results revealed that, fertilizer dose and harvesting time has great influence on plant height, chlorophyll content (SPAD value), dry matter production (TDM) and green fodder yield of ratoon sorghum. Higher plant height, chlorophyll content (SPAD value), 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, $N_{90}P_{45}K_{37}$ kg/ha and N_{90} kg/ha and harvested at 55 days after grain harvest of main crop. Though F_1H_3 combination gave the maximum gross return (Tk.144722/ha) and gross margin (Tk.121516/ha) but maximum benefit cost ratio (10.24) was recorded in F_5H_3 treatment combination. The results indicated that the fertilizer dose like $N_{120}P_{60}K_{50}$ kg/ha produced higher fodder yield of ratooning sorghum when harvested at 55 days after grain harvest of main crop but the economic point of view fertilizer dose only N_{90} kg/ha gave maximum profit.

Grain and fodder yield of sorghum as influenced by cutting time

S.S. Kakon, A.A. Begum, J.A. Chowdhury, M.R. Karim and D.A. Choudhury

The experiment was conducted at the research field of Agronomy Division, BARI,Gazipur, during *rabi* season of 2021-22 to find out proper cutting time for maximum yield of fodder and grain in sorghum. There were nine treatments *viz.* T_1= no cutting ,T_2 =cutting whole plant at 60 DAS for fodder purpose, T_3 = Cutting plant 8″ up from ground level at 70DAS for fodder purpose , T_4=Keeping main tiller then all tiller cut at 70 DAS for fodder purpose, T_5 = Keeping all tiller then main tiller cut at 70 DAS for fodder purpose T_6= Cutting plant 8″ up from ground level at 80 DAS for fodder purpose, T_7 = Keeping main tiller then all tiller cut at 80 DAS for fodder purpose and T_8= Keeping all tiller then main tiller cut at 80 DAS for fodder purpose.The experiment was laid out in a randomized complete block design with three replications. Seeds of Sorghum were sown on 07 December 2021 at a spacing of 60 cm between rows and 10 cm between the plants. Fertilizers were applied at the rate of 120-48-75-30-3-1kg/ha of N, P, K, S, Zn, B as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid. 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. 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. 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 influenced 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 (39.27t/ha) was recorded in cutting whole plant at 80 DAS for fodder purpose. The highest seed (4.00 t/ha) yield was recorded in no cutting treatment which was followed by keeping main tiller then all tiller cut at 80 DAS for fodder purpose but seed yield reduction was 3.42% over control. From the results it could be concluded that keeping main tiller then all tiller cut at 80 DAS may be chosen for fodder purpose and might be harvested at 80 DAS with slight reduction in seed yield for getting dual purpose of fodder yield and seed yield of sorghum.

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, M.Z.Ali and D. A. Choudhury

The experiment was conducted at Agronomy research field of Bangladesh Agricultural Research

Institute (BARI), Gazipur, during *rabi* (winter) season of 2020-22 to evaluate the effect of sowing time and spacing on chia. The experiment consisted of three sowing date viz. (15 Nov., 30 Nov. and 15 Dec.) and three spacing viz. (30 cm ×05 cm, 40 cm ×05 cm and 50 cm × 05 cm). The crop received 246 mm rain showers from October to March in two successive years. The crop was fertilized with 60-15-30 -5 N-P-K-S kg /ha, respectively (Karim *et al*., 2015). 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 and 11 March, 2022. 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 and yield components of chia. The November sowing produced the maximum TDM and LAI. 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 inflorences number and increased sterile inflorences. Wider spacing gave higher number inflorences but closer spacing gave higher seed yield. Plant height was higher in early planting and was minimum in late planting. It was also found that 15November sowing with row spacing of 30-40 cm × 05 cm produced the higher seed yield (1024kg/ha). Results revealed that November sowing with row spacing of 30-40 cm × 05 cm performed better and with the advancement of sowing dates the temperature increased, reduced the grain growth duration and decreased the seed yield.

Growth and yield of chia (*Salvia hispanica* L.) under different nutrient management practices

S.S. Kakon, S.Paul, J.A. Chowdhury, A.A.Begum and D.A.Choudhury

The field experiment was conducted at Agronomy Research Field, Gazipur and Regional Agricultural Research Station, Jashore of Bangladesh Agricultural Research Institute during *rabi* season of 2021-22 to evaluate the growth and yield of chia under different nutrient management practices. Treatments included were: T_1= N_{30} P_{20} K_{25} S_6 $Zn_{0.5}$ $B_{0.5}$kg/ha,T_2=$N_{60}P_{40}K_{50}S_8Zn_{0.5}B_{0.5}$kg/ha,$T_3$=$N_{90}P_{60}$ $K_{75}S_{10}Zn_{0.5}B_{0.5}$kg/ha, T_4= N_{120} P_{80} K_{100} $S_{12}Zn_{0.5}B_{0.5}$kg/ha and T_5= Control. Soils of the experimental plots were collected and analyzed. Organic carbon, N, K and B were under critical level in the soil. The experiment was laid out in a randomized complete block design with three replications. Chia seeds were sown at a spacing of 30 cm between rows and 5 cm between the plants. Seeds were sown on 24Nomveber, 2021 at Gazipur and on 11November, 2021 at Jashore. Data on growth parameters like leaf area and dry matter accumulation were measured at different dates with 15 days interval. Leaf area was measured by an automatic leaf area meter (L13100 c, L1COR, USA). Results revealed that, fertilizer levels showed great influence on leaf area index (LAI), dry matter production and yield of chia. The highest LAI was recorded inT_4 ($N_{120}P_{80}K_{100}Zn_{0.5}B_{0.5}$kg /ha) treatment. Significantly the highest chia yield (792.5kg/ha at Gazipur and 254 kg/ha at Jashore) was observed in T_4 treatment followed by T_3 and T_2 treatments. Cost and return analysis showed that the highest gross return (225150.00Tk./ha), gross margin (Tk.175706/ha) and cost of cultivation (Tk.49444/ha) were found in T_4treatment. But the highest benefit cost ratio (BCR) of 4.88-4.69 was obtained from T_2 and T_3.

Determination of seed rate and row spacing for higher yield of chia (*salvia hispanica)*

J.A. Chowdhury, S.S. Kakon, A.A. Begum, M.R. Karim, S.T. Zannat and D.A. Choudhury

The experiment was conducted at Agronomy research field of Bangladesh Agricultural Research Institute (BARI), Gazipur, during *rabi*(winter) season of 2021-22 to determine optimum seed rate and row spacing for higher yield of chia. The experiment consisted of three seed rate viz. 4, 5 and 6 kg/ha and three spacing viz. 30 cm, 40 cm and 50 cm with continuous sowing as treatments. The experiment was laid out in a RCB design with three replications. The crop was fertilized with 60-15-30-5 N-P-K-S kg/ha, respectively. The crops were harvested on 15, 20, 23 and 29 March 2022, 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. Seed rate and row

spacing showed great influence on yield components and yield of chia. It was found that 6 kg/ha seed rate with 30 cm row spacing produced the higher seed yield (1055kg/ha) followed by T_4 treatment (5 kg seed/ha with 30 cm spacing). Lower plant population gave higher number of inflorences but higher population gave higher seed yield. The results indicated that row spacing of 30 cm with seed rate of 5 kg/ha might be suitable for higher yield of chia cultivation.

Effect of sampling technique on yield assessment of lentil

M.R.Karim, J. A. Chowdhury, A. A. Begum, S. S. Kakon and D.A. Choudhury

The experiment was conducted in agronomy research field, Bangladesh Agricultural Research Institute, Gazipur during rabi 2021-22 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 squre yield, T_6 = Yield component based calculation and T_7 = Whole plot yield. 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). 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. All the treatments showed increased yield than whole plot yield. Maximum yield increase (36.27%) was found in T_6 and the lowest increase was found in T_3 (6.86%). Whole plot yield sampling is more preferable technique to asses 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.

Growth and yield of barley as influenced by spacing and seed rate

S.T. Zannat, S.S. Kakon, A. A. Begum and D.A. Choudhury

A field experiment was conducted during *rabi* seasons of 2021-22 to find out optimum seed rate and plant spacing of barley. Two plants spacing viz, R_1= 20 cm row spacing and continuous sowing, R_2= 25cm row spacing and continuous sowing and five seed rates viz; S_1 = 100 kg/ha, S_2 = 120 kg/ha, S_3 = 140 kg/ha, S_4 = 160 kg/ha, S_5 = 180 kg/ha were used as treatments. The experiment was laid out in a randomized complete block design with three replications. Seeds of BARI Barley-9 were sown on 24 November 2021. The crop was fertilized with 80-28-60-12-3.0 kg/ha (FRG' 2018) of N-P-K-S-Zn, respectively in the form of urea-TSP-MoP-gypsum-zinc sulphate and boric acid. A light irrigation was given after sowing of seeds for uniform germination. Four irrigations were done depending on soil moisture. Leaf area was measured by an automatic leaf Area Meter (L13200 C, LICOR, USA). The crop was harvested on 24 March 2022. The yield component data was taken from 5 randomly selected plants from each plot. At harvest, yield and yield contributing characters were 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 barley. Results revealed that, spacing and seed rate showed great influence on dry matter production and yield of barley. Dry matter (both in plants and spike) was found the highest with of 25 cm row spacing and continuous sowing with 100 kg/ha seed rate. Plants grown with 25 cm row spacing and 100 kg/ha seed rate (T_2 = S_1× R_2) gave the highest grain yield (20.10 t/ha) which was followed by 25 com row spacing and 120 kg/ha seed rate. The combination (S_1× R_2)produced the highest gross return (Tk.84000/ha) and highest benefit cost ratio (1.47). The results indicated that 25 row spacing with seed rate of 100 kg/ha might be economically profitable for barley production.

Determination of harvesting efficiency of mungbean

S.T. Zannat, M.R. Islam, M.A.K. Mian and D.A. Choudhury

An experiment was conducted at the Agronomy field of BARI, Gazipur and RARS Ishurdi, Pabna during the *kharif* season of 2021 and 2022. 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. The trial was set up in a randomized complete block design. Sowing was

done with spacing of 30 cm × 10 cm with three replications on 3 March 2021 on both the locations and in 2022 sowing was done on 1 March at Gazipur and 24 March at Ishurdi, Pabna. 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). 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 were harvested according to the treatments. Later harvesting increased the pods/plant which contributed to higher seed yield. The highest seed yield (859-1002 kg/ha) was recorded in T_3 (harvesting at 70 DAS) at Gazipur and T_4 (harvesting at 75 DAS) at Ishurdi. The average harvesting efficiency was computed the highest in T_3 (100%) treatment followed by T_4 (96.92%) treatment. Harvesting at 70 DAS-75 DAS would be suitable for higher seed yield of mung bean.

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, Gazipur during the *rabi* season of 2017-18, 2020-21, 2021-22. 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. 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. Three irrigations were given when it was necessary. 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 ^{o}C for 72 hours. The crop was harvested on 8 April 2022. 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. 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 4.77 at 85 DAS and TDM with the value of 5383.7 g/m^2 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 (10.43 t/ha) was recorded in 100000 plants/ha (T_3:50 cm × 20 cm spacing) and the lowest (8.93 t/ha) in 166666 plants/ha (T_5:30 cm × 20 cm spacing). The maximum grains/cob, 1000-grain weight were recorded in T_4 and T_1, respectively 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. Then the maximum predicated grain yield would be 10.43 t/ha.

Performance of mustard varieties at Moulvibazar

M. A. M. Miah, M. Shaheenuzzamn, M. Samsuzzaman, M.S. Alam, and M.H. Hossain

A field experiment was conducted at Regional Agricultural Research Station, BARI, Moulvibazar during *rabi* season of 2021-22 to evaluate the yield performance of BARI developed mustard varieties at Moulvibazar. 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, 2021 with 30 cm line spacing. The experiment was laid out RCB design with 3 replications. Rovral was sprayed to control Alternaria blight at every 10 days interval. Three irrigations required. 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 (1.88 t/ha) and it produced 79% higher yield than that of Tori -7. The second highest yield (1.59 t/ha) was recorded in BARI Sarisha 17. It was found 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 dates on the yield of sunflower at Moulvibazar

M.A.M Miah, M. S. Alam, M.A. Habib and M.H. Hossain

A field experiment was conducted at Regional Agricultural Research Station, BARI, Moulvibazar during *rabi* season of 2021-2022 to find out the optimum sowing date for BARI Surjomukhi-3 at Moulvibazar. There were four sowing dates viz., 1November, 15November, 30 November and 15 December in the study.Seeds were sown in line with 50 cm × 25cm 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. Significantly the highest yield (2.27t/ha) was obtained from 30 November sowing followed by 15 December sowing (1.58t/ha). The results revealed that 30 November - 15 December sowing performed better higher seed yield of BARI Surjomukhi-3 at Moulvibazar area.

Yield performance and storage quality of onion under integrated nutrient management at AEZ-9

M. R. Ali and J.Rahman

An experiment was carried out to find out suitable integrated nutrient management for yield performance and storage quality of onion at Regional Agricultural Research Station (RARS), Jamalpur during December 2021 to March 2022. The experiment consisted of seven treatments viz., T_1=Recommended fertilizer dose (FRG, 2018), T_2=125% RFD, T_3= Integrated plant nutrient system (IPNS) through 3 t/ha poultry manure (PM), T_4=IPNS through 3 t/ha farmyard manure (FYM), $T_{5=}$ IPNS through 3 t/ha vermicompost (VC), T_6= Recommended fertilizer dose +3 t/ha husk ash and T_7=Farmers' practice (69-19.69-40-9 kg/ha NPKS). BARI Piaz-4 was used in the study. The experiment was set up in randomized complete block design with 3 dispersed replications. The unit plot size was 3 m × 3 m and spacing 15cm × 10cm. Seedlings were transplanted on 12 December 2021 and onion was harvested on 28 March 2022. Weeding, irrigation and other intercultural operations was done as and when necessary. Yield was calculated in ton per hectare considering the whole plot as harvest area. Collected data were analyzed statistically with the help of STAR programme. Significantly the highest onion yield (22.99 t/ha) was found in integrated plant nutrient system (IPNS) and the lowest onion yield (12.85 t/ha) was obtained from farmers' practice. The highest gross return (Tk. 10,34,550/ha), gross margin (Tk. 7,74,183/ha) and benefit cost ratio (3.59) was found in IPNS with 3t/ha poultry manure and the lowest gross return (Tk. 5,78,250/ha), gross margin (Tk. 3,38,227/ha) and benefit cost ratio (2.41) was found farmers' practice. The result indicated that IPNS with 3 t/ha poultry manure would be profitable for cultivation of onion at AEZ-9 region**.**

Growth and yield of black cumin influenced by integrated nutrient management

M. R. Ali and J. Rahman

An experiment was carried out to evaluate the effect of integrated nutrient management for growth and yield of black cumin at Regional Agricultural Research Station (RARS), Jamalpur during December 2021 to March 2022. The experiment consisted of five treatments, viz., T_1=Recommended fertilizer dose (RFD): 60-24-45-15-2-1.4kg/ha of NPKSZnB (FRG, 2018), T_2=125% RFD, T_3= Integrated Plant Nutrient System (IPNS) with 3 t/ha PM, T_4=Integrated Plant Nutrient System (IPNS) with 3 t/ha FYM, T_5= Farmers' practice (69-11.8-15 kg/ha NPK). The treatments were tested in randomized complete block design with 3 replications. The unit plot size was 3 m × 4 m and spacing was 30 cm × 5 cm. BARI Kalogira-1 were used. Seeds were sown on 13 November 2021 and harvested on 23 March 2022. All fertilizers were used as per treatment. Weeding, irrigation and other intercultural operations was done as and when necessary. Yield was calculated in ton per hectare considering the whole plot. 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 Kologira yield was increased due to integrated nutrient management. The highest yield (1.57 t/ha) was found from Integrated Plant Nutrient System (IPNS) with 3 t/ha poultry manure and lowest yield

(0.50 t/ha) was found in farmers' practice. The highest gross return (Tk. 3,92,500/ha), gross margin (Tk. 3,06,980/ha) and benefit cost ratio (4.59) was in from IPNS with 3t/ha poultry manure and the lowest gross return (Tk. 1,12,000/ha), gross margin (Tk. 60,545/ha) and benefit cost ratio (1.94) was from farmers' practice. The result indicated that IPNS with 3t/ha poultry manure might be suitable for black cumin cultivation.

Effect of management practice for year round production of coriander

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 2021 and 2022 to determine the suitable management practice for year round coriander production. There are twelve sowing time and two management approaches for year round coriander leaf production as a condiment. The experiment was conducted at the research field of RARS, Jamalpur 24°56´ north latitudes and 89°55´ east longitudes. Treatments included in the experiment were: A. Sowing time: January, February, March, April, May, June, July, August, September, October, November and December and B. Management: a. Shade net condition and b. Raised bed. Design of the experiment was split plot with 3 replications. Each treatment was sown in unit plot having 2m × 2m with the spacing of 20 cm × 5cm. Fertilizers were applied at the rate of 50-20-32-10 (FRG, 2018) kg/ha of N-P-K-S. Weeding was done when necessary. Yield of coriander leaves were calculated from the whole plot area. Weather data (air temperature and rainfall) were collected from the Weather Station, RARS, Jamalpur . 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. Yield of coriander was considerably affected by sowing time and management. Different sowing times influenced shade net or raised bed management practices and as a result, this practice may be beneficial for farmer due to year-round market demand.

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

The experiment was conducted at RARS, Jamalpur during 2020 and 2021 to determine the suitable taro variety and planting date for higher yield and profit. Treatments included in the experiment were: Variety: 1. BARI PK-1 and 2. BARI PK-2; planting date: 1. January, 2. February, 3. March, 4. April, 5.August. Design of the experiment was split plot with 3 replications. Seedling were planted 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^{-1} 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. Weeding was done when necessary. Yield of rhizomes and stolon were calculated from the whole plot area. Data were analyzed with the help of a computer package program, Statistic 8.0 and means were separated following LSD test at 5% level of significance. The result revealed that both the variety performed well for higher yield and economic return in all planting dates through providing nutritious vegetables (stolon and rhizome) during the lag period and after the monsoon.

Effects of spacing and fertilizer dose on transplanted sunflower under zero tillage condition in southern region of Bangladesh

M.A. Rahmanand M.M. Rahman

The experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during Rabi season of 2021-22 to find out the optimum spacing and fertilizer dose for higher yield of transplanted sunflower under zero tillage condition. The experimental treatment comprised of two factors viz., Factor A. Three spacing (S_1 = 50 cm x 25 cm, S_2 = 40 cm x 25 cm and S_3 = 30 cm x 25 cm) and Factor B. Four doses of fertilizer (F_1 = Recommended dose, RD: 200-180-170-170-10-12 kg/ha urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid, respectively (FRG, 2018); F_2 = RD + 10% RD; F_3 = RD + 20% RD and F_4 = RD + 30% RD). The experiment was laid out in randomized complete block design with three replications. Seedlings (14-day old) of sunflower BARI Surjomukhi-2 were transplanted on 9 December, 2021 as per treatment specifications. The result revealed that all parameters were significantly differed by the interaction effects of plant spacing and fertilizer dose except plant population and plant height. Significantly the highest yield (2665 kg/ha) was recorded in S_2F_4 treatment and it was statistically

similar to S_2F_2treatment (2664 kg/ha). Highest gross margin (Tk. 136233/ha) and BCR(2.77) were recorded in S_2F_4treatment. From the result it may be concluded that 14-days old sunflower seedling could be grown through transplanting with row spacing of 40 cm and plant to plant distance 25 cm (S_2) along with 10-20% more recommended dose of fertilizer under zero tillage condition just after harvesting of T.*aman* rice in southern region of Bangladesh.

The field experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during two consecutive Rabi seasons of 2020-21 and 2021-22 after harvesting of T.aman rice (cv. BRRI dhan52) to test the dual performances (both fodder and seed yields) of BARI released grasspea varieties. The treatments of the experiment were: Factor A: Fodder cutting (C_0 = No fodder cut and C_1 = one cut of fodder at 50 days after emergence); Factor B: Six varieties of grasspea (V_1 = BARI Khesari-1, V_2 = BARI Khesari-2, V_3 = BARI Khesari-3, V_4 = BARI Khesari-5, V_5 = Faridpur local variety and V_6 = BARI Khesari-6). The experimental plots were fertilized with 35-60-45-45-10 kg/ha urea, TSP, MOP, gypsum and boric acid, respectively. Data were analyzed statistically using Statistic 10 software and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT) following Gomez and Gomez. The results revealed that shoot cutting had significant effect on days to flowering, days to harvest, plant height, number of branch/plant and straw yield in 2020-21. The seed yields were higher in non-cut treatment as compared to that of fodder cutting treatment in both the years. The highest seed yield (1378 kg/ha) was obtained from C_0V_6. Average over the years, the highest gross return(Tk. 152249/ha) and highest BCR (3.28)were recorded in C_1V_6.BARI Khesari-3, BARI Khesari-6, BARI Khesari-5 and Faridpur local variety cut at 50 DAE could be cultivated for fodder production and seed production in southern region of Bangladesh.

Performances of minor cereals 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 2020-21 and 2021-22 to evaluate the performances of minor cereals under different tillage conditions in rice based cropping systems. The treatments of the experiment 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: 7 (C_1 = Barley, C_2 = Kaon, C_3 = Cheena, C_4 = Sorghum, C_5 = Oat, C_6 = Buckwheat and C_7 = Chia. 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) in first year (2020-21). In second year (2021-22), the minor cereal crops were sown on 24 November 2021 (zero tillage), 13 December 2021 (minimum tillage) and 4 January 2022 (conventional tillage). The varieties of these crops were BARI Barley-8 (barley), BARI Kaon-4 (kaon), Tusar (cheena), BARI Sorghum-1 (sorghum), exotic variety (oat), local variety (buckwheat) and exotic variety (chia). 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, buckwheat 80 kg/ha and chia 6 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 chia. 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). Data were collected in relation to phenology, yield attributes and yields of the respective crops. Data were analyzed statistically and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT). Average of two years (2020-21 and 2021-22) experiment, the highest seed yield of barley was 2164 kg/ha in conventional tillage but minimum and zero tillage gave the seed yields of barley 1628 and 1692 In kaon, conventional, minimum and zero tillage gave the seed yields of 1654, 1222 and 1200 kg/ha, respectively. In respect of cheena, conventional, zero and minimum tillage showed the yields of 1454, 1116 and 1112 kg/ha, respectively. In case of sorghum, average seed yields were 3673,

2640 and 2493 kg/ha in conventional, minimum and zero tillage, respectively. In oat crop, seed yields were 1919, 1466 and 1380 kg/ha in conventional, minimum and zero tillage, respectively. In buckwheat, conventional, zero and minimum tillage produced the yields of 1345, 1046 and 1013 kg/ha, respectively. In case of chia, seed yields of 1214, 1047 and 967 kg/ha were found in conventional, minimum and zero tillage, respectively. The results revealed that all the minor cereal crops (chia, barley, kaon, cheena, sorghum, oat and buckwheat) could be cultivated under different tillage conditions but conventional tillage gave higher yield in southern region of Bangladesh.

Effect of tillage and fertilizer doses on sunflower growth and yield of sunflower in southern region of Bangladesh

M.M. Rahman, M. A. Rahman, M. A. Houque, M.A. Rahman and M. R. Uddin

The experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during the *Rabi* season of 2021-2022 to find out the effect of tillage and fertilizers on growth and yield of sunflower in Southern region of Bangladesh. The treatments of the experiment were: T_1 F_1= Conventional tillage(Farmers Practice)× Recommended dose, T_1 F_2= Conventional tillage(Farmers Practice)× 75% of RDF, T_1 F_3= Conventional tillage(Farmers Practice)×125% of RDF, T_2 F_1= Power Tiller Operated Seeder× Recommended dose ,T_2 F_2= Power Tiller Operated Seeder× 75% of RDF, T_2 F_3= Power Tiller Operated Seeder ×125% of RDF , T_3 F_1= Strip tillage × Recommended dose , T_3 F_2= Strip tillage × 75% of RDF, T_3 F_3= Strip tillage ×125% of RDF. The experiment was laid out in randomized complete block design with three replications. Seeds were sown on 2 January, 2022 in line sowing method at seed rate 12 kg/ha The unit plot size was 5m × 3m The initial soil moisture was 32% on oven dry basis. The experimental plots were fertilized as per recommendation of FRG,2018 (N,P,K,S,Mg,Zn and B @ 70-24-56-16-3-1 and 0.8 respectively). Data were analyzed statistically and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT). Significantly the highest yield (1.83t/ha) was observed in PTOS method× RDF and the lowest yield(1.12t/ha) was observed in strip tillage method×75% of RDF dose. From the economic point of view treatment Power Tiller Operated Seeder× 75% of RDF might be suitable for cultivation of sunflower (BARI Surjomukhi-3) under Ganges Tidal Floodplain.

Effect of different concentration and application time of gibberalic acid on growth and yield of potato

M. S. Huda and M.T. M. Khanum

The experiment was conducted to find out the appropriate application time and GA_3 concentration for maximizing seed potato production in Bangladesh by increasing seed tuber number per plant and yield at the research field of Agricultural Research Station, Rajbari, Dinajpur, during 2021-22. The treatments combinations were as follows; the different application time of GA_3 was used as Factor A: ie. A_1=Just after sprouting of seed, A_2=At 30 DAS (seedling stage), A_3=At 45 DAS (vegetative growth stage) and A_4=At 60 DAS (maturity stage). Different concentration of GA_3 were used as factor B; ie. G_{00} = 00 ppm, G_{20} = 20 ppm, G_{40} = 40 ppm and G_{60} = 60 ppm. The crop planted on 10 November 2021 in RCBD with 3 replication. Seeds of 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. Chemical fertilizers were applied with 120-39-75-20 N-P-K- S kg/ha, respectively (FRG, 2018). One gram GA_3 was dissolved in 70% ethyl alcohol (1 to 3 ml) and then make it volume 100 ml by adding distilled water, thus 10000 ppm GA_3 was prepared as stock solution. Then 20, 40 and 60 ppm GA_3 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 GA_3 solution and spread over the floor under diffused light for sprouting The crop was haulm pulled at 07 February 2022 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 number of tuber per plant, tuber weight per plant and yield were influenced by application of GA_3at 12 DAP. Application of GA_3 (20 to 40 ppm) in seed tuber or in seedling of potato could be increase the number

of tuber per plant and yield. Application of GA_3 (20 to 40 ppm) in vegetative stage of potato might be increase the yield of potato.

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* 2021-22 where 4 different sowing times viz., 15 November, 30 November, 15 December and 30 December 2020 were evaluated with 15, 20, 25 and 30 cm continuous line spacing to find out optimum sowing time and spacing for higher yield of linseed for Dinajpur region. The experiment was laid out in RCBD with 3 replications and plot size were 3 m × 4 m. 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. Significantly the highest yield (2.22 t/ha) was recorded from 15 November with 25 cm spacing which was statically similar with 30 November with 25 cm spacing (2.09 t/ha), 15 Nov with 30 cm spacing (1.98 ton/ha) and also 15 November with 20 cm spacing (1.96 ton/ha). The result indicated that November sowing with 25 -30 cm line spacing would be the most suitable for Dinajpur region of advanced linseed line of Lin-W-17.

Performance of garlic varieties at Dinajpur region

M.M. Khanum, M.S. Huda and D.A. Choudhury

The experiment was carried out at the research field of Agricultural Research Station, Rajbari, Dinajpur during *rabi* season of 2020-21 and 2021-22. The objective of this study was to evaluate the performances of garlic varieties and economic profitability of these garlic varieties. There were five garlic varieties, namely BARI Roshun-1, BARI Roshun-2, BARI Roshun-3, BARI Roshun-4 and a local cultivar. The experiment was laid out in randomized completely block design (RCBD) with three replications. The unit plot size was 1.7m × 1.5 m and spacing 15 cm×10cm were maintained. Seeds (clove) were planted in 09 November, 2020 and 16 November, 2021. The crop was fertilized with $N_{114}P_{48}K_{120}S_{30}$ Zn_2B_2 kg ha^{-1} and cow dung 5 t ha^{-1} (FRG'18). 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 (10.77 t/ha) was obtained from BARI Roshun-3and the lowest yield (6.79 t /ha) was recorded from the local one. BARI Rashun-3 produced 33, 23, 11 and 58% higher bulb yield than BARI Rashun-1, BARI Rashun-2, BARI Rashun-4 and local cultivar in two consecutive years. The highest gross return (Tk. 430600/ ha) and gross margin (Tk. 288433/ ha) and BCR (3.02) 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.

Effect of planting date and nutrient management on yield of broccoli

M.M. Khanum, M.S. Huda, A. Barman, S.S. Kakon and D.A. Choudhury

The experiment was carried out at the research field of Agricultural Research Station, Rajbari, Dinajpur during *rabi* season of 2021-22 to find out optimum planting time and nutrient dose of broccoli in early planting condition. The treatments of the experiment were of two factors viz., Factor A: three planting times viz. P_1= 30 October, P_2=15 November, P_3=30 November and Factor B:four levels of nutrients viz. T_1= STB Recommended chemical fertilizer (RCF) (120-24-60-20-2-1.5 kg/ha NPKSZnB), T_2=T_1+ 25% of NPK (150-30-75-20-2-1.5 kg/ha NPKSZnB), T_3=IPNS with vermicompost 1.5 t/ha, T_4= IPNS with vermicompost 3 t/ha. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 7.5 m^2 (3m×2.5m)and spacing 50cm×50cm were maintained. Fertilizers were applied as per treatments in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid, respectively. Seeds were sown in seedbed and then thirty days old healthy seedlings were transplanted into the main field according to the treatments. Irrigation was given the first 4-5 days after transplanting of seedlings. Broccoli was harvested several times according to planting date. Yield components of broccoli were taken from randomly selected 5 plants from each plot. Collected data were analyzed statistically by using R software packages and mean differences for each character were compared by Least Significant Difference.

Result revealed that highest yield (18.56 t/ha) was recorded in P_1T_4 (IPNS with vermicompost 3 t/ha when planted on 30 October). This treatment (P_1T_4) showed the maximum gross return (Tk. 556800/ ha) and gross margin (Tk. 379000/ ha) but the maximum benefit cost ratio (3.17) was obtained from P_1T_3 treatment due to less cost involvement in this treatment. It was found that IPNS with vermicompost 1.5 tha^{-1} when planted on 30 October (P_1T_3) might be more profitable and economically feasible for broccoli growers in the Dinajpur region.

Effect of plant population and integrated nutrient management on yield of dwarf yard long bean

S.S. Kakon, S. Paul, A.A. Begum, S.T. Zannat and D.A. Choudhury

The experiment was conducted during *Kharif* season 2022 at the Regional Agricultural Research Station, BARI, Jashore to find out the suitable fertilizer management and optimum spacing for higher yield of dwarf yard long bean *(Vigna unguiculata)*. Three fertilizer levels *viz.*F_1= Recommended fertilizer dose (21-27-23-9-1.2-1.2 Kg/ha NPKSZnB), F_2=IPNS+ Poultry Manure (3 t/ha) F_3= IPNS+ Vermicompost (3 t/ha) were assigned and two spacing *viz.* S_1=50cm × 30cm, S_2=40cm × 20cm and S_3=40cm × 30cm were used as treatments. The plot size was 4m ×3m. The experiment was laid in Randomized Complete Block design with three replications. The crop was sown on 24th March, 2022.1st flowering and 50% flowering started at 30th April, 2022 and 5th May, 2022 respectively. Harvesting was started at 17th May, 2022; then 26th May, 2022 and last at 02th June, 2022. Significantly the highest yield (3.18 t/ha) was recorded inplant spacing of 40 cm × 20 cm with IPNS with poultry manure (3 t/ha).The highest benefit cost ratio (1.65) of yard long bean was recorded in S_3F_2(Plant spacing of40cm × 30cm with IPNS+ Poultry Manure 3 t/ha) treatment. From the result it could be concluded that plant spacing of 40 cm × 20 cm (1,25000 plants/ha) and 40 cm × 30cm with IPNS + Poultry manure (3 t/ha) might be suitable for yard long bean cultivation at Jashore.

Evaluation of yardlong bean lines with BARI borboti-1

M.H. Rahman, S Paul, M.S Huda, M.R. Karim, S. Sultana, Ku Ahamed and D.A Chowdhury

The experiment was conducted at the research field ARS, Dinajpur during *Rabi* season of 2021-22 to find out the promising advanced line of yard long bean for winter season in Bangladesh. Two advanced long yard bean lines viz. JSRVU-002, JSRVU-003 were evaluated with the variety BARI Borboti-1 (control) The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4.0 m × 3.0 m. with 60 cm× 25 cm spacing, and recommended fertilizer dose 21-27-33-9-1.2-1.2 kg/ha NPKSZnB; RFD FRG, 2018. Fertilizer were applied in the form of Urea, TSP, MoP, Gysum, 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. Two 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. Yard long bean was harvested for several times and started on 17 May 2021. At harvest, the yield data was recorded plot wise. The collected data were analyzed statistically, and means were adjudged by LSD test The maximum number of pods per plant (32), pod length (25.49cm) and the highest (27.06 ton/ha) were recorded from JSRVU-003 at Dinajpur region.

Effect of irrigation on growth and yield of chia

D.A. Choudhury

Chia (*Salvia hispanica* L.) is an annual plant belonging to the Lamiaceae family native to Mexico and Guatemala. Chia seed is composed of protein (15% –25%), fats (30%–33%), carbohydrates (26%–41%), high dietary fiber (18%–30%), ash (4%–5%), minerals, vitamins, dry matter (90%–93%) and also contains a high amount of antioxidants. In Bangladesh, chia is a new crop, but the economic value of chia in international market and even in Bangladesh is very high. The growth and production of chia are is influenced by agronomic management factors and maximum yield is only obtained when an appropriate combination of these factors are provided for the plants. Irrigation is an important factor of crop production for maximizing the yield. Excess or deficit irrigation decrease plant growth and yield. Crop produce maximum output when optimum soil moisture available in the field. to find out the optimum water requirement of Chia for higher growth and yield. The experiment was conducted at Agronomy Research Field, BARI,

Gazipur during 2021-22 to find out the optimum water requirement of Chia for higher growth and yield. Seeds were sown on 2nd week of November. The crop was fertilized with recommended doses of fertilizers and different intercultural operations were done as and when required. Crop was irrigated as per treatments. Chia was harvested in 1st week of March. Significantly higher seed yield (1121kg/ha) of chia was found when irrigated at vegetative, flowering and grain filling stage over no irrigation and single irrigation at vegetative stage. On an average, about 30.0% higher yield was obtained in chia when irrigated 3 times over no irrigation.

Weed Management

Effect of weeding and nutrient management practice on yield of sweet gourd

M. Z. Ali, A. A. Begum, N. Aktar, S. S. Kakon and D. A. Choudhury

The field experiment was conducted at the Bangladesh Agricultural Research Institute, Gazipur during *rabi* season of 2021-2022 to find out the optimum fertilizer dose and appropriate weed management method for getting higher sweet gourd yield (Var. BARI sweetgourd-2) and economic return. The experiment was consisted of eight treatments viz. Note: Note: T_1 = STB: Soil test based fertilizer dose (75-37-82-21-2.0-1.4 kg/ha N-P-K-S-Zn-B, FRG, 2018) + no weeding, T_2 = 125% STB (94-46-103-26-3.0-2 kg/ha N-P-K-S-Zn-B, FRG, 2018) + two hand weeding at 25 and 50 DAT, T_3 = STB + Spading at 25 and 50 DAT, T_4 = 125% STB + Spading at 25 and 50 DAT, T_5 = STB + BARI weeder weeding at 25 and 50 DAT, T_6 = 125% STB + BARI weeder weeding at 25 and 50 DAT, T_7 = STB + Herbicide spray Pendicare 33 EC (Pendimethalin 33%) @ 2 L/ ha) at 4 DAT + one hand weeding at 50 DAT, T_8 = 125% STB + Herbicide spray Pendicare 33 EC (Pendimethalin 33%) @ 2 L/ ha) at 4 DAT + one hand weeding at 50 DAT were used in the study as treatment variable. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4 m × 4 m. The chemical fertilizers were used in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid. All of organic manure P, K, S, Zn and B were applied in pit 7 days before transplanting of sweet gourd seedling and mixed thoroughly with the soil while urea and MoP were side dressed in four equal split around the plant as at 15, 35, 55 and 75 days after transplanting of seedling under moist soil condition and mixed thoroughly with the soil as soon as possible for better utilization. In addition 5 t/ha of cow dung were applied before land preparation. Intercultural operation like weeding was done as per treatments. Other intercultural operation was done as and when require. The test variety was BARI sweet gourd-2. Sweet gourd plant was transplanted at 2 m × 2 m spacing on 02 December 2021. Four irrigations were given to crop at 15, 45, 60 and 75 DAE. Weed samples were collected using 50 cm × 50 cm quadrate, from randomly selected four places from each plot at 25 and 50 days after transplanting (DAT) of sweet gourd seedling. Number and dry weight of weeds were recorded carefully. BARI sweet gourd- 2 was harvested four times on 25 March 2022, 03 April 2022, 13 April 2022 and 24 April 2022. The yield component data was taken from 2 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 $LSD_{(0.05)}$ test. Economic analysis was also done considering local market price of harvested crops. 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. Among the treatments the highest weed control efficiency (84% at 25 DAT and 94% at 50 DAT) was found in T_2 (125% STB : 94-46-103-26-3.0-2 kg/ ha of N-P-K-S-Zn-B + two hand weeding at 25 and 50 DAT) treatment followed by T_3 (82% at 25 DAT and 93% at 50 DAT) and T_4 (81% at 25 DAT and 92% at 50 DAT) treatments and the lowest weed control efficiency was obtained from T_8 treatment (77% at 25 DAT and 88% at 50 DAT). Significantly the highest sweet gourd fruit yield (29.38 t/ha) was recorded inT_2 treatment(125% STB + two hand weeding at 25 and 50 DAT) but higher benefit cost ratio 2.79 was obtained from T_7 treatment (Soil test basis fertilizer dose + Herbicide spray Pendicare 33 EC (Pendimethalin 33%) @ 2 L/ ha) at 4 DAT + one hand weeding at 50 DAT) due to lower cost of production. The result indicated that STB (75-36-60-21-2.0-1.4 kg/ha N-P-K-S-Zn-B) + herbicide spray Pendicare 33 EC (Pendimethalin 33%) @ 2 L/ ha) at 4 DAT of sweet gourd seedling + one hand weeding at 50 DAT would be most effective to control weeds for getting higher fruit yield and economic return of sweet gourd.

Effect of integrated weed management on tomato cultivation

S.T. Zannat, S.S. Kakon, M.A.K. Mian 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 and 2021-22 to find out suitable weed management practices in tomato. Treatments consist of T_1= Two hand weeding at 25 and 45 DAT, T_2= Magzin 70 WG (Mteribuzin) @ 300-400 gm/ha + One hand weeding at 45 DAT, T_3= G-Penda 33 EC (Pendimethylene) @ 1 L/ha+ One hand weeding 45 DAT, T_4= Shagun 54 WG (Metribuzin 42% + Clodinafop Propargyl 12% WG) @ 400-500 g/ha + One hand weeding 45 DAT and T_5= 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 123-45-60-24-2-1 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 of 26 days old were transplanted in main field on 05 January 2022. 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 quadrate 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 31 March 2021. At the time of harvest, yield contributing characters were recorded from one linear meter and yield data was recorded by harvesting the whole plot.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. Two years results showed that Helencha (*Enhydra fluetuans*) was observed as a major weed in tomato field. Number of weed/$m^2$and weed control efficiency (WCE) was affected by different treatments. The highest weed populations (78.5/m^2 and 125.5/m^2) were recorded in control plot at 25 and 45 DAT, respectively. The highest WCE (weed control efficiency) was 92.13 and 93.62% at 25DAT and 45 DAT respectively in T_4 treatment. Significantly the highest fruit yield (74.72 t/ha) was recorded in T_4(Shagun 54 WG (Metribuzin 42% + Clodinafop Propargyl 12% WG) @ 400-500 g/ha + one hand weeding at 45 DAT) treatment.The highest gross return (Tk. 895200/ ha and Tk. 1120800/ha), gross margin (Tk. 733250/ha and Tk. 925746/ha) and BCR (5.53 and 5.75) was observed in T_4 {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 indicated 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.

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

M.R. Islam, J. Hossain, M.S. Alam, A.A.M.M. Mustakim and M.M. Uddin

A field experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during 2020-2021 and 2021-2022 to find out the appropriate dose and time of spray of Pendimethalin (Panida) for weed control of onion. Four doses of Pendimethalin herbicide viz; i) 3 ml/ L of water (D_1), ii) 5 ml/ L of water(D_2), iii) 7 ml/ L of water (D_3), iv) Control (D_4), and four spraying time namely, i) Spraying at just after planting and irrigation (T_1), ii)Spraying at 3 days after planting and irrigation (T_2), iii)Spraying at 5 days after planting and irrigation (T_3), iv)Spraying at 7 days after planting and irrigation (T_4) were included in the experiment. Herbicides were applied as per treatments. The experiment was laid out in a split plot design with three replications. Unit plot size was 3m x 2 m. The crop was fertilized with 240-260-150-110 kg ha^{-1} of Urea-TSP-MOP-Gypsum, and cowdung 5 t/ ha(Krishi Projukti Hatboi-2019). The bulb were harvested on 1 April and 7 April 2021 and 2022, respectively. The crop were irrigated at 20, 35 and

50 DAP. Weed sample was collected at 60 DAP and 80 DAP from every plot. Collected data were analyzed statistically with the help of 'R' program Results revealed that Spraying (7 ml /L of water) at just after planting and irrigation produced the highest bulb yield (14.78 t/ ha). On the basis of economic point of view spraying (7 ml /L of water) at just after planting getting highest gross margin (TK.201090/ ha) and BCR (2.19), and could be applied for controlling weed in onion field. The result revealed that spraying (7 ml /L of water) at just after planting would be effective to control weeds for obtaining higher yield of onion.

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

M.R. Islam, J. Hossain, M.S. Alam, A.A.M.M. Mustakim and M.M. Uddin

The experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during 2020-2021 and 2021-2022 to find out the suitable herbicide for controlling weed in garlic under zero tillage mulched condition. Nine treatments were included as treatments viz; T_1 = Commit (Pretilachlor), T_2 = 2,4-D Amine (2, 4-D), T_3 = Weednil (Quizalofop-p-ethyl), T_4 = Sunrise (Ethoxysulfura), T_5 = Whip Super (Fenoxaprop-p-ethyll), T_6= Ronstar (Oxadiazol), T_7= Panida (Pendimethalin), T_8 = Hand weeding at 25, 45 and 65 DAP, T_9 = Control. The experiment was laid out in a Randomized Complete Block design with three replications. The unit plot size was 3.5 m × 2.5 m. The crop was planted on 09 and 21 November 2020 and 2021, respectively. The bulb were harvested on 30 March and 3 April 2021 and 2022, respectively, Fertilizer was applied @ 155-35-125-36-2-1.4 kg/ haof N-P-K-S-Zn-B corresponding to 336-175-250-200-5.6-8 kg /ha of Urea-TSP-MOP-Gypssum-$ZnSO_4$-Boric acid, respectively. Herbicides were applied on muddy soil surface (42% moisture content condition) at 24 hr before planting of garlic. Data on weed growth, yield and yield contributing characters were taken and analyzed statistically. The results showed that the lowest weed dry weight at 120 DAP (42.07 g /m^2) was recorded in T_7 corresponding to 92% weed control efficiency (WCE) which was identical to T_6 (43.30 g m^{-2} with 92 %,WCE) and the highest weed dry weight (541.14 g/ m^2) was obtained from control. Among the herbicides Panida (Pendimethalin) and Ronstar (Oxadiazol)produced the significantly higher bulb yield (9.66 t/haand 9.65 t/ha) which was only 2.56% and 2.65. lower than T_8 (Hand weeding at 25, 45 and 65 DAP), and the lowest in Control (3.94 t /ha). From economic point of view, the highest gross margin and BCR were obtained from T_7 (Tk. 440900/ ha and 3.22) and T_6 (Tk. 440550 /ha and 3.22) followed byT_8. Therefore, on the bases of weed control efficiency and economic return Panida (Pendimethalin) and Ronstar (Oxadiazol) both were suitable herbicide for controlling weed in garlic under zero tillage mulched condition.

Integrated weed management of mukhikachu (*Colocasia esculenta*)

S. Paul, M.H. Rahman, K.U. Ahammadand D.A.Chowdhury

An experiment was conducted at Regional Agricultural Research Station, BARI, Jashore during Kharif Season, 2021 having nine treatments viz.T_1= Mulching (organic mulch),T_2= Mulching (polythene mulch), T_3= Hand weeding (5 times), T_4= Pre-emergence herbicide (Destroy 20 GR: Metalachlor+Bensulfuron Methyl), T_5= Pre-emergence herbicide+ Mulching (organic mulch), T_6= Pre-emergence herbicide+ Mulching (polythene mulch), T_7= Pre emergence herbicide+ Hand weeding (1 time), T_8= Hand weeding (3 times)) and T_9= Control (No weeding) and laid out in randomized complete block design with three replication The objective was to find out the effective weed management of Mukhikachu. The Mukhikachu variety BARI Mukhikachu-1 (Bilasi) was used as the test crop. In case of organic mulch mustard stover was used and incase of polythene mulch black polythene mulch was used. The unit plot size was 5.0m x 3.0m. Planting was done on 7th April, 2021. Row to row spacing was 60 cm and plant to plant spacing 30cm. 10-15 t/ha of well rotten farmyard manure was added in the field before planting. In addition, 80 kg of Nitrogen, 60 kg P_2O_5, and 60 kg of K_2O/ha[1] were applied. Half N and whole of P and K were added at the time of planting while the remaining half of nitrogen was applied 35-45 days after planting. Irrigation was applied when required. Treatments were applied accordingly. Weed density (no/ m^2) and dry weight of weed (g/m^2) were taken at 15 DAE,45 DAE and 75 DAE. Rhizome yield was recorded as per plot basis and then converted to t ha^{-1}. Highest weed intensity (%) was in T_9, T_4 and T_7 treatment and these treatments showed low weed indices. Weed density (no/ m^2) and dry weight of weeds (gm^{-2}) were the lowest in T_3 . The result revealed that the highest yield (22.73

t /ha) and BCR (6.49) was obtained in T_1 with the lowest weed density. The result also indicated that, the lowest weed density resulted in lowest crop-weed competition for natural resources and thereby produced highest yield. Besides, between organic mulch and black polythene mulch organic mulch showed the highest yield.

Weed management in groundnut

M. M. Rahman, M. A. Rahman and M. R. Uddin

A field experiment was carried out at the Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during the Rabi season of 2021-22 to know the effective and economic weed control method for groundnut cultivation. The treatments of the experiment were: T_1= Control, T_2= One hand weeding at 20 DAE, T_3= T_2 + Hand weeding at 40 DAE (W4), T_4= BARI mechanical weeder at 20 DAE, T_5= T_2 + BARI mechanical weeder at 40 DAE, T_6= Spraying of Weednil at 20 DAE@ 1.5 ml/L. Seeds were sown on 2nd December, 2021 in line at 100kg/ha seed (not shelled). The experiment was laid out in randomized complete block design with three replications. The unit plot size was 3m × 4m. Fertilizers applied @60-48-80-48-3-2.1-0.6 kg/ha of NPKSZnB. Seeds were sown in line sowing having 30 cm apart. Weeds were removed by herbicide sprayed as per treatment and plant protection measures are to be taken as required. Data were collected on different parameters such as weed population/ m^2 are to be collected at 20 DAE and dry matter are to be measured, relative weed density, yield and yield contributing characters. Data were analyzed statistically and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT). Weed population/ m^2andweed dry weight varied among the treatments. The highest weed population (213.87) was recorded in T_1 and lowest no. of weeds found in T_3treatment (51.83). Significantly the highest yield (1798.16 kg) was recorded from treatment T_3.treatment the highest weed dry weight was found in T_1 (554.64 g) and lowest one was T_5 (174.24 g).

Effect of different herbicides for controlling weeds in potato field

J.A. Chowdhury, M.A.H Khan, A.A. Begum, S.S. Kakon, M.Z. Ali, M.R. Karim, S.T. Jannat and D.A. Choudhury

The experiment was conducted at agronomy research field of Bangladesh Agricultural Research Institute, Gazipur and RARS Cumilla during the period from November 2021 to March 2022 to evaluate the effectiveness of different herbicides for controlling weed in potato. The treatments were: T_1 =Fashal Queen 5 EC (Quizalofop-p-ethyl 15%) @ 2.5 L/ha spraying at 4-8 DAP, T_2 =Harvester 30 EC (Pendimethalin) @ 2.0 L/ha spraying at 4-8 DAP, T_3 =Rapid Klin 34 EC (Pretilachlor 15% + Oxyfluorfen 12% + Oxadiazon 7%)@ 500 ml/ha spraying at 4-8 ADAP, T_4 =G-Mine 72 SL (2,4-D Amine Salt 72%) @ 2.24 L/ha spraying after emergence of weed, T_5 =SHORT OUT 40 SC (Bispyribac sodium 40% SC) @ 150ml/ha spraying after emergence of weed, T_6=Sirius Gold 40WP (Bensulfuron methyl 6% + Quinclorac 34%) @ 100 gm/haspraying after emergence of weed, T_7= Two hand weeding at 25 & 45 DAE, T_8= Control (No weeding and herbicide). The trial was set up in randomized complete block design with three replications. The unit plot size was 3 m × 3 m. The crop was fertilized with cowdung 5 t/ha and 180-40-180-20-4-1 kg/ha of NPKSZnB, respectively (FRG, 2018). Potato (BARI Alu-7) was planted on 28 December and 20 December 2021 at Gazipur and Cumilla respectively. Crop was harvested on 23 March and 22 March 2022 at Gazipur and Cumilla respectively. A light irrigation was given at 5 DAP for proper emergence. Weed samples were collected from randomly selected four places by using 50 cm × 50 cm quadrate from each plot at 25 and 45 DAE. Number and dry weight of weeds were recorded carefully. Weed control efficiency (WCE) was calculated according to following formula of Mani et al. (1973): WCE (%) $=\left(\frac{A-B}{A}\right)\times 100$ where, A = Dry weight of weeds in no weeding plot and B = Dry weight of weeds in treated plot. Data on yield and yield contributing characters were taken and statistically analyzed following MSTAT-C software package. Results showed that the highest weed population (128/m^2 at Gazipur, 198/m^2 at Cumilla at 25 DAE and 207/m^2 at Gazipur and 214/m^2 at Cumilla at 45 DAE) were recorded in control plot at 25 and 45 DAE, respectively. The lowest weed population (11/m^2 at Gazipur, 18/m^2 at Cumilla and 16/m^2 at Gazipur, 21/m^2 at Cumilla) was recorded in T_1 (Fashal Queen 5 EC)treatment at 25 DAP and 45 DAP respectively. The highest WCE 94% at Gazipur, 87.9% at Cumilla and 92% at Gazipur, 88.3% at Cumilla was found in T_1 (Fashal Queen 5 EC) treatment at 25 DAE and 45 DAE respectively. The highest tuber yield (24.80

t/ha at Gazipur and 27 t/ha at Cumilla) was obtained from T_1 treatment. All other herbicide treated plot and hand weeded plot gave the statistically identical yield with that of T_1. The results revealed that tested six herbicides would be effective for weed control and economically profitable for potato cultivation at Gazipur and cumilla.

Efficacy of different herbicides for controlling weeds in bare place

A.A. Begum, J.A. Chowdhury, M. Z. Ali, S. Zannat and D.A. Choudhury

A field experiment was conducted at Agronomy Research Field of Bangladesh Agricultural Research Institute, Gazipur, during rabi season of 2021-2022 to find out the efficacy and suitable herbicide to control weeds in bare place. The treatments were: T_1= Raisonate 20 SL (Glufosinate 20% SL) @ 5.25L/ha spraying at 20 days after land preparation (DALP), T_2 = Raisonate 20 SL (Glufosinate 20% SL) @ 5.25L/ha spraying at 20 DALP + 1 HW at 20 days after herbicide spraying (DAHS), T_3 = Raiquat 20 SL (Diquat 20 SL) @ 3.75L/ha spraying at 20 DALP, T_4 = Raiquat 20 SL (Diquat 20 SL) @ 3.75 L/ha spraying at 20 DALP + 1 HW at 20 DAHS, T_5 = Two HW at 20 and 40 days after land preparation and T_6 = Control (No weeding and no herbicide). The trial was set up in a randomized complete block design with three replications. The unit plot size was 5m × 3m. To make the land in sufficient moist conditioned, irrigation was applied before spraying herbicide. Herbicide was applied at 20 DALP on 10 December, 2021. Weed samples were collected from randomly selected four places by using 50cm × 50cm quadrate from each plot at 30 and 50 DALP (10 and 40 days after herbicide application). Number and dry weight of weeds were recorded carefully. Weed control efficiency (WCE) was calculated according to following formula: WCE (%) = $\left(\frac{A-B}{A}\right)100$; where A= Dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots.The target weed to control by Raisonate were Shyama (*Echinochloa crusgalli*), Khude shyama (*Echinochloa colonum*), Mutha (*Cyperus rotundus*), Durba (*Cynodon dactylon*), Lajjaboti (*Mimosa pudica*), Ulu (*Imperata cylindrica*) and Chapra (*Eleusine indica*). On the other hand, the target weed to control by Raiquat were Mutha (*Cyperus rotundus*), Nakphuli (*Cyperus difformis*), Manayona (*Commelina diffusa*), Chechra (*Scirpus maritimus*), Arrow leaf pondweed (*Monochorea vaginalis*). The highest number of weed population 280/m^2 and 315/m^2 were recorded in control plot at 30 and 50 DALP, respectively. The lowest number of weed population 15/m^2 and 12/m^2 were recorded in T_2 treatment followed by T_4. Weed control efficiency (83%-97%) was found at 30 and 50 DALP in herbicide treated plots. So the results revealed that both Raisonate 20 SL (Glufosinate 20% SL) and Raiquat (Diaquat 20% SL) post emergence herbicide would be effective for controlling weeds in bare place at Gazipur (AEZ 28).

Efficacy of different herbicides for controling weeds in onion field

M. Z. Ali, A. A. Begum, S. Paul, S. S. Kakon and D. A. Choudhury

A field experiment was conducted at Agronomy Research Field of Bangladesh Agricultural Research Institute, Gazipur and Regional Agricultural Research Station (RARS), Jashore during rabi season of 2021-2022 to find out the suitable herbicide for controlling weed in onion field. Eight treatments viz., T_1 = Pendicare 33 EC (Pendimethalin 33%) @ 2 L/ ha spraying at 2-3 days after transplanting of onion seedling, T_2 = Nirzash 46 SL (Bentazone 40% + MCPA 6%) @ 9 ml/L spraying at 2-4 leaf stage of weed, T_3 = Citro-55 SC (Atrazine 50% + Mesotrione 5%) @ 1 L/ha spraying at 2-3 days after transplanting of onion seedling, T_4 = Cutter 50 EC (Quizalofop – P – Ethyl 50%) @ 300 ml/ha spraying at 2-4 leaf stage of weed, T_5 = Raxil 50 EC (Quizalofop – P – Ethyl 50%) @ 300 ml/ha spraying at 2-4 leaf stage of weed,T_6 = Bay 30 WP (Bensulfuron-methyl 12% + Bispyribac sodium 18%)) @ 75 gm/ha spraying at 2-4 leaf stage of weed, T_7= Two hand weeding at 25 & 50 DAT and T_8 = Control (No weeding and herbicide) were in the experiment. The trial was set up in randomized complete block design with three replications. The unit plot size was 3 m × 3 m. The crop was fertilized with cowdung 10 t/ha and 140-60-120-40-4.5-2.1 kg/ha of N-P-K-S-Zn-B (FRG 2018) respectively. Seedlings of onion variety (BARI Piaj-4) were transplanted at Gazipur on 27 December 2021 and 13 December 2021 at Jashore. A light irrigation was given after transplanting. Weed samples were collected using 50cm × 50cm quadrate, from randomly selected four places from each plot as per treatment. Number and dry weight of weeds were recorded carefully. The Relative Density (RD) and

weed control Efficiency (WEC) were calculated by the following formula.

$$\text{WCE (\%)} = \left(\frac{A - B}{A}\right) \times 100$$

Where, A = Dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. The crop was harvested on 05 April 2022 at Gazipur and 26 March, 2022 at Jashore. Yield and yield contributing characters were recorded and analyzed statistically and mean separations were done by LSD test at 5% level of significance. Results showed that number of weed/m^2, weed control efficiency (WCE) and yield of onion were significantly influenced by the six herbicides. The highest weed population (78 and 150/m^2) was recorded in T_8 at 25 DAT in both locations and similar results found at 50 DAT (155 and 205/m^2) in both locations. The highest weed control efficiency (WCE) at 25 DAT (84.94% and 85.62%) was found in T_1 treatment and at 50 DAT the highest WCE (84.24% and 87.17%) was also found in same treatment. The highest onion bulb yield (18.25t/ha at Gazipur and 18.86t/ha at Jashore) was obtained from T_1 treatment. All herbicide treated plot and hand weeded plot gave the statistically identical yield with T_1. The highest gross return Tk. 6,38,685/ha at Gazipur and Tk. 6,60,269/ha at Jashore, gross margin Tk. 4,42,838/ha at Gazipur and Tk. 4,72,422/ha at Jashore followed by T_3, T_4, T_5, and T_6 treatments. The highest BCR (3.26 at Gazipur and 3.51 at Jashore) was obtained from T_1 treatment followed by T_3 (3.19 at Gazipur and 3.44 at Jashore), T_4 (3.16 at Gazipur and 3.41 at Jashore), T_5 (3.00 at Gazipur and 3.24 at Jashore), T_6 (2.67 at Gazipur and 2.90 at Jashore) and T_2 (2.40 at Gazipur and 2.62 at Jashore) treatments. So, the result revealed that six herbicides would be effective for weed control and economically profitable for onion cultivation at Gazipur(AEZ 28) and Jashore (AEZ 11).

Performance of different herbicides for controlling weeds in garlic

S.T. Zannat, J. Rahman, A.A. Begum and D.A. Choudhury

A field experiment was conducted at Agronomy Research Field of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur and RARS, Jamalpur in 2021-22 to find out the performance of two herbicides for controlling weeds in garlic field. The treatments were: ; T_1= Tabala 50 EC (Oxyflurofen 5% + Metolachlor 30% + Pendimethalin 25%) @ 2-3 L/ha spraying at 3 DBP + one hand weeding (HW) at 25 DAP; T_2 = Tabala 50 EC (Oxyflurofen 5% + Metolachlor 30% + Pendimethalin 25%) @ 2-3 L/ha spraying at 3 DAP; T_3 = Unirazine 50 SC (Atrazine) @ 600-700 ml/ ha spraying at 3 DBP + one hand weeding (HW) at 25 DAP; T_4 = Unirazine 50 SC (Atrazine) @ 600-700 ml/ ha spraying at 15 DAP + one hand weeding (HW) at 25 DAP; T_5 = Two HW at 25 & 45 DAP and T_6 = Control (No weeding and herbicide). The trial was set up in randomized complete block design with three replications. Sowing was done on 19, November at Gazipur and on Nov. 09, 2021 at Jamalpur. The unit plot size was 3 m × 3 m. Test crop was BARI garlic-4. The crop was fertilized with cow dung (5 t/ha), 115-48-90-30-3.0-2.1 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. All of P, S, Zn, B and half of N and K was applied as basal dose during final land preparation. Remaining N and K was applied in two equal splits at 25 and 45 DAP under moist soil condition and mixed thoroughly with soil as soon as possible for better utilization A light irrigation was given after sowing for uniform emergence. Weed samples were collected from randomly selected four places from each plot at 25 and 45 days after planting. Number and dry weight of weeds were recorded carefully. Harvesting was done from 29 March to April 04, 2022 and yield data were collected. Weed control efficiency (WCE) was calculated according to following formulae:

$$\text{WCE (\%)} = \left(\frac{A - B}{A}\right) \times 100$$

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 garlic. Results showed that number of weed/m^2, weed control efficiency (WCE) and yield of garlic were significantly influenced by the two herbicides. The highest weed population (77.00 and 179.00/m^2) was recorded in T_6 at 25 DAP in both locations and similar results were found at 45 DAP (136.67 and 190.67/m^2) in both locations. At 25 DAP the highest WCE (89.46% at Gazipur and 86.97%at Jamalpur)

was found in T_5 treatment and at 45 DAP the highest WCE (92.21% at Gazipurand 85.14%at Jamalpur) was also found in same treatment. Significantly the highest yield (8.44 t/ha at Gazipur and 7.60 t/ha at Jamalpur) was recorded in Tabala 50 EC (Oxyflurofen 5% + Metolachlor 30% + Pendimethalin 25%) @ 2-3 L/ha 3 days before planting with one hand weeding (HW) at 25 days after planting. The result indicated that, spraying of Tabala 50 EC (Oxyflurofen 5% + Metolachlor 30% + Pendimethalin 25%) @ 2-3 L/ha 3 days before planting with one hand weeding (HW) at 25 days after planting; and Unirazine 50 SC (Atrazine) @ 600-700 ml/ ha at 15 days after planting with one hand weeding at 25 days after planting would be effective for controlling weed in garlic field.

Multiple cropping

Intercropping of leafy vegetables 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 at the Agronomy Research Field of BARI, Gazipur during *rabi* season of 2021-2022 to find out the suitable intercrop combination of leafy vegetables with chilli for higher productivity and economic return. The treatments were viz., T_1= Two row spinach (66%) in between two rows of chilli (100%), T_2= Two rows red amaranth (66%) in between two rows of chilli (100%), T_3= Two rows raddish (66%) in between two rows of chilli (100%), T_4= Sole chilli (60 cm × 50 cm). The experiment was laid out in a randomized complete block design with three replications and each plot size was 3.6m× 3.0m. Chilli (var. BARI Morich-3), spinach (var. BARI Palongshak- 1), red amaranth (var. BARI Lalshak-1) and raddish (var. BARI Mula-1) were used as test crops. Chilli was transplanted with 2 seedlings per hill and later maintained one healthy seedling per hill. Chilli transplanted with spacing 60cm × 50cm. Intercrops were sown between the rows. Five tons of cowdung per ha was applied to the crop before transplanting. Sole chilli and intercrops were fertilized with 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, five randomly selected plants in each plot in respect to plant height, yield components and yield. Yield of leafy vegetable were taken from whole plot. Data on yield and yield contributing characters were taken and statistically analyzed following MSTAT-C software package. Means were adjudged by LSD test at 5% level of significance. The highest fruit yield of green chilli (7.19 t/ha) was obtained from sole chilli. Chilli equivalent yield were higher in all the intercrops (30.61- 33.85 t/ha) than sole chilli. The highest chilli equivalent yield (33.8 t/ha) was recorded when two rows spinach (66%) intercropped in between two rows of chilli (100%). The highest gross return (Tk. 3,38,500/ha), gross margin (Tk. 2,65,120/ha) and BCR (4.61) were also obtained from the same treatment. The result expressed that all intercropping treatments were found productive and profitable as compared to sole crop. Two rows spinach (66%) in between two rows of chilli (100%) intercrop combination showed the highest BCR but all other combinations was also found agronomically productive and economically profitable.

Maize- legume strip cropping for resource conservation

J.A. Chowdhury, A.A. Begum, S.S. Kakon, M.R. Karim and D.A. Choudhury

A field experiment was conducted under irrigated condition during *rabi* season, 2021-2022 at the Agronomy Research Field of BARI 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 garden pea (8 row), T_3= Maize (4 row) alternate with grass pea (6 row) and T_4= Sole Maize (8 row). The 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, garden pea (var. BARI Motorsuti-3) and grasspea (var. BARI Khasari-1) were used as test crops. All crops were sown on 17 November 2021. Five t/ha of cowdung was applied 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 garden 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) in the form of urea, TSP, MoP, gypsum, zinc sulphate

and boric acid. For maize one third of N and all of other fertilizer were applied during final land preparation and rest N was applied in two equal splits at 30 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 components and yield. Data on yield and yield contributing characters were taken and statistically analyzed following MSTAT-C software package. Means were adjudged by LSD test at 5% level of significance. The grain yield of maize (6.69t/ha) was higher in sole maize than all strip cropping plot. The maize equivalent yield (6.69 t/ha) was also highest in sole maize because heavy rainfall severely affected all legume strip.

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 BARI, Gazipur during *rabi*season of 2021 -2022 to find out the suitable intercrop combination of bush bean with sorghum for increasing total productivity, economic return, maximize land utilization through intercropping. Six treatments viz., T_1= Sorghum normal row 100% (60 cm × 10 cm) + 1 row bush bean in between two rows of sorghum 43.75% (30 cm × 5 cm), T_2= Sorghum normal row 100% (60 cm × 10 cm) + 2 row bush bean in between two rows of sorghum 87.50% (30 cm × 5 cm), T_3= Sorghum paired row 100% (30 cm/120 cm/30 cm× 10 cm) + 2 row bush bean in between two paired rows of sorghum 37.50% (30 cm × 5 cm), T_4= Sorghum paired row 100% (30 cm/120 cm/30 cm× 10 cm) + 3 row bush bean in between two paired rows of sorghum 56.25% (30 cm × 5 cm), T_5= Sole sorghum (60 cm × 10 cm) and T_6= 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 4.8 m × 5 m. Sorghum (Var. BARI Sorghum-1) and Bush bean (Var. BARI Jharsheem-2) were used in the experiment. Sorghum and bush bean seeds were sown on 22 November 2021. 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 (FRG, 2018) 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 of 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 side dressed 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 04 April, 2022 and bush bean was harvested 2 times on 02 and 10 February, 2022. Sorghum equivalent yield (SEY) was calculated by converting yield of intercrops on the basis of prevailing market price of individual crop. Land equivalent ratio (LER) also calculated. 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. The lowest light availability on bush bean was observed in T_2 treatment (SNR 100% + 2 rows bush bean 87.50%) and the highest was observed in sole bushbean (T_6) followed by T_3 treatment (SPR 100% + 2 row bush bean 37.50%).The highest grain yield of sorghum was observed in sole crop (4.52 t/ha) and it was decreased by 4.20-18.81 % among the intercrop combination. LER of different crop combinations ranged from 1.22 to 1.75 which indicating land utilization increased 22 to 75%by intercropping. The highest Sorghum equivalent yield (SEY) of 9.13 t/ha, gross return (Tk.1,82,600/ha), gross margin (Tk. 1,36,600/ha) and BCR (3.97)were obtained from T_2 treatment. The highest LER (1.75)was also found in the same treatment. The results revealed that sorghum normal

row 100% (60 cm × 10 cm) + 2 rows bush bean 87.50% (30 cm × 5 cm) intercropping combination was found agronomically feasible and economically profitable in respect of yield and profit.

Sorghum- legume strip cropping for resource conservation

M.Z. Ali, A.A. Begum, S.S. Kakon, J.A. Chowdhury and D.A. Choudhury

A field experiment was conducted at the Research Field of Agronomy Division BARI, Gazipur during *rabi* season of 2020-21 to find out the effect of strip cropping on productivity. The experiment consisted of four different treatments viz., T_1= Sorghum 4 rows alternate with 8 rows garden pea, T_2= Sorghum 4 rows alternate with 8 rows lentil, T_3= Sorghum 4 rows alternate with 6 rows chickpea, T_4= Sole Sorghum 8 rows. The experiment was laid out in a RCB design with three replications. The unit plot size was 4.8 m × 9.0 m. Seeds of sorghum (var. BARI Sorghum-1), garden pea (var. BARI Motorsuti-3) lentil (var. BARI Masur-6) and chickpea (var. BARI Chola-9) were sown on 23 November 2021 maintaining with spacing for sorghum 60 cm×20 cm, garden pea 30 cm×5 cm, lentil 30 cm×5 cm and chickpea 40 cm×5 cm. Recommended dose of fertilizer was applied to all crops (sorghum: 120-48-75-30-3-1 kg/ha N- P- K- S- Zn- B; garden pea: 45-24-30-12-1.4 kg/ha N- P- K- S- Zn, lentil: 21-18-21-9-2-1.2 kg/ha N- P- K- S- Zn- B and chickpea: 21-18-28-9-2-1.4 kg/ha N- P- K- S- Zn- B (FRG, 2018) in the form of urea, TSP, MoP, gypsum, zinc sulphate and boric acid. For sorghum one third of N and 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 under moist soil condition and mixed thoroughly with the soil as soon as possible for better utilization. For other three crops all fertilizer were applied during final land preparation. Five t/ha of cowdung was applied to the crop before sowing. The seeds of all crops were treated with provex @ 3g/ kg of seed. A light irrigation was given after sowing of all seeds for proper germination. All intercultural operation and plant protection were done as and when required. Sorghum was harvested on 10 April 2022, garden pea on 01 February 2022, lentil on 15 March 2022 and chickpea on 04 April 2022. Sorghum equivalent yield (SEY) was calculated by converting yield of intercrops on the basis of prevailing market price of individual crop. At harvest the yield data was recorded whole plot wise. Collected data of all 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. Yield of sorghum varied from 1.56 t/ha to 3.77 t/ha due to influence exerted by different treatments. The highest grain yield 3.77 t/ha of sorghum was obtained from Sole sorghum. Among the strip cropping, the maximum grain yield 1.70 t/ha of sorghum was recorded in T_1 treatment (Sorghum 4 rows alternate with 8 rows garden pea) which was statistically identical with T_3 (1.62 t/ha) Sorghum 4 rows alternate with 6 rows chickpea pea) and T_2 (1.56 t/ha; Sorghum 4 rows alternate with 8 rows lentil) treatments. In strip cropping combination. The highest sorghum equivalent yield 5.49 t/ha was recorded in T_3 treatment (Sorghum 4 rows alternate with 6 rows chickpea pea). The equivalent yield of sorghum was higher (36-46%) in all strip cropping, as compared to sole cropping. The highest gross return (Tk. 1,09,700/ha) was recorded from T_3 treatment (Sorghum 4 rows alternate with 6 rows chickpea pea). But the highest gross margin (Tk. 35,767/ha) and benefit cost ratio (1.49) was recorded in T_2 treatment (Sorghum 4 rows alternate with 8 rows lentil) due to lower cost of production. The results revealed that all strip cropping combinations are productive and profitable than sole sorghum and farmers could be benefited by cultivating sorghum legume strip cropping. Among the three strip croppings **s**orghum 4 rows alternate with 8 rows lentil strip cropping combination was found economically most profitable and agronomically feasible.

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, BARI, Gazipur, during *rabi* 2021-22 to evaluate the compatibility of minor cereals intercropped with groundnut. The experiment was laid out in RCBD with nine treatments i.e. T_1 = (Groundnut:Sorghum = 6:1), T_2 = (Groundnut:Cheena = 6:1), T_3 = (Groundnut:Cheena = 6:2), T_4 = (Groundnut:Kaon = 6:1), T_5 =

(Groundnut:Kaon = 6:2) and T_6 = Sole groundnut,T_7 = (Sole sorghum), T_8 = (Sole cheena), T_9 = (Sole kaon) . BARI Cheenabadam-8, BARI sorghum-1, Tushar and BARI kaon-3 were respectively taken as groundnut, sorghum, cheena and kaon verieties. 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 5.4 m × 3.6 m plot. Sorghum, cheena and kaon were used as additve series and were sown in between two rows of grondnut. The plants were fertilized with 15 – 80 – 60 – 60 – 1.8 kg/ha of N-P-K-S-B, respectively (FRG, 2018). Half N and all of other fertilizers were applied during final land preparation. Rest half N was applied at 40-45 DAS. Irrigation was done as and when necessary. Data on yield and yield components of all crops were collected. Crops were harvested as whole plot basis. Mean comparison among the treatments was made by LSD test at 5% level of significance. Intercropping minor cereals with groundnut gave maximum productivity as well as economic return than monoculture of component crops. Considering Groundnut equivalent yield, land equivalent ratio (LER) values, competitive ratio (CR), relative crowding coefficient (RCC) and economic return, Groundnut : Cheena = 6:2 combination was found superior i.e, two rows cheena in between six rows of groundnut could be accommodated for higher productivity and profitability instead of sole cropping.

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 *rabi* season of 2017-18 to 2020-21 to increase cropping intensity and productivity in rice based cropping pattern along with maintaining soil health. Four treatments of cropping sequence were as CP_1 = Mustard--Mungbean–T. *aus*– T.*aman*; CP_2 = Potato –Mungbean–T. *aus* – T.*aman*; CP_3 = Garden pea – Mungbean–T. *aus* – T.*aman*; CP_4 = 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:

Pattern	Crop	Sowing/ Transplanted time	Harvesting time	Crop Covering
Pattern 1	Mustard	November 15	January 30	340
	Mungbean	February 1	March 28	
	T. *aus*	April 2	July 11	
	T. *aman*	July 15	November 3	
Pattern 2	Potato	November 15	January 24	335
	Mungbean	February 1	March 27	
	T. *aus*	April 2	July11	
	T. *aman*	July 15	November 3	
Pattern 3	Garden Pea	November 15	January 18	315
	Mungbean	February 1	March 27	
	T. *aus*	April 2	July 11	
	T. *aman*	July 15	November 3	
Pattern 4	Potato	November 15	January 24	331
	Red amaranth	January 27	February 25	
	Maize	March 1	July 1	
	T. *aman*	July 15	November 3	

Fertilizer dose and application methods were followed as per recommendation of crops (FRG, 2018). 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). Collected data were 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: 38.44t/ha) was recorded from the cropping sequence CP_4.The highest gross margin (Tk. 491873/ha) and BCR (3.46) was also found in CP_4. Nitrogen level

was found 70.18%, 60.32% and 57.58% and 57.41% increased in CP_4, CP_2, CP_1 and CP_3 respectively. Amount of phosphorus was increased 41.00%, 38.50%, 15.33% and 11.67% in CP_4, CP_3, $CP_1$and CP_2, respectively. Potassium content was increased in all the cropping patterns (114.29%, 70.00%, 60.00% and 32.86% in CP_4, CP_3, CP_1 and CP_2, respectively. Amount of sulfur was increased 15.76%, 6.51% and 5.97% in CP_3, CP_4 and CP_2 respectively but decrease in CP_1 (14.93%). In all the patterns boron and zinc levels were decreased. The lowest decreased of boron and zinc was found in CP_1 (29.06% and 61.46%, respectively). Considering crop productivity and soil nutrient changing trends, CP_4 (Potato var. BARI Alu-7-Red amaranth var. BARI Lalshak-1-Maize var. BARI Hybrid maize-9-T. *aman* var. Parija) was found the most suitable pattern for sustainable crop production and maintaining soil health.

Performance of blackgram under mango orchard

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The field experiment was conducted at Regional Agricultural Research Station, BARI, Ishwardi, during the Kharif season of 2021 to observe the performance of different Black gram varieties growing under mango orchard of northern region of Bangladesh. The treatments consists of four varieties viz., BARI Mash-1, BARI Mash-2, BARI Mash-3 and BARI Mash-4. The experiment was laid out in randomized complete block design (RCBD). Each treatment was replicated thrice (03) with plot size 3m × 4m. The open space in between the mango tree line consider as a replication. The average canopy coverage of the mango tree was 6 m^2. The seeds were sown maintaining 30 cm apart row with continuous seeding on 10 September 2021 under mango orchard. All the seeds were treated before sowing with Bavistin 250 WP @ 2g/kg seed. The experimental plots were fertilized @18-24-30-18-2.0-1 kg/ha N-P-K-S-Zn and B as per FRG, 2018. All fertilizers were applied during final land preparation a post sowing irrigation was applied for ensure proper germination and seedling establishment. Other intercultural operations were done as when necessary. Thinning was done at 15 days after emergence to maintaining 5-6cm plant-to-plant distance. Weed control was also done during the thinning time. For controlling Powdery Mildew disease theovit Fungicide @ 2g per litre was sprayed at 40, 50 and 60 DAS. To prevent pod borer insect Imitaf @ 0.5ml per litre was sprayed at 40 and 50 DAS. Five plants were selected randomly from inner rows of each plot for recording the yield contributing data. The yield was measured by whole plot basis. The recorded data were statistically analyzed and the mean values were adjudged by LSD at 0.05 levels of probability. The blackgram varieties had no significant effect growing under mango orchard. However, the numerically highest seed yield was obtained in BARI Mash-2 (1.09 t/ha) followed by BARI Mash-4 (1.03 t/ha). The results indecated that Blackgram var. BARI Mash-2 performed better in terms of seed yield compare to other varieties in mango orchard.

Performances of different pulse crops under mango orchard in southern region of bangladesh

M.M. Rahman, M. R. Islasm, M.A. Rahman and M. R. Uddin

The experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during the Rabi and Late Rabi season of 2021-2022 to select the most appropriate pulse crop(s) for growing under mange orchard of southern region of Bangladesh. The treatments were: T_1= Mango + Grasspea (Var. BARI Kheshari-3), T_2= Mango + Blackgram (Var. BARI Mash-3), T_3= Mango + Mungbean (Var. BARI Mung-6),T_4= Mango + Cowpea (Var. BARI Felon-1),T_5= Mango + Fieldpea (Var. BARI Motor-3). The experimental site is situated in the latitudes and longitudes of 22º47/20.48//N and 90º17/37.65//E under AEZ-13. The soil type is medium high land and soil texture is loamy. All pulses except mungbean seeds were sown in line sowing method on 12 December, 2021 under mango orchard. Mungbean seeds were sownon 27 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 FRG, 2018. All fertilizers was applied during final land preparation. Irrigation was applied two times and other intercultural operations were done as shown in BARI, 2019. Data were collected on yield . Data were analyzed statistically and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT) following Gomez and Gomez

(1984).Different pulse crops had significant effect on growing under mango orchard. The highest seed yield of field pea was recorded in T_5 treatment (1811.2 kg/ha). The economic analysis showed that the highest gross return (Tk.72448/ha), gross margin (Tk. 43075/ha) and BCR (2.47) was found in field pea. The result revealed that field pea var. BARI Motor-3 could be cultivated as most appropriate crop under mango orchard in southern region of Bangladesh.

Intercropping of vegetables and spices with chilli in Chattogram region

M.M. Alam and Z.A. Firoz

The experiment was carried out at RARS, Hathazari, Chattogram during December 2021 to April 2022 to assess the performance of raddish, carrot, onion and garlic with chilli for higher productivity and economic return. There were five treatments viz., T_1= Sole chilli, T_2= Chilli + two rows radish, T_3= Chilli + two rows carrot, T_4= Chilli + two rows onion and T_5= Chilli + two rows garlic. The experiment was laid out in RCB design with three replications. The unit plot size was 5m × 4m. Radish and carrot seeds; onion and garlic bulbs and 30 days old chilli seedlings were sown/transplanted on 15 December, 2021. The land was fertilized at the rate of 97- 66-100-1 kg/haNPKS, respectively. Half of N and all other fertilizer were applied as basal. Rest N was applied at 30 DAS. Chilli and raddish were harvested during February to April 2022 but carrot, onion and garlic were harvested on 2nd week of March, last week of March and 1st week of April 2022, respectively. The recorded data were statistically analyzed and the mean values were adjudged by LSD at 0.05 levels of probability. The highest chilli yield 12.05 t/ha was obtained from treatment T_1 (sole chilli). All intercrop combinations performed better than sole chilli. Maximum chilli equivalent yield (17.43 t/ha) was obtained from treatment T_4 (Chilli + two rows onion). The highest gross margin (Tk 1,48,300/ha) and benefit cost ratio (1.74) was obtained from same treatment. The results revealed that intercrop of onion with chilli was more profitable to Chattogram.

Performance of cowpea intercropping with maize at Chattogram region

M.M. Alam and Z.A. Firoz

The experiment was conducted at RARS, Hathazari, Chattogram during December 2021 to April 2022 to evaluate the performance of maize-cowpea intercrop as influence by planting arrangement for higher productivity and economic return. Four treatment combinations viz., T_1= Maize normal row (MNR) (60cm × 20cm) + one row cowpea (60cm × 10cm), T_2= MNR (60cm × 20cm) + two row cowpea (20cm × 10cm), T_3= MNR (60cm × 20cm) + cowpea broadcast and T_4= Sole cowpea (40cm × 10cm) were tested. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4m × 4.8 m. Maize seeds were sown on 23 December in 2021. Maize var. BARI Hybrid maize- 9 and cowpea var. BARI felon- 1 were used as test crops. Maize seeds were sown on 23 December in 2021. Cowpea seeds were sown at two weeks after maize sown. Sole Maize and intercrop were fertilized with 250-55-120-50-5-1 NPKSZnB kg/ha, respectively. Sole cowpea was fertilized with 20-20-25 NPK kg/ha,, respectively. In case of sole maize 1/3 N and all other fertilizers as basal. Rest N was be applied at 35 and 55 DAS. In case of sole cowpea all fertilizers were applied as basal at the time of final land preparation. In case of Intercrop 1/3 N and all other fertilizers as basal. Rest N was applied at 25 & 45 DAS. Additional N (30 kg/ha) was applied in 2 split at 20 and 35 DAS as side dressing to cowpea in intercrop treatment. Plots were kept weed-free using hand hoes. During vegetative, flowering and pod development stages, cowpea plants were sprayed with insecticide Karate (50 g/ L). This was applied at the rate of 1.0 L/ha at the time when a few insects were noticed. Cowpea was harvested during 3rd week of March to 2nd week of April 2022. Maize was harvested during 3rd week of April to 2nd week of May 2022. Data were collected on an individual plant basis from five (5) randomly selected plants of each plot in such a way that the border effect was avoided for high precision. Data on yield and yield contributing parameters were recorded and statistically analyzed with the help of statistical package Statistix 10 (Analytical Software. Tallahassee, Fla, USA) and mean separation was tested by Duncan's Multiple Range Test (DMRT) (Steel and Torrie, 1960). Equivalent yield and economic analysis was also done. The different intercrop combinations had significant effect on yield and yield attributes. Cowpea equivalent yield of all intercrop combinations were higher (3.52- 4.10 t/ha) than sole cowpea (1.05 t/ha) indicated all intercropping were more productive than sole cropping. The highest cowpea equivalent yield (4.10) was recorded in Maize normal row

(60cm × 20cm) + one row cowpea (60cm × 10cm). The maximum gross return (Tk. 205000/ha), gross margin (Tk. 125000/ha) and BCR (2.73) were also recorded in same treatment. The overall results indicated that maize normal row + one row cowpea intercropping was effective than other intercrop combinations.

Intercropping cowpea with sorghum under different planting system

M.M. Alam and Z.A. Firoz

The experiment was conducted at Regional Agricultural Research Station, Hathazari, Chattogram during December 2021 to April 2022 to evaluate the performance of sorghum cowpea intercrop as influenced by planting arrangement for higher productivity and economic return. Five treatment combinations viz., T_1= Sorghum normal row (SNR) (60cm × 10cm) + one row cowpea (60cm × 10cm), T_2= SNR (60cm × 10cm) + two row cowpea (20cm × 10cm), T_3= SNR (60cm × 10cm) + cowpea broadcast and T_4= Sole sorghum (60cm × 10cm) and T_5= Sole cowpea (40cm × 10cm) were tested. The experiment was laid out in a randomized complete block design. The experiment had three replications with 5m × 4.8 m individual plot size. Seeds of both crops sorghum (var. BARI Sorghum-1) and cowpea (var. BARI Falon-2) were sown on 22 December in 2021. Sole sorghum and intercrop was fertilized with 120-48-75-30-3-1 kg/ha N-P-K-S-Zn-B, respectively. Sole cowpea was fertilized with 20-20-25 NPK kg/ha, respectively. In sole sorghum: 1/3 N and all other fertilizers were applied as basal. Rest N was applied at 25 & 45 DAS. In sole cowpea: All fertilizers were applied as basal at the time of final land preparation. Intercrop: 1/3 N and all other fertilizers as basal. Rest N was applied at 25 & 45 DAS. Additional N (30 kg/ha) was applied in 2 split at 20 and 35 DAS as side dressing to cowpea. Plots were kept weed-free using hand hoes. During vegetative, flowering and pod development stage. Cowpea plants were sprayed with Karate (50 g/L). This was applied at the rate of 1.0 L/ ha at the time when a few insects were noticed. Cow pea was harvested during 3rd week of March to 2nd week of April 2022. Sorghum was harvested during 3rd week of April to 2nd week of May 2022. Data on yield and yield contributing parameters were recorded and statistically analyzed with the help of statistical package statistix 10 (Analytical Software. Tallahassee, Fla, USA) and mean separation was tested by Duncan's Multiple Range Test (DMRT) (Steel and Torrie, 1960). Equivalent yield and economic analysis was also done.The different intercrop combinations were significantly different in terms of yield and yield attributes. Higher sorghum equivalent yield (2.48-2.65 t/ha) were observed in intercropping system than sole cropping (1.25 t/ha). The maximum gross margin (Tk.60500/ha) and BCR (1.86) were recorded in sorghum normal row (60cm × 10cm) + one row cowpea (60cm × 10cm) intercropping system. The result revealed that optimum and sustainable productivity and profitability of one row cowpea intercropping with sorghum normal row might be practiced in Chattogram region to increase productivity, land use efficiency and economic return.

Intercropping of hybrid maize with potato

M.M. Khanum, M.S. Huda, A.A. Begum and D.A. Choudhury

The experiment was carried out at the research field of Agricultural Research Station, Rajbari, Dinajpur (Latitude: 25°38'7.3" N, Longitude: 88°39'5.65" E) during *rabi* season of 2020-21 and 2021-22 to assess the economic performance of intercropping potato with maize. Six different treatments were employed in the study viz., T_1= Sole maize (60cm×20cm), T_2= Maize planting (60cm×20cm) +1 row potato in between two maize rows, T_3=Maize paired row (30cm/120cm/30cm×20cm) +1 row potato, T_4= Maize paired row (30cm/120cm/30cm×20cm) + 2 rows potato, T_5=Maize paired row (30cm/120cm/30cm×20cm) +3 rows potato and T_6= Sole potato (60cm×25cm). The experiment was conducted following RCBD with three replications. The initial soil sample (0-15 cm) was analyzed at the Soil Resources Development Institute (SRDI), Dinajpur, Bangladesh.The unit plot size was 14.4 m^2 (4m×3.6m).Fertilizers were applied @ 260-72-148-48-4-2 kg/haNPKSZnB and 180-40-180-20-6-1.2 kg/haNPKSZnB and 320-73-170-50-6-2 kg/haNPKSZnB in the form of Urea-TSP-MoP-gypsum-$ZnSO_4$-boric acid for the sole maize and sole potato and for intercrop combinations, respectively. One third of urea and full amount of other fertilizers were applied at final land preparation. Remaining urea was applied at 30 and 50 DAS in two equal splits. Maize (var. BARI hybrid bhutta-16) and potato (var. BARI Potato-36) was sown on 12 November, 2020 and 13 November,

2021 during the years. 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. Potato was harvested at 80 DAP and then 3rd irrigation was applied. Insecticide Tracer 45 SC (Spinosad) 0.4ml/L water was sprayed at every 7 days interval 2-3 times to control fall army warm on maize and Fungicide Acrobat MZ (Mencozeb+Dimethomorph) 4gm/L water or Headline Team (Pyraclostrabin+ Dimethomorph) 2.5gm/L water was sprayed at every 7-10 days interval to control late blight on potato. Maize grain yield and potato tuber 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). Maize equivalent yield was computed by converting yield of intercrops on the basis of prevailing market price of individual crop following the formula of Bandyopadhyay (1984). Collected data were statistically analyzed by using R software packages and mean differences for each character were compared by LSD) test. The highest grain yield of maize (9.99 t/ha) was obtained in sole cropping but the highest maize equivalent yield (37.89 t/ha) was obtained in Maize paired row (30cm/120cm/30cm×20cm) + 3 rows potato. The highest gross return (Tk. 4,54,680/ha), gross margin (Tk. 3,44,580/ha) and BCR (4.12) also obtained in same treatment. The results revealed that Maize paired row 30cm/120cm/30cm ×20cm + 3 rows potato intercropping combination was found agronomically feasible and economically profitable.

Intercropping onion, garlic, coriander with chilli in Cumilla region

M.A.H. Khan, M.Rahman and M.O. Kaisar

An experiment was conducted at the research field of RARS, BARI, Cumilla during 2021-22 to find out the suitable crop combination of onion, garlic and coriander with chilli through intercropping. Seven treatments viz., T_1 = Sole chilli (50 cm × 50 cm) , T_2 =Two rows of onion (15 cm × 10 cm) in between two rows of chilli (50 cm × 50 cm), T_3 = Two rows of garlic (15 cm × 10 cm) in between two rows of chilli (50 cm × 50 cm), T_4 = 100% coriander (leaf) (broadcast) in between two rows of chilli (50 cm × 50 cm), T_5 = Sole onion (15 cm × 10 cm), T_6 = Sole garlic (15 cm × 10 cm), T_7 = Sole coriander (15 cm × 5 cm). The trial was set up in a randomized complete block design with three replications. The unit plot size was 2.5 m × 2.0 m. 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. 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 at25 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 rows of chilli. Chilli (25 days old seedling) was transplanted on 24 November 2021. Onion seedling, garlic bulb and coriander seeds were planted and sown on 26 November 2021. 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 2022 and 10 March 2022 respectively. Chilli was harvested at four times and it was harvested on 10 March, 22 March,10 April and 30 April 2022. 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 statistix10 package and means were adjudged by LSD at 5% level of probability. 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 12.80 to 15.27 t/ha in intercrop combination compared to sole chilli 10.93 t/ha (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 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 (15.27 t/ha), gross return (Tk.7,63500/ha), gross margin (Tk. 5,07300/ha) and BCR 2.98.

Intercropping of summer onion with Mukhikachu in Cumilla region

M. A. H. Khan, M. Rahman and M. O. Kaisar

An experiment was conducted at the research field of RARS), Bangladesh Agricultural Research Institute (BARI), Cumilla during *Kharif* I, 2021 to find out the suitable combination of onion with mukhikachu for higher productivity and economic return. Six treatments viz., i) Sole mukhikachu (60 cm × 45 cm), ii) Two rows of summer onion (15 cm × 10 cm) in between two rows of mukhikachu (60 cm × 45 cm), iii) Three rows of summer onion (15 cm × 10 cm) in between two rows of mukhikachu (60 cm × 45 cm), iv) Two rows of summer onion (15 cm × 10 cm) in between two double rows of mukhikachu (20cm/55cm/20 × 45 cm), v) Three rows of summer onion (15 cm × 10 cm) in between two double rows of mukhikachu (20cm/55cm/20 × 45 cm), vi) Sole summer onion (15 cm × 10 cm). BARI Mukhikachu 1(main crop) and BARI Onion 3 (component crop) were used as variety. The trial was set up in a randomized complete block design with three replications. The unit plot size was 3.0 m × 2.70 m. Sole mukhikachu and intercrop treatments were fertilized with NPKS 96-27-81-18 kg/ha, respectively. Full amount of PKS was applied as basal. N was applied in two equal splits, one at 20 days after planting (DAP) and another at 45 DAP. Mukhikachu was planted on 24 April 2021. Onion seedling was transplanted on 26 April 2021. Irrigation and pesticide were applied as per necessary. For mukhikachu data on yield and yield contributing characters was taken and analyzed statistically. The yield component data of mukhikachu and onion was taken from 10 randomly selected plants prior to harvest from each plot. For mukhikachu and onion at harvest the yield data were recorded. The collected data were analyzed statistically using statistix 10 package and means were adjudged by LSD at 5% level of probability. Mukhikachu equivalent yield (MEY) was converted by converting yield of intercrops on the basis of market price of individual crop. Results showed that, different intercropping combination significantly influenced yield and yield contributing characters of mukhikachu. The yield of mukhikachu was comparatively lower in intercropping than sole mukhikachu but total productivity was increased due to additional yield of onion. Increased total productivity in terms of mukhikachu equivalent yield (MEY) was 38.72 to 42.28 t/ha in intercrop combination compared to sole mukhikachu 31.70 t/ha (main crop). All the intercropping combinations showed better performance in terms of mukhikachu equivalent yield, gross return and benefit cost ratio (BCR) over sole crops. Among the intercropping combinations three rows of onion in between two double rows of mukhikachu was the most feasible intercropping system in respect of mukhikachu equivalent yield (42.28 t/ha), gross return (Tk.8,45600/ha), gross margin (Tk. 5,18100/ha) and BCR(2.58).

Development of fertilizer packages for five crop based cropping pattern

M.H. Rahman, S. Paul, K.U. Ahammad and M.D.A. Choudhury

A field experiment was conducted at the RARS, BARI, Jashore, Bangladesh during 2019-2020, 2020-2021 and 2021-2022 consecutive years consecutive years to develop the fertilizer packages for five crop based cropping pattern. The eight fertilizer treatments were as follows: T_1 = 100% NPKSZnB (STB), T_2= T_1+ 25% N, T_3= T_1+ 25% NP, T_4= T_1+ 25% NK, T_5= T_1+ 25% PK, T_6= T_1+ 25% NPK, T_7= 75% of T_1 and T_8= Native fertility. This cropping pattern is composed with five crops; namely, T.*aman*- broccoli- spinach- yard long bean- T.*aus*. The experiment was laid out in a Randomized Complete Block (RCB) design with 3 replications. The unit plot size was 4 m × 3 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. 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. The collected data were analyzed statistically using statistix 10 package and means were adjudged by LSD at 5% level of probability. Rice equivalent yield was differed under different treatments. The maximum total REY 44.5 tha^{-1} was recorded from the treatment T_6 which was followed by T_4 (42.1 tha^{-1}), T_3 (40.4 t/ha), T_5 (40.3 t/ha) and T_2 (36.6 t/ha). The lowest total REY (11.2 t/ha) was obtained from the native nutrient treatment (T_8). Higher gross margin (Tk.180850/ha) was recorded from the treatment T_6 which was followed by T_4 (Tk.136000/ha). But the highest marginal benefit cost ratio (MBCR) 35.0 was obtained from the treatment T_4 which was followed by the treatment T_6 (29.5) and T_5 (29.3). Total REY was increased by (T_6) 26.66, (T_4) 19.94, and (T_3) 15.1 % compared to the STB (100%) nutrient treatment (T_1), respectively. The economic return was increased by 297 (T_6), 276 (T_4), 261 (T_3) and 260% (T_5) compared to the STB (100%) nutrient treatment (T_1), respectively. The result revealed that on crop based cropping pattern (T.*aman*-Broccoli-Spinach-Yard long bean-T.*aus*) produced higher yield of the component crops with 100% NPKSZnB (STB) + 25% additional NPK.

Development of improved cropping pattern for increasing cropping intensity and ensuring nutrition

M.H. Rahman, S. Paul, K.U. Ahammad and D.A. Chowdhury

A field experiment was conducted at the RARS, BARI, Jashore during 2018-19, 2019-20 and 2020-21 consecutive years to find out the suitable cropping pattern for higher productivity and nutrition as well as economic return. The cropping patterns were as: CP_1= T.*aman* rice (Binadhan-16) –Spinach (local) – Gardenpea (BARI Motorshuti-3) - Mungbean (BARI Mung-6) – T.*aus* rice (Binadhan-19); CP_2= T. *aman* rice (Binadhan-16) – Cabbage(Atlas70)–Spinach– Yard long bean (Aduri)- T. *aus* rice; CP_3= T. *aman* rice (Binadhan-16) – Cauliflower (Snowball)–Spinach– Yard long bean- T. *aus* rice; CP_4= T. *aman* rice (Binadhan-16) –Coriander (BARI Dhonia-1)– Gardenpea– Mungbean - T. *aus* rice; CP_5= T. *aman* rice (Binadhan-16) – Cauliflower –Spinach – Mungbean - T. *aus* rice and CP_6= T. *aman* rice (Binadhan-16) – 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 T. *aman* rice BRRI dhan75 and Binadhan-16 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 and 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 collected data were analyzed statistically using statistix 10 package and means were adjudged by LSD at 5% level of probability. The results showed that five crops might be grown successfully. The average highest rice equivalent yield (REY) 35.32 t/ha was recorded from the cropping pattern CP_3 which was followed by CP_2 (34.93 t/ha) and CP_5 (32.81 t/ha). The average lowest REY (20.97 t/ha) was obtained from the cropping pattern CP_1. The average highest gross return (Tk.7,06,400/ha) was recorded from CP_3 cropping pattern which was followed by CP_2 (Tk. 6, 98,600/ha) and CP_5 (Tk. 6, 57,192/ha). But average highest gross margin (Tk.3, 97,330/ha) was obtained from CP_2 which was followed by CP_3 (Tk.3, 93,725/ha). The rice equivalent yield was increased by 15.3% in CP_3 followed by 14.4 % in CP_2 and 8.8 % in CP_5 cropping pattern compared to Farmers' practice (FP). In case of gross margin, the income was increased by 17.5% in CP_2 followed by 16.8 % in CP_3 and 5.8 % in CP_5 cropping pattern compared to farmers' practice (FP). The highest marginal benefit cost ratio (MBCR) 3.26 was obtained from the cropping pattern CP_2 which was followed by CP_3 (2.56) and CP_5 (1.53). From the result it can be concluded that vegetables could be introduced in between T.aman and T.aus rice in Jashore.

Integrated nutrient management on garlic- maize -t.aman cropping in Rangpur region

S. Hasan, S.M.A.H. M. Kamal and A.K. Saha

A field trail was conducted at RARS, BARI, Burirhat, Rangpur with five treatments to find out the optimum fertilizer dose for Garlic-Maize-T.*Aman* cropping pattern during *Rabi* season 2020-21. There were five fertilizer dose treatments such as T_1= Fertilizer Recommended Guide (FRG) 2018, T_2= FRG, 2018 + 5 t/ha cowdung, T_3= FRG, 2018 + 2 t/ha vermicompost, T_4= FRG, 2018 + 3 t/ha poultry manure and F_5 = Control (Native fertilizer). The experiment was started on 18 November, 2020. The size of the unit plot was 3 m × 4 m. The design was RCB with 3 replications. Weeding, irrigation and spraying were done as required. Data were taken on different growth parameters like plant height, number of leaves per plant, one garlic weight and bulb yield per plot. Collected data was compiled and analyzed with Statistics -10 software. The highest bulb yield of garlic (9.58 t/ha), Maize (9.75 t/ha), T. *aman* ricr (4.60 t/ha), rice equivalent yield (32.78 t/ha) and gross return (819500 t/ha) were recorded from T_3 due to vermicompost use which was identical to T_1, T_2 and T_4. But the highest benefit cost ratio was recorded from T_1 due to higher price of vermicompost.

Development of alternate cropping pattern for increasing cropping intensity and productivity in Rangpur region

M.A.I. Sarker, M.S. Hasan, M.M. Sheikh. M.N. Sarker and A. K. Saha

A field experiment of different cropping patterns at Regional Agriculture Research Station, Burirhat, Rangpur during 2019-20 and 2020-21 to increase cropping intensity as well as crop productivity. Four cropping patterns viz., Earlypotato-Potato-T.*aus* rice-T. *aman* rice (CP_1), Early potato-Potato/Maize relay-T. *aman*rice(CP_2), Early potato-Wheat-Mungbean-T. *aman* rice (CP_3) and one farmers' improved patternPotato-Maize-T. *aman* rice (CP_4) 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	Years	CP_1: Early potato-Potato-T. *aus* rice -T. *aman* rice				CP_2: Early potato-Potato/Relay maize-T. *aman* rice			
		Early potato (Granola)	Potato (Granola)	T.*aus* (BRRI dhan48)	T.*aman* (Binadhan-7)	Early potato (Granola)	Potato (Granola)	Maize (BHM-9)	T.*aman* (Binadhan-7)
Sowing/ Transplanting date	1st	25.10.19	28.12.19	14.4.20	19.7.20	25.10.19	28.12.19	28.1.20	19.7.20
	2nd	24.10.20	29.12.20	16.4.21	23.7.21	24.10.20	29.12.20	24.1.21	23.7.21
Harvesting date	1st	26.12.19	18.3.20	13.7.20	15.10.20	26.12.19	18.3.20	30.6.20	15.10.20
	2nd	27.12.20	21.3.21	16.7.21	17.10.21	27.12.20	21.3.21	24.6.21	17.10.21
Crop duration	1st	62	80	90	88	62	80	153	88
	2nd	64	82	91	86	64	82	151	86
Turn around period	1st	10	2	27	6	10	2	-	19
	2nd	7	2	26	7	7	2	-	29

Cont'd.

Parameter	Years	**CP_3:** Early potato-Wheat-Mungbean-T. *aman* rice				**CP_4:** Potato-Maize -T. *aman* rice		
		Early potato (Granola)	Wheat (BARI Gom-30)	Mungbean (BARI Mung-6)	T.*aman* ((Binadhan-7))	Potato (Granola)	Maize (BHM-9)	T.*aman* (BRRI dhan49)
Sowing /Transplantin date	1st	25.10.19	27.12.19	22.4.20	19.7.20	21.11.19	28.2.20	17.7.20
	2nd	24.10.20	28.12.20	16.4.21	23.7.21	25.11.20	17.3.21	19.7.21
Harvesting date	1st	26.12.19	14.4.20	25.6.20	15.10.20	20.2.20	13.6.20	07.11.20
	2nd	27.12.20	13.4.21	21.6.21	17.10.21	27.2.21	6.7.21	12.11.21
Crop duration	1st	62	108	64	88	91	105	113
	2nd	64	106	66	86	93	111	116
Turn around period	1st	10	1	8	24	14	8	34
	2nd	7	1	3	32	13	18	13

Crops were fertilized with FRG, 2018. In terms of productivity and profitability the CP_1 and CP_2 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 CP_2 and the lowest in CP_4. The mean (average of two year). REY of CP_2, CP_1 and CP_3 patterns were 30.36, 29.97 and 22.30 t/ha which were 52, 5 and 12% higher, respectively than that of the CP_4 (19.97 t/ha). The gross margin was higher in CP_2 cropping pattern with system profitability (Tk. 1230.81 ha/day in 2019-20 and Tk.1208.86ha/day in 2020-21). The highest marginal benefit cost ratio (2.55 in 2019-20 and 2.58 in 2020-21) was obtained in CP_3. It was found that the highest land use efficiency (91.51 and 89.86% in 2019-20 and 2020-21, respectively) was recorded in CP_2 and the highest labour employment was generated in CP_1 (528) pattern with an increase of 49% over CP_4 (355). The cropping pattern CP_2 gave the highest additional income (Tk. 174900/ha in 2019-20 and Tk. 169940/ha in 2020-21) over the CP_4 pattern. Organic matter slightly increased in most of the cropping patterns as compared to initial soil. There were little changes with respect to other elements but all the elements maintained above critical level. Early potato-Potato/Maize relay--T. *aman* rice (CP_2), Early potato-Potato-T. *aus* rice-T. *aman* rice (CP_1), Early potato-Wheat-Mungbean- T. *aman* rice (CP_3) cropping patterns were more productive and remunerative for farmers of Rangpur region.

Unfavolurable Eco-System

Estimation of temperature co-efficient of wheat for adjusting optimum 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 2021-2022 to observe the growth behavior and yield of wheat as influenced by prevailing air temperature based on sowing time. The treatments were five sowing dates: D_1 = 10 November, D_2 =20 November, D_3 = 30 November, D_4=10 December and D_5=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, 2012), in the form of urea, TSP, MoP, gypsum, zinc sulphate and boric acid. Data on growth parameters like leaf area and dry matter accumulation were measured at different dates with 15 days interval. To record dry matter weight and leaf area, one linear meter was sampled at 15, 30, 45, 60, 75 DAS and at harvest. Collected samples were separated in to different plant parts and then oven dried at 80˚C for 72 hours. Leaf area was measured by an automatic leaf area meter (L13100 c, L1COR, USA). Daily air temperatures were recorded for computing the growing degree days (GDD). The GDD was calculated using the following formula:

$$GDD = \sum \frac{Tmax + Tmin}{2} - T_{base}$$

Where, T_{max} and T_{min}were daily maximum and minimum air temperatures, respectively. T_{base} indicated base temperature of wheat (5°C). Yield data were recorded by harvesting ten square meter area excluding border. Collected data was analyzed statistically following MSTAT-C software package Sowing time had great influence on total dry matter (TDM) production, leaf area index (LAI), physiological maturity, yield components and yield of wheat. The 30 November sowing produced the maximum TDM and LAI followed by 10 December and 20 November sowing. These parameters finally contributed to higher grain yield than earlier and later sowing date. The 30 November sowing took the longest crop growth duration(107 days for physiological maturity) due to prevailing lowest temperature (21.3˚C) with highest GDD (1766) produced the highest grain yield and 20 December sowing took the shortest period (94 days for physiological maturity) due to prevailing highest temperature (22.3˚C) with lowest GDD (1581) produced the lowest grain yield of wheat. It was also found that 30 November sowing produced the maximum grain yield (4.53 t/ha). The results revealed that 20 November to 10 December sowing produced higher grain yield might be due to favourable air temperature for growth and development. Early or late sowing before 20 November and after 10 December produced lower grain yield due to higher temperature prevailed at early growth stage (November) and the later growth stage (March) of wheat at Gazipur region. The temperature co-efficient of wheat was estimated at 1.11 t/ha indicated that grain yield would reduce @ 1.11 t/ha per increase of 1˚C of air temperature.

Effect of exogenous chemical application on growth and physiological changes of chilli under waterlog condition

M.R.Karim, J.A. Chowdhury, S.S. Kakon, S.T. Zannat, I.M. Ahmed and D. A. Choudhury

The experiment was conducted in the field laboratory of Agronomy Division, Bangladesh Agricultural Research Institute, Gazipur-1701 during December 2021 to May 2022. The experiment was laid out in randomized complete block design (RCBD) with four replications and six treatments viz. T_1 = Seedling pretreatment with ethophonn @ 35 µM, T_2 = Seedling pretreatment with ALA (5-aminolevulinic acid) @ 5mg/l, T_3 = Application of Ca^{++} @ 10 mM/l (after stress) , T_4 = Seedling pretreatment with ascorbic acid @ 6mM, T_5 = Application of KCl solution @ 60 kg/h (after stress) and T_6 = Control (No chemical application). Roots of 25 days old seedlings are soaked in chemical formulation according to the treatment (for T_1, T_2 and T_4) for 24 hours. Seedlings for T_3, T_5 and T_6 were soaked in pure distilled water. After ten days of sowing, seedlings were dipped for 48 hours to create waterlogging stress. Immadietly after stress, T_3 and T_5 treatments were imposed. Irrigation were done on the basis of requirement. Disease and insect control measures were taken as and when necessary. Data was collected on shoot length, root length, number of adventitious root, fresh biomass, dry biomass and yield. Statistical analysis was done with the help of 'STAR' computer software. Highest shoot length was found in T_3 (82.33 cm).Root length was found the highest in T_1 (14.67 cm). Highest number of adventitious root was found in T_4 (77). Highest root dry weight was found in T_4 (5.03 g). Highest number of fruits plant was found in T_4 (40). Highest fruit yield per plant was found in T_4 (83.90g). Application of exogenous chemicals on chilli under waterlogging were found effective. On the basis of yield and other parameters, seedling pretreatment with ascorbic acid @ 6mM (T_4) found more effective under waterlogging condition.

Effect of folic acid seed treatment on sunflower under salinity stress

M. R. Karim, J. A. Chowdhury, A. A. Begum, S. S. Kakon, S. T. Zannat and D. A. Choudhury

A pot experiment was conducted in the field laboratory of Agronomy Division, Bangladesh Agricultural Research Institute, Gazipur-1701 during 15 December 2021 to 15 April 2022. Six treatments, viz. S_0F_0= No salinity + No folic acid, S_0F_1= No salinity + 50 µM folic acid, S_1F_0= 6.0 ds/m salinity + No folic acid, S_1F_1= 6.0 ds/m salinity + 50 µM folic acid, S_2F_0= 8.0 ds/m salinity + No folic acid, S_2F_1= 8.0 ds/m salinity + 50 µM folic acid were imposed in randomized complete block design (RCBD) with three replications. Adequate amount of seeds for application was pre-soaked in beakers containing distilled water and FA under room temperature for 24 h. Three soaked seeds were then sown in each prepared pot. Irrigation was done using fresh and salt solution (as per treatment). Half urea and full amount of other fertilizers (Urea-TSP-MoP-Gypsum-Boron @ 2.0-1.5-1.2-1.2-0.1 g/pot) were applied at the time of final pot preparation. Rest amount of urea were applied in two split (25DAE & 45 DAE). After seedling emergence, keeping healthy one, rest were discarded. Appropriate care and pest-diseases control were confirmed in each pot during the experimental period. The collected data were analyzed statistically with the help of computer using 'STAR' analysis software. Seed treatment with 50 µM folic acid was found superior regarding plant height (cm), head diameter (cm), head breadth (cm), seed per plant, 1000-SW and yield per plant (g) under salinity stress. The maximum plant height was found in S_0F_0 (69 cm) which was statistically similar with S_0F_1 (68.33 cm). Highest effect of folic acid on head diameter was found in S_1F_1 (7.8 cm) which is 0.34 cm more than S_1F_0. Highest influence of folic acid on head breadth was found in S_1F_1 (8.37 cm) which is 0.60 cm more than S_1F_0. Highest number of seed per plant was found in S_0F_1 (288 seed per plant) which is statistically similar with S_1F_1 (279 seed per plant). Highest thousand seed weight was found in S_2F_1 (58.34 g). Highest yield was found in S_1F_1 (14.02 g seed per plant) which is statistically similar with S_0F_1 (13.48 g seed per plant). The result indicated that seed pretreatment with 50 µM folic acid might be useful for amelioration of salinity stress.

Integrated nutrient management for bitter gourd on floating bed cum trellis

M.A. Rahman

The experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal on bitter gourd (hybrid variety) during two consecutive Kharif seasons of 2020 and 2021. 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 nutrient management in bitter gourd comprised of five

treatments (fertilizer doses) viz., T_1 = 65-21-10-5-1 kg/ha N-P-K-S-B, respectively (BARC, 2018); T_2 = 75% of T_1; T_3 = 50% of T_1; T_4 = 25% of T_1; T_5 = No fertilizer. The experiment was laid out in randomized complete block design with three replications. The initial samples of water hyacinth, water fern (topapana) and dulalilata were collected for determining its chemical composition. 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 (including trellis) 5.03 m x 1.52 m (7.67 m^2) and plant spacing was hill to hill distance 1.0m and number of seedling/hill was 2. Bitter gourd seeds of hybrid variety (namely *Tia*) were primed with pond water for 4 hours 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 young seedlings (with ball) were transplanted on floating bed in two rows on raised pits (2 seedlings/pit) on 20 September, 2020 and 29 August 2021 in first and second years, respectively. 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 (T_1 = 100g urea, 105g diammonium phosphate, 20g muriate of potash, 31g gypsum, 6g boric acid/10m^2 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 liquid form of plant nutrients were applied around the crop plants on floating bed. Irrigation was applied daily at the initial stage of seedling transplanting upto the development of root system of the crop plants. Data were analyzed statistically using Statistix 10 computer software and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT). In *Kharif* 2020, fertilizer dose had significant effect on branch/plant, fruit length, fruit diameter, fruit/plant and fruit yield. The treatment T_1 produced the highest yield (13.27 t/ha), which was statistically similar to that of T_2 (12.31 t/ha). In *Kharif* 2021, the highest fruit yield (12.87 t/ha) was obtained from treatment T_1 that was statistically similar to T_2 (11.98 t/ha). The two years average results (*Kharif* 2020 and 2021) indicated that treatment T_1 increased the yield of 49.89%, while T_2, T_3 and T_4 treatments increased the yields of 39.30%, 25.86% and 16.76%, respectively over the control treatment. As treatment T_1 and T_2 (75% of T_1: 75g urea, 80g TSP, 15 MP, 25g gypsum and 5 g boric acid/10m^2 floating bed) produced statistically similar yields, therefore treatment T_2 could be applied for hybrid bitter gourd cultivation on floating bed cum trellis.

Integrated nutrient management for yard long bean on floating bed cum trellis

M.A. Rahman

The experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal on hybrid yard long bean (variety Hiramon) during Rabi season of 2021-22 to develop suitable nutrient management for yard long bean. The nutrient dose consisted of five treatments (fertilizer doses) viz., T_1 = 45-21-21-6-1 g N-P-K-S-B, respectively/10m^2 (BARC, 2018); T_2 = 75% of T_1; T_3 = 50% of T_1; T_4 = 25% of T_1; T_5 = No fertilizer. The experiment was laid out in randomized complete block design with three replications. Seeds of yard long bean were sown directly into the raised lines (1.0-1.5 cm depth) on floating bed with spacing of 6-7 cm seed to seed distance on 31 December, 2021. After sowing of seeds, trellis was made alongside the floating bed. Fertilizers were applied as per the treatment. 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 (T_1 = 60g urea, 105g diammonium phosphate, 42g muriate of potash, 38g gypsum, 6g boric acid/10m^2). 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 seed sowing on floating bed. The studied parameter of yard long bean in terms of plant population/m^2, plant height, number of branch/plant, fruit length, number of fruit/plant and fruit yield varied significantly due to different doses of fertilizers. The treatment T_1 gave the highest yield of fruit (27.25 t/ha), which was statistically similar to that of T_2 treatment (25.35 t/ha). However, treatments T_3 and T_4 produced the yields of 20.00 and 18.97 t/ha, respectively. The lowest yield (15.83 t/ha) was found in T_5 treatment. The results further

showed that treatment T_1 increased the yield of 72.08% over the control treatment (T_5). On the other hand, increased yields by the treatments of T_2, T_3 and T_4 were 60.10%, 27.54% and 19.83%, respectively over the control treatment. The result indicated that T_2 (75% of T_1) might be effective for yard long bean cultivation on floating bed cum trellis.

Sorjan based integrated farming systems research for increasing agricultural productivity in southern region

M.A. Rahman, M.M. Rahman and M.R. Uddin

The field trial on sorjan based integrated farming systems was conducting since July, 2018 to till now through holistic approach at RARS, Rahmatpur, Barishal. 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 modern sorjan system was bed length x breadth x high = 21m x 6m x 1 meter, canal length x breadth x deep = 21m x 6m x 2.13 meters. 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 sorjan canals. Fishes were cultivated in canal water between two sorjan beds. Fodder crop (cv. Packchong) was grown on slope and outside the sorjan beds. The area under sorjan based farming systems was 2820 m^2. 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 squire meter (1200 m^2 + 1620 m^2). 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. Trellis was made on the sorjan canals by using bamboo, *dhaincha* and nylon net. 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. Data were recorded on relevant parameters of crops, fisheries, livestock (dairy) and other enterprises. Mathematical and economic analyses were done of the recorded data for preparing the report of the sorjan based research programme. Average of two years (2020-21 and 2021-22), total harvested summer and winter vegetable/spice crops (bottle gourd, brinjal, kangkong, country bean, red amaranth, pumpkin, jackbean, knolkhol, cabbage, potato, spinach, stem amaranth, papaya, tomato, snake gourd, Indian spinach, bangi, chili etc.) was 4368 kg. The amount of fruits (guava, malta, mango and pineapple) harvested from the sorjan area was 234 kg. Average of 165 kg fishes (shoil, boal, sing, koi, magur, tilapia etc.) were harvested from the sorjan canal water. Besides, average production of beef meat 270 kg, milk 6274 litre, duck egg 3972 pieces, fodder 5113 kg and bio-slurry 2325 kg were obtained from the sorjan area. Two years average gross returns computed in vegetable and spice crops from the sorjan area was Tk. 66842 (Tk. 237027/ha). Fruit crops provided the gross return Tk. 8430 (Tk. 29894/ha) and sugarcane contributed Tk. 2550 (Tk. 9043/ha). On the other hand, the average gross returns obtained from milk was Tk. 376431 (Tk. 1334862/ha), duck egg Tk. 39720 (Tk. 140852/ha), fodder Tk. 25565 (Tk. 90656/ha), biogas Tk. 24000 (Tk. 85106/ha) and bio-slurry Tk. 11625 (Tk. 41224/ha). Total average gross return from vegetables, spices, fruits, sugarcane, fish, beef meat, milk, duck egg, fodder, biogas and bio-slurry was Tk. 875603 (Tk. 2508826/ha). However, gross return obtained from single rice crops was Tk. 110450/ha. The research findings indicated that sorjan based integrated farming systems are more profitable than that of single cropping system.

Performance of early vegetable production in the charland area

J. Rahman, M R Aliand M M Kadir

The experiment was carried out at Nawvanger char, sadar, Jamalpur 2021-2022 to find out the suitable time of vegetable cultivation for early marketing and profit. Treatments included were radish (leaf), jute (leaf), bottle gourd (leaf), amaranth (leaf), cabbage and cauliflower. Design of the experiment was RCBD with 03 (three) replications having the unit of plot 2m × 2m. BARI Badhacopi-2/Hybrid, BARI Phulcopi-2/Hybrid, BARI Mula-4, Binapatshak-1, BARI Lau-1 and BARI Danta-1 were used as a variety in the experiment. Treatments were included cabbage, cauliflower, radish (leafy vegetable), jute (leafy vegetable), bottle gourd (leafy vegetable) and amaranth (leafy vegetable). Seeds were sown on 19 September, 2021 and harvested on October 22, 2021

to December 07, 2021. Fertilizer was applied in accordance with the fertilizer recommendation guide FRG 2018. Intercultural operations like watering, weeding and spraying insecticides were followed as and when necessary. Collected data were analyzed statistically with the help of Star software and mean separation was done as per LSD test at 5% level of significance. Amaranth, jute and radish leaf were harvest 30-40 days after sowing. Bottle gourd leaf was harvest 40-45 days after sowing which continuing 6-8 times. Cabbage and cauliflower were late harvest than other vegetables in this experiment but these two vegetables production higher than others. Considering gross return, total variable cost gross margin and benefit cost ratio all the vegetables were grown early at charland area to escape sudden flood, drought and erratic rainfall. All of the vegetables were influenced by early sowing and climatic condition and as a result, this approach may be advantageous for charland farmers due to early and high market pricing.

Effect of planting time and earthing up on sweet potato in char land ecosystem

J. Rahman, M. R. Ali, M. M. Rahman and M. M. Kadir

The experiment was carried out at Nawvanger char, sadar, Jamalpur 2020-2021 and 2021-2022 to find out the suitable time for early market for higher, economic return of charland farmers. Design of the experiment was RCB with 03 (three) replications having the unit of plot 3m × 3m. BARI Misti Alu-8 was used as a variety in the experiment. Treatments included in the experiment were two management practice Factor A: Earthing up: E_1= Normal/Flat, E_2= Earthing up after 25 of transplanting Factor B:Sowing time: S_1= August, S_2= September. The crop was fertilized with 120-36-120-15-1.5-1 kg/ha of NPKSZnB(FRG, 2018). Fertilizers were applied in the form of Urea, Triple super phosphate (TSP), Muriate of potash (MoP) Gypsum, zinc sulphate and Boric acid, respectively. 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 DAS followed by irrigation. Intercultural operations like watering, weeding and spraying insecticides were followed as and when necessary. Collected data were analyzed statistically with the help of Statistix 8.0 software and mean separation was done as per LSD test at 5% level of significance. From two year pooled data it was found that sowing dates and management had a significant impact on sweet potato. Significantly highest yield (23.79 t/ ha) was recorded under Normal × First sowing and it was found statistically at par Normal × Second sowing (21.72 t/ ha) while Earthingup × First sowing was recorded the lowest (17.04 t /ha). The result indicated that every planting may be advantageous for charland farmers due to early market prices.

Performance of different onion varieties in charland area of Cumilla

M. A. H. Khan, M. Rahman and M.O. Kaisar

The experiment was conducted at farmer's field of charland area under Roghunathpur village of Meghna upazila in Cumilla district during rabi season of 2021-22 to compare the yield performance of BARI released onion varieties against local variety with the aim to replace it by the best one. The onion varieties viz. BARI Piaz-4 and BARI Piaz-6 were compared with local variety. The experiment was laid out in randomized complete block design with three replications. Bulb of onion were planted on 15 December 2021 and harvested on 20 March 2022. The unit plot size was 5.0 m x 2.0 m having plant spacing of 15 cm x 10 cm. The fertilizers were applied in the form of urea, triple super phosphate, muriate of potash, gypsum @ N_{120}, P_{54}, K_{75}, S_{20} Kg ha^{-1} and 5 t ha^{-1} cow-dung. The entire quantity of cow-dung, P, S, Zn, B and one third of K were applied at the time of final land preparation and the rest K and urea were applied at 25, 50, and 75 days after planting. Irrigation was given at 30, 50 and 70 days after planting. Fungicide (Ruvral @ 2.5 g/l) was sprayed alternately at 15 days interval starting from 60 days after planting. Data on plant height (cm), number of leaves/plant, bulb length (cm), bulb diameter (cm), individual bulb weight (g) were recorded. The recorded data were statically analyzed by using statistix10 software to find the significance of variation resulting from experimental treatments. The highest bulb length (5.8 cm), bulb diameter (3.90 cm), individual bulb weight (38.9 g) and yield (16.5 kg ha^{-1}) were recorded in BARI Piaz-4 which was statistically similar to BARI piaz-6. BARI Piaz-6 and BARI Piaz-4 was given 40-70% higher yield than the check local variety. So, the local variety might be replaced by high yielding BARI Piaz-4 and BARI Piaz-6 variety.

Adaptation of pluse and mustard varieties in charland

M.R. Islam, A.A.M.M. Mustakim and M.M. Uddin

The adaptive trial was conducted at charland, Koikunda, Lakkikunda, Ishurdi, Pabna during 2021-

2022. One mustard, lentil and pea variety namely BARI Sarisha-18, BARI Masur-8 and BARI Motor-3 were demonstrated among the selected farmer fields of Koikunda with two Bigha of land. The crops (like: mustard, lentil and pea) were sown on 7 December, 23 and 29 November 2021, respectively. Harvesting were done on 01, 30 and 29 March 2022, mustard, lentil and, respectively. Crops were sown in residual soil moisture. One irrigation was applied 50 DAS in mustard and no irrigation was applied in lentil and pea 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 the crop varieties were collected as whole plot basis. The tested variety yielded (mustard:1.29 t/ ha, lentil: 2.48 t /ha and pea: 1.94 t /ha, respectively. BARI released lentil and pea variety viz., BARI Masur-8 and BARI Motor-3 showed better performance at charland of Padma, Koikunda, Lakkikunda, Ishurdi, Pabna. However, BARI released mustard variety BARI sarisha-18 showed moderate yield. Farmers are much interested to grow BARI released varieties.

Performance of intercropping leafy vegetables with sweet potato in char area of Rangpur

M.A.I. Sarker, M.S. Hasan, M.M. Sheikh. M.N. Sarker and A. K. Saha

The field experiment was conducted at Mohipur char area, Gangachara, Rangpur during *rabi* season of 2020-2021 and 2021-22 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 24 November, 2020 and 17 November, 2021. The vine of sweet potato was planting in line and other seeds of intercrop were broadcast. 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. 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 2 April, 2021 and 7 April, 2022. On the other hand, intercrops were harvested after 30 to 45 days after sowing in both the year. 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. In intercropping, the highest sweet potato equivalent yield (30.20 t/ha and 30.76 t/ha in 2020-21 and 2021-22, respectively) was observed in T_3 treatment (Sweet potato + spinach) which was 66.7% in 2020-21 and 65.8% in 2021-22 increased of SPEY over sole sweet potato. In both the year, the highest gross return and gross margin was observed in T_3 treatment (Sweet potato + spinach). The highest marginal benefit cost ratio was obtained in T_3 and T_2 treatment in 2020-21 and 2021-22, respectively. Thus, Sweet potato + spinach and Sweet potato + red amaranth intercropping would be agronomically feasible and economically profitable for Mohipur char area, Gangachara of Rangpur.

Effect of management practices on yield of mustard in Chalanbeel area

S.S. Kakon, A.A.Begum, J.A. Chowdhury and D.A.Choudhury

The experiment was conducted at Dobila, Tarash of Shirajgonj in Chalanbeel during the rabi season of 2021-2022 to find out suitable management practices in mustard in Chalanbeel area. The treatments were T_1 = High management practice: Sowing seeds on November 10 + BARI sarisha-14 + fertilizer (HYG) (105-32-40-24-2-1 kg/ha of NPKSZnB) + line sowing (30 cm row to row) + plant protection measures (use of seed treatment, insecticide and fungicide), T_2= Medium management practice: Sowing seeds on November 10 + BARI sarisha-14 +fertilizer (MYG) (60-18-21-10 kg/ha of NPKS) + broadcast + pest management and T_3= Farmers' practice { low management practice : Sowing seeds on November 10 + Tori-7 +fertilizer (FP) (20-40-25 kg/ha of NPKS) + broadcast + no plant protection measure)}. Recommended fertilizer packages (FRG, 2018) following the application methods were used. 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).Crop cut was done from an area of one square meter at three spots from each plot for yield samples in all cases. The results revealed that maximum response in yield (1767 kg /ha) was observed with timely sowing (November 10) with complete package. The highest gross return (Tk. 1,06,020 /ha), gross margin (Tk. 42360/ ha) and benefit cost ratio (2.50) were observed in T_1 treatment, i.e. the high management practice. Delay in sowing (20 November) and omitting chemical fertilizer, seed treatment, and plant protection measure from complete package were the production factors limiting seed yield of mustard. Hence, complete recommended package must be followed for getting desirable yield of mustard in Chalanbeel.

Performance of minor cereal crops in acidic soil at Moulvibazar

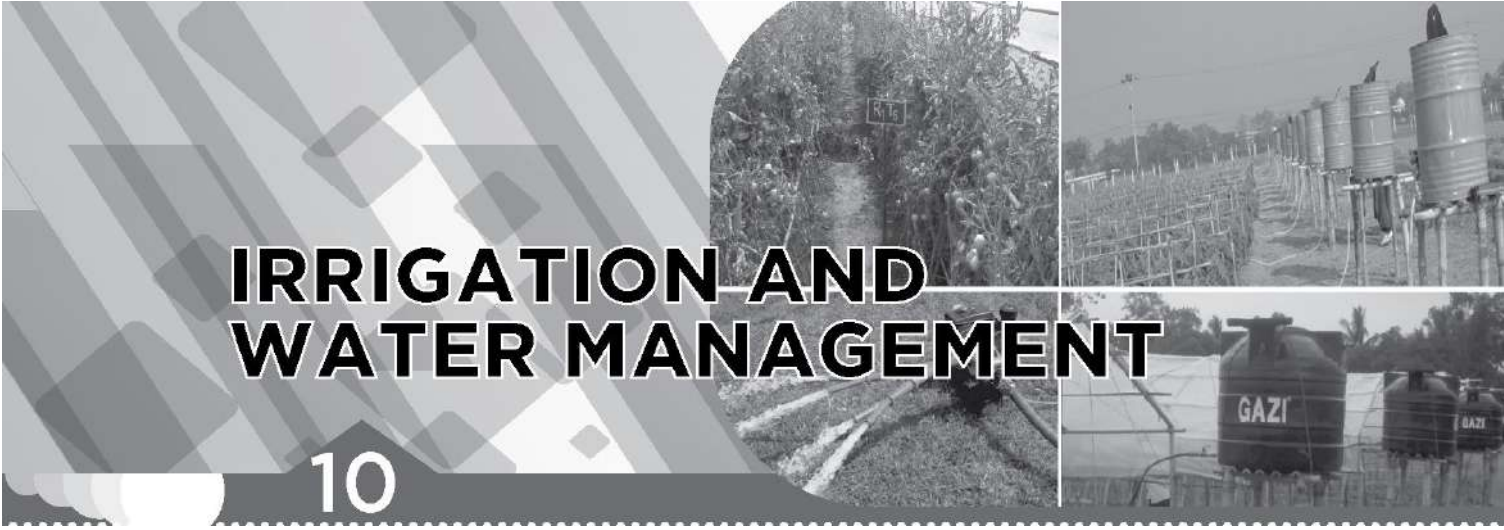
M. Shaheenuzzamn, A.A. Begum, M.A.M. Miah and M.H. Hossain

An experiment was conducted at Regional Agricultural Research Station, BARI, Akberpur, Moulvibazar during the Rabi season of 2021-22 which was belongs to AEZ 20 and (AEZ-29) to evaluate the performances of minor cereal crops at acidic soil condition. The treatments were as follow: T_1=BARIBarley-6, T_2= BARIBarley-7, T_3=BARIBarley-8, T_4 = BARIBarley-9, T_5 =BARI kaon-2, T_6=BARI kaon-4, T_6 = BARI Sorghum-1 and T_8=BARI Cheena-1.The experiment was laid out in randomized complete block design with three replications. The seeds of minor cereal crops were sown on 11 November, 2021. The seed rate of Barley was 120 kg/ ha, Kaon 10 kg/ ha, Cheena 20 kg /ha, sorghum 10 kg/ ha. Seeds were sown in rows following row to row distance 20 cm for barley, 25 cm for kaon, 25 cm for chena and 50 cm for sorghum. The plant-to-plant distance was 10 cm for all the crops. Fertilizer were applied as per their respective recommended doses and methods (FRG, 2018), The crops were harvested when attained to their respective physiological maturity. Data were collected in relation to phenology, yield attributes and yields. Data were analyzed statistically and the mean differences were adjudged with Duncan's Multiple Range Test (DMRT) For Barley, number of days to 50% flowering, 1000-seeds weight and yield/ ha were differed significantly. In case of Kaon, days to flowering, plant height (cm), DM/Plant (g), seeds Spike^{-1} and yield/ ha were differed significantly at acidic soil at Moulvibazar. In Sorghum, T_7 (BARI Sorghum-1) days to flowering maturity (98 days), days to maturity (126 day), spike length (20.50 cm), plant height (110.51cm), DM Plant^{-1} (15.27 g), seeds Spike^{-1} (475.5 nos),1000-seeds weight (118.66 g), yield /ha (2049.46 kg) and stover yield (9900 kg) at acidic soil at Moulvibazar. In Cheena, T_8 (BARI Cheena-1) days to flowering maturity (81 days), days to maturity (104 days), spike length (17.56cm), plant height (57.27cm), DM Plant^{-1} (7.07 g), seeds Spike^{-1} (302.33 nos),1000-seeds weight (5.45 g), yield ha^{-1} (721.46 kg) and stover yield (2863 kg) at acidic soil at Moulvibazar. Sorghum might be recommended to cultivate on the basis of gross margin, gross return and BCR in the acidic soil at Moulvibazar as well as Sylhet region.

Performance of BARI released blackgram varieties in acidic soil of semi hill valley at Moulvibazar under rainfed condition

M. A. M. Miah, M.Shaheenuzzamn, M.S.Alam, M. Samsuzzaman and M.H.Hossain

The experiment was conducted at Regional Agricultural Research Station, BARI, at Moulvibazar during the *kharif*-II season of 2021-2022 to select blackgram varieties for the Moulvibazar area. Four blackgram varieties viz. BARI Mash-1, BARI Mash-2, BARI Mash-3, BARI Mash-4 were sown on 12 september, 2021. Seeds were sown in line with 30cm line spacing. The experiment was laid out RCB Design with 3 replications. Fertilizers were applied as basal at 40-85-40-50 kg ha^{-1}, of N, P_2O_5, K_2O, S, in the form of Urea, TSP, MOP, Zypsum. Weeding was done at 20 days after emergence of the crop. Grain yield was calculated from the whole plot.Yield contributing characters were taken from 05 randomly selected plant from the middle rows of each plant. Data on different parameters were subjected to analyze of variance and the treatment means were compared by Least Significance Difference (LSD) test. Among the varieties, the highest no of pods per plant was recorded in BARI Mash- 4 (48.55) while the lowest (30.55) was in BARI Mash-1.BARI Mash-4produced the highest yield (2.03 t /ha) followed by BARI Mash-3 (1.92 t /ha), and the lowest yield (1.42 t/ ha) was observed in BARI Mash-1. The result indicated that BARI Mash-4 could be recommended for the Moulvibazar.



IRRIGATION AND WATER MANAGEMENT

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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 mandate 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 52 irrigation and water management technologies and most of them are being used at the farm level.

Response of mungbean to different levels of irrigation

S.S.A. Kamar, S.K. Biswas, M.A. Hossain, M.R. Uddin, Rajzuddin and M.R. Rahman

To increase crop and soil productivity in single rice cropped areas of Bangladesh, mungbean is being considered for the dry period. Due to uncertainties in onset, frequency, and amount of pre-monsoon rainfall, the yield of mungbean often hampered by shortage of water, with its incidence and severity exacerbated by the present long term dry period effect in agriculture. This study examined the potential benefits of different levels of irrigations on mungbean cultivation at two different agro environmental region (Gazipur and Barishal). The experimental design was randomized complete block and the plots were distributed into three replications. Four different levels of irrigation (control, irrigation at early vegetative stage, irrigation at early vegetative stage and flowering stage and lastly irrigation at early vegetative stage and pod formation stage) were used to determine the most efficient water productive irrigation system for mungbean cultivation. With irrigation (at early vegetative stage and flowering stage), yields were greater (1215.94 kg/ha at Gazipur and 1434.67 kg ha^{-1} at Barishal) than without irrigation treatment (1029.00 kg ha^{-1} at Gazipur and 1077.67 kg/ha at Barishal) at both locations. When mungbean were irrigated, yields were also increasing according to the irrigation levels. Smaller yields in all scenarios were associated with either water deficit stress or waterlogging stress. Results indicate that mungbean productivity in single rice production systems in Bangladesh could be increased by managing irrigation levels and selecting optimum planting time. Farmers could acquire higher yield, water productivity and as well as profit.

Optimize fertigation management to minimize nitrate leaching from drip irrigated brinjal field

D.K.Roy, S.K. Biswas, K.F.I. Murad and K.K. Sarkar

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, 2020-2021, and 2021-2022 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 is observed that yield and yield contributing characters were varied significantly among the irrigation treatments for the three growing seasons and that yield components followed the similar

trend. It is 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 seasons 2020-2021 and 2021-2022, the trend of water application remained the same. Modelling results for optimizing fertigation management is being conducted and will be presented in the final version of the report.

Daily and multi-step ahead forecasting of potential Evapotranspiration using machine learning Algorithms with limited climatic data

D.K. Roy, S.K. Biswas and M.A. Hossain

Accurate prediction of potential evapotranspiration (ET_0) is essential for efficient planning and management of limited water resources through judicial irrigation scheduling. The FAO-56 Penman-Monteith (FAO-56 PM) 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. Based on the previous years' finding, LSTM and Bi-LSTM models were found to be the best performer over others (other machine learning based models) for daily and one-step ahead ET_0 predictions, respectively. In this effort, the generalization capability of the developed best models developed at Gazipur station was evaluated on a new unseen data (from 01 January to 30 April 2022) obtained from a test station, Barishal. Moreover, the developed ET_0 model using the data from 01 January 2004 to 30 June 2019 at Gazipur station was further tested at the same station with the new dataset spanning over 01 July 2019 to 30 April 2022. The model performance was evaluated on several statistical performance evaluation indices computed on the FAO-56 PM estimated and model predicted daily ET_0 values. The generalization results revealed that, for the daily prediction, the LSTM performed equally well as with the training station (Gazipur) dataset, for which the models were developed. The daily ET_0 prediction using the Barishal dataset provided higher values of R, NS, and IOA (R = 0.909, NS = 0.559, IOA = 0.904) as well as lower values of RMSE, NRMSE, MAD, and MAE (RMSE = 0.687 mm d^{-1}, NRMSE = 0.214, MAD = 0.229 mm d^{-1}, MAE = 0.618 mm d^{-1}) indicating an outstanding generalization capability of the LSTM model developed at Gazipur station. On the other hand, the developed LSTM model produced RMSE, NRMSE, R, MAD, MAE, NS, and IOA values of 0.596 mm d^{-1}, 0.1714, .0887, 0.219 mm d^{-1}, 0.459 mm d^{-1}, 0.719, and 0.933, respectively for the recent new dataset from the Gazipur station, for which the model was not developed. In addition, multi-step ahead forecasting was performed using the Barishal data based on time-lagged information obtained through the partial autocorrelation functions of the ET_0 time series. Results revealed that although the forecasting performance decreases with the increases in the forecasting horizon, the Bi-LSTM model produced acceptable values of performance evaluation indices (higher values of the benefit indices: R, NS, IOA and lower values of the cost indices: RMSE, NRMSE, MAD, MAE). Hence, 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 model (LSTM) to generalize the prediction capabilities outside the training station. Multi-step ahead forecasting results revealed the practical applicability of the proposed Bi-LSTM model in forecasting days ahead ET_0 values.

Effect of drip irrigation and mulching on growth and flowering of chrysanthemum as cut flower

F. Akter, M.A. Hossain, S.K. Biswas, S.S.A. Kamar and FN. Khan

The experiment was conducted in the experimental field of IWM Division, BARI, Gazipur during 2020 -21 and 2021-22 to evaluate the effect of different irrigation amount with different mulching systems on growth and flowering of chrysanthemum as cut flower. 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) followed by RCBD design with three replications. Black plastic mulch conserves the highest moisture status and temperature among the three mulching system with each irrigation level and the lowest was from no mulch system. The lowest soil moisture enhances early flowering by one to two days but did not affect

the burst bud diameter. Plant height was the highest with the lowest deficit moisture condition. When decreasing irrigation amount from 100 to 80%, plant leaves was increased in chrysanthemum during 2020-21, but at 2021-22 it was observed from 100% irrigation level. Stem length, number of branches/plant, number of bud/plant, number of flower/ branches, number of flowers/plant in chrysanthemum were increased when moisture content was also increased, but flower diameter was reduced with the constant highest moisture condition. The highest marketable branch/ plant, flowers/marketable branch, marketable branch/10m^2 were obtained from moderate moisturized soil. High water stress enhanced the plant fresh weight and dry weight destructively, decreased it to the lowest level. Constant higher moisture content conditions in the range of 24.69% to 31.18% showed decreasing fresh and dry weight patterns of chrysanthemum. The highest plant quality was generally produced under the paddy straw mulch with 100% ET_0 of irrigation level. A decrease in water stress reduced the root length of chrysanthemum, but increased the root fresh weight and dry weight. Consequently, plant root to shoot ration increased with the increasing level of water stress. The water productivity was generally decreased by 30±84% in consecutives two years might be due to reduced yield. The highest BCR was found for paddy straw mulch with optimum irrigation level followed by black plastic mulch and paddy straw mulch with 20% less irrigation water. However, results of this study revealed that the drip system of irrigation at 100% ET_0 or 80% ET_0 with black plastic mulch or paddy straw mulch or no mulch system with 100% ET_0 of water could be adopted by the farmers based on their feasibility and water availability for gladiolus cultivation in Bangladesh.

Performance of fertigation system on pumpkin cultivation

M.A. Hossain, K.F.I. Murad, S.K. Biswas, and M. Kamruzzaman

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 and 2021-22 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.

Effect of irrigation on mango fruit cracking in Chattogram region

M.P. Haque, Z.A. Riroz, M.A. Hossain and S.K. Biswas

The study was conducted at existing HRC Mango Orchard of Regional Agricultural Research Station, Hathazari, Chattogram during the Rabi season of 2019-20, 2020-21 and 2021-22 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 full bloom), T_3 (irrigation at fruiting setting), T_4 (irrigation at full bloom and fruit setting), and T_5 (irrigation at 2 weeks interval),). The highest yield (76.5Kg plant^{-1}, 74.6 Kg plant^{-1} and 74.8 Kg plant^{-1} in successive years) was found at higher frequency irrigation (T_5). The maximum irrigation (average 1865 litres plant^{-1}) was applied at two weeks interval irrigation (T_5). In rain-fed condition (T_1), yield was lowest (56.8 Kg plant^{-1} and 55.2 Kg plant^{-1} and 43.5 Kg plant^{-1} in successive years). The lowest number of fruits dropping (average 18 no. fruits) was occurred in irrigation at full bloom and fruit setting (T_4). The lowest number of cracking (average 14no.fruits) as well as the highest sweetness (average TSS=24%) occurred irrigation at fruit setting (T_3) and the benefit-cost ratio was also higher in this treatment.

Yield and water productivity indices of different onion varieties under sprinkler irrigation

S.K. Biswas, M.A. Hossain and D.K. Roy

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 and 2021 – 2022. 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 (Ky) that derived from the linear relationship between relative evapotranspiration deficits (1-ETa/ETm) and relative yield decrease (1-Ya/Ym). Statistical analysis revealed that leaf number was not much affected by the level of irrigation while, plant height, 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 and 31.56 t/ha in first and second year, respectively, for BARI Piaj-4 (V_4) under140% ETo water regime while the lowest yield of 11.74 and 14.01 t/ha was obtained from BARI Piaj-1 (V1) under 60%ETo water regime. 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. On average over the years, bulb yields of V2, V3 and V4 varieties were comparable and significantly higher than the yield of V1 under all irrigation regimes. Value of Ky determined for the whole growing season over the study years was found higher for V_4 (Ky: 1.13),V2 (1.12) and V_3 (Ky: 1.05) than BARI Piaj-1 (Ky: 0.913) 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 (100 - 120% ETo) in case of V_4, V_3, and V_2 but for V_1, higher WP was obtained from 80 - 100% ETo water regime. Though seasonal evapotranspiration was higher under wetter water regimes, yield was somewhat lower and consequently WP was the lowest. Considering Ky as a limiting factor, application of irrigation at 80 - 100% ETo was a marginal for V_1 and V_2 and 100 - 120% ETo for V_2, V_3 and V_4, beyond that yield losses are unacceptable.

Effect of fertilizer and irrigation frequency on the yield and quality of export and processing potato

S.K. Biswas, M.A. Hossain, D.K. Roy, K.F.I, Murad, F. Akter and S.S. A. Kamar

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 during 2020 – 2021 and 2021 – 2022 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 F_1: Recommended fertilizer dose, F_2: Recommended dose with 75% MOP + 25% SOP + Vermicompost @2t/ha, F_3: Recommended dose with 50% MOP + 50% SOP. Similarly, three irrigation levels were I_1: 3 irrigations at 30, 45 and 60 days after planting (DAP), I_2: 4 Irrigations at 30, 45, 60 and 75 DAP and I_3: 4 Irrigations at 30, 45, 60 and 80 DAP. All irrigations were applied up to field capacity (FC), except last irrigations that received water 50% of FC at 75 and 80 DAP. The results indicate that fresh tuber yields of potato were not significantly influenced either by the irrigation treatments or by the fertilizer treatments. Due to late replanting, tuber yields were considerably lower in second season than first season. Water productivity also found higher in first season that ranged from 11.87 to 12.74 kg/m^3 under I_1, from 11.66 to 13.0 kg/m^3 under I_2, and 11.63 to 11.98 kg/m^3 under I_3 irrigation regimes with minimum values in F_1 and maximum in F_2 while in the second season it ranged from 8.6 to 9.2, 8.2 to 9.6 and 8.4 to 9.5 kg/m^3, respectively, for I_1, I_2 and I_3 water regimes. The fertilizer treatment F_2 produced slightly higher tuber yield and dry matter content compared to F_1 and F_3 in both the years.

While the trivially higher yield was obtained from the irrigation treatment I_2 where last irrigation was applied at 75 DAP up to 50% of FC. Thus, the combination of I_2 and F_2 contributed the highest tuber yield, dry matter content and water productivity compared to other combinations of irrigation and fertilizer.. 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 Mung bean

F. Akter, M. A. Hossain, S.K. Biswas, I.M. Ahmed, M.K. Alam, R.P, Rannu and K.F.I, Murad

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. The treatments comprised different combinations of three salinity levels (4 dS/m, 8 dS m^{-1} and 12 dS m^{-1}) 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.

Coastal groundwater management using an uncertainty-based coupled simulation-optimization approach

D.K. Roy, S.K. Biswas and B. Datta

Pumping induced saltwater intrusion in coastal aquifers is a challenging problem, due to the increased abstraction of groundwater resources to meet the growing demand for freshwater supplies. Sustainable beneficial water abstraction from coastal aquifers can be ensured by optimizing water abstraction from a set of production and barrier wells. An optimal pumping management strategy can be prescribed for a coastal aquifer system by utilizing an integrated simulation-optimization (S-O) approach. In this study, the integrated S-O approach was used to develop a saltwater intrusion management model for a real world coastal aquifer system in Barguna district of southern Bangladesh. The aquifer processes were simulated by using a calibrated and validated 3-D finite element based combined flow and solute transport numerical model using the code FEMWATER. The modelling and development of strategies for the management of seawater intrusion processes was performed based on the very limited quantity of available hydrogeological data. The model was calibrated with respect to hydraulic heads for a period of five years from April 2010 to April 2014. The calibrated model was validated for the next three years' period from April 2015 to April 2017. The calibrated and partially validated model was then used within the integrated S-O management model to develop optimal groundwater abstraction patterns to control saltwater intrusion in the study area. Computational efficiency of the management model was achieved by using a MARS based meta-model emulating the combined flow and solute transport processes of the study area. This limited evaluation demonstrates that a planned transient groundwater abstraction strategy, acquired as solution results of a meta-model based integrated S-O approach is useful for developing management strategy for optimized water abstraction, with saltwater intrusion control. This study shows the capability of the MARS meta-model, based an integrated S-O approach, to solve real-life complex coastal aquifer management problems in an efficient manner.

Prediction of salt water intrusion for different scenarios of aquifer recharge and groundwater extraction under changing climate

D.K. Roy, S.K. Biswas and M.A. Hossain

Pumping induced saltwater intrusion in coastal aquifers is a challenging problem, due to the increased abstraction of groundwater resources to meet the growing demand for freshwater supplies. The present study intends to evaluate the effects of changing groundwater recharge scenarios as well as anthropogenic activity of enhanced groundwater

extraction on the inland progression of saltwater wedge a real world coastal aquifer system in Barguna district of southern Bangladesh. The aquifer processes were simulated by using a calibrated and validated 3-D finite element based combined flow and solute transport numerical model using the code FEMWATER. Simulation was performed with the combination of different scenarios for a period of 50 years. Results demonstrate that the influence of the future scenarios on the salinity intrusion process is remarkable although not significant. It is revealed that salinity intrusion in designated monitoring locations increases with the simulation period. Therefore, an optimal pumping management strategy can be prescribed for the simulated coastal aquifer system by utilizing an integrated simulation-optimization (S-O) approach.

Monitoring of ground water level at different research station of BARI

M. A. Hossain, S.K. Biswas, D.K. Roy, K.F.I, Murad, S.S.A. Kamar, F. Akter, M. Morshed and M.A. Rahman

This study was conducted at the research fields of Irrigation and water Management Division (IWM), RARS, Rahmatpur, Barisal, and RARS Ishurdi, Pabna of Bangladesh Agricultural Research Institute (BARI) during 2019-2020, 2020-2021 and 2021-2022. 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.

Assessment of groundwater quality for irrigation and drinking purposes in some selected BARI research station

S.K. Biswas, D.K. Roy and M. A. Hossain

The present investigation is aimed at understanding the temporal and spatial variability of groundwater quality for its use in irrigation and drinking purposes in different regional station of BARI. The groundwater samples of STWs, DTWs and HTWs that used for irrigation and domestic uses were collected during November – December of 2021 in pre-irrigation season and during March – April of 2022 in post-irrigation season. Water quality indices, namely sodium adsorption ratio (SAR), exchangeable or soluble sodium percent (SSP or %Na), residual sodium carbonate (RSC) and Kelly's ratio (KR) were calculated for separate bore wells. Besides, the composite influence of different water quality parameters on the overall quality of water was also assessed using water quality index (WQI). The upper limit of SAR of 0.41 (less than 10), SSP 17.06% (less than 20%), RSC 2.54, and KR of 0.304 (<1) implies that all the groundwater samples were suitable for irrigation. According to the WQI values, all the samples were found to be "excellent" except few were found "good" in post-irrigation season. Thus, the majority of the area is occupied by good water in both pre- and post-irrigation season.

Conservation of groundwater and raising its use efficiency and productivity in irrigated agriculture in Bangladesh

S.K. Biswas, G.W. Sarkar and M. Assaduzzaman

Increased crop production and sustainable agricultural development of Bangladesh is largely depending on judicious use of water which translates into conservation (both groundwater and surface water) wherever possible leading to water savings for either other economic and social uses as well as making it cost effective. Most of the groundwater based irrigation use deep tube well (DTW) and shallow tube well (STW) and surface water based irrigation through low lift pump (LLP). These irrigation devices are mostly operated and managed by the private sector. In case of DTWs, two public organisations, namely BMDA and BADC are active. In case of surface water irrigation BWDB is the main public agency involved.

As of June 2020, the country provided irrigation facilities for about 5.6 Mha, which is about 65% of

the total cultivated area of 8.6 Mha. But potential capacity of irrigation facilities developed and conjunctive use of water can irrigate about 76% of the total cultivable area (MoA, 2020), which indicates low efficiency of irrigation system and thus lead to higher irrigation charges than is absolutely essential. Therefore, emphasis should be given on irrigation development with water savings and cost-effectiveness. The Agricultural Policy (2018) has given emphasis on reducing irrigation cost, introduction of efficient irrigation systems and expansion of water saving irrigation facilities with efficient water delivery system from the source to field.

The Government of Bangladesh, after consulting with relevant stakeholders within the government, private sector and civil society, and supported by the 2030 Water Resources Group, World Bank, established the Bangladesh Water Multi-Stakeholder Partnership (BWMSP) with the objective of contributing to addressing challenges in the Water Sector. A study has been carried out on Economic Policy Incentives (EPI) for water resources management. Among others, the EPI study made the recommendation for a transition from a low-productivity, low-efficient and wasteful use of irrigation water to one with higher productivity, higher efficiency and less wasteful system. The report highlighted the following recommendations:

i) A water charge regime based on *volume of water abstracted* rather than on area irrigated for a fixed fee;

ii) A system where individual farmers have direct control over abstraction for irrigating his/her land through *issuance and use of individual smart cards*;

iii) Introduction of *crop water-saving technology* (such as Alternate wetting and drying (AWD)) to minimize need for irrigation water;

iv) Higher *supply-side efficiency* through investment in more efficient water delivery system from the source of water to the field of farmers; and

v) S*ocial mobilization* for a community-based system of water management where the above four types of actions may be combined for wider acceptance by farmers.

These five elements exist in various degrees and form in case of BMDA and BADC deep tube well (DTW) areas. The present study has been carried out to examine how far their combinations support the hypothesis of a change from a low productivity, low efficiency and wasteful water use to a better one. Thus, a socio-economic, institutional and technical survey has been conducted to understand the effectiveness of the five elements of a proposed necessary interventions as indicated in preceding sub-section for ground water conservation, raising water use efficiency and water productivity in BADC and BMDA deep tube well (DTW) areas particularly for dry period boro rice production. Additionally, information will be collected for shallow tube well (STW) and private deep tube well (DTW) water markets for possible future intervention for attaining the objectives.

With this view in mind, the present feasibility study 'Conservation of Groundwater and Raising Its Use Efficiency and Productivity in Irrigated Agriculture in Bangladesh' has been taken under implementation by BARI, DAE, BADC and BMDA under MoA. The lead agency of the project is DAE. The main task of the project is to conduct baseline survey, mid-term monitoring and end line survey in different irrigation schemes of Bangladesh. These are largely the responsibility of the BARI.

Effects of floating agriculture practice on the water body of pond

S.S.A. Kamar, M. A. Hossain, S.K. Biswas, D.K. Roy, K.F.I, Murad and M.M.R. Talukder

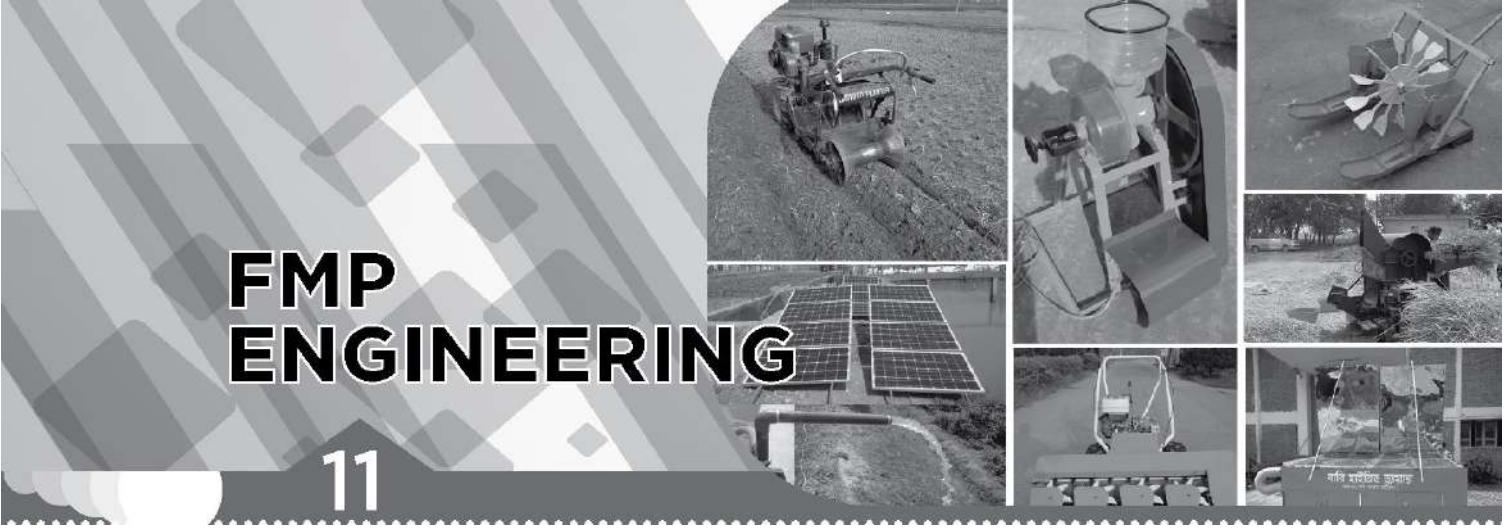
This experiment was conducted at RARS, Rahmatpur, Barishal to determine the change of water quality of ponds for cultivating fish and household uses. The water samples were collected from three selected ponds of RARS, Rahmatpur, Barishal. The selected ponds were mentioned as; FL-1 (Floating Agriculture 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 some months of 2020 and 2021 due to the lockdown retained for Covid-19 pandemic. The water temperature was observed below 34^0C which is good for fish cultivation during the study period at all three ponds. The pH level was ranged from 6.66-8.59 at all three selected ponds. The (UIA) Un Ionized Ammonia level at all selected ponds were suitable for only channel catfish production. However, the application of fertilizers and pesticides

effected the UIA level. The total dissolved solids (TDS) were in desirable limit but in case of floating agriculture practiced ponds (FL-1 and FL-2) the TDS level was found much higher than fresh pond (F). The Ca levels were in affordable range for only channel fish cultivation. The P values were found good for fish production but the floating agriculture practiced ponds have higher P levels than fresh pond. According to the observation, the nitrate levels during the study age were in tolerable limit. No detrimental effects of floating agriculture were detected in using the enclosed ponds water for household uses.

Dissemination of Water Saving Irrigation Technologies for Non-rice Crops in Saline Prone Areas of Bangladesh

M. A. Hossain, D.K. Roy, S.K. Biswas, K.F.I. Muard and S.S.A. Kamar

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 upazilas 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. Again in 2021-2022, field demonstrations were continued to five upazillas under five districts of southern Bangladesh. In 2019-2020, twelve demonstrations were conducted at the selected areas whereas in 2020-2021, four additional demonstrations were performed and in 2021-2022 fifteen demonstrations were conducted at the selected locations. 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, brinjal, sweetgourd 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, sstatistically significant yield difference was observed among the treatments (solar powered drip irrigation system and farmer's practice) for sweet gourd, brinjal, watermelon and tomato cultivation in the study areas in 2019-2020, 2020-2021 and 2021-2022 growing seasons. AFI and solar powered drip irrigation treatments provided highest BCR for all crops and for the consecutive three growing seasons. The farmers were benefited and interested in using this promising water saving irrigation technologies.



FMP ENGINEERING

11

Development and evaluation of four-wheel tractor operated seeder

M. A. Hoque, M. S. Miah, M. R. Karim and M. A. Hossain

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 in the establishment and productivity of crops. 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, four-wheel tractors (4WT) 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. It was designed and fabricated during 2020-21 at FMP Engineering Division, BARI, Gazipur and it was modified during 2021-22. To reduce turning radius of the seeder and to address skid of the seeder drive wheel, the seeder drive wheel was removed from the design. The power of the seeder was taken from the tractor wheel shaft. With this seeder, maximum 09 lines of seeds can be sown, and the tilling width was 180 cm. The effective field capacity of the 4WT operated seeder for wheat, maize and sunflower were found to be 0.248, 0.248 and 0.231 ha/h, respectively. The field efficiency of the seeder for wheat, maize and sunflower were likely as 78.73, 78.73 and 77.77%, respectively. Seed emergence of wheat, maize and sunflower were 95.25, 100 and 92.50 %. The blades of the tractor rotavator were modified for strip tillage arranged on the shaft to create 70mm wide tillage strip. The field performance was evaluated during 2021-22 with three different treatments as 4WTOS strip till planting, 4WTOS planting on ploughed land and conventional planting. There was no yield sacrifice of sunflower planted by the seeder compared to conventional planting. The experiment will be repeated in order to improving and evaluating the performance of the seeder for different crops.

Design and development of a tractor operated vegetable seedling transplanter

M. S. Miah, M. Z. Hasan, M. Asaduzzaman and M. A. Hossain

The current method for transplanting vegetable seedlings is manual, which requires making a hole in the soil, placing the seedling at the proper depth, and finally 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 in the field. A three-dimensional projection of furrow opener type tractor operated vegetable seedling transplanter was drawn with SolidWorks 2020. Transplanter was designed and fabricated with locally available iron materials at Farm Machinery and Postharvest Process Engineering Division of BARI, Gazipur during 2021-22. It consisted of pressing wheel, seedling holder, seedling dropper, leveler wheel, seedling tray, irrigation devices, furrow opener, etc. The machine can transplant seedling two rows at a time. Row to row and seedling to seedling spacing were adjustable. So that the machine can be suitable for all kind of seedlings. The transplanter had an irrigation system to provide water in the row to help transplanted seedlings recover from their initial stress. This is the first year of the experiment. The experiment will be carried out again next year in order to improve the machine and also to evaluate its field performance.

Energy use analysis of conservation tillage systems for the rice-maize cropping pattern

M. A. Hoque and M. A. Hossain

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 thus contributes 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 FMPE Division, BARI during 2021-22. 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 did not vary significantly. 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 the farmers.

Design and development of onion and garlic detopper

M. A. Hoque, M. A. Hossain, M. A. Mottalib and S. Brahma

Onion and garlic both are important spice crops in Bangladesh. After harvesting onion or garlic, the bulb is separated from the stem by cutting or detopping (keeping only 15–30 mm stem with the bulb). This is usually done manually, one by one, mostly using a sharp kitchen knife (*boty*) which is laborious, time consuming and costly. The detopper was improved for garlic at the FMPE Division of BARI during 2021–22. The detoppers were made with locally available materials and operated with a 0.37 kW electric motor. Capacity of the detopper for garlic was 120 kg/h whereas only 50 kg/h could be cut by two persons manually. Stem length of garlic after detopping by the modified machine was close to the manual method. The capacity of the machine was calculated for dried garlic which should be further verified with different sizes of onion and garlic in both green and dried conditions.

Investigation of long term Conservation Agriculture at BARI and adaptive trials of conservation machinery and water management systems in the southern delta of Bangladesh

M. A. Hossain, M. A. Hoque, M. J. Alam, M. M. Alam and C. K. Saha

Conservation agriculture (CA) is a tool of sustainable agriculture utilized in many countries. 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 BARI, Gazipur during 2020-21 and continued in 2021-22. The maize and mungbean experiments were conducted with four tillage methods such as T_1= Conventional; T_2= Strip tillage; T_3= Zero tillage and T_4= Bed planting. Rice experiment was conducted with the tillage methods as T_1= Manual transplanted in conventional tilled soil; T_2= Mechanical transplanted in conventional tilled soil; T_3= Manual transplanted in unpuddled soil and T_4= Mechanical transplanted in unpuddled soil. The long term CA trials were initiated. Different facilities were created in the CA Park for conducting long term experiments. The yield of maize, mungbean and *Aus* rice did not vary with the treatments since advantage of CA could not be 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. Significantly the highest yields of jute stalk and jute were obtained from strip tillage than PTOS and conventional tillage methods. The experiments will be continued in the next year to observe the long term effect of CA in on station and farmers' fields.

Design and development of tractor operated potato harvester

M. S. Miah, M. A. Hoque, M. R. Karim and M. N. Amin

The current potato harvesting method is manual, which requires to open the soil, collecting potatoes

from the soil and bagging. All of these works are time-consuming, labour intensive, and expensive. This experiment was undertaken in context of the present agricultural system for potato harvesting in the field. A three-dimensional projection of tractor operated potato harvester was drawn with SolidWorks 2020. Now the machine is being fabricated at FMPE Division of BARI, Gazipur. The developed potato harvester is a semi-automatic digging machine, and it consists of (i) digging blade (ii) conveyer flat chain (iii) guide plate (iv) shaker (v) collector and (vi) Power transmission arrangement with a dimension of 1890 mm x 1200 mm x 750 mm**.** The machine will do digging, separating potato from soil, bagging at a time. In order to relieve the farmer's labor and save time, money, and potato losses. However, potato farmers are always at risk of poor weather, especially during harvest. Therefore, a potato harvester can cover a large area quickly, avoid adverse weather, and maintain stable potato production.

Development of orchard weeder cum mini tiller

M. A. Hoque, M. A. Gulandaz, M. S. Miah, M. R. Karim, M. N. Amin and M. A. Hossain

Number of fruit orchards have been increasing in Bangladesh and farmers need suitable power weeder for weeding and cultivating vegetables and spices in the inter-row space. A diesel engine operated power weeder was developed during 2010 which was less capable of using in the orchard. 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 redesigned during 2020-21. Then the weeder was fabricated according to design with locally available materials and spare parts. The power weeder was operated with a 4.0 HP diesel engine. The weight of the weeder was 140 kg. The effective field capacity of the weeder in the orchard and kitchen garden as mini tiller were 0.068 and 0.075 ha/h and field efficiency were 73.71 and 77.84%, respectively. The operating cost of the weeder was 1701 Tk./ha. Net profit of the weeder was 149999 Tk./year. The BCR of the machine was 1.64. The payback period of the weeder was 0.33 year. It can be used in high density orchard since the width is less than that of the power tiller. Thus, the orchard weeder cum mini tiller could be recommended for the orchard farmers.

Design and fabrication of petrol engine operated boom sprayer for field crops

M. R. Karim, M. A. Hoque, Roknuzzaman and M. A. Hossain

A petrol engine operated boom sprayer was designed and fabricated at the workshop of Regional Agricultural Research Station, BARI, Jashore during 2019-20. It was gradually improved in 2020-21 and 2021-22 at the workshop of FMPE Division of BARI, Gazipur. A spray pump was incorporated with this improved machine with the replacement of front wheel-based reciprocating pumping system. The machine was tested at the laboratory and experiment field. The improved sprayer consisted of a light weight power unit (6.5 HP, 4 Stroke petrol engine) and a spraying unit. It consisted of two narrow rubber wheels in front side and one mild steel (MS) made rear wheel in rear side which was powered from engine through belt, pulley, chains and sprockets. The ground clearance of the machine was 900 mm. The rear wheel acted not only as a support but also as power wheel. The spray unit consisted of a tank made of MS sheet which contains 75-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 laboratory 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 the 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 sprayers. The field performance was evaluated following the RCBD experimental design with four treatments such as boom sprayer, electric knapsack sprayer, manual knapsack sprayer and control with three replications. Full cone nozzles were used for spraying the herbicide *Affinity 50.75 WP*. The crop was Barley and the variety was BARI Barley-6. Significant difference was not found in yield but highly significant difference was found on time requirement of spraying and found to be eliminated a remarkable number of weeds.

Development of an automatic irrigation device

M. Z. Hasan and M. R. Karim

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 that is why 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. An automatic irrigation device was fabricated in FMPE Division, BARI in 2021 to initiate precision agriculture practices among Bangladeshi farmers. Modification of the device was done from July 2021 to February 2022. During February, brinjal plants were transplanted in the field to test the device. But unusual thunderstorm in February hampered plant growth. Afterwards, early rainfall in mid-April and subsequent heavy monsoon rain throughout May and early June hindered to find any irrigation effects on the plants under the field condition. Therefore, the device was set up on the rooftop garden located at the Horticulture Research Centre, BARI, Gazipur during mid-June 2022 in a container plantation of coleus (*Plectranthus scutellarioides*) under a polythene shed. Fifteen coleus plants prepared from cutting, were planted into 4 L containers. Coleus plants were arranged in randomized complete block design (RCBD) with three treatments and five replications. The treatments were- irrigation using watering can (control), drip irrigation by manual method, drip irrigation by the automatic irrigation device. The plants are in rooting stage. Data on plant height, canopy length, growth index, LAI and dry matter content will be taken and analyzed in the next year.

Development of spraying system for coconut tree

M. Z. Hossain, M. Hasan, M. Z. Hasan, M. N. Amin, M. A. Hoque and M. A. Hossain

Coconut is the livelihood for many landless and marginal farmers in our country. However, the yield of coconut in Bangladesh is still very low because of the infestation of different insect pests and diseases. Spraying chemicals are the most common practice for controlling insect, mites, disease etc. However, coconut trees in Bangladesh are taller than 10 meters. Therefore, with the existing method, an excessive amount of pesticides is sprayed because of the height of the coconut tree and an extra amount of chemicals (pesticide, fungicide, miticide, etc.) are exposed to the environment. A prototype of a coconut spraying machine was designed and fabricated at FMPE Division, BARI, Gazipur during 2021-22. The climbing part is being fabricated using locally available MS angle, MS pipe, and MS sheet. The spraying unit will be incorporated with the climbing part and performance of it will be evaluated in the next year.

Development of a barley thresher

M. Z. Hasan and M. R. Karim

Barley is becoming an important health food (for diabetes) 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 endeavor fabrication of, a new model of barley thresher was started during 2021-2022. The new model consisted of a conveyor part, threshing part and dehulling part. Most of the parts have been fabricated and assembled. After completion trials will be done with bundles of harvested barley to record threshing data.

Development of a power operated coconut tree climber

M. Hasan, M. N. Amin, M. Z. Hossain and M. R. Karim

Most of the coconut growers harvest coconut manually in Bangladesh. Traditional manual techniques for harvesting of coconut are used in the different locations of Bangladesh. 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 sitting type. Nowadays, there is huge demand for developing power operated coconut tree climber. For this reason, a power operated coconut tree climber was imported from India. The cost of the power climber was Tk.1,95,911 which was very high. Total weight of the model was 55 kg. During operation the highest speed of the climber during

climbing up a tree was 0.47 ms^{-1} and the highest speed of climber during climbing down from a tree was 0.58 ms^{-1}. The average speed of the climber during climbing up was 0.42 ms^{-1} whereas it was 0.53 ms^{-1} during climbing down from the tree. There are some problems in coconut climbing machine but it will be useful for both the homestead and commercial growers. The experiment will be continued next year to make a cheaper and user-friendly climber in the FMPE workshop for solving the problems of the imported model.

Testing and evaluation of combine harvester for harvesting mungbean and soybean in coastal areas

M. R. Karim, M. S. Miah, M. A. Hoque, M. N. Amin and M. A. Hossain

A combine harvester was tested at the experimental fields of the FMPE Division for soybean and at the Pulse Research Centre (PRC), BARI, Gazipur (block no. 15; plot no. 01) for mungbean in the year 2022. The aim of the research was to evaluate the performance of the combine harvester for harvesting mungbean and soybean as well as to modify and improve the combine harvester. Two types of tests i.e. laboratory test and field test were conducted to determine field capacity, field efficiency, threshing recovery (%), un-threshed grains (%), threshing efficiency (%), cleaning efficiency (%), damaged grains (%), blown grains (%), etc. The moisture content of the tested soybean plants was 14% (wb) and the average field capacity of the combine harvester was found to be 0.62 ha/h and 0.58 ha/h whereas the field efficiency was 77% and 82% for soybean and mungbean, respectively. The percentage of threshing recovery, unthreshed grains, threshing efficiency, cleaning efficiency, damaged grains and blown grains were 85%, 14%, 86%, 84%, 9% and 1% respectively. The experiment will be continued in the following two years with the necessary modifications to improve the efficiency of mungbean and soybean harvesting, threshing, and cleaning.

Development of soymilk making machinery

M. A. Hoque, M. A. Hossain and M. M. Ali

Soybean provides a cheaper and high protein rich alternative substitute to animal protein. In Bangladesh, uses of soybean for preparing food items are restricted due to unavailability of proper machines. The design of the plant for production and pasteurization of soymilk would assist in increasing soybean in human consumption. The experiment was conducted to develop soymilk making machinery to increase consumption of soybean as human foods during 2019-20. A blender and a pasteurizing units were designed and fabricated for making soymilk. A blender was improved during 2020-21 for making soymilk with increased blade speed. During 2021-22, Soymilk was prepared using the machines and soya *poneer* and soya yogurt were prepared. The soymilk was prepared by blending soybean with power blender followed by 20 minutes pasteurizing. Sensory evaluation of the prepared soymilk, soya *poneer* and soya yogurt was done by twenty panelists. The yogurt prepared from 50% soybean powder and 50% cow milk were disliked by the panelists in terms of flavor and taste. The panelists showed their satisfaction on soymilk, soya *poneer* and soya yogurt (prepared by mixing 50-75% cow milk with soymilk) in sensory evaluation. The yogurt produced by mixing 50-70% cow milk with soymilk could be recommended for increasing use of soya bean for human consumptions.

Development of a four blades automatic cashew shelling machine

M. N. Amin and M. Hasan

Cashewnut is one of the high value crops in 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 of 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 (CNSL) 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 semi auto four blades cashew nut sheller was designed. Fabrication of the sheller will be started in August 2022.

Improvement of mechanical coconut dehusker

M. N. Amin and M. Hasan

An improved coconut dehusking machine was designed and fabricated with locally available materials at FMPE Division, BARI, Gazipur. The overall dimension of the dehusker was 920×750×1120 mm and its weight was 258 kg. The capacity of the improved coconut dehusker was

higher than that of the previous one. The breakage percentage of coconut was found to be reduced to 0-5%. The dehusking cost of the dehusker was found to be reduced to 0.21 from 0.27 Tk./nut. The machines will be disseminated among the farmers and traders through training, workshop and leaflet, booklet etc. The machines would be useful for commercial purpose in coconut growing areas and coconut oil industry, wholesale and retail market for shelling coconuts.

Upscaling of coffee postharvest processing machinery

M. N. Amin and M. Hasan

The coffee growers of Hill Tracts process the green coffee at home and the quality is very low. They consume it for their own purpose but for commercial purpose the quality must be maintained. Like other processing steps, coffee pulping, drying, dehulling, roasting and grinding are also machine involved process because it is a very labor intensive job. BARI has developed small scale coffee dehuller, roaster and grinder. A small size dehuller was fabricated with local materials with some modifications and tested with dried coffee cherry. The capacity of the improved dehuller was higher with less breakage percentage than the previous one. Whole coffee bean was found to be higher (96%) than that of previous dehuller (75%). On the other hand, six times lower broken coffee beans were observed in the improved dehuller than that of previous dehuller. The panel board of roasting machine was replaced at front side from backside for easy controlling and observation. A higher capacity of grinding machine was fabricated with stainless steel that was tested with the roasted coffee. The capacity of the improved grinder varied from 2.6-10 kg/h that was two-three times higher than previous one. The study will be continued for designing and fabrication of combination with roasting and grinding machine.

Design and development of a jute decorticator

M. R. Karim, M. Z. Hasan, M. S. Miah, M. A. Hoque and M. A. Hossain

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 a labor and cost intensive operation. 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 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 m^2 in 2019-20. 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 were recommended to be avoided. The machine could not be tested as per design of the experiment in the year 2020-21 because jute was in pre-maturity stage during the reporting time and test was done later. The machine was modified to get unbroken jute sticks in 2021-22 and was tested successfully. The modification of the machine to get unbroken jute sticks was successfully done and tested. A sub grant was received from CIMMYT Bangladesh to complete the necessary improvement and fabrication of the machine. It has been done with the engagement of two private machinery manufacturing companies having MoU with BARI as per terms of agreement signed between CIMMYT and BARI. The decorticator will be fine-tuned and tested in large scale in the ongoing season when matured jute will be harvested.

Development and adoption of suitable technology for hygienic potato chips production

M. A. Hoque, T. N. Barna, M. Hasan, M. A. Gulandaz, M. M. Alam, M. G. F. Choudhury and M. A. Hossain

Excessive production of potato in Bangladesh is leading the necessity towards an alternate profitable use and suitable technology. Sun drying is the most commonly used method to dry the agricultural products. The excess moisture in fresh produce causes spoilage and reduces the shelf life of the product. A study was conducted during 2020-22 to improve and adopt BARI machinery for rural region to enhance healthy and quality potato slices, to design and develop a low cost solar tunnel dryer for efficient and hygienic drying of potato slices. The development works were done at FMP Engineering workshop. The construction material was stainless

steel. The modified slicer (SS model) was capable to slice variable thickness slices. Capacity of the power operated slicer was almost double than that of the manual slicer during 2021-22. The developed dryer took only 6.5 hours to dry the potato sliced from primary moisture content 85% (wb) to final moisture content 5% (wb), which was suitable for long term storage and marketing. The developed dryer took only 13 hours to dry the mushroom from primary moisture content 93% (wb) to final moisture content 5% (wb). The dryer temperature was higher than the ambient temperature. The RH in the dryer were decreasing with the drying time. The power slicer could be used for slicing and then solar tunnel dryer could be used for drying after blanching in automatic blanching machine for producing hygienic potato chips by the farmers.

Adaptive trial of BARI chilli seed separator

T. N. Barna, M. S. Miah, M. A. Hossain and M. N. Amin

In Bangladesh, there is still no mechanical option involved in separating chilli seeds out of fruit. However, several traditional methods have been devised including beating inside sack, chopping and hand rubbing etc. These methods impact seed viability and are time-consuming, difficult, and expensive. In large-scale enterprises, a few imported large-scale seed separating machines are available. A power operated economic, portable, and user-friendly chilli seed separator was designed and fabricated with locally accessible iron materials in the workshop of the FMPE Division of BARI, Gazipur during 2020-21. Adaptive trail of the chilli seed separator was done in Char Sanmania with thirty chilli producing farmers from nearby four locations Kamargaon, Ghagtia; Dighda, Vuleshwar; Karihara and Char Sanmania, Kapasia. The average throughput capacity and separation efficiency of the machine were 34.87 kg/h and 88.14%. The seed separation capacity was 12 kg/h. The machine operation was better than traditional practices. The benefit cost ratio of the machine was found 1.9 and break-even point was 84 days, respectively.

Improvement of tomato seed separator cum pulper

T. N. Barna, M. A. Hossain and M. N. Amin

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. The mechanical method is a better solution to this problem. Therefore, a power operated tomato seed separator was designed and fabricated at FMPE Division, BARI during 2021-22. Modifications were done on the seed separating unit and power transmission system. The average seed separation capacity was found to be 2.44 kg/h, friction loss was 8.45%, throughput capacity 49.52 kg/h and seed separation efficiency was 93.95%. Extracting capacity of machine was nine times greater than that of manual extraction. The pulping capacity was found to be 45.94 kg/h, cylinder loss 11.23 % and cleaning efficiency was 62.12%. However, hybrid tomatoes have a very low number of flesh to seed ratio and the machine performance was not satisfactory.

Development of a suitable fruit bagging tool

M. Hasan, M. N. Amin, M. S. Miah and M. R. Karim

Several good agricultural practices (GAP) are becoming popular throughout the world for the production of high-quality fruits with less dependency 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 bag easily. For this reason, mechanical 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 seconds and the maximum time for fruit bagging was 47 seconds and the average time required for bagging of a mango was 42.4 seconds. 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 was 1.0 kg. The price of the machine was calculated about Tk. 1000. The experiment will be continued next year to make it more effective.

Development of a mungbean dehuller

M. Hasan, M. N. Amin and M. Z. Hasan

Legumes provide a rich source of protein for animals and humans. They also supply a substantial amount of minerals and vitamins. After harvesting mung beans

(*Vigna radiata L.*) are dehulled to improve cooking and nutritional qualities and to reduce cooking time. Mung beans can be consumed as dehulled splits, whole, canned, boiled, roasted or ground into flour to make a variety of desserts, snacks and main dishes. These legumes are hard to dehull because of the presence of mucilage and gums which form a strong bond between the hulls and the cotyledons. Therefore, an experiment was undertaken to develop a mung bean dehuller. The dehuller was fabricated at FMPE Division, BARI with available local materials during 2021-22. The machine was operated with a 3.0 HP electric motor. The weight of the dehuller was 50 kg. The initial testing was done but the performance was not desirable.

Development of an oat dehulling machine

M. Z. Hasan and M. R. Karim

Bangladesh achieved the status of a lower middle income country in 2015 and now officially will graduate to become a developing country in 2026. Beside economic indicators, people's food habit and demand for certain products bear testimony to this fact. Bangladeshi stores, both online and physical, display variety of oat products like oatmeal or rolled oats and ground oats which were considered as exotic foods in the past. Still minor among other minor cereals, oat has potential to become a cash crop in the future. FMPE Division of BARI undertook a programme to develop an oat dehulling machine to boost oat cultivation in the country since there is no specific machine in Bangladesh for dehulling oat grains. The machine was conceptualized as similar to the rice rubber-roll sheller. However, due to the nature of oat hulls, some modifications were planned for the machine. Knurled mild steel pipes were procured instead of the traditional rubber rollers used for rice shelling. An additional secondary roller and concave were also procured to rasp the grains after passing from the primary rollers to ensure complete dehulling of the input. Most of the parts have been procured and assembly is going on. Data will be taken and represented according to appropriate statistical tools after completion of machine fabrication.

Development of a sensor based automated squirrel repellent

M. Z. Hossain, M. Z. Hasan, M. S. Alam, A. T. M. Hasanuzzaman, M. R. Karim and M. A. Hossain

Squirrels are important for our ecosystem. However, Squirrels are considered to be an agricultural pest because they spoil significant quantities of fruits, grain seeds and vegetables. Thus we need to repel them so that they cannot destroy agricultural produces. Deep learning technology is being used to develop an automated squirrel repellent at FMPE Division, BARI, Gazipur in 2021-22. YOLO V5 algorithm was used to detect squirrels. The program was run into a Raspberry Pi 4 microcontroller. The system consisted of a camera and ultrasound speaker to detect squirrel presence and scare the squirrel, respectively. The initial test result revealed that the model can detect the presence of squirrels successfully. The part of different components of the prototype is being fabricated at the workshop of the FMPE Division, BARI, Gazipur.

Development of sensor based seed metering device in precision seeder to overcome missing of grain seeds

M. R. Karim, M. Z. Hasan, M. S. Miah, M. Hasan, M. A. Hoque and M. N. Amin

The importance and effectiveness of computer vision are increasing in recent years due to its wide-ranging applications in agriculture. FMPE Division of BARI has developed PTOS which is already being used in field and a precision seeder which is under improvement. Though this machine is being popular to farmers' day by day but there are some problems till now like blockage of furrow opener with soil and residue, sometimes double dropping of bold grain seeds, seed missing due to seed locking/bridging as well as due to variation of sizes of bold grain seeds (maize, chickpea. field pea and ground nut, etc.). The double dropping and missing of seeds could not be controlled with the existing seed meter. The experiment is being conducted in FMPE Division BARI in 2021-2025 under FMDP project with the aims to overcome seed missing due to seed locking/bridging, evaluate field performance of the sensor-based supplementary seed meter for sowing maize/chickpea/ground nut. A supplementary seed metering device is being developed through this experiment. The developed seed meter will supplement the seed where / when missing will going to be occurred during seeding by precision seeder. The coding (algorithm) has been completed which is capable to detect the missing of seeds. The open CV library which is a huge open -source library for computer vision, machine learning and image processing as well as

supports a wide variety of programming languages like python, C++, Java, etc. has been used in this experiment to train the machine on images of the seeds (fill or empty) and live camera is used to detect the real situation of seed missing or not. The code has been run and got the accuracy of detection of seed missing 81% which will be improved for more accuracy.

Development of cost-effective, intensified and sustainable Recirculating Aquaculture System (RAS) in Bangladesh

M. A. Hoque, M. A. Hossain and A. M. Shahabuddin

People are now very concerned about food safety issue that influences farmers to produce fish on the contaminant free environment. Recirculating Aquaculture System (RAS) is a healthy fish production system and can be located virtually anywhere. Fishes are grown at high density under controlled environmental conditions. The most of all RAS used in Bangladesh, have been imported from abroad. The application of RAS for commercial producers in many cases has been found as failure cases elsewhere in Bangladesh. 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, seven units of different imported RASs were visited by the research team. The BARI part designed and fabricated a mini-RAS with cheaper water tanks, drum filter, water pump and a solar system to minimize operation cost during 2021-22. The drum filter operation, pumping water to the overhead tank and operation of aerator was done with a solar panel powered DC system. A fish tank was fabricated with a maximum capacity of 10000 liters but potential capacity of 8000 liters. A mechanical drum filter of capacity to clean 4000 l/h water circulation with a gravitational force was designed and fabricated. A solar powered DC water pump of 40 l/h discharge capacity was fabricated to lift the water from the secondary tank to the overhead tank. The biological filter and improved solar use with backup system will be developed.

Development of a fertilizer sensor using fluorescence technology for the field mapping of soil fertility

M. S. Miah, M. Z. Hasan and M. R. Karim

The purpose of this research was to monitor the fluorescence properties of soil, organic matter, and fertilizer in order to create a sensor for determining the soil's current fertility level and, ultimately, for prescribing proper fertilizer dose for a particular crop. A portable image acquisition system was fabricated at the FMPE Division workshop; locally available materials were used to create a portable image acquisition system. Two UV lights and four halogen lights were used as lighting sources for this system. The system used a Cannon Kiss 7i camera mounted with an 18-55 mm lens. This system used to develop images can be fully customized to capture high-quality images. The experiment, which is in its initial year, will be repeated in the following year in an effort to enhance the soil sensor and its field performance will be evaluated.

Development of an IoT-based seed storage for high-value spices and vegetable seeds

M. Z. Hossain, M. Z. Hasan, M. S. Miah, M. A. Hoque, M. N. Amin, M. H. H. Khan and M. A. Hossain

Seed storage is crucial for high-value spices and vegetable seeds due to improper storage systems. In Bangladesh farmers store their seeds either in a plastic drum or plastic bag, gunny bags, *motka* etc., thus seeds are contaminated by insects, pests, molds, fungus, etc. which diminish seed quality. To date, there is no suitable smart storage system for small-scale farmers. An automated (IoT-based) cold storage (50,000 cm^3 and 100,000 cm^3) has been developed for storing high-value vegetable and spice seeds at BARI, Gazipur during 2021-22. The storage will be tested and modified in the next year.

Improvement of BARI Solar Cabinet Dryer

T. N. Barna, M. N. Amin and M. A. Hossain

Seed is the vital factor for successful crop cultivation. Proper drying of seeds is essential to boost agricultural production. FMPE Division, BARI, Gazipur developed a solar cabinet dryer to dry moist vegetable seeds under desirable temperature (<45°C) from solar radiation suitable for vegetable seeds drying. In absence of sun, the dryer can dry seeds using auxiliary heating source

(electric heater). The small solar cabinet dryer was tested with freshly harvested wax gourd seeds and pumpkin seeds. Trials were done to test drying performances of the dryer during sunny, gloomy days and drying only using electric heaters. 860 grams of freshly harvested wax gourd seed with an initial moisture content of 57% was dried within 6 hours to a final moisture content of 6%. 3.8 kg of freshly harvested pumpkin seeds were dried within 10 hours from 47% moisture content to final moisture content of 6%. The dryer while run only with electric heaters, dried 3.5 kg of freshly harvested pumpkin seeds within 9 hours to a final moisture of 10.6%. However, germination with mixed drying showed a better result compared to only heater drying. The collector efficiency was found 13-30%, Heater efficiency was found between 8-25% And drying cabinet efficiency was in between 50-51%. The mean cabinet drying seed germination was 77%, while germination of open sun drying was 33.33%. The price of the dryer was Tk. 60000.00. Break-even-point, BCR and payback period of the dryers were obtained to 450 hours per year, 1.04 over net return and 64 days for small size respectively.

Adaptive trial of BARI developed agricultural machinery for crop production in the coastal areas of Bangladesh

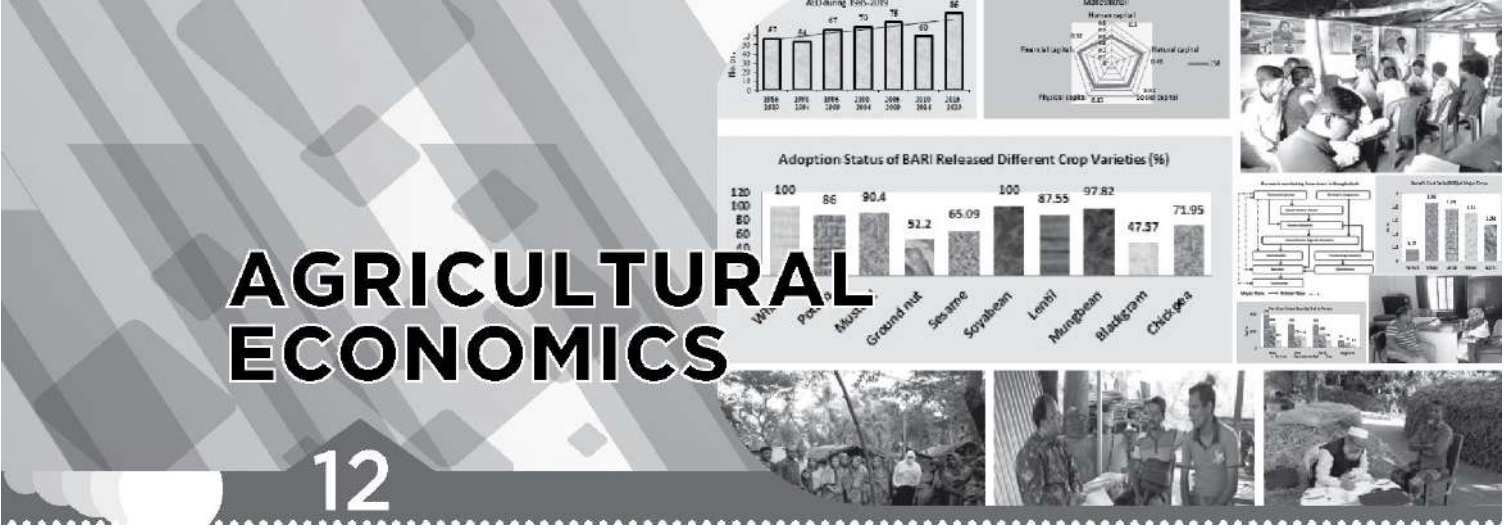
M. A. Hossain, M. S. Miah, M. R. Karim and P. C. Sarker

Farm mechanization part of Smallholder Agricultural Competitiveness Project (SACP) was implemented in five different coastal districts such as Patuakhali, Barguna, Bhola, Noakhali and Sathkhira by FMPE Division of BARI during 2021-22. 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 among farmers and local service providers through 30 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. In adaptive trials, farmers operated the machines, and operating techniques and troubleshooting of the machines were taught to them. Farmers opined that the machine reduced their drudgery and cost significantly and often obtained higher yields compared to hand sowing. Seven local service providers (LSPs) in the working areas were developed and totally 2.7 ha of area was covered under trials and 133 ha of area was covered by LSPs. Feedbacks from the farmers as well as the LSPs were collected and necessary measures were taken. After observing the performance of the machines, many of the farmers were interested to buy the machines. 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 if needed.

Adaptation of BARI developed farm machinery in the selected areas of Bangladesh

M. N. Amin, M. A. Hossain, M. A. Hoque, M. Hasan, M. S. Miah, M. Z. Hossain, T. N. Barna, M. Z. Hasan and M. R. Karim

Farm machinery technology development for profitable crop production project (FMDP) has been implemented in 10 districts by FMPE Division, BARI, Gazipur during 2021-22. BARI developed twenty types of different agriculture machinery were disseminated among farmers and local service providers were developed through adaptive trials and trainings with the help of OFRD, BARI and Department of Agricultural Extension (DAE). This year 100 batches of training and 150 adaptive trials were done in the project areas. In each adaptive trial, 40 farmers and service providers participated who were practically demonstrated at least one machine in the farmers' fields and 20 farmers/operators/LSPs participated in 2-day long trainings in each batch. 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 the seeder reduced labour requirement for weeding. One hundred thirty-seven local service providers (LSPs) in the working areas were developed. They are working on their own land and also others farmer field on custom hire basis. This year 195 officers from GO/NGO were trained on BARI developed machinery. Three manufacturers' in-house training were done in Jamalpur, Dinajpur, and Bogura.



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Cost and returns of selected pulse crops in Bangladesh

M. A. Rashid, M. Khatun and M.S. Rahman

The study was undertaken to estimate the financial and economic returns and competitiveness of selected pulse crops in Bangladesh. A total of 300 pulse growers (50 for each location and for each crop) were randomly selected for the study. Cost and return analysis was done on both variable and total cost basis. Domestic resource cost (DRC) was also estimated for evaluating the comparative advantage of selected pulse crops. The study revealed that the gross margins of producing selected pulse crops were found positive. However, highest gross margin was estimated for chickpea (Tk 56562/ha) followed by blackgram (Tk 43705/ha) and grasspea (Tk.32852/ha). Comparatively lowest net return was calculated for grasspea (Tk 18067/ha) than other two selected pulse crops in the study areas. The highest benefit cost ratio was for blackgram (1.71) followed by chickpea (1.61) and grasspea (1.56). The estimates of DRC showed that Bangladesh had comparative advantage in chickpea, grasspea and blackgram production as these estimates were less than one implied that the production of chickpea, grasspea and blackgram would be highly efficient for import substitution. Responded farmers mentioned that low market price at harvesting time and market syndicate were the major constraints for pulses production. Again due to severe infestation of insect and diseases of selected pulses crops yield were drastically reduced and it leads to heavy loss to the growers. The constraints mentioned were fertilizer not working properly might be due to adulterations, crisis of labour at harvesting time and high wage rate in the study areas. Government should take initiatives for reasonable price at harvesting time. DAE personnel should visit frequently to the farmers field. Mechanization should be promoted to the farmers field for minimize the labour crisis.

Value chain analysis of selected *Gher* based vegetables in southern region of Bangladesh

M. A. Rashid, Moniruzzaman, M. Khatun and M.S. Rahman

The study was carried out at Bagerhat, Khulna and sathkhira districts to analyse the supply chain of *Gher* based fresh vegetables and to document the current market situation of *Gher* based fresh vegetables with regard to production, consumption, and trade during January-May, 2022. Twelve major important vegetables, namely country bean, yard long bean, bitter gourd, bottle gourd, ash gourd, sweet gourd, ridge gourd, snake gourd, brinjal, cucumber, tomato and okra were selected for the study. Both vegetable producers and traders were selected for the study. The producers (200 farmers) of the selected vegetables who come to the market for selling their produces were randomly selected for interview. A number of traders (100 traders/market actores) i.e. Bepari, arotder and retailer were selected for selected vegetables through establishing a congenial relationship with them. In the study areas producers sold a lion share to different traders and consumers immediate after harvesting. Majority of selected vegetables farmers used auto-van for transporting their products in the market. Cent percent selected vegetables farmers of all areas reported that they sold their produce in the primary market i.e. local market in the study areas. About 90% product ran through Farmer –Bepari –Aratdar– Retailer -Consumer in this channel Average postharvest loss of vegetables was 10.43% at farm level and the total post-harvest loss of selected vegetables in the supply chain was estimated at 25.43% meaning a huge loss occurred at different levels of marketing. Estimated producers' shares to the consumers' prices for different vegetables

ranged from 33-39%. Average marketing cost of all areas was found to be the highest for Bepari and the net margin of all vegetables was found to be the highest for retailer followed by bepari. The total price spreads of all vegetables was ranged from Tk. 18-25 per kg. in the study areas. Among the selected vegetables sweet gourd, ridge gourd and tomato were more efficient than other studied vegetables. Disease infection and insect infestation were the acute problem of vegetable cultivation in the study areas and lack of capital, high transport cost and unstable price and lack of market place were the major problems for the traders.

Supply chain analysis of malta (sweet orange) in Bangladesh

M. A. Rashid and M. I. Kaysar

The study estimated the profitability of malta (sweet orange) cultivation, identify supply chains, measuring marketing efficiency and explore the problems of its cultivation in the study areas of Bangladesh. A total of 225 respondents consisting of 50 producers and 25 traders for each districts (Khagrachari, Banderban and Panchagar) were selected for the study. Data were collected through a pre-tested interview schedule during 2021-22. The analysis revealed that malta cultivation was profitable in the study areas. 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, on an average 50% of products flow through longer channel-I (Farmer-Bepari-Arathdar-Retailer-Consumer). The highest net marketing margin received by retailer (Tk. 10779/ton) was found in the study areas. 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. The information system must be developed so that traders and suppliers will get supply market information regularly based on the various marketing variables. Cold storage warehouse should be set up in the major wholesale market to preserve or store malta during off-period consumption.

Farm typology delineation and characterization in coastal areas of Bangladesh

Esmat Begum, Mahanam Das, Afroza Chowdhury, Rupak Goswami, Subhasis Mandal, Krishnendu Ray, Kuntal Chakravarty, Marta Monjardino

The study was conducted on 150 farms of Bangladesh covering six polders namely P-31, P-30, P-15, P-48, P-43, and P-44. Twenty variables were identified for typology delineation and characterization through expert consultation and literature survey. A combination of principal component analysis (PCA) and cluster analysis (CA) was used to delineate farm typology. PCA reduced the dimensionality of multiple variables into six principal components (PC), which was used in CA to categorize 150 farms into meaningful clusters (farm types). The number of clusters was identified by studying the generated dendrogram. The study found 10 distinct farm types and characterized them by variables concerning farm households' resource endowment and production characteristics.

Impact of climate change on crop farming in selected coastal zone of Bangladesh

Moniruzzaman, Md. Abdur Rashid and M A Monayem Miah

The study was conducted with the overall objective of analyzing the economic impacts of climate change on crop farming in 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, iii) To predict a range of potential future impacts on crop production, and iv) To assess farmer's perceptions and to investigate farmers' adaptation measures due to climate change. 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 during (April-June, 2021 and January – February ,2022 on 600 crop farming sample farmers' selected randomly and secondary data on average long-term temperature and rainfall data from 1971 to 2020 (49 years) over 6 districts in coastal region of Bangladesh. Results indicate that climate has a nonlinear effect on net income from crop farming. The marginal impact of the temperature and rainfall on farmers' net crop income are a significant ($p <$

0.01) and negative. The elasticity results showed that the changes in net crop income are very high for crop faming 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 is more by the year 2100 than in 2070, 2050 and 2030. Farmers have taken some adaptation strategies to reduce these adverse effects on crop production. The major adaptation strategies include cultivation of short-duration saline tolerant crop varieties, changing planting dates, higher levels of irrigation, find out off-farm jobs and change in crop. Estimates from a multinomial logit model (MNL) specify that gender, education level of household head, farm size, access to agricultural credit, irrigation facilities and extension services, govt. subsidy on agricultural inputs and access to climate information affect adaptation choices significantly. Therefore, policy makers should target these determinants to boost farmers' adaptation and thereby lessen the adverse effects of climate change. Consequently, the government should design policies aimed at improving the aforementioned factors.

Adoption status of BARI developed onion varieties at farm level in Bangladesh

M. Khatun, M. A. M. Miah and M. A. Rashid

The study assessed the adoption of BARI released onion varieties, determined the factors responsible for BARI onion variety adoption, explored farmers' perceptions on BARI onion variety cultivation, storage and post-harvest loss of onion at farm level in Bangladesh. The study analyzed 320 household's data collected from BARI onion variety adopters and non-adopters spread in the four onion growing districts namely Faridpur, Magura, Pabna, and Rajshahi. Along with descriptive statistics, the study used probit model for analyzing the data. Only 17% farmers cultivated BARI onion variety (BARI piaz-1 and BARI piaz-4). Six varieties of onion occupied about 12% of total onion areas in 2020-2021. In 2019-20 area under BARI onion varieties was only 9.5% and in 2018-19 it was approximately 10%. From this findings it is stated that area under BARI onion varieties cultivation is increasing. Farm size, training on onion cultivation, innovativeness, and contract with extension personnel had a positive and significant influence on adoption of BARI onion variety. The average total cost of cultivation was highest Tk. 365,018 in Taherpuri cultivation. Total cost of BARI Piaz-1 and BARI Piaz-4 were Tk. 321213 and Tk. 299545 respectively. The benefit-cost ratio of Lalteer king was highest 1.83 followed by Super king (1.80), Taherpuri (1.79), BARI Piaz-1 (1.71), Red king (1.68) and BARI Piaz-4 (1.53). However, the profitability indicators imply that the cultivation of onion at the farm level is highly profitable. About 89% farmers stored their produced onion following traditional storage method and only 11% farmers did not store onion, 21% farmers stored their onion on the ceiling of their bedroom by using plastic paper spreading sandy soil on it, 37% farmers stored onion on macha and 42% farmers stored onion on the ceiling of other rooms. They did not follow any scientific method even drying before storage. They stored 4 to 8 months for getting better price. Total post-harvest loss at farm level was estimated about 21.41% where, highest 17% loss was occurred during storage. If the farmers followed scientific method of storage, post-harvest loss can be reduced and supply of onion will be increased to meet the domestic demand.

Price volatility of watermelon in Bangladesh

M. S. Rahman and M. A. Rashid

Watermelon is highly demandable as a fresh fruit in Bangladesh. During the last few years with the increasing demand its prices seems to be very fluctuated in Bangladesh. The present study was conducted to identify the inherent causes of price volatility and probable solutions to keep the price in a congenial level. Data and information was collected from purposively selected four intensive watermelon producing areas of Bangladesh. Qualitative tools such as focus group discussion and key informant interview were also used to collect the data and information. Besides, farm level production data was also collected from 100 watermelon farmers from the survey areas. Watermelon production was found profitable in all the surveyed areas. The highest profitability was found in Chattogram district (BCR 5.24) and the lowest was in Thakurgaon district (BCR 1.00). Faria, wholesaler, retailer, and consumer were the main market actors in the survey areas. About 49% of the produced watermelon was sold in farm

gate while only 19% of them transported to the big terminal market. Ramadan month, hot summer season, higher demand, traders syndicate and higher market toll were some of the important causes of price hike as opined by farmers in the survey areas. While less production, higher market toll, hot weather and higher transportation cost were regarded as the prime reason for watermelon price spiral as suggested by the traders in different markets. Farmers also suggested some measures to control prices viz. reduction of market toll and taxes, strong punishment for the market malpractices, government controlling system, and reducing the prices of production inputs. On the other hand, providing transport subsidy, reduction of market toll and road subscription and strong market monitoring were the crucial measures to keep price to a reasonable level as suggested by the traders in the survey areas.

Socioeconomic study on local cultivar Duhazri Alu in Chattogram district

M. Jamal Uddin and Z.A. Firoz

The local cultivar of potato (Dohazari Alu) is very popular for their distinct features. It has high market demand in the study areas. That's why the present study was carried out in 11 villages covering 55 farmers under Chandanish Upazila in Chattogram district to examine the input use, productivity, profitability and to know farmers and consumers perceptions to this cultivar. Results revealed that farmers used less inputs particularly fertilizer doses during its production period. The yield was recorded at 13.75 tons/ha. The gross margin was calculated at Tk. 1,71,467/ha. The BCR was found to be 1.83 for variable cost basis. The cost of production per kg was calculated at Tk.17.91. Regular training of farmers on fertilizer and pest & disease management will increase its productivity. If the management practices could be improved, the way of income of the farmers will be easier.

Baseline study on cashew nut production processing and marketing in Bandarban hill district

M. Jamal Uddin and Z.A. Firoz

The study was carried out in 17 paras/villages under four Upazilas in Bandarban hill district with a view to document current status of cashew nut production, processing and marketing covering 105 samples household for data collection. Multi-stage sampling technique was followed for selecting the specific locations. Results revealed that farmers used less inputs particularly fertilizers during production period. The yield was obtained at 0.425 tons/ha irrespective of locations which are lower than that of global average yield of cashew nut (0.75 ton/ha). The gross margin was calculated at Tk.1,48,76/ha. The BCR was found to be 2.03 irrespective of locations indicating that the cashew nut production is profitable. Productivity will increase if the improved production technologies can be adopted and common diseases and pests are controlled. Cultivating more productive varieties in new places could increase production manifold. Resulting export opportunities will be increased. Simultaneously, the number of processing factories needs to be increased locally in line with the increase in production. Currently, farmers need hands on training on improved production technologies, post-harvest management, storing and marketing for ensuring fair prices of their produces.

Level of pesticide use on brinjal production at selected areas of Jashore region

P. Hajong and K.U. Ahammad

The study was designed to assess the level of pesticide use and profitability of brinjal production at farm level in selected areas of Jashore region during January-May, 2022. Average brinjal cultivated area per farmer was 0.08 ha. Most of the farmers cultivated local cultivars which called Chega, Vangor, Airet, makra, lafa begun, BARI Bt-begun-4 etc. Cent percent farmer spray insecticide in their fields to protect crops from different insect, pest and disease. Cent percent farmer argue that crop production did not possible without insecticide and insecticide protect crops from insect pest. In general cultivation a farmer spray every day or every alternate day to his brinjal fields and its about 77 times in a season. Some farmer spray at morning and some one at evening, every day farmer spray pesticide in their fields. Bt-brinjal farmer spray less pesticide than local farmer and its averages 28 times that a Bt-brinjal farmer spray once a week in his fields. Half of the costing was involved in the pesticide buying by the farmer. Though Bt-brinjal required less pesticide but farmer did not encourage to cultivate due to less market demand. Pheromone trap was most effective method used in brinjal fields. But farmer did not use it properly, farmer argue that IPM technology was time consuming method. Farmer faced different types of problem such as insect pest infestation, plant

deformation, little leaf of brinjal, disease infestation (wilting) etc. Considering the benefit cost ratio (BCR) brinjal cultivation was profitable.

Impact of and returns on investment from lentil research and development in Bangladesh

M. A. Monayem Miah, M. A. Rashid and S. M. A. Shiblee

There is a need for better evidence for the impact of plant breeding research on pulses to guide policy-making and investment. Lentil (*Lens culinaris*) is one of the major pulses in Bangladesh that has an important contribution to food security and agricultural sustainability. The objectives of this study are to quantify the impact of and returns on investment from lentil research and development (R&D) in Bangladesh. This study applies the economic surplus model, which is a widely applied method to quantify the economic impact of agricultural technology adoption at the aggregate level. Both primary and secondary data are used in this study. The study reveals that the most adopted lentil variety is BARI Masur-6 (24.4%). About 85% of areas are covered by BARI lentil varieties and 13% by local cultivars. The adoption of improved lentil varieties have created numerous socioeconomic impact in Bangladesh. Improved variety adoptions have increased lentil yield by 33.5%, farmers' net profit by 169.56%, and ensured comparative advantage of production (DRC=0.72). During the period from 1992-93 to 2020-21, these adoptions have added 75401 tons of nitrogenous fertilizers to the soil, produced 260 thousand tons of livestock feed, and created 16.97 million man-days of additional employment. The increased production of lentils attributed to research and development, has saved foreign exchange Tk 30.66 billion. The returns to investment reveals an encouraging scenario of the investment in lentil R&D since the estimated IRR (71.20%), NPV (Tk 514.73 billion) and BCR (4.33) were much higher compared to other rates of returns estimated for other crops in Bangladesh.

Climatic stresses, adaptation strategies and capacity assessment of pulses growing farmers in the coastal areas of Bangladesh

N. D. Kundu, M.S. Rahman and M. S. Uddin

Climate change and its variability cause different biotic and abiotic stresses that negatively affecting the agricultural crops and the livelihoods of coastal farmers. But data and information regarding these issues are scarce in Bangladesh. Therefore, the study was conducted to assess the adaptation knowledge and strategies to cope with climate variability stresses, identify the factors that determine the adaptation capacity of the farmers, and identify potentiality and problem of adaptation to climate variability stresses faced in pulse crop production by the farmers. The study revealed that draught and uneven rain were the severe stresses (100%) followed by water salinity (30%), soil salinity (25%), disease infestation (21%) and insect attack (21%) that negatively affect the yield of crops. Climate variability stresses negatively affect the crops yields which in turn give low return to the farmers. To adapt adverse situation farmers adopt different measures like reserve rain water, digging well, use salt tolerant variety, irrigation, drainage system, use pesticides, insecticides, and migrate to other occupations on a temporary basis. Age, family size, experience and farm size were identified as the significant determinants of adaptation capacity of the farmers to the climate variability stresses. Lack of capital, lack of adequate seed of salt, water and draught tolerant variety of crops, lack of adequate irrigation equipment's, lack of proper knowledge on soil and water conservation technique were found to be the major constraints to adapt climate variable stresses.

Profitability and varietal adoption of chickpea in selected areas of Bangladesh

M. S. Rahman, M. A. M. Miah and M. A. Rashid

Chickpea is an important pulse crop widely grown in Bangladesh. BARI has developed many improved chickpea varieties and disseminated to the farmers fields. The up-to-date information regarding adoption and financial profitability of this crop are unknown to the researchers and policymakers. Therefore, the study was conducted in Rajshahi district to determine the adoption status and profitability of BARI chickpea production and to examine the factors affecting the yield of BARI chickpea during 2020-21. The study revealed that 58% farmers cultivated BARI chickpea varieties in the study area. The average level of adoption of BARI Chickpea-1, BARI Chickpea-2, BARI Chickpea-3 and BARI Chickpea-5 were 25%, 3%, 5% and 25%, respectively at farm level. The cultivation of chickpea was profitable to the farmers

since per hectare total cost, gross return and gross margin of chickpea cultivation were Tk 71830, Tk 87128 and Tk 53688, respectively. Unavailability of latest BARI chickpea seed, lack of technical know-how, lack of training, and diseases (root rot) were the main constraints to BARI chickpea cultivation at farm level.

Socioeconomic study of floating agriculture in haor area of Kishoreganj

M. Mohiuddin

The aim of this study was to examine the cost benefit analysis and economic viability of vegetables production on the floating bed in Kishoreganj district of Bangladesh. The study area was selected purposively and 30 households (HHs) were surveyed through purposive sampling technique from a population of 45 households. From the results of the primary data, it was found that majority of the farmers were relatively younger and middle aged and were in a position to put more physical effort for floating garden in the studied area. Agriculture is the main occupation of 90% of the farmers who are involved in floating farming. On an average, gross return of the demo farmer was calculated at Tk. 30690 per year for three bed (each bed size was 30 feet long and 4.5 feet wide) which was 67% higher than non-demo farmers' of Tk.18390 and total cost was estimated at Tk. 17180 and Tk. 11010 in demo and non-demo farmers, respectively. Gross margin was estimated at Tk. 13510 in demo farmers which was 83% higher than non-demo farmers. Benefit cost ratio was 7% higher in demo farmers than non-demo farmers due to use modern variety and improved management.

Case study of farm machinery in char areas of Mymensingh district

N. Akter and M. M. Zaman

The study aimed at exploring farmers' perception towards farm mechanization and finding out its relationships with the selected characteristics of the farmers. Problems faced by the farmers in farm mechanization and their corresponding solutions were also explored. Data were collected by using a pre-tested interview schedule at Sader upazila of Mymensingh district from randomly selected 60 respondents by using simple random sampling method during February to March 2022. Farmers' attitude towards farm mechanization was the focus issue of the study and was measured by Likert scale. The observed score of farmers' attitudes towards farm mechanization ranged from 13 to 59 with the mean score of 33.33. Among the farmers, 40.0 percent belonged to neutral attitude category while 31.66 percent belonged to unfavorable and 28.33 percent to the favorable attitude category. Two out of eight selected characteristics of the farmers viz, educational qualification and extension contact had significant positive relationships and annual income had negative significant relationship with their attitude towards farm mechanization. Rests of the characteristics had no significant relationship with the focus issue. Based on Problem Facing Indices (PFIs) the top ranked problem in relation to farm mechanization is machinery use is not profitable (PFI 143) and the top ranked solution suggested by the farmers is government subsidy in heavy farm machineries. Different agricultural development organizations should address the existing problems of farm mechanization and step forward for solving these problems.

PLANT GENETIC RESOURCES

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Exploration and collection of plant genetic resources during 2021-22

M M Ali, M S Nahar, R Afroz, N Pervin, S Rahman, M G Hossain, I Ahmed, M R Molla, N Jahan, M F Khatun, Q M Ahmed And N Jahan

Multi-crop exploration and collection program was undertaken in 31upazilas of 19 districts in Bangladesh during 2021-2022. Five hundred and seven (507) germplasm of 63 crops were collected from Bogura, Chapainawabganj, Chattogram, Chuadanga, Coxsbazar, Dhaka, Faridpur, Gazipur, Jamalpur, Jashore, Kurigram, Khustia, Lalmonirhat, Narayanganj, Narsingdi, Natore, Pabna, Rangamati and Rangpur. The germplasm were 6 cereals, 12 pulses, 13 oilseeds, 360 vegetables, 97 spices, 12 fruits, 7 other crops. These germplasms were collected from home garden, field, threshing floor, farm store, cultivated habitat, market and hilly area 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 hyacinth bean germplasm

Q M Ahmed, R Afroz, S Rahman, M G Hossain, M R Molla, N Jahan, M F Khatun, N Jahan And M M Ali

The experiment was conducted on hyacinth bean (*Lablab purpureus* L. Sweet) at Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur, during October 2021 to May 2022 to estimate the characterization and variability in the germplasm. The germplasm was grown in augmented RCBD design including 67 germplasm with three check BARI released varieties. Green and purple colors were found in hypocotyl, epicotyl, stem pigmentation and leaf vein among the germplasm. Leaf anthocyanin was observed in 28.57% among the germplasm. Variations were observed in ramification index and stem pigmentation. Different pod shapes and pod curvatures were found. Variations of fresh seed color and dry seed color such as Green cream, purple, brown and black were discovered. The higher amount of coefficient of variations was observed in the number of pods per rachis. Phenotypic coefficient of variance (PCV) was significantly higher than the corresponding genotypic coefficient of variation (GCV) for all the character. Heritability % range from 12.88 to 96.4. Most of the characters were shown high heritability except the lowest heritability was found in leaf length. The highest genetic advance was found in number of pods per plant. High heritability coupled with high genetic advance was obtained for number of pods per plant, number of rachis, harvest duration and total seed weight. High heritability coupled with low genetic advance was observed for seed breadth, flower bud length, edible pod length, and yield per plot. Some promising germplasm were found.

Characterization of ash gourd germplasm during 2021-22

Q M Ahmed, R Afroz, S Rahman, M G Hossain, M R Molla, N Jahan, M F Khatun, N Jahan And M M Ali

The present experiment was conducted with 41 germplasm of ash gourd (*Benincasa hispida* Thumb.) at the Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI) during the Kharif season 2021-22. Germplasm was varied for seventeen qualitative and eleven quantitative characters. Qualitative

characters of ash gourd variation were revealed in early plant vigor, plant growth habit, leaf, inflorescences and fruit characters. The monoecious flower was recorded in all of the germplasm. Based on the fruit qualitative characters' maximum variations were obtained in fruit shape as well as stem-end and blossom-end fruit shape. The early female flowering (35 days) germplasm was found in AC-256, AC-278 and AC-433 followed by TRMR-2 as well as late was found in TRMR-147 (53 days) followed by NSR-56. The highest fruit length was obtained by the germplasm AC-96/1 (24.75 cm) followed by AC-61 (23 cm). The fruit width ranged from 9.0 to 12.50 cm and an average of 10.71 cm. The highest individual fruit weight was found in germplasm AC-256 (3.20 kg) followed by AM-25 (1.45 kg). The highest flesh thickness was recorded in AC-117 (2.40 cm) followed by AM-25 and AC-454 whereas the lowest in MRI-21 (1.00 cm) followed by AC-223 (1.33 cm). Based on recorded data it was observed a wide range of variations were found in most of the traits which indicate scope for breeding planning.

Characterization of ash gourd germplasm during 2020-21

Q M Ahmed, R Afroz, S Rahman, M G Hossain, M R Molla, N Jahan, M F Khatun, N Jahan And M M Ali

The experiment was conducted with 36 germplasm of ash gourd (*Benincasa hispida* Thumb.) at the Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI) during the Kharif season 2020-21. Germplasm was varied for different qualitative and quantitative characters. Twenty-one qualitative characters of ash gourd variation was revealed in early plant vigor, plant growth habit, leaf and fruit characters as well as seediness. Monoecious flower was recorded in all of the germplasm. The earlier female flower and the longest petiole length was found in ZS-05. Maximum fruits per plant were found in AMA-316 and AMA-62. The highest fruit length, weight and yield per plant were recorded in RC-197 close to AMA-71. Germplasm were grouped into four clusters. Cluster I, II, III, and IV contained member 6, 10, 6 and14, respectively. Cluster I had the highest mean values for germination percent, peduncle length, Number of primary branches, fruit length and individual fruit weight. Cluster II had the highest mean values for number of fruits per plant, fruit breadth and yield per plant. Sex ratio was maximum in cluster III and the nearest nodal position and earlier flower appearing was observed in female flower. Principal components analysis (PCA) revealed first eight most informative components PC8 cumulative variance 84.91 % whereas PC1 22.21%. Therefore, selection of these genotypes might play a significant role for future breeding program.

Characterization of bottle gourd germplasm

R Afroz, M G Hossain, M F Khatun And M S Nahar, M M Ali

Characterization and genetic variability for 30 characters in 98 accessions of bottle gourd (*Lagenaria vulgaris*) were studied. All accessions showed variation in qualitative and quantitative traits. Highly significant differences were observed among the quantitative traits. In qualitative traits, variability was found in fruit shape, pre-dominant fruit skin color, secondary fruit skin colour, plant vigor, stem pubescence, leaf colour, leaf size, depth of leaf lobes on leaf margin, leaf pubescence on dorsal and ventral part, fruit firmness, seed size, seed colour and flower colour. In quantitative traits, the highest mean value was observed in case of days to fruit maturity (128 days) followed by days to green fruit harvest (128 days) and days to first female flower (101days). The lowest mean value (5) was for number of fruit per plant. The highest standard deviation (SD) was found in days to green fruit harvest (13.49) and the lowest in weight per fruit in kilogram (0.94). The maximum coefficient of variation (CV) (45%) was obtained from number of fruit per plant followed by total number of female flower per plant (31.85%), number of primary branch per plant (29.30%) and fruit length in centimeter (26.71%).

Characterization of sponge gourd germplasm

M G Hossain, M R Molla, I Ahmed, N Jahan, M F Khatun, Q M Ahmed, S Rahman, R A Chhanda And M M Ali

Characterization of available germplasm helps to estimate diversity among the germplasm which is the key elements to develop new improved crop varieties. To identify the important traits of collected 56 sponge gourd (*Luffa cylindrica)* germplasm, a characterization experiment was carried out at PGRC research field, BARI, Gazipur during kharif 2021-22 season. Variation in Qualitative and

quantitative characters were observed in all recorded traits except stem shape, presence of tendrils and flower color. A good number of variations in stem pubescence, leaf shape and leaf size were observed. Different leaflet size viz. small for 10 accession (17.86%), intermediate for 30 accessions (53.57%), and large for 16 accession (28.57%) were recorded. Variation among the germplasm for leaf shape such as; ovate, orbicular and reniform were found in 4 (7014%), 8 (14.29%) and (78.57%) accessions respectively. Dissimilarity in stem pubescence like dense pubescence appeared on 8 (14.29%) and it was thin in 18 (32.14%) accessions while 30 accessions did not produce any pubescence. Significant variations were observed in respect of days to emergence, days to 1st flowering, internode length, lateral shot, peduncle length, petiole length and stem pubescence among the tested accessions. Early flowering was observed in accessions AR-260, TRMR-231 and TT-104 (11 DAT) while it was late in TT-59 (57 DAT) that took 57 days to flower. Internode length varied from 8.6 to 14.4 cm where, 18 accessions may consider as short statured (8.6−9.8 cm) and 3 accessions as tall (13-14.4cm). NQ-76, TT-59 and NSR-149 produced the highest number of lateral shoots (6-7) and the lowest were NRI- 90 and TRMR-112 which produced only 2 shoots. Petiole and peduncle length also showed a huge variation among the tested accessions.

Characterization of ridge gourd germplasm

M F Khatun, N Jahan, M J Hossain, S Rahman And M S Nahar

To know about the genetic diversity of 43 germplasm of ridge gourd, an experiment was conducted at the experimental field of Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur, during the Kharif season of 2021-22. Variations were found in both qualitative and quantitative characters among the germplasm. In the qualitative character variations were found in cotyledon size, cotyledon color, leaf size, leaf lobe, dorsal leaf pubescence, ventral leaf pubescence, blossom end fruit shape, stem end fryit shape, fruit shape, fruit rib, fruit color, flesh color, flesh taste, flesh moisture, flesh texture and skin hardness except stem shape, tendril, leaf spot colour, leaf margin, growth habit, flower colour, sex type, skin texture and flesh test. The maximum (Six types) variation was found in fruit shape which was the elliptical shape (44.19%), elongate elliptical (18.60%), pyriform (13.95%), elongate slim (9.30%), elongate tapered (6.98%) and oblong blocky (6.98%). The highest coefficient of variation was observed in stem thickness (83.10%) which was followed by the number of fruits per plant (43.16%) and no. of the primary lateral shoot (34.48%). Considering the fruit yield per plant, early flowering, fruit length the germplasm AC-193, IAH-284, IA-43, AMA-395, AC-147, AHI-37 and TRMR-14 were found better which can be used in the future improvement or breeding programs.

Characterization of indian spinach germplasm during 2020-21

M F Khatun, R A Chhanda, M S Uddin, S Rahman, M G Hossain, Q M Ahmed And M S Nahar

The study was conducted at the experimental field of Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur, during the Kharif season 2020-21. Forty-two germplasm of Indian spinach were characterized in this study. Most of the qualitative characters showed a few variations. The variations were found in leaf colour, leaf shape, stem colour, stem shape, leaf margin colour, leaf margin, flower colour as well as seed colour and seed size. Among the germplasm maximum variation was observed in seed colour whereas maximum color was observed in dark brown (42.86%), Brown (33.34%), light brown (9.52%), reddish-brown (9.52%), and straw (9.52%). Plant growth habit was observed in three types such as twining (26.19%), procumbent (59.52%), and bushy (14.29%). The stem colour showed green (76.19%), dark red (15.10%), and light red (9.52%). Among the germplasm, the stem shape mostly provided angular type (95.24%). The green-colored leaf was the highest (32 germplasm) followed by light green (4 germplasm) and dark green (6 germplasm). The highest coefficient of variation 43.69% was found in leaf weight (leaf yield) which was followed by stalk weight 41.67% which indicates stalk yield per meter vine. Three distinct clusters observed by cluster analysis where cluster 1 was found to better due to the highest mean value.

Characterization of chilli germplasm

M F Khatun, N Jahan, N Jahan, N Pervin And M S Naher

The study was conducted in the experimental field at the Plant Genetic Resources Centre (PGRC) of

BARI Gazipur, during the winter season of 2021-22. 35 qualitative characters and 12 quantitative characters were recorded from 38 genotypes to characterize the chilli germplasm as per documented followed by IBPGR descriptor. Qualitative variation was observed in overall leaf color, flower color, fruit color at the immature stage and fruit shape at the blossom end. The maximum variation was observed in leaf color such as light green (21.05%), green (47.37%), dark green (28.95%), and light purple (2.63%). Variation was also found in corolla colour where white (65.78%), light yellow (28.95%), purple (26.32%), and white with a purple margin (2.63%). The fruit shape at the blossom end was found in four categories such as pointed (63.16%), blunt (26.32%), sunken (7.89%), and sunken and pointed (2.63%). The highest coefficient of variation was recorded in stem length (56.7%) which was followed by fruit width (49.5%), and individual fruit weight (49.42%). Considering the yield, AHM-176, AMA-199, RC-79, IAH-96, RC-81, and ATR-03 were shown superior.

Characterization of brinjal germplasm

N Jahan And M F Khatun

The experiment was conducted with forty-one (41) germplasm of brinjal (*Solanum melongena* L.) in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI, during winter 2021-22 to find out the variability in the germplasm. All the qualitative characters showed distinct variation among the germplasm except fruit cross section and fruit position. The maximum variation was observed in overall fruit length breath ratio and fruit calyx prickles. The highest quantitative variation was observed in fruit length (CV-43.79%), followed by individual fruit weight (CV-32.91%) and yield per plant (CV-30.12%). More of the germplasm were scattered into cluster I. Cluster II and Cluster III included ten germplasm, respectively. The maximum cluster mean value were observed in Cluster II for the characters days to 50% flowering (67.90%), plant height (97.97 cm), Individual fruit weight (107.35 g) and yield per plant (2.51%). The first PC explained 27.28% of the total variability and the second PC explained 22.36% of the variation among 41 brinjal germplasm. In biplot, the brinjal germplasm NF-20, NF-13, NF0-7, NF-4, NF-25, NF-16 and NF-2 etc. were separately isolated from the others and they were away from centroid. These results showed their uniqueness and divergence of the germplasm in respect to the measured traits.

Characterization of muskmelon germplasm

N Jahan, Q M Ahamed, M F Khatun, N Pervin And M M Ali

Forty-two muskmelon *(Cucumis melo)* germplasm were studied at the Plant Genetic Resources Centre of BARI, Gazipur during February-June 2022 to identify the variations among the germplasm. Variation was found on fruit shape, predominant fruit skin colour, secondary fruit skin colour, primary colour of immature fruit, secondary colour of immature fruit, secondary skin colour pattern. In fruit character, there were globular (14.29%), flattened (19.05%); oblate (33.33%), elliptical (2.38%), pyriform (2.38%), elongated (23.81%) fruit shape were identified. In fruit cracking habit, 28.57% germplasm showed deep cracking, 9.52% intermediate and 33.33% superficial. The maximum 52.38% germplasm showed pale orange fruit flesh colour. The maximum 69.05% germplasm contained grainy-firm fruit flesh texture. All germplasm had contained internal aroma. The range of fruit length was 9.50 cm to 51 cm and breath was 5 cm to 18 cm. The average value of flesh thickness was 2.38 cm. The minimum fruit weight was 0.33 kg and the maximum was 5.46 kg. Maximum coefficient of variation 73.53 % was estimated in fruit weight followed by fruit length (46.35%).

Characterization of spinach germplasm

N Jahan, N Jahan And M R Molla

Fifty-one germplasm of spinach (*Spinacia oleracea L.*) were evaluated for several qualitative and quantitative traits at the Plant Genetic Resources Centre of BARI, Gazipur during rabi 2021-22 to know the variability in the germplasm. Variation was found in all the characters except Inflorescence color and seed type. Leaf shape was exhibited as elliptic, broad elliptic, ovate and broad ovate where elliptic shape was found in maximum germplasm (64.71%) where as 11.76% germplasm had broad elliptic leaf shape and 13.73% had ovate leaf shape. Leaf texture of the germplasm exhibited as smooth (90.20%) and slight crinkled (9.80%). The highest quantitative variation was observed in edible leaf weight per plant (CV-30.59%) followed by petiole length (CV-22.21%) and number of lateral branches (CV-19.40%). Germplasm TRMR-95, NT-34, TRMR-136, NRI-121 had longer leaf and NRI-121, TRMR-136, RC-139, TRMR-12 and NT-33 had broader leaf. Germplasm RC-139 had highest number of lateral branches (9). The germplasm NQ-

68 required 85 days for bolting which was followed by TRMR-136 (83 days) and RNF-126 (83 days) that was most important characters for spinach. The dendrogram shown that the maximum thirty-six germplasm were grouped into cluster I. Cluster IV was occupied by only one germplasm. The maximum cluster mean value were observed in Cluster II for the characters leaf length (cm), leaf width (cm) and edible leaf weight per plant (g). The first PC explained 37.10% of the total variability and the second PC explained 22.90% of the variation among fifty-one spinach germplasm. Populations with high scores for the first eigenvectors are leaf length (0.4860), leaf width (0.4827) and petiole length (0.4792) these traits were the most important contributors towards diversity of the germplasm in PC1. Considering leaf characters and bolting time, germplasm TRMR-136, TRMR-144, R-342, RNF-26, NQ-68 and RC-139 were selected for future breeding program.

Characterization of amaranth germplasm

N Jahan, M G Hossain, M R Molla, Q.M Ahmed And M S Nahar

Seventy-two accessions of amaranth (*Amaranthus* spp. L.) were studied in augmented block design at the Plant Genetic Resources Centre (PGRC), BARI, Gazipur during winter 2021-22. All the accessions showed 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. Moreover, different color variations were displayed in leaf (yellowish green 05.56%, green 23.61%, pinkish green 27.78%, reddish green 31.94%, red 05.56% and dark red 05.56%), inflorescence (yellowish orange 13.89%, purple 11.11%, red 02.77%, reddish green 30.56% and green 41.67%), stem (05.56% pink, 15.28% red, 54.17% reddish green and 25% green), and seed (red 15.28% and black 84.72%). In case of quantitative character, plant height ranged from 14.30-198.6cm. The accessions flourished with 50% flower within 41-109 days giving 17.40 cm long inflorescence on an average. Average seed yield per plant was 14.67 g. Nevertheless, highest CV was found in case of number of days to germination (45.58%) and lowest in leaf length (19.91%). The accessions namely, N-94, TT-99, TT-140, TT-142, TT-198, NRI-268, MRI-41, SSR-3, SSR-25, SSR-45, RC-35 and RC-151 have been recommended for using in future breeding program.

Characterization of lentil germplasm (set-i)

K U Ahamed And M M Uddin

The study was conducted at Regional Plant Genetic Resources Center, Regional Agricultural Research Station, Ishurdi, Pabna during Rabi season of 2021-2022 to study the genetic diversity in lentil germplasm and to identify accession having useful traits. The experiment involved 324 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-3819, BD-3844, BD-4044, BD-4045, BD-4105, BD-4106, BD-5958, BD-5959, BD-5963, BD-5964, BD-6023, BD-6024, BD-6025 and BD-6027 (46 days) than the other accessions. The earlier maturity observed in BD-5998 (101 days). Variations were observed among lentil accessions in different qualitative characteristics like plant pigmentation were observed in stems, leaves and flowers. Seedling stem pigmentation was observed present for 34.26% and absent 65.74%. Variations in tendril length found rudimentary for 28.09% and rest accessions found in prominent maximum for 71.91%. Flower ground colour observed maximum white colour for 75.93%, white with blue veins for 16.05%, blue for 6.17%, violet for 7.84% and rest accessions showed pink for 0.62%. Pattern of testa showed absent for 0.31%, dotted for 89.20%, spotted for 2.47%, marbled pattern of testa showed for 5.56% where rest accessions 2.47% showed complex. Colour pattern on testa observed absent for 0.31%, black for 0.93%, grey for 11.11% where brown colour pattern of testa showed for 87.65%. Cotyledon colour found yellow for 0.31% and rest 99.69% accessions showed orange-red colour. Pest and disease susceptibility found low for 23.77%, medium showed for 43.52% and rest 32.72% accessions showed high susceptibility to pest and disease which affected by aphid and stemphylium blight disease symptom in stem and leaves. Variations were observed in different quantitative characteristics as numbers of pods per plant varied from 41.50 to 388.00, maximum number of pods per plant recorded 201.00 to 388.00, moderate for 100.00 to 199.00 and rest accessions found lowest 41.50 to 99.00 number pods per plant and BD-

10726 produced significantly the highest number of pods per plant (388.00). Seed yield varied from 1.13 to 14.88g per plant, where BD-3829, BD-3904, BD-4033, BD-4056, BD-4098, BD-5960, BD-5980, BD-6000, BD-6008 and BD-10726 showed high yielding 10.02 to 14.88 g per plant, moderate yielding 6.03 to 9.83 g per plant and rest found lowest yielding 1.13 to 5.98 g per plant. The highest seed yield 14.88 g per plant was recorded from BD-3904 lentil accession and the lowest yield 1.13 g per plant found from BD-4078 lentil accession.

Characterization of lentil germplasm (set-ii)

M G Hossain, M R Molla, I Ahmed, N Jahan, M F Khatun, Q M Ahmed, S Rahman, R A Chhanda And M M. Ali

Characterization of collected germplasm helps to estimate diversity among the germplasm. germplasm. Fifty-three accessions of lentils (*Lens culinaris)* were characterized at PGRC research field, BARI, Gazipur during rabi 2021-22 season following augmented RCB experimental design to identify the important traits. Diversity both for qualitative and quantitative characters were observed in all characters except number of seeds per pod and number of flowers per peduncle. Variations in leaf pubescence and seedling stem pigmentation were observed. Different leaflet size viz. small for 15 accession (28.30%), medium for 37 accessions (69.81%), and large for 1 accession (1.89%) were recorded. Dissimilarity in ground color of testa viz. grey, brown and black were identified. Significant variations were observed in days to 50% flowering, days to 90% maturity, plant height, number of primary branches, number of pods per plant, 100-seed weight and seed yield per plant among the tested accessions. Early flowering was observed in accession NSQR-07 and NSQR-23 (47 days) while the earlier maturity was observed in NSQR-23 that took only 98 days. The accessions NQR- 17 possessed the maximum number of pods per plant (263). NSQR-08 produced the highest number of primary branches per plant (4.4). The tallest plant was found in NSQR-13 (39.2cm) while the dwarf was in NRI-95 (20.6cm). The highest seed yield (40.19 g/plant) was recorded from NSQR-06 and the lowest (3.63 g/plant) from NRI-101 and N-101 (3.65 g/plant) lentil accession.

Nutritional and morphological characterization of tomato germplasm for varietal improvement

S Rahman, Q M Ahmed, M S Nahar, M M Ali

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, in 2019-20 to 2020-21 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%). 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%). Organoleptic test showed sweetened, sower-sweetened, crispy and Juicy tomatoes. Currently nutritional analysis is ongoing. 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 blackgram germplasm

M I Riad And M M Kadir

Blackgram (*Vigna mungo* L.)**, one of the most important pulse crops belongs to the family** Leguminosae**.** Eighty-eight (88) germplasm of blackgram were characterized at plant Genetic Resources Centre (PGRC), RARS, Jamalpur during 2021-2022. In qualitative variation was predominantly present in most of the characters except petiole colour, calyx colour, pod curvature, seed colour and seed shape. The germplasm were analyzed for 35 qualitative and quantitative characters. In quantitative traits, early flowering and maturity was observed in germplasm BD-6837 (42

days and 59 days). The characters number of primary branches/plant, number of pods/plant, pod length, number of seeds/pod, 100 seed weight and seed yield/plant batter performance was found in germplasm BD-6805 (10), BD-6797 (50), BD-6806 (4.82 cm), BD-6834 (7), BD-6866 (5.72 g) and BD-6797 (13.46 g). The character plant height showed highest standard deviation (30.07) and coefficient of variation (CV %) (40.51%) and mean (172.47) was found in the character days to maturity.

Characterization of grasspea germplasm (set-i)

M S Kobir, N Jahan, M R Molla, S Rahman, M S. Nahar, K U Ahamed And M M Ali

The study was conducted at Plant Genetic Resources Center, Regional Agricultural Research Station, BARI, Jashore during Rabi season of 2021-22 to identify the important traits of grasspea accessions. The experiment involved 200 grasspea accessions. Variations among grasspea accessions were observed in qualitative characteristics like seedling vigor, plant growth rate stage-I, plant growth rate stage-II, plant growth habit, stem colour, leaf colour, leaflet shape, flower size, flower colour, pod shape, seed size and seed colour. Plant growth rate stage-I was observed low for 60 accessions (30%), medium for 77 accessions (38.5%) and high for 63 accessions (31.50%). Plant growth habit was recorded erect for 17 accessions (8.5%), semi-erect for 14 accessions (7%), spreading for 88 accessions (44%) where prostrate showed 78 accessions (39%). Flower colour was observed blue for 198 accessions (99%), pink for 2 accession (1%). Seed size showed small for 11 accessions (5.5%) and medium for 189 accessions (94.5%). 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, seed yield plot^{-1} and seed yield ha^{-1} among grasspea accessions. BD-4350 and BD-5340 produced highest number of pods per plant (124). The lowest days (58) to first flowering was observed in BD-3378, BD-4756, BD-4860, BD-4978. The lowest days to 50% flowering was observed in BD-4759, BD-4756 and in BD-4978. The highest seed yield was observed in BD-3629 (3844.43 kg ha^{-1}) which was followed by BD-4753 (3700 kg ha^{-1}), BD-4768 (3615.55 kg ha^{-1}), BD-4839 (3582 kg ha^{-1}), BD-3718 (3573.33 kg ha^{-1}), BD-3795 (3526.67 kg ha^{-1}), BD-4743 (3504.45 kg ha^{-1}) and BD-4754 (3437.77 kg ha^{-1}) whereas the lowest seed yield was found in BD-5243 (1142.3 kg ha^{-1}) and these better performing genotypes may be considered as better accessions. These accessions may be used in grasspea improvement programme.

Characterization of grasspea germplasm (set-ii)

M Hossain And A K Shaha

To assess the genetic diversity of 200 Grasspea germplasm a field experiment was conducted in the experimental field of RARS, Burirhat, Rangpur during the winter season of 2021-22. A high degree of diversity was found among the pea germplasms both for qualitative and quantitative traits. All the studied qualitative characters showed distinct variation among the germplasm except leaf pubescence and flower colour. The maximum variation was observed in stem colour. The maximum percentage of seedling (47 %) was found vigorous, then 41.5% seedling was found intermediate and 11.5% was found poor, respectively. In respect of stem colour, green colour of stem was found the maximum of 55.55 %, then 29.5% was light green and 15 % gemplasm was containing dark green stem colour, respectively. The highest quantitative variation was observed in the number of pods per plant (CV-50.29 %). The germplasm BD-5669 produced the highest number of seed (6.60) per pod. The highest seed yield (28.70 g) was recorded from the germplasm BD-5648. Therefore, selection of these genotypes might play a significant role for future breeding program.

Characterization of grasspea germplasm (set-iii)

K U Ahamed And M M Uddin

The study was conducted at Regional Plant Genetic Resources Center, Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2021-2022 to identify the important traits of grasspea accessions. The experiment involved 202 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 earlier in BD-5741(49 days) than the other accessions and days to 50% flowering was determined by recording earlier in four accessions such as BD-5715, BD-5745, BD-5746 and BD-5753 (62 days). The earlier maturity was found in BD-5798 (105 days) than the other accessions. Variations were observed among grasspea accessions in different qualitative

characteristics like pigmentation found in stems, leaves and flowers. Stem colour was showed light green for 18.32%, green for 75.25%, purple-green for 4.95% and rest was purple for 1.49%. Four types of plant growth habit were found as recorded erect type for 0.99%, semi-erect for 20.30%, spreading for 45.05% where prostrate showed 33.66%. Three types of number of leaflets per leaf were observed one pair for 13.37%, two pair for 76.73% and rest accessions showed more than two pair for 9.90%. Different types of leaflet shape were found as linear for 9.41%, lanceolate for 39.60% and rest 61 accessions showed ovate-lanceolate for 30.20%. Two types of flower colour were observed blue for 97.52% and rest accessions showed violet flower colour for 2.48%. Seed shape was observed oblate or flattened for 0.49%, square for 13.37%, triangular for 5.94%, obtriangular for 3.46% and spherical type seed shape showed 0.49%. Seed size was observed small for 3.96%, medium for 42.08% and rest accessions showed large for 53.96%. Seed coat pattern was recorded absent for 0.99%, marbled for 56.93%, dotted for 41.58% and rest accessions showed mixture for 0.50%. Different cotyledon colour was observed among accessions as yellow for 38.61% and rest showed orange for 61.39%. Different biotic stress susceptibility on pest and diseases were found among 202 grasspea accessions. Variations were observed in different quantitative characteristics among grasspea accessions as number of secondary branches per plant varied from 4.33 to 15.33, 118 accessions showed maximum number of secondary branches per plant (10.33-15.33). Nnumber of pods per plant varied from 36.50 to 115.00, while 15 accessions showed highest number of pods per plant (100.00−115.00), 84 accessions gave moderate number of pods per plant (70.50−99.00) and rest 103 accessions produced lowest number of pods per plant (36.50−69.00). Yield varied from 2.14 g to 28.11 g per plant, where BD-5737, BD-5719, BD-5752, BD-5762, BD-5819, BD-5837, BD-5888, BD-5923, BD-5933 and BARI Grasspea-2 showed high yielding (20.09−28.11 g/plant), 139 accessions showed moderate yielding (10.14−19.92 g per plant) and the rest 53 accessions showed low yielding (2.14−9.79 g per plant). The highest seed yield (28.11 g per plant) was found from BD-5737 grasspea accession and the lowest yield (2.14 g per plant) found from BD-5889 grasspea accession.

Characterization of mustard germplasm

M A A Malek, M R Molla, S Rahman, M Rabi And M R Ahmad

This experiment was conducted at the hill valley of Hill Agricultural Research Station, Khagrachari. Quantitative characters showed variation in days to 50% flowering ranged from 38 to 56 days, pod formation ranged from 45 to 61 days, harvesting ranged from 81-97 days. Accession BD-7105 showed first flowering and BD-7809 & BD-9292 were late flowering. Accession BD-7125 showed maximum plant height 170.4 cm. The seed of all accessions will store in cold storage of PGRC at Gazipur for further evaluation.

Characterization of red amaranth (*Amaranthus* spp.)

S Rahman, N Jahan, N Jahan, M S Nahar And M Ali

The present investigation was conducted in the experimental field of Plant Genetic Resources Centre (PGRC), BARI to evaluate and characterize seventy-six diverse germplasm of red amaranth collected from different districts in Bangladesh. The characterization results revealed wide range of variation for most of the qualitative morphological parameters except plant growth habit (erect), stem colour (red), stem surface (ridged) and inflorescence shape (semi-drooping). The maximum variation observed in early plant vigour, leaf colour, inflorescence colour. Quantitatively, the highest variation was observed in petiole length (CV-35.14%).

Characterization of okra germplasm

N Jahan, Q M Ahmed, N Pervin, R Afroz And M S Nahar

An experiment was conducted with 37 germplasm of okra (*Abelmoschus esculentus* L.) in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI, Joydebpur, Gazipur, during summer 2021-22 to find out the variability in the germplasm. Qualitative characters showed distinct variation among the germplasm except shape of epicalyx segments, position of fruit and seed shape. The maximum variation was found in leaf shape followed by leaf color, fruit shape, mature fruit color and early plant vigour. Quantitatively highest variation was observed in yield per plant (CV- 34.46%) followed by number of epicalyx segments (CV-22.36%) and plant height (CV-

22.22%). Considering maximum number of fruits per plant the promising germplasm were identified as. NQ-10, NRI-289, NSR-98, NSR-133, NSR-158, SRS-63, SSR-11, AMA-40, AMA-126, MAH-59, NQR-20, NQR-40, RAI-157 and SNQR-44 for future breeding programs.

Screening evaluation and identification of mungbean germplasm under waterlog condition

R Afroz And M M Ali

One hundred fifty-eight (158) germplasm of mugbean (*Vigna radiata*) were characterized at plant Genetic Resources Centre, BARI, Gazipur during 2018-19. Qualitative variations were observed; deltoid 66.46% and ovate 33.54% were exhibited in the terminal leaflet shape followed by sparse 40.51%, medium 52.53%, abundant 6.96% such variation found from leafiness. Petiole length such as short 58.22% and medium 41.77%; raceme position such as mostly above canopy 45.57% and intermediate 54.43% were observed. The maximum range of number of pod per plant was 70.72 to 1201.15 and mean 406.21. In plant height, mean 31.54 cm and range 18.53 to 47.35cm, in number of seed per pod range 5.8 to 13.74 and mean 10.42. The maximum coefficient of variation 78.22% was obtained from seed yield per plant followed by No. of pod per plant 65.4%, no. of primary branches per plant 24.47%. The frequency distribution observed higher on no of primary branch/plant, Plant height and no. of seed /pod. Unique selection and trait information is available within the population studied which may offer crop improvement opportunity. In the same time 158 germplasm evaluate under waterlog condition at vegetative stage until four days and 94 germplasm survived. During 2021-2022 the experiment was carried out with 90 germplasm of mung bean with 4 check varieties, all germplasm were evaluated under waterlog system at flowering stage. In vegetative stage 94 germplasm survive under waterlog condition until 4 days and in flowering stage only 15 germplasm showed tolerant character which were sub merged in water reservoir for 72 hours. Further evaluation will be needed in field condition.

Screening of sesame germplasm at seedling stage for waterlogging stress tolerance

M R Molla, I Ahmed, Nasrin Jahan, M M Rohman, S H Habib, M S Nahar And M M Ali

Waterlogging is an illustrious abiotic stress and the constrictions it enforces on plant roots have negative effects on growth and development. This study was undertaken to investigate waterlogging stress tolerant potential in sesame (*Sesamum indicum* L.) at seedling stage. Thirty days old seedlings of 42 sesame genotypes were exposed to waterlogging stress maintaining water height 3–5 cm over the soil surface artificially for 3-4 days. This duration (31–34 DAE) was termed as waterlogging period, and subsequent withdrawal of waterlogging condition (35-41 DAE) was regarded as a recovery phase. Based on their survival performance, among the 42 genotypes of sesame, acute decreasing of survival and increasing of death percentage was observed in most of the genotypes under waterlogging and recovery. The genotype BD-10659 showed the strong tolerance whereas BD-10660, BD-7026 and BD-11637 expressed moderate tolerance under waterlogging stress.

Molecular characterization of landraces of chilli in Bangladesh

M R Molla, I Ahmed, S Rahman, R Ara, M S Nahar And M M Ali

Microsatellites combine a number of characteristics of a perfect molecular marker, and they are increasingly employed in a variety of plant genetic investigations and applications. Characterization of chilli genotypes on the basis of DNA fingerprinting has become an efficient tool to link genotypic variation. This work is reporting the utilization of a set of 10 previously developed microsatellite (SSR) markers for the identification and discrimination of 22 landraces. The modified SDS and phenol: chloroform: IAA protocol found to be cost effective and latex free high quality genomic DNA was obtained successfully. All microsatellite markers were found to be polymorphic. Variation was found in number of alleles, allele frequency, observed and expected heterozygosity. Using 10 primers across 22 genotypes a total of 41 alleles with an average number of 4 alleles per locus were found of which CAMS-647 showed the highest number of alleles (6) (size ranging from 191 to 275 bp) followed by 5 alleles (165 to 194 bp and 239 to 289 bp) were detected at the loci CAMS-679 and CAMS-117 respectively. The primer CAMS-647 also yielded the highest number of PIC value (0.776). Genetic differentiation (Fst) values were found in the ranges from 0.243 to 1.000 with an average of 0.728 and gene flow (Nm) values ranged from 0.000 to 0.781 with an average of 0.094. Broad genetic base was

found among the chilli genotypes. Over all Nei's genetic distance value from 0.124 to 0.999 among 231 pair resulting as a means of permutation combination of 22 chilli genotypes. In the UPGMA dendrogram, among 22 genotypes of chilli, 20 grouped in cluster "A" and other two in cluster "B". Bindu morich, Amoina morich, Noadaria morich, Bine morich, Balujhuri morich and Halda morich were identified as distinct landraces of Bangladesh.

Molecular characterization of landraces of guava in bangladesh

M R Molla, H Barua, I Ahmed, Q M Ahmed, M S Nahar And M M Ali

Five released varieties of guava viz., BARI Peyara-1, BARI Peyara-2, BARI Peyara-3, BARI Peyara-4, IPSA Peyara-1; three exotic germplasm viz.,Thai Peyara-3, Thai Peyara-5, Thai Special; 10 landraces PG Sit-001, PG Sit-002, PG Sit-003, PG Sit-004, PG Muk-004, PG Muk-005, Lata, Poltola, Purnamandali, Poly-peyara and 15 advance line viz., PG Hat-004, PG Hat-009, PG Hat-010, PG Hat-011, PG Hat-012, PG Hat-013, PG Hat-014, PG Hat-015, PG Hat-016, PG Hat-017, PG Hat-018, PG Hat-019, PG Hat-020, Swarupkathi-1, Swarupkathi-3 were characterized with a view to identifying degree of molecular variation of guava within genotypes, and to establish a permanent database for documentation of guava. Molecular characterization was carried out with SSR markers. Using 20 primers across 33 genotypes a total of 62 alleles with an average number of 3.1 alleles per locus were found of which mPgCIR139 showed the highest number of alleles (5) (size ranging from 201 to 296 bp). However, the lowest number of allele (2) was observed in the locus mPgCIR25, mPgCIR27, mPgCIR48, mPgCIR180, mPgCIR191 and mPgCIR111, respectively. The polymorphic information content (PIC values) ranged from 0.316 to 0.709, with a mean value of 0.573 for all loci. Of 20 SSR primers, it was identified 11 (55.90%) highly informative (PIC value $\geq$0.5). The higher level of heterozygosity indicated that greater diversity of genotypes used in the present study. Band patterns corresponding to individual genotype have been identified to discriminate the genotype. The genotypes presented genetic distances between 0.048 and 0.997. The dendrogram generated from UPGMA cluster analysis broadly placed 33 guava genotypes into two major clusters, "A" and "B" in which 21 genotypes grouped in cluster "A" and other 12 grouped in Cluster "A".

Conservation of germplasm in active and base collection

S Rahman, Q M Ahmed, M S Nahar And M Ali

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 60C) and long-term storage (at -18 to -220C). 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 12494 (twelve thousand four hundred ninety-four) accessions of 82 different crops in its gene bank. Among them, 1775 accessions were cereals, 3553 pulses, 616 oilseeds, 487 spices, 4780 vegetables, 283 fruits and 57 other crops. In 2021-22, a total of 146 germplasm was assigned as new accession and were conserved in gene bank of PGRC.

Monitoring of germplasm in active and base collection

S Rahman, Q M Ahmed, M S Nahar And M Ali

The monitoring of 1076 accessions from different year (batch references) among 14 important crops viz. 167 cucumber (167), yard-long bean (394), radish (117), horse gram (67), pigeon pea (83), jute (25), sunhemp (7), tobacco (29), barley (100), buck wheat (10), rosel (16), napa sak (42), Kangkong (17) and zirani (2) were tested in 2021-22 by germination test. Among the monitored germplasm 570 accession from active collection and 506 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 better 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, Q M Ahmed, M R Molla, M S Nahar And M Ali

Germplasm distribution is one of the important activities of Plant Genetic Resources Centre

(PGRC). The centre distributed 1294 accessions of 23 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 2021-22. Among the germplasm, 335 accessions were cereals (Buck wheat, maize, sorghum, and wheat), 261 oil seeds (Linseed, sesame, soybean and sunflower), 103 pulses (mung bean, cowpea and pigeon pea), 40 spices (chilli and black cumin), 555 vegetables (Bitter gourd, bottle gourd, brinjal, cucumber, okra, hyacinth bean, pumpkin and tomato). Ten to hundred seeds or 5-10 g seeds per accession were supplied to the users.

Multiplication of newly collected germplasm of hyacinth bean, brinjal, okra and bitter gourd

N Pervin

The experiment was conducted at the experimental field of Plant Genetic Resources Centre, BARI, Gazipur, during rabi and kharif 2021-22 to multiply the newly collected germplasm of hyacinth bean (9), brinjal (12), okra (12) and bitter gourd (4). All the germplasms were planted from 26 October, 2021 to 3 March, 2022 with recommended practices to get adequate quantity of seed for future use. Each germplasm were harvested in time. Proper procedure was followed during drying, cleaning and curing the seed. Some qualitative data were recorded to assess the overall performance. Seeds obtained from newly collected germplasm were conserved in the gene bank.

Regeneration of conserved accession of french bean and buck wheat

N Pervin

The experiment was conducted at the experimental field of Plant Genetic Resources Centre, BARI, Gazipur, during rabi 2021-22 to regenerate the conserved accession of French bean (10) and Buck wheat (3). All the germplasms were planted from 25 November, 2021 to 27 November, 2021 with recommended practices to get adequate quantity of seed for future use. The crops were harvested at time to time for each germplasm. Proper activities were done during drying, cleaning and curing the seed. Some qualitative data were recorded to assess the overall performance. Seeds were obtained from newly collected germplasm and conserved accession and conserved in the gene bank.

Regenaration of muskmelon germplasm

N Jahan And M R Molla

The regeneration of twenty-three muskmelon (*Cucumis melo*) germplasm was conducted in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI, Gazipur, during February–June, 2022. Germplasm regeneration leads to get the sufficient seed quantity with increase viability for future use. The most important qualitative and quantitative characters were recorded to know the variations among the germplasm. After completing all the post-harvest operations, the seeds were conserved properly for future study.

Regenaration of soybean germplasm

N Jahan And M R Molla

The regeneration of fourteen soybean (*Glycine max* L.) germplasm was conducted in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI, Gazipur, during January – May, 2022. Germplasm regeneration leads to get the sufficient seed quantity with increase viability for future use. The most important qualitative and quantitative characters were recorded to know the variations among the germplasm. After completing all the post harvest operations, the seeds were conserved properly for future study.

Regeneration of Indian spinach germplasm

M F Khatun

The regeneration experiment was conducted at the research field of Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur during the Kharif season of 2020-21. Thirteen germplasm were taken for regeneration. Variations were observed in both qualitative and quantitative traits among the germplasm. Some of the qualitative and quantitative data were recorded and an adequate amount of seeds were harvested for conservation and future use.

Regeneration of ridge gourd germplasm

M F Khatun, Q M Ahmed And N Jahan

The experiment was conducted at Plant Genetic Resource Centre, BARI, Gazipur during the Kharif season 2021-22. Sixty-two germplasm were

regenerated to increase sufficient seed for conservation. A few qualitative and quantitative data were recorded. Among the collected data, the maximum variations were observed in fruit shape and fruit colour. Different types of fruit shapes were found which was oblong blocky, elongate slim, elongate elliptical, elongate tapered, elliptical and pyriform. In the color of the fruit were found light green, green and dark green. Some important qualitative and quantitative characters were recorded during the regeneration of the germplasm. After completing the study, the sufficient seeds were conserved for distribution and other research purpose.

Conservation of gerplasm in field gene bank

M G Hossain And M M Ali

Many perennial crops and horticultural species are either difficult or impossible to conserve as seeds because they produce recalcitrant seeds or reproduce vegetatively. Hence, they should be conserved as live plants in Field Gene Banks (FGB). FGBs provide an opportunity for easy and ready access to conserved material for research and utilization. Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute, Gzaipur maintaining a total of 281 germplasm including 213 accessions of 76 crops both indigenous and exotic germplasm in its field gene bank. In 2021-22, new 06 germplasm of 5 crops were collected from different district which has been maintaining in field gene. The fruits germplasm are mango litchi, banana, guava, jackfruit, jujube, aonla, bael, bilimbi, bullocks heart etc. The vegetables germplsm 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.

Data base development and data entry for germplasm documentation

R Afroz, Q Maruf And M M Ali

The total four thousand one hundred (4107) 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 research

her. 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). 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.

ON-FARM STUDIES

14

Project I: On-Farm Soil Fertility Management

Nutrient management for bulb production of BARI Piaz-4 under Onion-Jute-T.Aman cropping pattern in Faridpur

A trial was conducted at the FSRD Site, Sholakundu, Faridpur during the *rabi* season of two consecutive years (2020-2021 and 2021-2022) to find out an optimum fertilizer package for sustainable productivity of BARI Piaz-4 under farmers' field condition. Four treatments were considered as T_1 (STB following FRG, 2018)=144-30-47-9-2-0.7 kg N-P-K-S-Zn-B ha^{-1}, T_2 (IPNS basis recommended fertilizer dose with cow dung as per FRG, 2018)=115-53-49-30-3-1.5 kg N-P-K-S-Zn-B ha^{-1}+cow dung (5 t ha^{-1}), T_3 (150% of chemical fertilizer)=210-90-90-45-4.5-2.2 kg N-P-K-S-Zn-B ha^{-1} and T_4 (Farmer's practice)=205-125-100-30-3-1-1.5 kg N-P-K-S-Zn-B-Mg ha^{-1}. The experiment was laid out in randomized complete block design with five dispersed replications. BARI Piaz-4 was used as planting material in the study. The highest average bulb yield (24.28 t ha^{-1}) was obtained from T_4 followed by T_3 (23.37 t ha^{-1}) treatment while the lowest bulb yield (21.61 t ha^{-1}) was recorded in T_2. Consequently, maximum gross return (Tk 509880 ha^{-1}) and gross margin (Tk 301061 ha^{-1}) were obtained from farmer's practice. Maximum benefit cost ratio was obtained from T_4 (2.44) treatment followed by T_3 (2.38). However considering rationale fertilizer use and economic benefit T_3 treatment would be sustainable for BARI Piaz-4 production in the AEZ-12.

Integrated nutrient management for bitter gourd cultivation in calcareous soil in Faridpur

A trial was conducted at the FSRD Site, Sholakundu, Faridpur during the Kharif season of 2020 and 2021 to find out a suitable nutrient package for increasing 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 treatments were considered as T_1 (Soil Test Based fertilizers following FRG, 2018)=80-25-25-5-1-1.5 kg N-P-K-S-Zn-B ha^{-1}, T_2 (120% of STB)=96-30-30-6-1.2-1.8 kg N-P-K-S Zn-B ha^{-1}, T_3 (IPNS basis T_1 with Cow dung)=55-18-14-5-1-0.5 kg N-P-K-S-Zn-B ha^{-1}+Cow dung (5 t ha^{-1}), T_4 (IPNS basis T_1 with Vermicompost)=55-40-4-13-1-0.5 kg N-P-K-S-Zn-B ha^{-1} + Vermicompost (2 t ha^{-1}), $T_5 = T_1$ + 8 kg Mg ha^{-1}, $T_6 = T_1$ + 10 kg Mg ha^{-1} and T_7 (Farmer's practice)=115-50-50-45-4-2 kg N-P-K-S-Zn-B ha^{-1}. The highest bitter gourd yield was obtained from farmers practice (14.37 t ha^{-1}) followed by STB dose with 8 kg ha^{-1} Mg treatment (13.87 t ha^{-1}). The lowest average fruit yield was obtained from T_4 (8.19 t ha^{-1}). The maximum gross return (Tk 592763 ha^{-1}) and gross margin (Tk 392113 ha^{-1}) were obtained from farmer's practice followed by T_5. The highest benefit cost ratio was obtained from T_5 (2.99) followed by T_7 (2.95). The chemical fertilizers used in farmers practice (T_7) specially for Sulphur, phosphorus and potassium was irrational and might be harmful to the environment, whereas T_5 treatment (T_1 + 8 kg Mg ha^{-1}) gave the statistically similar bitter gourd yield for both the years with farmers practice (T_7) by reducing production cost in fertilizer use. So the package of 80-25-25-5-1-0.5-8 kg N-P-K-S-Zn-Mg ha^{-1} might be recommended for bitter gourd production in calcareous soil of Faridpur region.

Effect of variety and fertilizer on onion bulb production under zero tillage condition in Onion-Jute/B.Aman cropping pattern in Shariatpur

An experiment was carried out at farmer's field of Uttar Dubaldia under Jajira upazilla, Shariatpur during the rabi season of 2019-20 and 2020-21 to find out a suitable variety and fertilizer dose for

increasing bulb yield of onion under zero tillage condition. Six treatments i.e. T_1: BARI Piaz-1 + Soil Test Based (STB) fertilizer dose, T_2: BARI Piaz-1 + 150% STB, T_3: BARI Piaz-1 + Farmer's fertilizer dose, T_4: Local variety + STB fertilizer dose, T_5: Local variety + 150% STB and T_6: Local variety + farmer done were used. The experiment was design with randomized complete block with 4 dispersed replications. The highest bulb yield (17.91 t ha^{-1}) was obtained from T_4 followed by T_5 (16.72 t ha^{-1}). While the lowest bulb yield was found in T_2 treatment (15.08 t ha^{-1}). The highest gross return (Tk 1035100 ha^{-1}) and gross margin (Tk 735388 ha^{-1}) were accounted from T_4 due to obtain the highest yield. However, the use of local variety with the application of STB dose (120-60-80-25-3-1.5 kg N-P-K-S-Zn-B ha^{-1}) would be the best suitable combination of fertilizer for higher and economically profitable yield of bulb onion under zero tillage condition in Shariatpur region.

Performance of water hyacinth residue as an organic manure for cauliflower production at AEZ-14

The experiment was conducted at FSRD site, Gopalganj and Nazirpur upazila of Pirojpur district during rabi season of 2021-2022 to determine a suitable organic manure for cauliflower production. There are four doses of different organic fertilizer viz. T_1=5 ton cow dung ha^{-1} (control), T_2=5 ton water hyacinth residue ha^{-1}, T_3=8 ton water hyacinth residue ha^{-1}, and T_4=11 ton water hyacinth residue ha^{-1} were considered with randomized complete block. Result revealed that treatment T_1 gave the highest yield (44.69 t ha^{-1}) where 5 ton cow dung ha^{-1} was used as organic fertilizer and it is statistically similar to T_4 treatment (43.28 t ha^{-1}) where 11 ton water hyacinth residue ha^{-1} was used with recommended chemical fertilizers. The lowest yield (34.03 t ha^{-1}) was observed in T_2 (5 ton water hyacinth residue ha^{-1}) treatment. The highest gross return (Tk 893800 ha^{-1}) and benefit cost ratio (3.61) were obtained from T_1 followed by T_4 treatment (Tk 865600 $ha^{-1}$and 3.5, respectively). Considering yield and economic performance it might be used 11 ton water hyacinth residue ha^{-1} as an alternative of cow dung for cauliflower production in AEZ-14.

Effect of nutrient management on the yield of sweet potato in Kushtia

An experiment was conducted at Kumarkhali, Kushtia during 2021-22 at farmer's field to observe the nutrient management of sweet potato. Three treatments viz T_1=IPNS (126-15-115-8 kg N-P-K-S ha^{-1} + 3 t Poultry Manure ha^{-1}), T_2=IPNS (128-13-118-12 kg N-P-K-S ha^{-1} + 6 t cow dung ha^{-1}) and T_3= Farmer's practice (160-160-180-70 kg N-P-K-S ha^{-1}) were applied in randomized complete block design with four replications. The planting material BARI Mistialu-12 was used in this trial. The highest tuber yield was obtained from T_1 (22.88 t ha^{-1}) and the lowest was from T_3 (19.32 t ha^{-1}). The gross return (Tk 343200 ha^{-1}) was maximum in T_1 treatment. Based on findings, IPNS basis (126-15-115-8 kg N-P-K-S ha^{-1} + 3 t Poultry Manure ha^{-1}) fertilizer dose is the best fertilizer package for sweet potato cultivation in Kushtia region.

Validation of biofertilizer on lentil in Kushtia

An experiment was conducted at Kumarkhali, Kushtia during the rabi season of 2021-2022 to observe the effect of rhizobial biofertilizer on lentil. Three treatments were: T_1= Without *Rhizobium* inoculant + P-K-S-Zn, T_2= With *Rhizobium* inoculant (1.5 kg ha^{-1}) + P-K-S-Zn and T_3= 50-22-42-20-5 kg N-P-K-S-Zn ha^{-1} were applied on BARI Masur-8. The trial was laid out in randomized complete block design with four dispersed replications. The highest seed yield was obtained (1.45 t ha^{-1}) from rhizobium inoculant plot and it was followed by only N-P-K-S-Zn plot (1.42 t ha^{-1}). Gross return and gross margin was also higher with rhizobium inoculant than that of without rhizobium inoculant. Based on findings, it might be concluded that the seed yield of lentil could be increased by applying 1.5 kg rhizobium biofertilizer ha^{-1}.

Validation of fertilizer management on fruit yield of BARI Bt brinjal

The field experiment was conducted under Shibaloya upazila of Manikganj district during Rabi season of 2021-2022 to observe the response of fertilizers on the yield performance of BARI Bt brinjal in the farmers' field. The experiment was conducted in randomized complete block design with three replications. Three fertilizer treatment combinations of T_1 = 180-54-135-22-3-1.50 kg, N-P-K-S-Zn-B ha^{-1} +5 t cow dung ha^{-1} (STB Recommended dose+50% NPK); T_2=150-45-112-

18-2.5-1.25 kg N-P-K-S-Zn-B ha^{-1} + 10 t cow dung ha^{-1} (STB Recommended dose+25% N-P-K+5 t cow dung ha^{-1}) and T_3= 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 N-P-K-S-Zn-B) were evaluated. Among the treatments, T_1 (STB Recommended dose+50% N-P-K) gave the highest fruit yield (43.93 t ha^{-1}) followed by soil test based fertilizer dose T_2 (STB Recommended dose + 25% NPK + 5 t cow dung ha^{-1}) produced 36.82 t ha^{-1}. T_3 (STB Recommended dose+25% of NPKSZnB) provided the lowest fruit yield (34.00 t ha^{-1}). Treatment T_1 (180-54-135-22-3-1.50 kg N-P-K-S-Zn-B ha^{-1} + 5 t cow dung ha^{-1}) on STB Recommended dose+50% N-P-K was the best in respect of economic return with higher BCR (5.43).

Effect of phosphorus levels on yield and yield attributes of lentil under different crop establishment method in rice based system

Performance of lentil on the appropriate level of phosphorus fertilizers under crop establishment method, were evaluated in rice-based system in Bangladesh. The tillage treatments were conventional tillage, relay method and strip planting (SP) and three levels of phosphorus were recommended dose of P (P_1), 50% of recommended P (P_2) and 150% of recommended P (P_3). The field experiment was conducted during November, 2021 to March, 2022 at Gangarampur, Pabna. The crop sequence Mustard-Jute-T.Aman were practiced at SP site while Mustard-Sesame-T.Aman were practiced at relay and CT sites before commencing of the experiment. The crops under SP flowered 50% on average 8-5 days earlier than that of relay and CT methods. The highest plant population counted in P_1 and P_3 levels under CT method (94) followed by SP and P_2 (83) while the lowest plant population counted in relay with P_3 method (48). The tallest plants counted in SP with P_1 and SP with P_2 (44) while the shortest plants in relay with P2 (34). The pods/plant of SP (66) was higher and the lowest pods/plant (55) was recorded from CT. Regardless of tillage methods, the pods/plant was higher at P_3 treatment (64) followed by P1 (60), and the lowest pods/plant was recorded from P_2 (55).The seed yield of SP had 11 % higher and the lowest seed yield was recorded from relay methods. However, the relay method reduced yield by 7.5% than that of CT method. The seed yield was higher at P_1 and P_3 treatment (1.9 t ha^{-1}) and the lowest was recorded from P_2 (1.6 t ha^{-1}). This short-term effect was positive towards conservation agriculture than CT system and this study will be continued for a long-term period for a concrete conclusion.

Evaluation of plant nutrient management approaches on yield of onion

The experiment was conducted at FSRD site, Gangarampur, Pabna during the rabi season of 2021-2022 to find out the performance of onion under different nutrient management approaches. Different treatments viz. T_1=recommended dose as FRG, 2018, T_2=IPNS + 2 t ha^{-1} Vermicompost, T_3=IPNS+ 5 t ha^{-1} Cow dung, T_4=IPNS + 5 t ha^{-1} ash and T_5=Farmer's practice was tested on BARI Piaz-1. The highest yield (11.83 t ha^{-1}) was obtained from IPNS + 2 t ha^{-1} Vermicompost treatment which is statistically similar with IPNS+ 5 t ha^{-1} Cow dung and IPNS + 5 t ha^{-1} ash treatments. The maximum economic return in terms of gross return and gross margin was obtained from IPNS + 5 t ha^{-1} Cow dung. Therefore, application of IPNS+ 2 t Vermicompost ha^{-1} or IPNS+ 5 t Cow dung ha^{-1} or IPNS+ 5 t ash ha^{-1} in soil seems promising for onion production in Pabna region.

Effect of irrigation and rice husk ash on yield and post harvest quality of onion

The experiment was carried out at Agricultural Research Station, Pabna during the *rabi* season of 2021-2022 with a view to the performance of onion under four irrigation treatments with two levels of rice husk. The irrigation treatments were one irrigation at 1 days after transplanting, two irrigations at 1 and 21 DAT, three irrigations at 1, 21 and 41 DAT and four irrigations at 1, 21, 41 and 61 DAT and two levels of rice husk ash were 2 t ha^{-1} and without ash were evaluated on BARI Piaz-1. Application of two irrigations provided the highest plant height, bulb diameter and individual bulb weight which is identical to three times irrigations and the lowest from once irrigated treatment. The maximum onion bulb yield (11.1 t ha^{-1}) was obtained from two irrigations treatment which is statistically similar with three times irrigations. On the contrary minimum yield (9.38 t ha^{-1}) was found from one time irrigated plot. Application of 2 t ash ha^{-1} significantly increased plant height, leaves $plant^{-1}$ bulb diameter and individual bulb weight and bulb yield over without ash treated treatment. So application of 2 to 3 irrigations with 2 t rice husk ash ha^{-1} are the best treatment for yield of onion in Pabna region.

Evaluation of profitable and agro-ecologically suitable cropping pattern considering soil fertility for increasing cropping intensity in northern region of Bangladesh

Increment of cropping intensity in rice-based cropping system is very important for food security, poverty alleviation and livelihood improvement. The main challenge is to produce more food in limited area and the most important option is to increase cropping intensity by producing three or more crops over the same piece of land in a year maintaining soil fertility. To develop agro-ecologically suitable and profitable intensive cropping pattern with proper fertilizer combinations for increasing productivity and farmer's income, the trial is continuing in the farmer's field of Rangpur district. Three promising alternative cropping patterns (viz. CP_1= Mustard (BARI Sarisha-14)-Mungbean (BARI Mung-6)-T. Aus (BRRI dhan48)-T. Aman (BRRI dhan75); CP_2= Potato (BARI Alu-25)-Maize (Kaveri)-Sesbania (Local)- T. Aman (BRRI dhan75); CP_3= Potato (BARI Alu-25)/Sweet gourd (Sweety)-Jute (BJRI Toshapat-8)-T. Aman (BRRI dhan75) were tested against existing cropping pattern i.e. CP_0 = Boro rice (BRRI dhan28)-Fallow-T. Aman rice (Swarna). The whole pattern rice equivalent yield (REY) were obtained 14.10, 18.65, 29.73 and 33.46 t ha^{-1} from cropping pattern CP_0, CP_1, CP_2 and CP_3, respectively. The total field duration of the cropping pattern was 233, 324, 343 and 332 days in CP_0, CP_1, CP_2 and CP_3, respectively. From the findings Potato/Sweet gourd-Jute-T. Aman and Potato-Maize-Sesbania-T. Aman cropping pattern are more profitable in terms of rice equivalent yield, production efficiency, land use efficiency, gross margin and MBCR.

On farm trial of sweet potato yield as influenced by integrated nutrient management

The field experiment was conducted during the rabi season of 2021-2022 in the farmer's field of Multi-location Testing site, Pirgonj, Rangpur to determine the optimum dose of fertilizer of sweet potato. Three fertilizer doses viz. T_1= STB (100-40-100 kg K-P-N ha^{-1}) + 3 ton Poultry manure ha^{-1}, T_2 = STB + 3 ton Vermicompost ha^{-1} and T_3 = STB were considered in this study. The highest sweet potato yield was obtained from treatment T_2 (23.26 t ha^{-1}). The lowest sweet potato yield was obtained from T_3 treatment. The highest gross return (Tk 279120 ha^{-1}) and gross margin (Tk 152433 ha^{-1}) were recorded from T_2 treatment. The lowest gross margin obtained from T_3 treatment. So the combination of STB (100-40-100 KPN kg ha^{-1}) and 3 ton Vermicompost ha^{-1} is the suitable package for sweet potato cultivation in Pirgonj region, Rangpur of Bangladesh.

Validation of biofertilizer on groundnut at Jamalpur region

The experiment was conducted at the farmers' field at Naovanghar Char, Jamalpur during rabi season 2021-2022 to observe the yield performance of groundnut by application of biofertilizer. Treatments were randomly distributed within the blocks as follows: T_1=Without Rhizobium inoculant + P-K-S-Zn, T_2=With Rhizobium inoculant + P-K-S-Zn and T_3=N-P-K-S-Zn. The maximum nut yield of 1.97 t ha^{-1} was obtained from T_2 treatment and the minimum (1.81 t ha^{-1}) from T_1 treatment. The maximum gross return (Tk 137900 ha^{-1}) and gross margin (Tk 60580 ha^{-1}) were obtained in T_2 treatment. Considering yield potentiality and economic point of view, rhizobium inoculum is the best combination of fertilizers for ground nut production in Jamalpur region.

Effect of fertilizer doses on turmeric at Madhupur tract under AEZ-28

A field experiment was conducted at MLT site, Madhupur (AEZ-28), Tangail during 2021-2022 to find out an optimum fertilizer dose for turmeric production in Madhupur tract. Six treatment combinations viz. T_1=STB, T_2=T_1 + 20% NK, T_3=T_1 + 20% NKS, T_4=T_1 + 20% NKSZn, T_5=IPNS fertilizer + 5 t Cow dung ha^{-1} and T_6=Farmers' practice. The experiment was laid out in randomized complete block design with three compact replications. Application of STB dose +20% NKSZn significantly increased rhizome yield. The highest rhizome yield (18.83 t ha^{-1}) was recorded from T_4 treatment combination. The lowest rhizome yield (14.67 t ha^{-1}) was obtained from T_1 treatment. The highest gross return (Tk 282450 ha^{-1}) and gross margin (Tk 152558 ha^{-1}) were recorded in T_4 treatment whereas the lowest gross return (Tk 220050 ha^{-1}) and gross margin (Tk 90844 ha^{-1}) were obtained from T_1 treatment. The results indicated that the application of STB fertilizer with 20% NKSZn produce the maximum rhizome yield and higher economic return.

Effect of fertilizer application methods on maize grown under strip tillage system in high barind tract

A field experiment was conducted in the farmer's field at FSRD site, Basantopur, Godagari, Rajshahi during Rabi 2019-2020, 2020-2021 and 2021-2022 to develop the best fertilizer application method in conservation agriculture for Maize cultivation in High Barind Tract. The experiment was performed using randomized complete block design with three replications. There were four treatments namely, T_1= fertilizer and seeds sown simultaneously on the same row by strip machine, T_2= fertilizer and seeds sown simultaneously on a 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, 7.22, and 7.04 t ha^{-1} in Yr1, Yr2, and Yr3, respectively) were recorded in T_2 when fertilizer and seeds were sown in different rows simultaneously with strip machine. Contrarily, treatment T_1 where fertilizer and seeds were sown on the same row simultaneously showed poor performance regarding germination rate (65, 63, and 66% in Yr1, Yr2, and Yr3, respectively), grain yield (4.11, 4.09, and 4.07 t ha^{-1} in Yr1, Yr2, and Yr3, respectively) and other parameters. From the result, it might be considered that fertilizer and seed could be sown in separate rows simultaneously for the cultivation of Maize in the CA system

Development of fertilizer recommendation for Maize-T.aus-T.aman cropping pattern in karatoa bengali flood plain

The trial was conducted in the farmers' field of Multilocation Testing Site, Sherpur, Bogura, during the Rabi season of 2020-2021 to develop a suitable fertilizer recommendation for Maize-T.Aus-T. Aman rice cropping pattern. For the first crop maize, the treatments were T_1= STB dose, T_2= T_1 +25% extra NPK, T_3= T_1+50% extra NK, T_4= IPNS based on T_1 @ 5 t cow dung ha^{-1} and T_5 = IPNS based on T_3 @5 t cow dung ha^{-1}. Treatments were assigned randomly in complete block with three replications. In case of maize, maximum grain yield (8.56 t ha^{-1}) was recorded from the T_3 treatment and it was statistically similar to T_2 and T_5, and the minimum (6.92 t ha^{-1}) from the T_4 treatment. A similar trend was also observed for stover yield. Higher grain yields of both T. Aus rice and T. Aman rice were associated with a higher dose of NPK or NK in T_3 and T_2. The highest gross return (Tk 381230 ha^{-1}) accounted to T_3 treatment but the higher gross margin (Tk 161657 ha^{-1}) obtained from T_2. Minimum gross return (Tk 338430 ha^{-1}) and gross margin (Tk 119578 ha^{-1}) were obtained from the T_4 treatment. Therefore, it could be recommended that farmers may apply 25% NPK or 25% NK as extra with the STB dose for higher yield and return from the pattern.

Effect of OCP compound fertilizer on the yield of lentil

The study was conducted at Ramchandrapur area under Dewli union, Shibganj, Bogura during the Rabi season of 2021-2022 to determine the effect of OCP compound fertilizer on yield of lentil with the help of OCPF-BARI-ICARDA collaborative project. BARI Moshur-8 was used as the test crop. The experiment was laid out in an randomized complete block design with four replications. Three different fertilizer management packages were considered for the trial as viz. T_1 = OCP compound fertilizer, T_2 = Farmer's practice and T_3= PRC recommended dose. The highest seed yield (1.91 t ha^{-1}) was obtained from the OCP compound fertilizer applied plot, which was identical to PRC recommended fertilizer (1.82 t ha^{-1}) and the lowest amount (1.72 t ha^{-1}) was weighed from the farmer's practice. Application of both OCP compound fertilizer and recommended dose of fertilizer showed better performance over farmer's practice and significantly increased lentil seed yield. Upon cost and return analysis, the highest benefit cost ratio (3.05) was recorded from OCP compound fertilizer treated plot (T_1), followed by PRC recommended fertilizer treated plot (T_3) and the lowest (2.88) from farmers practiced plot (T_2). Therefore, the OCP compound might be suggested for getting higher yield of lentil.

Effect of OCP compound fertilizer on the yield of onion

The study was conducted at the Laxmikhola area under Dewli union, Shibganj, Bogura, during the Rabi season of 2021-2022 to determine the effect of OCP compound fertilizer on the yield of onion with the help of OCPF-BARI-ICARDA collaborative project. BARI Piaz-4 was used as the test crop. The experiment was laid out in an randomized complete block design with four replications. Three different fertilizer managements were considered for the trial, viz. T_1: OCP compound fertilizer, T_2: Farmer's practice and T_3: SRC recommended dose. Most bulb parameters and yield contributing characters were

statistically significant by the different fertilizer practices. The higher bulb yield (13.32 t ha^{-1}) was weighed from the OCP compound fertilizer applied plot, which was identical to SRC recommended fertilizer (12.85 t ha^{-1}) and the lowest amount of bulb (11.73 t ha^{-1}) was found from the farmer's practice. Regarding cost and return analysis, the highest benefit cost ratio (2.33) was recorded from OCP compound fertilizer treat plots (T_1), followed by SRC recommended fertilizer treated plots (T_3) and the lowest (2.09) from farmers practiced plots (T_2). The highest gross return (Tk 466200 ha^{-1}) and BCR (2.33) were obtained from the application of OCP compound fertilizer and the lowest gross return (Tk 410550 ha^{-1}) and BCR (2.09) from farmer's practice. Considering the yield and economic performance the OCP compound might be suggested for selling higher yield of onion.

Effect of OCP compound fertilizer on the yield of garlic

The study was conducted at Laxmikhola under Dewli union, Shibganj, Bogura, during the Rabi season of 2021-2022 to determine the effect of OCP compound fertilizer on the yield of garlic funded by the OCPF-BARI-ICARDA collaborative project. BARI Rasun-1 was used as the test crop. The experiment was laid out in randomized complete block design with four replications where three fertilizer managements were considered as treatments viz. OCP compound fertilizer, SRC recommended dose and farmer's practice. The significant higher bulb (9.17 t ha^{-1}) was weighted from the OCP compound fertilizer applied plot which is identical to SRC recommended practice (8.92 t ha^{-1}). The farmer's practice weighed the lowest amount of bulb (7.89 t ha^{-1}). Application of OCP compound fertilizer management options showed better performance over the farmer's practice regarding bulb yield of garlic. The highest gross return (Tk 687750 ha^{-1}) and benefit cost ratio (2.57) were obtained from the application of OCP compound fertilizer. The lowest gross return (Tk 591750 ha^{-1}) and BCR (2.26) were recorded from the farmer's practice. Therefore, the OCP compound can be suggested for getting higher yield of garlic.

Effect of OCP compound fertilizer on the growth and yield of blackgram

The study was conducted at OFRD station, BARI, Bogura during the Rabi season of 2021-2022 to find out the effect of OCP compound fertilizer on the yield of blackgram funded by the OCPF-BARI-ICARDA collaborative project. The test crop was BARI Mash-3. The experiment was laid out in randomized complete block design with four replications. Three different fertilizer management were considered as the treatment for the trial, viz. OCP compound fertilizer, PRC recommended dose and farmer's practice. Yield and yield contributing characters were statistically significant among the different fertilizer practices. The higher seed yield (1.63 t ha^{-1}) was weighed from the OCP compound fertilizer applied plot which was identical to PRC recommended practice (1.51 t ha^{-1}) and the lower (1.32 t ha^{-1}) from the farmer's practice. Considering the cost and return analysis, the highest economic return obtained from OCP compound fertilizer treated plot followed by PRC recommended fertilizer and the lowest return from the farmers. The highest gross return (Tk 102180 ha^{-1}) and benefit cost ratio (2.83) were obtained from the application of OCP compound fertilizer. The lowest gross return (Tk 83060 ha^{-1}) and BCR (2.39) from the farmer's practice. S0, the OCP application might for recommend for selling higher yield of blackgram.

Effect of OCP compound fertilizer on the growth and yield of chilli

The study was conducted at Voria, Purbapara of Dewli union under the MLT site Shibganj, Bogura, during the Kharif-1 season of 2021 to determine the effect of OCP compound fertilizer on the yield of chilli funded by OCPF-BARI-ICARDA collaborative project. BARI Morich-2 was used as the test crop. The experiment was laid out in randomized complete block design with four replications. Three different fertilizer management treatments were considered for the trial, viz. OCP compound fertilizer, SRC recommended dose and farmer practice. The highest yield of green chilli (14.56 t ha^{-1}) was recorded from the OCP compound fertilizer applied plot. Farmer's practice gave the lowest amount of green chilli (11.45 t ha^{-1}). The highest gross return (Tk 582400 ha^{-1}), gross margin (Tk 459525 ha^{-1}) and benefit cost ratio (4.74) were obtained from the application of OCP compound fertilizer and the lowest gross return (Tk 458000 ha^{-1}), gross margin (Tk. 335125 ha^{-1}) and BCR (3.73) were obtained from farmers practice. Application of OCP compound fertilizer showed better performance than the existing practices and significantly increased the fruit yield of green chilli.

Development of fertilizer recommendation for Lentil-Maize-T.aman rice cropping pattern

The experiment was conducted in farmer's field of Paba MLT site, Rajshahi from the rabi season of 2020-2021 to evaluate the effect of nutrients management packages on lentil, maize and rice cultivation and to find out a suitable combination of different fertilizers for Lentil-Maize-T.Aman rice cropping pattern. The experiment was laid out in randomized complete block design with three replications. Four fertilizer treatments viz. T_1=Soil test based fertilizer dose (FRG, 2018), T_2=75% of T_1, T_3=125% of T_1 and T_4=Farmers dose. Among the treatment, the highest yield and gross margin was obtained from T_3 followed by T_2 and the lowest was obtained from T_4.

Development of fertilizer recommendation for Garlic/Brinjal-T.aman rice cropping pattern

The experiment was conducted in farmer's field of Shibpur, Rajshahi during the *robi* season of 2020 to evaluate the effect of nutrient management packages on Garlic, Brinjal and T.Aman rice cultivation. The experiment was laid out in randomized complete block design with three replications. Four fertilizer treatments viz. T_1=Soil test based fertilizer dose (FRG, 2018), T_2=75% of T_1, T_3=125% of T_1 and T_4=Farmers dose were considered for the trial. Among the treatment, the highest yield and gross margin was obtained from T_3 followed by T_2 and lowest obtained from T_4.

Effect of organic fertilizer to mitigate soil salinity and maximize yield of potato in coastal saline soil

An experiment was conducted at MLT site Kuakata, Patuakhali in the Rabi season of 2021-22 to observe the effect of different organic matter to mitigate soil salinity and maximize yield under farmers' field condition. Different types of organic matter along with soil test based inorganic fertilizers were used in this trial. The treatments of the trials were as T_1 (STB + 3 t cow dung ha^{-1}), T_2 (STB+1.5 compost t ha^{-1}), T_3 (STB + Vermicompost 2 t ha^{-1}) and T_4 (Control; Soil Test Based chemical fertilizer only). 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 Electrical conductivity was found lower in organic fertilizer treated plots. Vermicompost reduced salinity more than compost and cow dung. The highest number of tuber per plant (7.16), weight of tuber per plant (590 g) as well as highest yield (29.47 t ha^{-1}) was found in T_3 treatment. The highest gross return (Tk 353640 ha^{-1}), gross margin (Tk. 145940 ha^{-1}) and BCR (1.71) was also recorded from T_3 treatment. The lowest gross return (Tk. 264240 ha^{-1}) and BCR (1.53) was recorded from T_4. From the finding it may be recommended that Vermicompost application could be the better way for maximizing potato yield in coastal saline soil.

Characterization of new polder in coastal region

A polder characterization program was conducted at polders named Polder No. 44 (Kachufatra, Taltoli, Borguna), 46 (Sonatala, Kalapara, Patuakhali) & 48 (Diaramkhola, Kalapara, Patuakhali) to know the soil properties and salinity status of the crop fields during 2021-22. It was observed that the polder soils carrying favorable physical and chemical properties for crop production with some limitations like N and B deficiency. During 01 December, 2021 to 01 May, 2022, ground water, pond water and canal water salinity were found 1.72-4.20 dS/m, 0.65-1.0 dS/m and 2.8 to 18.5 dS/m, respectively. So, ground water and reserved pond water should be considered to irrigate the crops instead of canal water.

Effect of foliar application of boron on the yield of mungbean

Foliar application of boron can increase pollen fertilization, seed size and seed weight. Mungbean being a dominant rainfed rabi crop in Barishal, faces high temperature in flowering stage. Pollen fertilization hampers, seed size and weight decreases. To overcome the problem, a field study was carried out at the farmer's field of Babuganj, Barishal to evaluate the different doses of foliar application of Boron in mungbean cultivation in late rabi season of 2022. *The experiment* was carried out with four different doses of Boron viz. T_1= Control, T_2=1% Boron solution, T_3=2% Boron solution, and T_4=3% Boron solution under randomized complete block design with three replications. BARI Mung-6 was used as the test crop. Results revealed that application of 2% Boron solution gave the maximum pod per plant, hundred seed weight and seed yield (1363 kg ha^{-1}) compared to other treatments. Application of 2% Boron solution has been found profitable to other treatments. So foliar application of Boron in can be a good option for quality and exportable seed production and to combat high temperature induced pollen sterility of mungbean production in Barishal region.

Integrated nutrient management of BARI Shahebikachu-1 in southern region of Bangladesh

BARI Shahebikachu-1 is a recently developed upland taro variety with high nutritive and qualitative edible attribute. As being a tuber crop, its fertilizers requirement is quite high. Judicious fertilizer packages still not determined. An approach was undertaken to justify some fertilizer packages based on soil test and IPNS were evaluated and compared with farmer's practice. The experiment was carried out with three fertilizer doses viz. T_1=Soil test based inorganic dose on RDF (120-46-128-20 kg, N-P-K-S ha^{-1}), (FRG, 2018), T_2=T_1+5 t cow dung ha^{-1} (IPNS approach), T_3=Farmers practice. As the crop was in growth stage, yield and yield contributing characters were measured. The results indicated that yield and yield contributing characters were better in IPNS approach. The highest estimated rhizome length (18.46 cm) and rhizome yield (718 g) was observed from IPNS based approach.

Effect of lime and fertilizer management on yield of onion in Sylhet region

Liming in acidic soil is a common practice in many countries, but not yet successfully in Bangladesh. Field experiments were carried out in 2021-2022 at the farmer's field on an area with acidic clay loam soil at farming system research and development site, Kamalbazer, South Surma, Sylhet. Two factors experiments viz. A) Fertilizer management, M_1: Soil test based fertilizer recommendation, M_2: 80% of STB dose and M_3: Farmers practice and B) Level of limes viz. L_1: 0 t ha^{-1}, L_2: 1.0 t ha^{-1} and L_3: 2.0 t ha^{-1} were considered as treatments. These tested onion variety was BARI Piaz-4. Trials were laid out in randomized complete block factorial 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 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 (2.0 t lime ha^{-1} 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 marginal benefit cost ratio (6.60) was recorded in L_1M_1. Considering the overall benefit of lime in relation of soil acidity and nutrient availability for crop production the cost for lime might be over looked. So, the application of lime (1.00 t ha^{-1}) along with STB fertilizer dose might be better treatment combinations in onion production in Sylhet region.

Effect of lime and fertilizer management on the yield of mukhikachu in acidic soils of Sylhet region

An experiment was carried out in 2021-2022 at the farmer's field in acidic clay loam soil at multilocation testing site, Moulvibazer. Two factors experiments *viz*. A) Fertilizer management, M_1: Soil test based fertilizer recommendation M_2: 80% of STB dose and M_3: Farmers practice and B) Level of limes viz. L_1: 0 t ha^{-1}, L_2: 1.0 t ha^{-1} and L_3: 2.0 t ha^{-1} were considered as treatments. These was tested on BARI Mukhikachu-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 yield of mukhikachu varied significantly with different lime doses and fertilizer management practices. The highest yield of mukhikachu (34.63 t ha^{-1}) was obtained from treatment combination L_3M_1 (2.0 t lime ha^{-1} and STB fertilizer dose) followed by L_3M_2 and L_2M_1. The highest gross margin (Tk 478050 ha^{-1}) was obtained from L_3M_3. Moderate lime dose (1.0 t ha^{-1}) along with 80% of STB fertilizer might be useful for mukhikachu cultivation in acidic soil of Moulvibazer region.

Project II: Improvement of Cropping Systems

Development of four crops based cropping pattern Mustard-Mungbean-T. Aus-T. Aman against Mustard-D. Aus-T. Aman rice cropping pattern in Bhola

The On-farm trial was conducted at MLT site Daulatkhan and Bhola sadar under AEZ-18 during 2021-2022 to increase cropping intensity and productivity through a four crop-based cropping pattern instead of farmer's existing practice of Mustard-D. Aus-T. Aman. The four crop-based cropping patterns was Mustard- Mungbean-T.Aus-T. Aman and variety of each crop were BARI Sarisha-14, BARI Mung-6/8, BRRIdhan82 and BRRIdhan72/87, respectively. It was observed that four crops, pattern produced the highest rice equivalent yield (18.78 t ha^{-1}) than farmer's practice (12.34 t ha^{-1}) at MLT site daulatkhan and the highest rice equivalent yield (18.63 t ha^{-1}) than farmer's

practice (12.04 t ha^{-1}) at Bhola sadar. Cost-benefit analysis showed that the four-crops pattern gave the highest gross return in both locations. The marginal benefit-cost ratio of the four crop patterns over the existing pattern was 3.73 and 3.53 in Daulatkhan and Bhola sadar, respectively.

Improvement of existing cropping pattern Soybean-D. Aus-T. Aman of Bhola

The study was performed at Bhola sadar under Bhola district during 2021-22 cropping season. The experimental design was RCB with three dispersed replications. In improved pattern, the yield of Soybean, -T. Aus and T.Aman rice were 1.71, 4.50 and 5.15 t ha^{-1}. Whereas in existing pattern, the yield of Soybean-D. Aus and T.Aman rice were found 1.28, 3.85 and 4.37 t ha^{-1}, respectively. The improved cropping pattern gave higher Rice Equivalent Yield (14.86 t ha^{-1}) while existing one recorded 12.17 t ha^{-1}. The whole system Rice Equivalent Yield was 22.10 % higher in improved pattern due to addition of high yielding improved varieties. The whole pattern MBCR was 3.84.

Development of alternate cropping pattern Potato-Maize+Coriander-T.Aman rice against Potato-Maize-T. Aman rice cropping pattern

A field experiment was conducted at the farmers' field of Daudkandi Upazillas under AEZ-19 of Cumilla district during (2020-21) to fit Coriander in the existing cropping pattern and also to increase cropping intensity and productivity. Two treatments i.e, T_1: Existing cropping pattern (Potato-Maize-T. Aman) and T_2: Alternate cropping pattern (Potato-Maize+Coriander-T. Aman) were evaluated in the farmer's field. From the research findings, it is documented that Rice equivalent yield (REY) in alternate cropping pattern was 51.1 t ha^{-1}, which was almost 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 HYV coriander leaves and higher yield of modern variety BARI Alu-46.

Development of improved cropping pattern Potato/Aroid-T. Aman rice against Potato-Fallow-T. Aman rice

A field experiment was conducted at the farmers' field of Amratoli, Barura, Cumilla under AEZ 19 with the following rice based cropping pattern during 2020-21 to fit Aroid in the Potato-Fallow-T. Aman cropping pattern to increase cropping intensity. Two treatments i.e. T_1: Existing cropping pattern (Potato -Fallow-T. Aman) and T_2: Improved cropping pattern (Potato/Aroid - T. Aman) was studied. From the cropping pattern research findings, it is documented that Rice equivalent yield (REY) in alternate cropping pattern was 63.5 t ha^{-1}, which was almost 176% higher over existing pattern (23.0 t ha^{-1}). Higher gross return (Tk. 952500.00 ha^{-1}) and gross margin (Tk. 756814.00 ha^{-1}) as well as higher MBCR (4.86) were also obtained from improved cropping pattern over existing cropping pattern due to additional stolon yield of aroids and higher yield of modern variety BARI Alu-46.

Development of improved cropping pattern Wheat-Mungbean-T.Aman against Wheat-Fallow-T. Aman rice in medium high land of AEZ-1

An experiment was executed at multi-location testing (MLT) site, Pirgonj, Thakurgaon during 2019-20 and 2020-21 to improve the existing cropping pattern for increasing cropping intensity and productivity by inclusion of Mungbean and to increase crop yield and farmer's income. The alternate cropping pattern was Wheat-Mungbean-T. Aman rice against the existing Wheat-Fallow-T.Aman rice pattern. The variety of Wheat, Mungbean, T. Aman was BARI Gom-31, BARI Mung-8 and BRRI dhan87, respectively. The whole pattern rice equivalent yield in alternate cropping pattern was 17.02 t ha^{-1} while 10.87 t ha^{-1} in existing pattern. The higher gross return and gross margin were substantially higher in the alternate pattern than the farmer's existing pattern. The mean marginal benefit cost ratio (MBCR) was found 3.70 which indicated the superiority of alternate pattern over the farmer's existing pattern.

Development of improved cropping pattern Maize-Mungbean-T. Aman against Maize-Fallow-T. Aman rice in medium high land of Dinajpur region

The field experiment was conducted at MLT site, Raniganj, Dinajpur for two consecutive years 2019-20 and 2020-21 to improve the existing cropping pattern for increasing cropping intensity and productivity by inclusion of mungbean and to increase crop yield and farmer's income. The alternate cropping pattern was Maize-Mungbean-T. Aman rice against the existing Maize-Fallow-T.

Aman rice pattern. The variety of Maize, Mungbean and T. Aman was Miracle, BARI Mung-7 and BRRI dhan34, respectively. The experiment was laid out in randomized complete block design with four dispersed replications. Two years mean data displayed significantly higher yield in improved pattern. The entire pattern rice equivalent yield in alternate cropping pattern was 22.65 t ha^{-1} $year^{-1}$ while 14.85 t ha^{-1} $year^{-1}$ in existing pattern. The higher gross return of the alternate pattern was Tk.407656 ha^{-1}which was more than 52.54 % higher than farmers pattern of Tk.267237ha^{-1}.

Development of improved cropping pattern Wheat-Summer Onion-T. Aman against Wheat- Fallow-T. Aman rice in medium high land of AEZ-1

A trial was executed at multi-location testing (MLT) site, Raniganj, Dinajpur during 2020-21 to improve the existing cropping pattern for increasing cropping intensity and productivity by inclusion of Summer onion and to increase crop yield and farmer's income. The alternate cropping pattern was Wheat-Summer onion -T. Aman rice against the existing Wheat-Fallow-T. Aman rice pattern. The variety of wheat, summer onion and T. Aman were BARI Gom-31, BARI Piaz-5 and BRRI dhan87, respectively. The whole pattern rice equivalent yield in alternate cropping pattern was 28.21 t ha^{-1} while 10.24 t ha^{-1} in existing pattern. The higher gross return and gross margin were substantially higher in the alternate pattern than the farmer's existing pattern.

Development of improved cropping pattern Boro-T.aman-Mustard against Boro-T.Aman-Fallow in Faridpur

A trial was conducted at the FSRD site, Faridpur started during the rabi 2021 with alternate cropping pattern Boro-T.Aman-Mustard against existing cropping pattern Boro-T.Aman-Fallow to increase yield and economic return. The field belongs to the agro-ecological zone of Low Ganges River Floodplain Soil (AEZ # 12). BRRI dhan89, BRRI dhan75 and BARI Sarisha-14 were given as the improved variety in the alternate pattern whereas, the varieties of the existing cropping pattern were BRRI dhan28 and BRRI dhan39. The product yield of different three crops in alternate cropping pattern of Boro, T.Aman and mustard were 7.21, 4.51 and 0.55 t ha^{-1} while in existing pattern 5.65 and 4.17 t ha^{-1}, respectively. Alternate cropping pattern gave higher rice equivalent yield (15.64 $t^{-1}ha^{-1}yr^{-1}$) against existing cropping pattern (11.58 $t^{-1}ha^{-1}yr^{-1}$). Higher rice equivalent yield (35% over existing pattern) was obtained in alternate cropping pattern due to inclusion of mustard. The production efficiency was slightly higher (1.82%) in existing cropping pattern due to the lower yield of relay mustard. The yield of mustard hampered due to cyclone "Jawad" (6-7 December, 2021). The higher gross return (Tk.429940ha^{-1}) and gross margin (Tk.150100ha^{-1}) were obtained in alternate Boro-T.Aman-Mustard cropping pattern and lower gross return (Tk. 318570 ha^{-1}) was in existing pattern. The MBCR of alternate cropping pattern was 2.41 over existing cropping pattern.

Development of existing cropping pattern Mustard-Sesame-T.Aman at Faridpur

A trial was conducted at the FSRD site, Faridpur started during Kharif I 2021 with sesame to improve the existing cropping pattern Mustard-Sesame-T.Aman to increase yield and economic return in rice based cropping system. The trial field belongs to the agro-ecological zone of Low Ganges River Floodplain Soil (AEZ # 12). BARI Sarisha-18, BARI Til-4 and BRRI dhan75 were given as the improved variety whereas, the varieties of the existing cropping pattern were BARI Sarisha-14, local til and Binadhan-7. The crop cycle was started with the sesame at Kharif I season. The product yield in improved cropping pattern of sesame, T.Aman and mustard were 1.59, 5.21 and 1.83 t ha^{-1} while in existing pattern 1.41, 4.29, 1.37 t ha^{-1}, respectively. REY was increased 21%, over existing cropping sequence. Existing cropping pattern required 283 days field duration and improved cropping pattern required 292 days (excluding seedling age of rice) to complete the cycle. The production efficiency was increased near about 18.29 % over existing cropping sequence. The higher gross return (Tk.443372 ha^{-1}) and gross margin (Tk. 220412 ha^{-1}) were obtained in improved Mustard-Sesame-T.Aman cropping pattern and lower gross return (Tk151443 ha^{-1}) was found in existing cropping pattern. The MBCR of improved cropping pattern was 8.20 over existing cropping pattern.

Development of an alternate cropping pattern Sunflower-Jute-T.Aman against existing cropping pattern Lentil-Jute-T.Aman at Faridpur

A trial was conducted at the FSRD site, Faridpur started during Kharif I 2021 with an alternate

cropping pattern of Sunflower-Jute-T.Aman against existing cropping pattern Lentil-Jute-T.Aman to increase yield and economic return in rice based cropping system. The trial field belongs to the agro-ecological zone of Low Ganges River Floodplain Soil (AEZ # 12). BARI Surjomukhi-2, JRO 524 and BRRI dhan75 were given as the improved variety in the alternate pattern whereas, the varieties of the existing cropping pattern were BARI Masur-8, JRO 524 and Binadhan-7. The crop cycle was started with the jute at Kharif I season. The product yield in alternate cropping pattern of jute, T.Aman and sunflower were 2.96, 5.30, 2.15 t ha^{-1} while in existing pattern with lentil yielded 2.80, 4.65, 1.58 t ha^{-1}, respectively. REY was increased 20% over existing cropping sequence. Existing cropping pattern required 323 days field duration and alternate cropping pattern required 325 days (excluding seedling age of rice) to complete the cycle. The production efficiency was increased 15% over existing cropping pattern. The higher gross return (Tk.609790ha^{-1}) and gross margin (Tk.281712 ha^{-1}) were obtained in an alternate Sunflower-Jute-T.Aman cropping pattern and lower gross return (Tk509690 ha^{-1}) was found in existing cropping pattern Lentil-Jute-T.Aman. The MBCR of alternate cropping pattern was 3.35 over existing cropping pattern.

Determination of optimum sowing time of jute as relay with onion under Onion/Jute-T.Aman cropping pattern

The experiment was conducted at Saltha Upazilla of Faridpur during the rabi 2020-21 to find out suitable sowing time of jute as relaying with onion in Faridpur. The tested variety of onion and jute was Lalteer King and JRO-524, respectively. The experiment was laid out in randomized complete block (RCB) design with five replications. Four treatments were considered as T_1: Jute seed sowing at 6 days before onion harvest, T_2 (farmers practice): Jute seed sowing at 13 days before onion havest, T_3: Jute seed sowing at 19 days before onion harvest, T_4:Sole onion and sole jute. Significantly the highest bulb yield was calculated from sole onion (18.93 t ha^{-1}) followed by T_1 (18.41 t ha^{-1}). The lowest bulb yield was obtained from T_3 (17.26 t ha^{-1}) due to application of irrigation just after jute sowing before 19 days of onion harvest. That may hamper the bulb yield. In case of relay-based treatments, the maximum fiber yield was obtained from T_3 (3.08 t ha^{-1}) because of getting maximum field duration (121 DAS). The lowest fiber yield was calculated from T_1 (2.90 t ha^{-1}) might be due to minimum field duration (106 DAS). The stick yield ranged between 4.97 to 5.51 t ha^{-1}. The highest fiber equivalent yield was calculated from T_4 (10.93 t ha^{-1}) where sole onion and sole jute was cultivated. The lowest fiber equivalent yield was observed in T_2. Therefore, in relay condition, treatment T_1 (Jute seed sowing 6 days before of onion harvest as relay) was more profitable in terms of yield & monetary return.

Development of Mustard-Sesame-T. Aman cropping pattern against Boro-Fallow-T. Aman in active Brahmaputra Jamuna floodplain of Gaibandha

The experiment was conducted at Kamolpur, Saghata, Gaibandha under On-Farm Research Division during 2021-22 to increase the cropping intensity and productivity by integrating short-term mustard in rice-based cropping pattern. Alternate cropping patterns were agronomically and economically more profitable than the existing patterns. The system productivity based on rice equivalent yield (RYE) in the alternate cropping pattern was 18.18 t ha^{-1}, which was 58% higher than that of the existing cropping pattern (11.51 t ha^{-1}). The gross return from the alternate cropping pattern was Tk. 363600 ha^{-1}, 58% more compared to the existing cropping pattern with a value of Tk. 230200 ha^{-1}. Similarly, the 70% higher gross margin was recorded from the alternate cropping pattern (Tk. 123600 ha^{-1}) than the existing cropping pattern (Tk. 72700 ha^{-1}). The marginal benefit-cost ratio (MBCR) of the whole cropping pattern was 1.62 over the existing cropping pattern. Replacement of Boro rice, as well as the inclusion of oilseed crops (sesame and mustard) in the existing cropping system using modern improved varieties, resulted in increased productivity and profitability.

Development of alternate cropping pattern T. Aus- Cauliflower-relay Pointed gourd against T. Aman- Cauliflower-Fallow

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 (T. Aus - Cauliflower + Knolkhol - Relay Pointed Gourd) instead of farmers existing practice of Mustard-Boro-T. Aman. It was observed that four-crops pattern produced the higher rice equivalent yield (15.59 t ha^{-1}) than farmers practice (12.65 t ha^{-1}). Production efficiency was also higher in four-crops pattern (113.82 kg $ha^{-1}day^{-1}$) than farmers practice

(70.26 kg $ha^{-1}day^{-1}$). Four-crop pattern produced higher gross return (Tk. 311880 ha^{-1}) and gross margin (Tk. 163500 ha^{-1}). However, there are challenges in the timely establishment of crops due to variability in the weather condition, seed availability, sources of irrigation water, shortage of laborers, credit facilities etc.

Improvement of Sweet gourd-Kenaf-Fallow cropping pattern against existing cropping pattern in haor areas of Kishoreganj

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 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 during 2021-22. Two crops Sweet gourd -Kenaf-Fallow was tested at on-farm condition over the existing single crop pattern with Boro rice after flood water receded. Results showed that the highest rice equivalent yield (14.75 t ha^{-1}) was obtained from two crops cropping. The highest average gross return and gross margin of the two crops cropping were obtained Tk.295010 and Tk. 150190 ha^{-1} which were 98 and 138 % higher over farmers' pattern. Farmers' practice gave the lower gross return (Tk. 148800 ha^{-1}). The marginal benefit cost ratio (MBCR) was found 2.47 which indicated the superiority of two crops cropping over the farmers' existing pattern. From the findings of concluded that inclusion of sweet gourd and kenaf instead of single rice in the existing pattern might be profitable and acceptable to the farmers.

Improvement of Lentil-Sesame-T.Aman cropping patternin Kushtia

An experiment was conducted at Kushtia sadder Upazillas during 2021-2022 to improved cropping pattern Lentil-Sesame-T.Aman with latest varieties. The varieties of Lentil (BARI Masur-6)-Sesame (local)-T.Aman (BRRI Dhan-39) were replaced by BARI Masur-8, BARI Til-4 and BRRI Dhan-75. Gross return and gross margin (Tk. 409663 ha^{-1} and Tk. 244013 ha^{-1}) were higher in improved system where existing cropping pattern were Tk. 354413 ha^{-1} and Tk. 197863 ha^{-1}.

Development of oilseed crop based cropping pattern in Boro–Fallow-Mustard at Manikganj

The field trial was conducted at Shabalala Upazila of Manikganj district during cropping season 2021-2022 to improve oilseed-based cropping pattern Boro rice (BRRI dhan-89) – Fallow - Mustard (BARI Sarisha-14) against farmers existing cropping pattern with Tori-7. The objectives of the trial were to increase productivity through inclusion of high yielding of oilseed crops in farmers existing cropping systems. The yield of different crops in alternate cropping pattern of Boro rice (BRRI dhan-89) – Fallow - Mustard (BARI Sarisha-14) were 7.37 t ha^{-1} in BRRI dhan-89, and 1.43 t ha^{-1} in BARI Sarisha-14 while that in the existing pattern BRRI dhan29 yieded 7.09 t ha^{-1}, and Tori-7 yielded 0.87 t ha^{-1}, respectively. The higher gross return (Tk. 312695 ha^{-1}) and gross margin (Tk. 120105 ha^{-1}) were obtained in alternative Boro rice (BRRI dhan89) – Fallow - Mustard (BARI Sarisha-14). In existing pattern gross return was (Tk.262371 ha^{-1}) and gross margin was Tk. 68036 ha^{-1}. The BCR of improved cropping pattern (1.60) was 18.51% higher over existing cropping pattern (1.35).

Development of oilseed crop based cropping pattern Sesame-T. Aman rice-Mustard at Manikganj

The field trial was conducted at Sadar Upazila of Manikganj district during cropping season 2021-2022 to develop oilseed-based cropping pattern Sesame (BARI Til-4) – T. Aman (BRRI dhan-75) – Mustard (BARI Sarisha-14) against farmers existing Sesame (Local variety) – T. Aman (BRRI dhan-49) – Mustard (Tori-7) cropping pattern. The objectives of the trial were to increase productivity through inclusion of high yielding oilseed crops in farmers existing cropping systems. The yield of BARI Til-4, BRRI dhan-75, BARI Sarisha-14 were 1.36 t ha^{-1} 4.52 t ha^{-1} 1.45 t ha^{-1}, respectively. In the existing pattern of Sesame (local variety) – T. Aman (BRRI dhan49) – Mustard (Tori-7), yield of crops were 0.99 t ha^{-1} in sesame, 4.20 t ha^{-1} in BRRI dhan49 and 0.89 t ha^{-1} in Tori-7. The higher gross return (Tk. 329490 ha^{-1}) and gross margin (Tk. 161850 ha^{-1}) were obtained in alternative Sesame (BARI Til-4) – T. Aman (BRRI dhan75) – Mustard (BARI Sarisha-14) and while in existing pattern minimum gross return (Tk.250855 ha^{-1}) and gross margin (Tk. 89215 ha^{-1}) were found. The MBCR was found 13.11 in

alternate pattern which indicated the superiority of the improved pattern.

Development of five crops based cropping pattern against farmers three crops based cropping pattern

The experiment was conducted at Mymensingh sadar Upazila under On Farm Research Division, Bangladesh Agricultural Research Institute, Mymensingh during 2020-2021 to study the comparative agro economic performance as well as increasing cropping intensity and productivity of five crops based pattern and farmers' existing three crops based cropping pattern. Five crops based cropping pattern (Garden pea-Red amaranth-Jute leaf-Kangkong-T. Aman) against farmers' existing cropping pattern (Potato-Jute leaf-T. Aman) were tested. Five crops can be grown successfully according to crop sequence in the pattern. The highest rice equivalent yield (44.82 t ha^{-1}) was obtained from 5 crop based cropping pattern. The improved pattern provided 117% higher gross return with marginal benefit cost ratio of 4.89, which suggested that inclusion of garden pea and kangkong with improved management practice in the existing pattern might be profitable to the farmers.

Development of Mustard-Summer vegetables-Jute cropping pattern against Mustard-Fallow-Jute cropping pattern

The experiment was conducted at Netrokona Sadar, Upazila, Mymensingh under On Farm Research Division, Bangladesh Agricultural Research Institute, during 2020-2021 to study the comparative agro economic performance of three crops based pattern and existing two crops based cropping pattern for increasing cropping intensity and productivity. Three crops based cropping patter (Mustard-Summer vegetables-Jute) against existing cropping pattern (Mustard-Fallow-Jute) were tested. Three crops can easily be grown successfully one after another in sequence by inclusion of any short duration vegetable crop, modern variety following proper production technology in the existing pattern in the tested location. The highest jute equivalent yield (6.3 t ha^{-1}) was obtained from 3 crops based cropping pattern. Gross return of the improved pattern was Tk.514000 ha^{-1} which was 119 % higher over farmers' pattern. The marginal benefit cost ratio (MBCR) was found 3.70; which expressed that inclusion of summer vegetables with improved production practices 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

The experiment was conducted at OFRD, BARI, Shibpur, Narsingdi during the year 2018-19, 2019-2020 and 2020-2021 to improve the existing cropping pattern by inclusion of vegetable and to increase crop yield and farmers income. Alternate cropping pattern Cauliflower (Var. 770) - Boro (BRRI dhan50) - T. Aman (BRRI dhan57) gave higher whole pattern gross margin (Tk. 136500 ha^{-1}) against the existing pattern Vegetable (Snow white) - Fallow-T. Aman (BRRI dhan39).

Development of alternate cropping pattern Vegetable-Vegetable-T. Aman rice against Vegetable-Fallow-T. Aman

The experiment was conducted at OFRD, BARI, Shibpur, Narsingdi during the year of 2020-2021 to improve the existing cropping pattern by inclusion of vegetable and to increase crop yield and farmers income. Alternate cropping pattern of Potato (Var. BARI Alu40) - Ladies finger (BARI Derosh-2) - T. Aman (BRRI dhan71) gave higher gross margin (Tk. 385340 ha^{-1}) against the existing pattern of Cabbage (Atlas 70) - Fallow-T. Aman (BRRI dhan49).

Development of alternative cropping pattern Mustard- T.Aus- T.Aman rice against Fallow-Boro- T.Aman cropping pattern in Rajshahi region

A field trial was conducted at the farmers' field of Paba, Rajshahi during 2020-2021and 2021-2022 to develop Mustard- T. aus- T. aman cropping pattern. There were two treatments i.e, T_1: Existing Cropping pattern: Fallow- Boro-(BRRI dhan-28)- T.aman (Sharna) and T_2: 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}). In the year 2021-2022, in improved cropping pattern, yield of Mustard, T.Aus and T.aman rice were 2.05, 4.5 and 5.1 t ha^{-1} while in existing pattern, yield of Boro and T. aman rice were 5.81 and 4.76 t ha^{-1}, respectively. Improved cropping pattern gave higher rice equivalent yield (15.04 t ha^{-1}) against existing cropping pattern (10.87 t ha^{-1}). Total gross

return and gross margin of improved cropping pattern were Tk. 438540 ha^{-1} and Tk. 231413 ha^{-1} whereas in existing cropping pattern those were Tk. 318690 ha^{-1} and Tk. 152037 ha^{-1}, respectively and MBCR was 2.96 due to introduction of new crops and varieties.

Development of alternative cropping pattern Onion/Brinjal- T.Aman rice against Onion- Jute-T.Aman cropping pattern in Rajshahi region

A field trial was conducted at the farmers' field of Puthia, Rajshahi during 2021-2022 to develop Onion/Brinjal -T. Aman cropping pattern. There were two treatments i.e, T_1: Existing Cropping pattern: Onion (BARI Peaj1)-Jute (Nabin)-T. aman (BRRI dhan75) and T_2: Alternate Cropping pattern: Onion (BARI Peaj-1)/Brinjal (Rangila) - T. aman (BRRI dhan75). Higher Rice Equivalent yield (66.7 t ha^{-1}) and gross margin (Tk. 1282347 ha^{-1}) were obtained from alternate cropping pattern over existing cropping pattern (43.1 t ha^{-1}, Tk. 774658 ha^{-1}), respectively and MBCR was 6.58 due to introduction of new crops and varieties.

Development of mechanization package for four crops based cropping pattern

Four crop-based improved cropping pattern was tested under possible mechanization package against farmer's traditional practice at FSRD site, Ajoddhapur, Rangpur under On-Farm Research Division, BARI, Rangpur during the year of 2020-21 and 2021-22 (partial) to develop mechanization package for four crops-based cropping pattern and to assess the crop productivity by reducing the turnaround time. The results exposed that all component crops of Potato/Sweet gourd-Jute- T. aman cropping pattern produced under mechanization system could be established more successfully with short duration crop varieties than farmers' practice. In this study, mechanization system was more profitable and viable than farmer's traditional practice in terms of agronomic and economic views. The rice equivalent yield (REY), crop productivity and profitability were higher in mechanization system than farmers' traditional practice. Use of improved planting and harvesting machineries in all component crops production system, helped in timely planting and harvesting, which reduced the turnaround time vice versa increased the field duration of crops. The reduction of production cost and increment of yield under mechanization system was enhanced total productivity and profitability.

Development of healthy oilseed crops based cropping pattern

Healthy oilseed-based alternative cropping patterns were tested against farmers traditional practiced at stable char land of Bongram, Chilmari, Kurigram under On-Farm Research Division, BARI, Rangpur during the year of 2020-21 and 2021-22 (partial) to find out the profitable cropping pattern by inclusion of safe oilseed crops/variety BARI Sarisha-18 and BARI Surjamukhi-3. Two alternative cropping pattern i.e. CP_1: Sunflower-Proso millet-T. Aman and CP_2: Mustard (BARI Sarisha-18)-Jute-T. Aman were tested against existing cropping pattern Mustard (BARI Sarisha-14)-Proso millet-T. Aman. The results showed that the rice equivalent yield (REY) was higher in CP_2 (18.33 t ha^{-1}) and CP_1 (15.29 t ha^{-1}) than existing pattern (12.54 t ha^{-1}). The maximum gross margin was calculated in CP2 (Tk. 212681 ha^{-1}) followed by CP_1 (Tk. 187011 ha^{-1}). The maximum production efficiency and MBCR was also found in CP_2 followed by CP_1 and minimum in existing cropping pattern.

Development of Zinc fortified crops based cropping pattern

A field trail was conducted at char Bongram, Ranigonj, Chilmari, Kurigram, OFRD, and Rangpur during Rabi season 2020-21 to find out the feasibility of fitting Zn enriched and or medicinal crops in cropping pattern and increase Zn availability in food system. The highest rice grain equivalent yield (11848 $kgha^{-1}$) was produced by T_1 whereas 8106 $kgha^{-1}$ was obtained from existing cropping pattern. The gross margin and benefit cost ratio of T_1 cropping pattern were Tk. 202650 ha^{-1} and 3.68 which was much higher than T_2, respectively. So, the Lentil (BARI Masur-8) -T. Aus (BRRI dhan-48)-T. Aman rice (Bina dhan-20) cropping sequence was better in char land condition in Rangpur.

Increasing cropping intensity and productivity by adoption of short duration mustard varieties in rice based cropping system

The experiment was conducted at farmers filed at FSRD, Tarakandi, Sherpur during 2021-2022 to study the comparative agronomic performance of existing cropping pattern Fallow- Boro-T. Aman rice and improved cropping pattern Mustard- Boro-T. Aman rice by introducing a short duration mustard (BARI Sarisha-14) after harvest of T. Aman rice. The higher rice equivalent yield (17.47 t ha^{-1})

was obtained from improved cropping pattern, which was 58.81% higher over farmers existing pattern. At the same time improved cropping pattern Mustard- Boro-T. Aman rice gave higher gross return (Tk. 425878 ha^{-1}) and gross margin (Tk. 176976 ha^{-1}) which was 59.86 and 108 % higher over farmer's pattern. Farmers practice gave the lower gross return (Tk. 266400 ha^{-1}) and gross margin (Tk. 85048 ha^{-1}).

Increasing cropping intensity and productivity by adoption of short duration mustard varieties in rice based cropping system

The experiment was conducted at farmer's field under Multilocation Testing (MLT) site, Boushi, Sarishabari, Jamalpur during 2021-2022 to study the comparative agronomic performance of existing cropping pattern Fallow-Boro-T. Aman rice and improved cropping pattern Mustard- Boro-T. Aman rice by introducing a short duration mustard (BARI Sarisha-14) after T. Aman rice harvest. The higher rice equivalent yield (14.85 t ha^{-1}) was obtained from improved cropping pattern which was 48.5% higher over farmers existing pattern. It also gave higher gross return (Tk. 413400 ha^{-1}) and gross margin (Tk. 136018 ha^{-1}). Farmers practice gave the lower gross return (Tk. 249400 ha^{-1}) and gross margin (Tk. 44326 ha^{-1}).

Improvement from Fallow-T. Aus-T. Aman rice to Mustard-T. Aus-T. Aman rice under AEZ 20 of Sylhet region

An experiment was executed at multilocation testing (MLT) site, Moulvibazar during years of 2020-2022 to see the performance of improved cropping pattern and to increase the productivity and income of the farmers. The experimental design was RCB with six (6) dispersed replications. The existing cropping patter (EP): Fallow-T. aus-T. aman rice and improved cropping pattern (IP): Mustard-T. aus-T. aman rice, respectively has been tested under this experimentation. BRRI dhan48 of T. aus rice and Binadhan-16 of T. aman rice were used in this trial. The improved pattern (IP) provided 16.74 t ha^{-1} of rice equivalent yield which was almost 69 % higher than that of existing pattern. Similarly, the higher mean gross margin (Tk. 385020 ha^{-1}) with marginal benefit cost ratio (2.17) was obtained over existing pattern. It's also revealed that 35 % extra cost provided an ample scope of considerable improvement of the productivity with the inclusion of modern mustard and T. aman rice variety in improved pattern.

Validation of four crop-based cropping pattern Mustard-Vegetables-T. Aus-T. Aman rice against farmers existing pattern

A field trial was conducted at the multi-locational testing (MLT) site, Moulvibazar under On-farm Research Division (OFRD) of Bangladesh Agricultural Research Institute (BARI), Sylhet to study the comparative agronomic performance and economic return of four crops based cropping patterns. The cropping patterns were as follows- CP_1: Fallow-T. aus (BRRI dhan48)-T. aman (BRRI dhan49) as control; CP_2: Mustard green (cv. Local laishak) - T. aus (BRRI dhan48)-T. aman (BRRI dhan49); CP_3: Mustard green (cv. Local Laishak)-Patshak (BJRI deshipatshak-1)-T. aus (BRRI dhan48)-T. aman (BRRI dhan49) and CP_4: Mustard green (cv. Local Laishak)-Data shak (BARI Datashak-1)-T. aus (BRRI dhan48)-T. aman (BRRI dhan49). The results showed that four crops could be grown successfully one after another in a sequence in the field. The highest rice equivalent yield 39.46 t ha^{-1} was obtained from the cropping pattern CP_3 (Mustard green-Patshak-T. aus-T. aman) and it was followed by CP_4 (35.58 tha^{-1}) and CP_2 (29.56 tha^{-1}) during two years of crops cycle. The highest gross margin Tk. 606860 ha^{-1} was also obtained from CP_3 followed by CP_4 (Tk. 511490 ha^{-1}). The highest MBCR (5.92) was found in the same crop sequence (CP_3). However, based on overall yield performance, economic benefit and climatic situation of Sylhet region it may be concluded that CP_3 was the best pattern than others.

Improvement of existing cropping pattern Mustard-T. Aus-T. Aman rice through inclusion of modern varieties of mustard and rice in AEZ 20 of Sylhet region

The study was conducted at the farmer's field in Sylhet under AEZ 20 during 2020-2021 to compare the productivity and profitability of cropping patterns viz. improved pattern (IP): Mustard (BARI Sarisha-18-T. Aus (BRRI dhan48)-T. aman ric (BRRI dhan75) by introducing high yielding varieties of mustard and rice in existing pattern (EP): Mustard (BARI Sarisha-14-T. aus (BRRI dhan48)-T. aman rice (Binadhan-7). The experiment was laid out in randomized complete block design with six dispersed replications. Results showed that the improved pattern with management practices provided 24 % higher rice equivalent yield (REY) than existing pattern. Similarly, the highest mean

gross margin (Tk. 224430 ha^{-1}) with marginal benefit cost ratio (1.49) was obtained over existing pattern. Results revealed that 4.41 % extra cost provides an ample scope of considerable improvement of the productivity with the inclusion of modern mustard and T. aman rice varieties in improved pattern.

Enhance production of mustard through inclusion in Fallow-Boro-T.Aman rice cropping pattern

An on-farm trial has been conducted at FSRD site Atia, MLT site Ghatail, Madhupur and Dhanbari to increase cropping intensity and productivity through inclusion of mustard in fallow period at farmers existing practice of Fallow-Boro-T. Aman. The variety of different crops were BARI Sarisha-14, BRRI dhan29 and BRRI dhan49, respectively. It was observed that at FSRD site Atia, MLT site Ghatail, Madhupur and Dhanbari three crop patterns produced rice equivalent yield of 14.34, 16.47, 16.61 and 17.46 t ha^{-1}, respectively and these were 40, 48, 48 and 52% higher than farmers practice, respectively. Cost-benefit analysis over four locations in Tangail district showed that improved pattern gave higher gross return (Tk. 364950) and gross margin (Tk. 196004) which were 46.95 and 75.50 % compared to that of existing pattern with only 23.63 % extra cost. The marginal benefit-cost ratio of the three crop pattern over the existing pattern was 2.64, which indicates three crops cropping pattern might be profitable.

Variety replacement in the existing cropping pattern Wheat- Jute-T. Aman rice

The study was conducted at the farmers' field of FSRD site Atia, Tangail to evaluate the agro-economic performance of Wheat (BARI Gom-32)-Jute (BJRI Toshapat-8)-T. Aman rice (Hybrid Arize-7006) cropping pattern against farmers' existing cropping pattern Wheat (Local)-Jute (0-9897)-T. Aman rice (BR-11) through incorporation of modern high yielding varieties during 2020-21. Two cropping pattern viz., improved pattern and existing pattern were the treatments variables. The experiment was laid out in randomized complete block design with six dispersed replications at farmers' field. The result showed that the replacement of varieties for Wheat- Jute-T. Aman rice cropping pattern provided higher rice equivalent yield (20.44 t ha^{-1}) over existing cropping pattern (15.64 tha^{-1}). Average gross return (Tk. 562250 ha^{-1}) and gross margin (Tk. 265500 ha^{-1}) of improved pattern were 30.36 and 45.48 % higher, respectively compared to that of existing pattern with only 19.27 % extra cost. The marginal benefit cost ratio of 2.73 indicated the superiority of improved cropping pattern over existing cropping pattern.

Variety replacement in the existing cropping pattern Wheat- Sesame -T. Aman rice

The study was conducted at the farmers' field of FSRD site, Atia, Tangail to evaluate the agro-economic performance of Wheat (BARI Gom-32)-Sesame (BARI Til-4)-T. Aman rice (Hybrid Arize-7006) cropping pattern against farmers' existing cropping pattern Wheat (BARI Gom-32)-Sesame (Local)-T. Aman rice (BR11) through replacing of modern high yielding varieties and improved management practices for crop production during 2020-21. Two cropping pattern viz., improved pattern and existing pattern were the treatments variables. The experiment was laid out in randomized complete block design with six dispersed replications at farmers' field. The result showed that the replacement variety with improved management practices of Wheat-Sesame-T. Aman rice cropping pattern provided higher rice equivalent yield (13.16 t ha^{-1}) over existing cropping pattern (9.36 t ha^{-1}). Average gross return (Tk. 368650 ha^{-1}) and gross margin (Tk. 199424 ha^{-1}) of improved pattern were 46 and 65 % higher, respectively compared to that of existing pattern with only 28.25 % extra cost. The marginal benefit cost ratio of 3.12 indicated the superiority of improved cropping pattern over existing cropping pattern.

Development of garden Pea-Boro-T. Aman rice cropping pattern against T. Aman-Fallow-Boro cropping pattern

The study was conducted at the farmers' field of FSRD site, Atia, Tangail to evaluate the agro-economic performance of T. Aman (Hybrid Arize-7006)-Garden Pea (BARI Matarsuti-3)-Boro rice (BRRI dhan29) cropping pattern against farmers' existing cropping pattern T. Aman rice (BR11)-Fallow- Boro rice (BRRI dhan29) through incorporation of modern high yielding varieties and improved management practices for crop production during 2020 and 2021. Two cropping pattern viz., improved pattern and existing pattern were the treatments variables of the experiment. The experiment was laid out in randomized complete block design with six dispersed replications at

farmers' field. The result showed that the improved management practices for T. Aman-Garden pea-Boro rice cropping pattern provided higher rice equivalent yield (16.70 t $ha^{-1}yr.^{-1}$) over existing cropping pattern (10.05 t $ha^{-1}yr^{-1}$). Average gross return (Tk. 477300 ha^{-1}) and gross margin (Tk. 190750 ha^{-1}) of improved pattern were 63.68% and 100% higher, respectively compared to that of existing pattern with only 46.02 % extra cost. The marginal benefit cost ratio of 2.06 indicated the superiority of improved cropping pattern over existing cropping pattern.

Development of alternate cropping pattern Wheat-Jute-T. Aman against farmers existing Fallow-Jute-T. Aman pattern in Gopalganj region

The experiment was conducted at the MLT site, Tungipara, Sader and Moksedpur under Gopalganj district and Najirpur under Pirojpur district during 2020-`21 and 2021-22 to improve the productivity and profitability of existing cropping pattern Fallow-Jute-T. Aman by new cropping pattern. It was found that improved cropping pattern Wheat-Jute-T. aman gave highest rice equivalent yield (22.39 t ha^{-1}) where farmers practice gave much lower (16.57 t ha^{-1}). The improved cropping pattern Wheat-Jute-T. aman gave the highest gross return (Tk. 559750 ha^{-1}), gross margin (Tk. 204418 ha^{-1}) and the MBCR was 2.02.

Intercropping of soybean within maize in Bhola

A field trial was conducted at Bhola sadar and Daulatkhan during the rabi season of 2020-21 and 2021-22 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 utilization of the land for higher yield, land equivalent ratio (LER) and economic return. The experiment was laid out in randomized complete block design on farmer's field condition in Bhola sadar. Four treatments were considered as $T_{1=}$ Sole maize, $T_{2=}$ Sole Soybean, $T_{3=}$ Two row maize (60cm x 25cm) with 2 row Soybean (30cm x 6cm), $T_{4=}$ Pair row maize (120cm x 25cm) with 4 row Soybean (30cm x 6cm). Variety was BARI Hybrid Maize-16 and BARI Soybean-6. In case of maize no. of cobs $plant^{-1}$, 1000-grain wt. (g) of maize was significantly influenced by intercrop combination in two consecutive years. The highest no. of grains cob^{-1} (545 & 558) was recorded from T_1 followed by T_4 (536 & 539) and the lowest (518 & 496) was obtained from T_3 treatment in 2021 & 2022. The highest maize grain yield (7.83 & 7.92 t ha-1) was obtained from sole maize in both the years. Grain yield (1.72 & 1.82 t ha-1) of sole soybean was significantly higher and lowest soybean grain yield (1.30 & 1.25 t ha-1) was obtained from T_3 treatment in 2021 & 2022. The highest Maize Equivalent Yield 9.41 t ha-1 and 9.63 t ha-1 was recorded from T_3 intercropped combination in two consecutive years. The LER was higher in T_4 treatment (1.80 & 1.71) and lower (1.67 & 1.60) in T_3 treatment in both years. Growing maize and soybean in intercropping under rainfed condition resulted in higher LER indicting beneficial association between the two crops.

Intercropping of short duration winter vegetables with sweet gourd in hill valleys of Bandarban

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 2021-22 to evaluate the performance of intercropping, to increase land use efficiency and to find out best intercrop combination. Five intercrop combinations such as T_1= Sweet gourd + radish (leaf), T_2= Sweet gourd + chinese cabbage, T_3= Sweet gourd + red amaranth, T_4= Sweet gourd + spinach and T_5= Sweet gourd + bushbean were used as treatments and sole sweet gourd were used in the experiment as control (T_0). Intercropping short duration winter vegetables with sweet gourd influenced sweet gourd yield and increased production in system. T_3 (Sweet gourd + red amaranth), T_5 (Sweet gourd + bushbean) and T_2 (Sweet gourd + chinese spinach) intercropping combinations performed better than sole sweet gourd. However, the results indicating that highest sweet gourd equivalent yield (40.13), gross return (802600 Tk. ha^{-1}), net return (604600 Tk. ha^{-1}) and BCR (4.05) was obtained from Sweet gourd and red amaranth crop combination (T_3) 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.

Intercropping of black cumin with groundnut at Sangu Riverbank of Bandarban hill district

The experiment was carried out at the farmers' field of On-Farm Research Division, Bangladesh Agricultural Research Institute (BARI), Bandarban

during the rabi season, 2021-22 to find out the suitable intercropping system for increasing crop productivity and profitability of black cumin with groundnut intercropping system. The treatments were T_1=sole groundnut, T_2=sole black cumin, T_3= one row of black cumin in between two rows of groundnut and T_4= 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 rows of groundnut (T_3) showed higher groundnut equivalent yield (3331.12 kg ha^{-1}), highest land equivalent ratio (1.43), gross return (Tk. 199867 ha^{-1}), net return (Tk. 149367 ha^{-1}) and benefit cost ratio (3.96) over the other treatments. 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 vegetables, spices and red amaranth with chewing type sugarcane

A trial was carried out at the FSRD site, Sholakundu, Faridpur during the two consecutive *rab*i 2020-21 and 2021-22 to find out suitable and profitable intercrop combinations with chewing type sugarcane and to intensify use of land for growing vegetables and spices crops. The experimental plot represents agro-ecological zone #12. Four treatments *viz* T_1: red amaranth (Lalshak) in between four rows of onion bulb, T_2: red amaranth in between three rows of coriander (leaf purpose), T_3: red amaranth in between three rows of radish, and T_4: 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 for onion, red amaranth, radish, coriander and sugarcane, respectively. The highest cane yield was calculated from T_2 (81.87 t ha^{-1}) where red amaranth & coriander leaf were intercropped and the lowest from farmer's practice; T_4 (79.60 t ha^{-1}). The highest average onion equivalent yield (10.23 t ha^{-1}) was calculated from T_1 followed by T_4 (8.14 t ha^{-1}). The lowest average OEY was found from T_3 (5.64 t ha^{-1}) where red amaranth was sown in between two rows of radish. The highest margin was found from T_1 (Tk 587624 ha^{-1}) followed by T_2 (Tk. 523852 ha^{-1}). The lowest grown margin was observed in T_4 (Tk 499617 ha^{-1}).

Intercropping of cauliflower with Bt. Brinjal

An experiment was carried out at MLT site Tularampur, Narail during 2021-2022. There were four treatments, viz. T_1= 1 row cauliflower between 2 rows of brinjal, T_2= 2 rows, cauliflower between 2 rows of brinjal, T_3= 1 cauliflower between 2 brinjal plant along with line, and T_4= 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 (BARI Bt. begun-4).Yield and yield contributing characters of of Bt. begun showed no significant difference due to intercropping. The highest Bt. begun yield (25.9 t/ha) was produced from T_3 (1 cauliflower between 2 brinjal plant) followed byT_4 (Sole brinjal) and T_2 (2 row cauliflower between 2 rows of brinjal). The lowest yield (25.3 t ha^{-1}) recorded from T_1 (1 row cauliflower between 2 rows of brinjal). The highest equivalent yield (49.8 t ha^{-1}) of Bt. begun was obtained from T_2 and the lowest (25.46 t ha^{-1}) from T_4. The highest gross margin (1020417 Tk. ha^{-1}) and marginal benefit cost ratio (5.51) were found from T_2 (2 row cabbage between 2 rows of brinjal) and the lowest gross margin (430000 Tk.ha^{-1}) was found from T_4 (Sole Bt. begun).

Performance of mungbean and sesame intercropping in southern district of Bangladesh

The experiment was conducted at MLT site Kuakata, Patuakhali and MLT site Amtoli, Borguna during rabi season of 2021-22 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 (100%) in row (30 cm × 5 cm) and T_4 = Sole crop of sesame (100%) in row (30 cm x 5 cm) were evaluated at each location. Sole mungbean and sesame gave higher yields than intercrop treatments in all the locations. Among the intercrop treatments, the highest seed yield of mungbean was obtained from T_2 treatment in all the locations while the lowest from T_1. Intercropping increased mungbean equivalent yield (MEY) and land equivalent ratio (LER) compared to sole cropping. Over the locations, the highest MEY (2.33 t ha^{-1}), LER (1.44) and BCR (1.87) was found in T_1 (100% mungbean in rows (30cm × 5 cm) + 50% sesame as broadcast)

treated plot as compared to the other intercropping and sole cropping system.

Intercropping of short duration vegetables and spices with bushbean in Sylhet region

A field experiment was laid out during 2021-22 in winter season at MLT site, Moulvibazar. Four different intercropping combinations, T_1 = Bush bean (100%) + Radish (100%), T_2 = Bush bean (100%) + Carrot (100%), T_3 = Bush bean (100%) + Coriander (100%), T_4 = Bush bean (100%) + Chilli (100%) and T_5 = Bush bean sole (100%) were considered. The experiment was randomized complete block design with three replications. The highest bush bean equivalent yield (18.85 t ha^{-1}) was obtained from the combination of Bush bean + Chilli, whereas, the lowest yield (11.03 t ha^{-1}) was found from the Bush bean + Coriander. The highest gross return (Tk. 848250 ha^{-1}) and gross margin (Tk. 562750 ha^{-1}) were obtained from the combination of Bush bean + Chilli. Whereas the lowest gross return (Tk. 212850 ha^{-1}) and gross margin (Tk. 62150 ha^{-1}) were obtained from Bush bean sole cultivation. Maximum percent increased of bush bean equivalent yield (298%) followed by Bush bean + Radish (276%). The highest benefit ratio (3.04) 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

The trial was conducted at farmer's field during winter 2021-22 under MLT site, Moulvibazar. Six intercrop combinations viz. T_1: Groundnut sole, T_2: Coriander sole, T_3: Groundnut + coriander (100%), T_4: Groundnut + coriander (90%), T_5: Groundnut + coriander (80%) and T_6: Groundnut + coriander (70%) were considered as treatments. The variety BARI Chinabadamm-8 and Local coriander were used in this trial. The experiment was setup in randomized complete block design with three replications. Among the combinations, the highest pod yield (2.64 t ha^{-1}) of groundnut and green leaf yield of coriander (3.81 t ha^{-1}) was found in their respective sole crops. On the contrary, in intercrop situation the maximum yields of coriander leaf (3.44) and GEY (6.10 t ha^{-1}) was obtained from T_3 (groundnut+ 100% coriander) which was increased 131% over than sole groundnut. Intercrop combination (100% groundnut+ 100% coriander) also gave the maximum gross margin (Tk. 251000 ha^{-1}) with higher marginal rate of return (620) followed by T_4 (groundnut + 90 % coriander) combination. So, the combination of 100 % groundnut with 100 % coriander can be a good tool for escalating the yield and profit of haor farmers in Sylhet region.

Intercropping of onion with groundnut at the charland of Tangail

An experiment was conducted at the MLT site, Bhuapur during the Rabi season of 2020-21 and 2021-22 to find out a suitable intercrop combination of groundnut and onion to increase the productivity and income of farmers. Four treatments viz., T_1= Sole groundnut (100%), T_2= Sole onion (100%), T_3= One row of onion between two rows of groundnut, T_4= Two rows of onion between two rows of groundnut were considered. Both two crops generally yielded more when grown as a single crop compared with when groundnut was intercropped with onion. In intercropping groundnut with onion, groundnut yield was not significantly affected; however, onion yield was significantly reduced (4.36-45.23%). Groundnut equivalent yields were recorded higher from all intercrop treatments as compared to sole groundnut and sole onion production. Analysis of intercropping treatments revealed that two rows of onion in between two rows of groundnut (T_4) resulted in the highest groundnut equivalent yield (10.78 t ha^{-1}) as well as gross margin (Tk. 440155 ha^{-1}). The lowest groundnut equivalent yield (1.90 t ha^{-1}) as well as gross margin (Tk. 57955 ha-1), were obtained from sole groundnut treatment.

Validation of intercropping of black cumin with groundnut in charland areas

An experiment was conducted at the MLT site, Bhuapur during the Rabi season of 2021-22 to find out the optimum row arrangement of black cumin for intercropping with groundnut for higher productivity and return. Four treatments viz., T_1= Sole groundnut (100%), T_2= One row of black cumin in between two rows of groundnut, T_3= Two rows of black cumin in between normal rows of groundnut, T_4= Sole black cumin (100%). Groundnut intercropping with black cumin makes effective use of land and other resources and results in reduced cost of production. Groundnut equivalent yields were recorded higher from all intercrop treatments as compared to sole groundnut and sole black cumin production. Analysis of intercropping treatments revealed that two rows of black cumin in

between two rows of groundnut resulted in the highest groundnut equivalent yield (3.06 t ha^{-1}) as well as gross margin (Tk. 99398 ha^{-1}). The lowest groundnut equivalent yield (1.43 t ha^{-1}) as well as gross margin (Tk. 29848 ha^{-1}) were obtained from sole groundnut treatment.

Validation of intercropping garlic, onion, fenugreek, black cumin with groundnut in charland areas

An experiment was conducted at the MLT site, Bhuapur during the rabi season of 2021-22 to find out the suitable intercrop combination of groundnut for higher productivity and profitability of Charland areas stakeholders. Five treatments viz., T_1= Sole groundnut (100%), T_2= Two rows of black cumin in between two rows of groundnut, T_3= One row of fenugreek in between two rows of groundnut, T_4= One row of garlic in between two rows of groundnut, T_5= One row of onion in between two normal rows of groundnut. Analysis of intercropping treatments revealed that one row of onion in between one row of groundnut resulted in the highest groundnut equivalent yield (9.48 t ha^{-1}) as well as gross margin (Tk. 450348 ha^{-1}). The lowest groundnut equivalent yield (1.47 t ha^{-1}) as well as gross margin (Tk. 32248 ha^{-1}) were obtained from sole groundnut treatment.

Intercropping of sweet gourd with cabbage

The experiment was conducted at MLT site, Dhirashram, Gazipur sadar during rabi season of 2021-22 to evaluate the performance of sweet gourd as intercrop with varying plant population of cabbage and to increasing of farmers income. Five treatments viz. T_1= Sole Sweet gourd (2 m × 2 m), T_2=Sole Cabbage (60 cm × 45 cm), T_3= Sweet gourd (2m × 2m) + Cabbage (60 cm × 45 cm), T_4= Sweet gourd 2m × 2m) + Cabbage (65 cm × 50cm) and T_5=Sweet gourd (2m × 2m) + Cabbage (70 cm × 55 cm) were tested. BARI Mistikumra-2 and Autumn queen variety were tested as sweet gourd and cabbage with three replications. Cabbage equivalent yield (84 t ha^{-1}) in sweet gourd (2 m × 2 m) + Cabbage (65 cm × 50 cm) combination was higher than sole cabbage (60 cm × 40 cm). Maximum gross return was calculated in T_3 (Tk. 993500 ha^{-1}) and T_4 (Tk. 886600 ha^{-1}), respectively.

Effect of seed rate of mustard and cowpea mixed cropping in Bhola

A field trial was carried out at Daulatkhan and Bhola sadar during the rabi season of 2019-20,2021-21 and 2021-22 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., T_1= Sole mustard (100%), T_2= (Mustard 100% + 20% cowpea), T_3= (Mustard 100% + 30% cowpea), T_4= (Mustard 100% + 40% cowpea) were tested. In three years average, it is clearly found that no of siliqua plant-1 in case of mustard was statistically significant among the treatments. The highest number (78.58) of siliqua plant-1 was recorded from T_1 treatment where sole mustard was used and the lowest (67.31) was found from T_4 treatments. Number of seed per siliqua was also higher (23.91) in T_1 treatment that was significant compare to other treatments, but among the T_2, T_3 and T_4 treatments there was no significant differences. The highest mustard yield (1.38 t ha^{-1}) was observed in the sole mustard followed by T_2 treatment (1.30 t ha^{-1}) and the lowest mustard yield (1.21 t ha^{-1}) was recorded from T_4 treatment. In case of cowpea there was no significant difference in number of seeds per pod and 1000 seed weight. The maximum cowpea yield was observed in the T_4 treatment with a value of 0.67 t ha^{-1} followed by T_3 treatment (0.49 t ha^{-1}) and lowest (0.31 t ha^{-1}) in T_2 treatment. In three years average the highest mustard equivalent yield was found in T_4 (1673 kg ha^{-1}) from the T_4 treatment where 100% Mustard + 40% cowpea used followed by T_3 treatments (1609 kg ha^{-1}) and T_2 treatment (1514 kg ha^{-1}). The lowest mustard equivalent yield was found in T_1 (1380 kg ha^{-1}) where sole mustard was used.

Mixed cropping of mustard with lentil at a different seed ratios

The experiment was undertaken to study the effect of lentil (BARI Masur-8) and mustard (BARI Sharisa-14) mixed cropping in different plant population at Shibpur and Paba, Rajshahi during 2021-2022 cropping season. In this experiment, lentil and mustard were mixed using additive percentages. In this study, the main plots were pure stand of two crops as well as three mixed cropping ratios (90% lentil + 10% mustard, 80% lentil + 20% mustard, 70% lentil + 30% mustard). Mixed cropping treatment of T_1 (90% lentil + 10% mustard) gave the superior yield (1.92 t ha^{-1}) as compared to sole lentil and other mixed cropped treatment. The maximum gross return, gross margin and BCR were

also recorded in T_1 (90% lentil + 10% mustard) that was followed by sole lentil.

Mixed cropping of black cumin with lentil at different seed ratios

The experiment was undertaken to study the effect of lentil (BARI Masur-8) and black cumin (BARI kalojira-1) mixed cropping in different plant population at Paba and on station, Rajshahi during 2021-2022 cropping season. In this experiment, lentil and black cumin were mixed using additive percentages. In this study, the treatments were T_1=80% lentil + 20% black cumin, T_2=70% lentil + 30% black cumin, T_3=100% lentil and T_4=100% black cumin. Mixed cropping treatments T_1= (90% lentil + 10% black cumin) gave the superior yield (1.92 t ha^{-1}) as compared to sole lentil and other mixed cropped treatment. The maximum gross return, gross margin and BCR were also recorded in the T_1(90% lentil + 10% black cumin) that was followed by T_4 (100% lentil).

Performance of mixed lentil and linseed under the strip and conventional tillage method

The experiment was undertaken to study the effect of lentil (BARI Masur-8) and linseed (BARI Tisi-3) mixed cropping in different plant population at Paba and on station, Rajshahi during 2021-2022 cropping season. In this experiment, lentil and linseed were mixed using additive percentages. In this study, the treatments were T_1 (90% lentil + 10% linseed), T_2 (80% lentil + 20% linseed), T_3 (70% lentil + 30% linseed), T_4 (60% lentil + 40% linseed), T_5 (50% lentil + 50% linseed) and T_6 (75% lentil + 25% linseed). Mixed cropping of lentil and linseed (T_6= 75% lentil + 25% linseed) gave the superior yield (1.79 t ha^{-1}) as compared to sole and other mixed cropped treatment. The maximum gross return, gross margin and BCR were also recorded in the T_6(75% lentil + 25% linseed) that was followed by T_5 (50% lentil+50% linseed) and lowest was in T_3 (sole linseed).

Performance of mastard varieties as relay crop with T. Aman rice

A field trial was conducted in the farmer's field at Daulatkhan and Bhola sadar, Bhola during 2020-21 and 2021-22 to study 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 both the consecutive year (1.30 & 1.40 t ha^{-1}) and BARI Sharisha-15 gave minimum (1.18 &1.23 t ha^{-1}). Average of two years, the highest gross return (Tk. 102000 ha-1) and gross margin (Tk. 59020 ha-1) was obtained from the treatment T_3 (BARI Sharisha-17) followed by T_1 (BARI Sharisha-14). The lowest gross return (Tk. 90750 ha-1) and gross margin (Tk. 47770 ha-1) was obtained from treatment T_2 (BARI Sharisha-15). The height BCR (2.37) was found from BARI Sharisha-17 due to higher yield.

Performance of grass pea varieties as relay with T. Aman rice in low lying areas

An experiment was carried out at Tularampur MLT site, Narail during 2021-22. There were 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 khesari were influenced significantly due to relay cropping with T. aman. The highest yield (1.75 t ha^{-1}) was obtained from BARI Khesari-5 variety followed by BARI Khesari-3 (1.56 t ha^{-1}), Local (1.53 t ha^{-1}) and this lowest from BARI Khesari-2 (1.32 t ha^{-1}). The highest gross margin (51250 Tk.ha^{-1}) and benefit cost ratio (3.73) was found from BARI Khesari-5 followed by BARI Khesari-3. The lowest gross margin (34050 Tk.ha^{-1}) and benefit cost ratio (2.82) was found from BARI Khesari-2.

Weed management for dry direct seeded Aus rice in high barind tract

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. Adoption of DSR changes weed dynamics and communities and therefore necessitates adjusting weed control methods. A field experiment was conducted at FSRD site, Basantapur, Godagari, Rajshahi during 2020 and 2021 to develop effective weed management strategies for DSR Aus rice in High Barind Tract. Six weed management strategies such as-WM_1: Pre-emergence (no spray) +post-emergence (no spray); WM_2: Pre-emergence (Pendimethalin)+post-emergence (no spray); WM_3: Pre-emergence (no spray) + post-emergence (Bispyribac + Pyrazosulfuron Ethyl), WM_4: Pre-emergence (Pendimethalin) + post-emergence

(Bispyribac + Pyrazosulfuron), WM_5: Pre-emergence (Pendimethalin) + post-emergence (Penoxulam) and WM_6: Pre-emergence (Pendimethalin)+post-emergence (Hand weeding). A randomized complete block design with three replications was used with strip tillage system. Weed management treatment WM_4 gave the highest grain (4.63 and 4.64 t ha^{-1} in 2020 and 2021, respectively) and straw yield (5.10 and 5.14 t ha^{-1}, in 2020 and 2021, respectively) of Aus rice. The WM_5 was identical with WM_4 considering the yield performance. The WM_4 and WM_5 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.

Integrated weed management of mungbean

A field study was carried out 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 e.g. i) Control (W_1) ii) One hand weeding at 20 DAE (W_2), iii) BARI weeder at 20 DAE (W_3), iv) W_2 + BARI weeder at 40 DAE (W_4) v) Weednil @1.5ml/L water at 20 DAE (W_5) under randomized complete block design with three replications. BARI Mung-6 was used as the variety. Results revealed that, (one hand weeding at 20 DAE + Application of BARI Weeder at 40 DAE) significantly increases seed yield of mungbean (1635.3 kg/ha). The highest BCR can be found from application of BARI weeder at 20 DAE (4.04).

Planting date influence phenology, growth and yield of chickpea in high barind tract

A study was conducted to evaluate the effect of planting date on phenology, growth, and yield of two chickpea varieties. The experiment comprised of three planting dates viz., 20 November, 30 November and 10 December. The planting dates were tested on two chickpea varieties, viz., BARI Chola-5 and BARI Chola-11 in two separate trials. The experiment was laid out in a randomized complete block design with three replications. It was observed that BARI Chola-5 (6-7days) emerged earlier than that of BARI Chola-11 (7-8 days). The BARI Chola-5 took 64-66, 71-73. 91-93, and 111-125 days for its floral initiation, 1st flower, pod starting, and physiological maturity, respectively. Delayed planting took less time to mature. The variety recorded 105-110, 863-994, 963-1074, 1278-1334, and 1780-1969 GDD for its emergence, floral initiation, 1st flower, pod starting and physiological maturity, respectively. Early crop planting recorded higher GDD for all stages of BARI Chola-5. The BARI Chola-11 received 7-8, 36-39, 44-45, 49-51 and 105-116 days for its emergence, floral initiation, 1st flower, pod starting and physiological maturity, respectively. BARI Chola-11, delayed planting took somewhat more time for emergence, floral initiation, 1st flower and pod starting but less time for pod maturity. The variety received 124-128, 543-594, 619-706, 703-784 and 1633-1748 GDD for its emergence, floral initiation, 1st flower, pod starting and physiological maturity, respectively. Crops planted on delayed recorded lower GDD for all the stages of the variety. The seed yield of BARI Chola-5 (1.26-1.65 t ha-1) was higher than that of BARI Chola-11 (0.93-1.34 t ha-1). The BARI Chola-5 gave the highest seed yield planted on 20 November. Contrarily, the BARI Chola-11 showed the maximum seed yield from 30 November followed by 20 November.

Effect of mulch on zero tillage garlic production in coastal area

An experiment was conducted at Bhola sadar and Daulatkhan under Bhola district during the rabi season of 2021-22 to evaluate the suitable mulch material for garlic under zero tillage condition and to increase the production as well as farmer's income. There were three treatments i.e., T_1: Rice straw mulch, T_2: Water hyacinth mulch and T_3: No mulch. The tested garlic variety was BARI Rashun-1. Among the treatments the highest average bulb yield (6.79 t ha^{-1}) and gross margin (Tk. 292540 ha^{-1}) were obtained from T_1 treatment. The lowest yield (4.16 t ha^{-1}) and gross margin (Tk. 154000 ha^{-1}) were obtained from T_3 treatment. In case of benefit-cost ratio, the highest value (3.55) was recorded from rice straw mulch and the lowest (2.61) was found in no mulch.

Effect of planting method on the yield of lentil

A field experiment was conducted in the farmer's field of Sujaitput, Sonatola, Bogura during the rabi season 2021-22 to observe the performance of lentil (BARI Masur-8) under different tillage options in the Karatoa Bangali Floodplain soil (AEZ#4). Four tillage options i.e.,T_1 = Seeding with bed planter, T_2 = Seeding with PTOS, T_3 = Seeding with strip planter and T_4 = Farmers' practice were used in this

experiment. Machinery tillage-based cultivation system provided higher yield benefits to the BARI Masur-8. Among the options, the bed planter tillage method was superior in yield and economic return. The maximum seed yield (1750 kgha^{-1}) was obtained from the bed planting system followed by STRIP planting system (1642 kgha^{-1}) and the minimum from the farmers practice (1518 kgha^{-1}). Overall 7.51 to 15.28% yield advantage was achieved from the mechanized seeding system of lentil. Higher seed yield contributed to the higher economic return. Maximum gross return (Tk.146040 t ha^{-1}) was obtained in planting systems.

Effect of planting time on sweet potato in char land condition

The experiment was conducted at Chinirpotol char of Saghata, Gaibandha under the supervision of OFRD, Gaibandha during the rabi season of 2021-22 to find out the suitable planting time of sweet potato vines and increase the productivity in char land condition. Three sowing dates were compared; T1: 15 October, T2: 30 October, and T3: 15 November along with three sweet potato varieties; V1: BARI Mistialu-8, V2: BARI Mistialu-12, and V3: Local cultivatvar following the RCBD (two factor) design. The significant highest tuberous root yield was recorded from BARI Mistialu-8 (37.6 t ha^{-1}) when the vines were planted on 15 October, similar to BARI Mistialu-12 (35.6 t ha^{-1}) with the same date of vine plantation. The tuberous root yield of sweet potato was significantly decreased with late plantation from the date of 15 October. The tuberous root yield has been decreased by 17-19.9% in BARI Mistialu-8 and by 7.4-13.8% in BARI Mistialu-12 for every 15 days of late vine plantation from 15th October. Considering the variety, BARI Mistialu-8 and BARI Mistialu-12 produced 62% and 53% more yield compared to the local sweet potato variety. In terms of crop variety, BARI Mistialu-8 produced 51-71% (or 9.1-15.6 t ha^{-1}) and BARI Mistialu-12 produced 17-19% (8.6-13.6 t ha^{-1}) more root yield compared to the local sweet potato variety (17.8-22.0 t ha^{-1}).

Effect of different planting methods on the yield and maturity duration of sunflower in the haor area of Kishoreganj

A field study was conducted at Guroy, Nikli upazilla under OFRD, BARI, Kishoreganj during 2021-22, 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 (1.68 t/ha) followed by poly bags seedling at 7 days (1.56 t/ha) and poly bags seedling at 14 days (1.47 t/ha). The highest gross return (84000 Tk/ha), gross margin (36180 Tk/ha) and BCR (1.76) was obtained from direct seeding followed by Poly bags seedling at 7 days but maturity is earlier in poly bags seedling at 14 days.

Effect of planting methods on the yield of ginger

The experiment was conducted at farmer's field of Fulbaria under Mymensingh district during of 2021-2022 to find out the effect of planting methods and varieties on the growth and yield of ginger. The study consisted the following treatments; A. planting materials: i) BARI Ada-1 (V_1), ii) BARI Ada-2 (V_2), iii) BARI Ada-3 (V_3), iv) Advanced line (V_4), and local cultivar (V_5); B. planting methods: i) Ridge method (M1), ii) Furrow method (M2), iii) Flat method (M3). Ginger varieties had significant influence on all the parameters. The highest rhizome yield (16.7 t ha^{-1}) produced by advanced line followed by BARI Ada-2 while the lowest yield (14.1 t ha^{-1}) produced by BARI Ada-1. Planting method also significantly influenced the growth of plant. The highest yield (19.8 t ha^{-1}) produced by ridge method followed by furrow method while the lowest yield (17.0 t ha^{-1}) produced by flat method. The gross return and gross margin were varied among the varieties. Out of five varieties, the calculated highest gross return (Tk. 1002000.00 ha^{-1}) and gross margin (Tk.683700.00 ha^{-1}) were recorded from advanced line might be due to higher yield potentiality. The lowest gross return (Tk. 846000.00 ha^{-1}) and gross margin (Tk.527700.00 ha^{-1}) was recorded from BARI Ada-1. The gross return and gross margin were also varied among the planting method. Out of three method, the calculated highest gross return (Tk. 1188000.00 ha^{-1}) and gross margin (Tk. 869700.00 ha^{-1}) were recorded from ridge method might be due to higher yield potentiality. The lowest gross return (Tk. 1020000.00 ha^{-1}) and gross margin (Tk.7011700.00 ha^{-1}) were recorded from flat method.

Performance of garlic with zero tillage method in coastal region

An experiment was conducted at MLT site Bauphal, Patuakhali in the Rabi season of 2021-22 to find out the performance of garlic production under zero tillage condition. Two types of sowing methods i.e. T_1 = Sowing in zero tillage field and T_2 = Sowing in ploughed field (traditional) was tested in the trial. The significant influence was found on growth, yield and yield contributing traits of garlic. It was observed that all the 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. Highe bulb yield (7.23 t/ha) was obtained from zero tillage field compared to traditional (6.49 t/ha). Zero tillage system also gave higher gross return (Tk. 361500) and gross margin (Tk. 263500) as its production cost was lower than tillage system.

Effect of different sowing dates on the yield of mungbean in coastal area

The experiment was conducted at Keoyabunia, Amtoli, Borguna during late rabi season of 2021-22. Mungbean variety viz. BARI Mung-6 was sown at 10 day intervals starting from 20 January to 9 February to find out suitable sowing date for increasing yield in coastal area. Treatments consisted of three sowing dates (20 January, 30 January and 9 February). The yield and yield contributing characters of mungbean plant was significantly affected by the different sowing dates. Sowing at 30 January produced maximum number of pods/plant (20.53), number of seeds/pod (11.67), 1000-seed weight (51.53 g), and seed yield (1.73 t/ha), stover yield (3.03 t/ha) and harvest index (37.86 %). The seed yield decreased by 2.31 and 27.75% when seeds were sown, in early (20 January) or late (9 February). The maximum gross return (Tk. 112450/ha), gross margin (Tk. 70900/ha) and BCR (2.71) were recorded from 30 January sowing. The lowest economic return was recorded from T_3 (Tk. 81250/ha) and BCR (1.96).

Effect of sowing time on yield and quality of BARI begun-12

An experiment was conducted at MLT site Kuakata, Patuakhali in the Rabi season of 2021-22 to identify the optimum sowing time of BARI Begun-12 to obtain higher quality fruit and maximum yield under farmers' field condition. Four treatment *viz*., T_1=15 October transplanting, T_2= 30 October transplanting, T_3= 15 November transplanting, and T_4= 30 November transplanting were used. From the experiment it was observed that early October to early November treatment gave the earliest harvest with maximum yield. T_2 treatment gave the largest fruit (594.35gm) with the highest yield (46.85 t/ha) and T_4 treatment gave the lowest yield (27.96 ton/ha). From the economic point the highest gross return (Tk.1171250/ha), gross margin (Tk.976750/ha) and BCR 6.03) was recorded from T_2 treatment, followed by T_1. The lowest economic return was recorded from late transplanting (T_4) plot (Tk.699000/ha) with minimum value of BCR (3.60). So, BARI Begun 12 can be suggested to transplant late October to mid November to the farmer field.

Validation trial of maize seedling transplantation in coastal area

The experiment was conducted at MLT site Kuakata, Patuakhali during the rabi season of 2021-2022 to establish a sowing practice for maize cultivation in fallow saline coastal area after Aman rice harvest. Seeds/seedlings of hybrid Miracle variety were sown/transplanted in two planting systems (T_1=Direct seed sowing and T_2= 20 days old polybag seedling). The polybag seedlings establishment rate was higher (98%) and maturity came 20 days earlier than direct seed sowing. More grain yield was obtained from seedling transplantation method (8.27 t/ha) compared to direct seed sowing method (7.46 t/ha).

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

This trial was carried out at the farmer's field of Kuakata, Kalapara, Patuakhali during late Rabi season of 2021-22. In the saline area, soil moisture is rapidly lost during the late Rabi season which is a critical problem for producing winter crops. The experiment was taken to find an effective ways to retain moisture in the soil by 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 T_1: no mulch, T_2: straw mulch, T_3: rice husk and T_4: polythene mulch were tasted under randomized complete block design with three replications. BARI Felon-1 was used as the variety. Results revealed that, polythene

mulch (1.69 t ha^{-1}) significantly increased the highest seed yield of cowpea whereas the lowest (1.48 t ha^{-1}) was from no mulch. The higher BCR was obtained from straw mulch treatment (1.49) followed by no mulch (1.37).

Effect of seed potato cutting on the performance of potato planted with potato planter

Mechanization in potato cultivation is the time demand and an experiment was conducted on it at FSRD site, Ajoddhapur, Rangpur under On-Farm Research Division, BARI, Rangpur during the year of 2021-22 to identify the suitable cutting dimension of seed Potato for production with Potato planter and to increase profitability of the farmers. Among the two potato varieties, BARI Alu-41 produced maximum tuber yield (30.79 t ha^{-1}). Whole tuber produced identically higher yield (29.99 t ha^{-1}) with single cut in lengthwise (29.45 t ha^{-1}) under planting with BARI potato planter. Single cut of tuber in crosswise produced the lowest tuber yield (26.95 t ha^{-1}) compared to other cutting system. Cutting effect on potato varieties was found insignificant. In terms of economical point of view, potato planting with planter was more profitable than manual planting in farmers practice due to low production cost as well as relatively higher yield except planting with crosswise cut tuber. Potato tuber might be allowed to cut in lengthwise under planting with BARI potato planter.

Effect of sowing dates and varieties on early planted potato

A field trail was conducted at Magura, Kishoreganj, Nilphamari, OFRD, Rangpur with five potato varieties and three sowing dates to find out the better BARI devolved early suitable potato varieties to compare with local varieties in relation to tuber yield in Rangpur region during Rabi season 2021-22. The better tubers yield 36858 t/ha were given from 10 October sowing with BARI Alu-90. The highest gran return (921450 Tk./ha), gross margin (729050 Tk./ha) and benefit cost ratio (4.78) were obtained from same combination than others. However, considering of all things, potato varieties BARI Alu-90, 29 & 41 gave higher tuber yield production in this area with compare to local variety seven.

Yield performance of different garden pea varieties at sherpur region

The experiment was conducted in the farmer's field at Char habor, Sreebordi, Sherpur during rabi season 2021-2022 to evaluate different pea varieties. Three pea varieties viz., BARI Motorsuti -1, BARI Motorsuti -2 and Natore local were included in this experiment. Result revealed that BARI Motorsuti -2 gave the highest yield of 14.82 t ha^{-1} whereas Natore local produced the lowest yield of 7.73 t ha^{-1}. Highest gross return 3,84,900/-Tk ha^{-1} and Gross margin 2,73,100/-Tk ha^{-1} observed in BARI Motorsuti -1.

Effect of sowing date on yield performance of garden pea variety

The experiment was conducted in the farmer's field at Tarakandi, Sherpur sadar, Sherpur during the rabi season of 2021-2022 to evaluate sowing time on pea production. Three time sowing ie. 10th November, 25th November and 10th December was included in this experiment. Result reveal that maximum yield (9.30 tha^{-1}) obtained from 25th November sowing whereas 10th December sowing produced lowest yield (7.27 t ha^{-1}). Highest gross return 4,75,075/-Tk ha^{-1} and Gross margin 3,67,675/-Tk ha^{-1} were observed from 10th November sowing.

Effect of plant spacing on bulb yield of onion

The experiment was undertaken to determine the effect of different plant spacing bulb yield of onion. Three different spacing's were taken viz., 5x10 cm, 10x10 cm and 15x10 cm. Variety BARI Piaz-4 was used for the study. The results demonstrated that plant spacing had significant effect on bulb yield of onion. The weight of individual onion bulb was highest (41.62 g) with the widest spacing of 15x10 cm. The highest (25.74 t/ha) yield was recorded from wider spacing (15 x10cm) and the lowest (19.74 t/ha) was at closer spacing (5x10 cm). Maximum Gross return and gross margin per hectare were found Tk.5,14,800/- and Tk.3,98,555/- from wider spacing (15 x10cm).

Performance of sesame under different sowing options

A field experiment was conducted at farmer's field of Gangarampur, Pabna during March to July in 2021 to study the performance of sesame under different planting methods. Four sowing methods, namely raised bed planting (RB), relay cropping (RC), strip planting (SP) and conventional method which is considered as farmer's practice (CT) were applied on sesame variety, BARI Til-4. The results of the experiment showed that days to 50%

flowering and days to maturity in RC were earlier than RB, SP and CT. Relay method produced lower plant populations than the plant population of other treated plots. The tallest plant was recorded at CT and the shortest was recorded at RC treatment. The highest pods/plant was recorded from RB and the lowest pods/plant was obtained at RC treatment. The highest grain yield (1.14 t/ha) was obtained at CT which was statistically similar to RB (1.13 t/ha) and SP (1.10 t/ha), and the lowest grain yield (1.67 t/ha) obtained from RC treatment. However, this study will be continued for the next year to draw a concrete conclusion.

Performance of plant growth regulator (east gold) on cabbage

The study was conducted at the on-station research field of On-Farm Research Division (OFRD), Bangladesh Agricultural Research Institute (BARI), Gazipur, and at the farmers' field of Shibpur, Narsingdi during rabi season 2021-22 to evaluate the effect of 'East Gold' plant growth regulator (PGR) on cabbage. There were seven treatments viz. T_1: 0 ppm PGR, T_2: 250 ppm PGR at 25 days after planting (DAP), T_3: 500 ppm PGR at 25 DAP, T_4: 750 ppm PGR at 25 DAP, T_5: 250 ppm PGR at 25 DAP + 250 ppm PGR at 50 DAP, T_6: 375 ppm PGR at 25 DAP + 375 ppm PGR at 50 DAP and T_7: 500 ppm PGR at 25 DAP + 500 ppm at 50 DAP. The experiment was laid out in a randomized complete block design with three replications. The highest curd yield (103.9 t ha^{-1}) was obtained from the spray of 500 ppm both at 25 DAP and 50 DAP in Gazipur. However; in Narsingdi, the highest yield (80.0 t ha^{-1}) was obtained from the spray of 750 ppm PGR at 25 DAP. The spray of East Gold increased the yield of cabbage by 10.2-25.2% at Gazipur and by 3.9-18.5% at Narsingdi compared to the non-spray control.

Rainfall and vegetation dynamics in Bangladesh based on landsat time-series analysis

Monitoring on changes in vegetation growth has been subjected to considerable research in Bangladesh during the last few years. In this study, we combined dataset of satellite-derived Normalized Difference Vegetation Index (NDVI) and climatic factor viz. rainfall to analyze spatio-temporal patterns of changes in vegetation growth and their relation with changes in rainfall of the whole country from 1985 to 2020.

Management of gummosis disease of citrus in Narsingdi

The experiment was conducted with Colombo lebu at Dattergaon and Joymongal, Shibpur, Norsingdi during 1st week of March, 2020. The experimental was laid out randomized complete block design with three replications. Five to eight years aged, 20 disease infected plants were selected for the experiment and a set of five tree was considered one replication. Treatments were (i) Redomil gold pest. (ii) Bourdo mixture (iii) Alkatra (iv) control. Clean the wounded portion and applied redomil pest and spray four times 2gm L^{-1} after 15 days interval. Length and diameter of lesion was measured and remarkable reduction was observed after thrice application. The length and diameter reduced about 82.31 and 82.81% respectively in Redomil gold treatment. While it reduced about 64.27 and 65.22% respectively in Bordeaux mixture treatment and 72.14 and 75.34%, respectively in Alkatra treatment.

Integrated management approach for controlling root rot (caused by *sclerotium rolfsii*) of sunflower

The experiment was conducted at FSRD site, Jamla, Dumki, Patuakhali during rabi season of 2021-22 to find out suitable management approach for controlling root rot disease in sunflower field in southern region of Bangladesh. Five treatments namely: T_1: Seed treatment with Carboxin+Thiram (Provax 200WP) + three sprayings of Carbendazim (Autostin 50WDG), T_2: Seed treatment with Carboxin+Thiram (Provax 200WP) + three sprayings of Difenoconazole (Score 250EC), T_3: Seed treatment with Carboxin+Thiram (Provax 200WP) + three sprayings of Savlon, T_4: Seed treatment with Carboxin+Thiram (Provax 200WP) + three sprayings of Mancozeb + Metalaxyl (Metaril 72WP), T_5: Only seed treatment with Carboxin+Thiram (Provax 200WP) were evaluated. Percent disease incidence (wilting) was the lowest (0.27%) at 30 DAS and 1.38% at 50 DAS in T_1 while the highest were found at T_5 (Only seed treatment with Provax 200WP) in 30 and 50 DAS. At 70 and 90 DAS, the percent disease incidence did not vary significantly. Among all the treatments, statistically the highest yield was observed at T_1 treated plot (2.01 t ha^{-1}) while T_5 showed the lowest (1.72 t ha^{-1}). The maximum (1.21) marginal benefit cost ratio (MBCR) was returned from T_1 treated plot followed by (1.16) T_2. The research result revealed that, T_1

(Seed treatment with Provax 200WP + three sprayings of Autostin 50WDG) showed the lowest disease incidence percentages for wilt and also gave the highest yield.

Evaluation of integrated controlling approach against flower thrips and pod borers of mungbean in coastal area

The experiment was conducted at Keoyabunia, Amtoli, Borguna during late rabi season of 2021-22 to evaluate the efficacy of integrated approach based on their marginal benefit cost ratio against flower thrips and pod borers of mungbean in coastal area by various means, including blue sticky trap, bio and chemical insecticides. Five approaches namely: T_1 = Installing blue sticky trap + two sprayings of Success 2.5 SC and single spraying of Siena 6WG, T_2 = Installing blue sticky trap + two sprayings of Antario and single spraying of Coragen 20SC, T_3 = Installing blue sticky trap + two sprayings of Fytomax aza 3% and single spraying of Nitro 505EC, T_4 = Four sprayings of Imitaf 20SL, T_5 = Four sprayings of Voliam flexi 300SC were evaluated. The integrated management approaches showed significantly different performance against flower thrips and pod borer of mungbean. The highest percentage (65.73%) of reduction of thrips population was found in T_1 treated plot and the lowest percentage (9.79%) of pod infestation by pod borer observed by the same treatment followed by T_3. The highest yield (1.92 t ha^{-1}) was also obtained from T_1 as well as maximum gross return (Tk. 124800/ha), gross margin (Tk. 74715/ha) and BCR (2.49) was recorded from same treatment. The lowest economic return was recorded from T_2 (Tk. 95550/ha) with minimum BCR (1.83). Considering the overall eco-friendliness and profitability, integrated management approach T_1 would be the best for controlling of flower thrips and pod borers of mungbean with higher yield in the insects' prone cropping areas.

Controlling of bird pests in sunflower crop using different repellent tools at coastal areas of Bangladesh

The experiment for controlling of bird pests in sunflower production was conducted under farmer's field condition in Kuakata, Patuakhali during robi season of 2021-22 to evaluate the effectiveness of repellent tools against bird pests in sunflower. Four management techniques (MT) namely: MT_1 = Hanging red ribbon, MT_2 = Plastic bottle windmill, MT_3 = Bird repellent mechanical device and MT_4 = Control were evaluated. Among the using management techniques, Plastic bottle windmill as repellent tool having minimum (21.25%) % head damaged by bird and minimum (27.5%) % plant infested followed by Bird repellent mechanical device (23.13% and 30.0%). Hanging red ribbon (29.38% and 32.5%) showed maximum damaged in control. In respect of yield, the maximum yield (1.78 t ha^{-1}) and the maximum BCR (1.43) were obtained from Plastic bottle windmill used plot than all other repellent tools.

Bio-rational based management techniques for the control of mango fruit fly *Bactrocera dorsalis* in Rajshahi region

Adaptive trials were conducted at farmer's field of Charghat and Bagha upazilla of Rajshahi district during the mango fruiting season of 2022 in a randomized complete block design with 4 treatments and 10 replications. Among the treatments, male attractant impregnated yellow sticky trap was more effective in catching mango fruit fly male adult populations followed by attract & kill method and methyl eugenol pheromone trap, respectively. 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 mid-June. The lowest fruit infestation (3.9–4.3%) was found in plants where attract and kill methods were installed as compared to male attractant impregnated yellow sticky trap (4.7–6.0%) and methyl eugenol pheromone trap (5.5–6.64%). The highest infestation was found in farmer's practice (9.4–12.1%) where insecticides were sprayed to control mango fruit fly. Considering marginal cost benefit ratio attract & kill method produced the highest marketable yield (98.67 kg/tree) and higher MBCR (9.28).

ICM techniques in reducing flower and fruit dropping of mango in high barind tract

On-farm trials of Integrated Crop Management (ICM) techniques were conducted during 2021-22 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 @ o.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

The trial was conducted at farmer's field at Basantopur FSRD site, Godagari, Rajshahi during Rabi 2021-22 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 grain yield of chickpea following randomized complete block design (RCBD) with 6 promising varieties with 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.

Bio-rational based management of pod borer, *Helicoverpa armigera* Hubner infesting chickpea

The experiment was conducted in the farmer's field at Basantopur FSRD site, Godagari, Rajshahi during Rabi 2021-22 crop season to evaluate different biopesticides based IPM packages against chickpea pod borer *Helicoverpa armigera* (Hubner) attacking chickpea. Results indicated that the infested pod ranged from 2.88 to 20.05% and there was significant difference among the treatments. All treatment applications significantly reduced the pod damage and increased grain yield over untreated control. The lowest pod damage (2.88%) and highest grain yield ((1.43 t/ha) were recorded from sex Pheromone mass trapping + Spraying of *Celastrus angulatus* (Bio-chamak 1% EW) @ 2.5 ml/l of water followed by sex Pheromone mass trapping + Spraying of Chlorantraniliprole (Coragen 18.5 SC) @ 0.5 ml/l of water (1.36 t/ha).

Survey and documentation of insect pests attacking potato in rajshahi region

Survey was conducted at farmer's field of Godagari, Tanor and Mohanpur upazilla of Rajshahi district during Rabi 2021-22 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.

Survey, monitoring and documentation of major insect pests of pulse crops in high barind tract

A field survey was conducted in western region of Bangladesh during rabi season, 2020-21 and 2021-22 to record the infestation and major pest of pulse crops in High Barind Tract in Bangladesh. 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. Among these pests, thrips infestation was more severe. 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' infestation were observed in grasspea, e.g, aphid, green sting bug, thrips and cowpea weevil/bruchid.

Survey, monitoring and documentation of major insect pests of betel leaf in Rajshahi region

Betel leaf is an important cash crop that has gained prominence in Bangladesh in recent years. The betel (*Piper betle*) is a vine of the family Piperaceae, which includes pepper and kava. Betel leaf is mostly consumed in Asia, and elsewhere in the world by some Asian emigrants, as betel quid or in paan, with Areca nut and/or tobacco. The current study was conducted in a betel leaf garden in the Rajshahi district of Bangladesh between 2020-21 and 2021-22 to track betel leaf insect infestations. During the research period, twelve insect pests were discovered. Various insect pests were observed during the study

period, including betel vine blackfly, whitefly, semi looper, common cutworm, scale insects, mealy bug, snail, trips, red spider mite, betel vine bug, and betel vine termite. The betel vine blackfly, semi looper, scale insects, whitefly, and red spider mite were discovered to be the most harmful pests. The betel vine Blackfly, one of the insect pests, begins attacking in March and has its peak infestation in May and October. In Bangladesh, betel is grown all over the country but the commercial production of betel, with bigger leaves and dark green colour combined with thickness. Successful betel farm in Bangladesh can provide a supplemental income to a farmer. The average production cost for these betel farms in Bangladesh are about Tk 300,000 per hectare, and the farm owners can earn a profit of over Tk 100,000 per hectare. Pests damage the crop on the leaves and roots, resulting in significant losses. In order to design effective management techniques, it is vital to document the pests. The purpose of this study is to identify the pests that exist in the research locations.

Performance of intercropping coriander leaf with turmeric under mango based agroforestry system

The experiment was conducted at the farmers' fields of Barura, Chandina, Cumilla during April 2021 to March 2022 to evaluate the performance of intercropping coriander leaf with turmeric varieties under mango based agroforestry system. The results showed that intercropping of coriander with all varieties of turmeric exhibited better performance under mango based agroforestry system. However, intercropping of coriander (cv. BARI Dhania-2) with local variety of turmeric showed the best performance regarding mango equivalent yield and economic return.

Development of guava based agroforestry system with high value crops

The experiment was carried out at extrapolation areas of FSRD site, Ganggarampur, Pabna during the Rabi season of 2021-22 to evaluate the performance of high value vegetable crops in guava-based agroforestry system and to increase productivity and farmers income. Different high value crops such as cauliflower, cabbage, broccoli, tomato, brinjal, chilly, onion, carrot and red amaranth were grown with existing guava orchard under guava-based agroforestry system. Maximum fruit equivalent yield was obtained from guava+ brinjal (31.95 t ha^{-1}) which was identical to guava + cauliflower (30.46 t ha^{-1}). Regarding economic benefit, higher gross return (Tk. 1278000 ha^{-1}) and gross margin (Tk. 1070200 ha^{-1}) were achieved from guava + brinjal followed by guava+ Cauliflower. Considering total system productivity guava+ brinjal followed by guava+ cauliflower agroforestry system seems more promising at Pabna region.

Upscaling mango based agroforestry with elephant foot yam at farmers field

The research program was carried out at FSRD site, Ganggarampur, Pabna during 2021 to assess the performance of mango based agroforestry system with elephant foot yam over sole mango cultivation. The higher system productivity in terms of fruit equivalent yield (16.41 t ha^{-1}) was obtained from the mango based agroforestry system with elephant foot yam as compared with sole mango cultivation (6.60 t ha^{-1}). Regarding economic benefit, remarkably higher gross return (Tk. 984600 ha^{-1}) and gross margin (Tk. 743285 ha^{-1}) and satisfactory MBCR (3.33) were also obtained from agroforestry system.

Project III: On-Farm Trials with Advanced lines and Technologies

Adaptive trial of BARI barley varieties

The trial was conducted at Tangail, Kurigram, Rangpur, Bogura, Chandpur, Cumilla, Manikganj and Faridpur districts during Rabi 2021-22 to observe the yield performance of BARI barley varieties and to popularize the varieties among the farmers. The experiment was laid out in RCB design with 6 dispersed replications with different BARI Barlry. Two varieties of barley viz., BARI Barley-7 and BARI Barley-9 in the char areas of Tangail, Kurigram, Rangpur and Bogura whereas four varieties viz. BARI Barley-6, BARI Barley-7, BARI Barley-8 and BARI Barley-9 were evaluated in the farmer's field of Cumilla and Manikganj. In Faridpur, the trial consists of three barley varieties viz. BARI Barley-7, BARI Barley-9 and a local variety as check. Among the tested varieties, the highest grain yield of 1.86 and 1.90 t ha^{-1} were observed in BARI Barley-7 at Bhuapur and Atia of Tangail, respectively with gross return of Tk. 31530 and 27815 ha^{-1} and gross margin of Tk. 83700 and 76000 ha^{-1}. In Rangpur, the highest grain yield of 4940 kg ha^{-1} was obtained from BARI barley-9 and the lowest from BARI barley-7 (4135 kg ha^{-1}). In Bagura, BARI barley-9 gave higher

yield (2.45 t ha^{-1}) over BARI barley-7 (2.32 tha^{-1}) with higher gross margin (Tk. 79720 ha^{-1}) compared to BARI barley-7. In Cumilla, the maximum grain yield (3.3 t ha^{-1}) was observed in BARI Barley-8 followed by BARI Barley-9 (3.2 t ha^{-1}). In Manikganj, the highest grain yield (2.60 t ha^{-1}) was obtained from of BARI Barley-6 with higher gross margin (Tk. 85170. ha^{-1}) than in BARI Barley-9 (1.99 t ha^{-1}) with gross margin (Tk. 61220 ha^{-1}). In Faridpur, the highest grain yield (2.66 tha^{-1}) was obtained from BARI Barley-9 and the lowest from the local variety (1.90 t ha^{-1}).

Performance of selected barley varieties and advanced lines in coastal and barind area

The experiment was conducted at farmer's field of Khulna and Rajshahi districts during Rabi season 2021-22 to study the performance of three BARI barley varieties viz. BARI Barley-7, BARI Barley-8 and BARI Barley-9, and two barley lines viz. BHL-25 and BHL-27. The experiment was laid out in RCB design with six dispersed replications. Among the varieties and lines, no significant variations in yield was observed but among the two sites yield and yield components were higher at Dacope. The highest grain yield was obtained from BHL-27 (2.5 t ha^{-1}). At Rajshahi, BARI Barley-9 gave the highest grain yield (2.15 t ha^{-1}) followed by BHL-27 (1.98 t ha^{-1}) and the lowest from BHL-25 (1.68 t ha^{-1}). Considering the yield and yield contributing characters, BARI Barley-9 was found suitable in High Barind Tract.

Regional yield trials of hull-less barley in char areas

A field trail was conducted at char Bongram, Ranigonj, Chilmari, Kurigram and OFRD, Rangpur during Rabi season 2021-22 to find out the performance of hull-less barley lines. The experiment was laid out in RCB design with six dispersed replications. The highest grain yield (1947 kg ha^{-1}) was obtained from INBON-19-E-24 line and the lowest (1650 kg ha^{-1}) from INBON-19-E-100 followed by BHL 16 (1675 kg ha^{-1}). However, among the barley lines, INBON-19-E-24 gave the highest grain yield in char areas. Limited market failities is a constraint as reported by the farmers. Further trial is needed to confirm the result.

On-farm trial of BARI developed foxtail millet variety

The experiment was conducted at Cumilla, B. Baria, Chandpur under OFRD, Cumilla; Rajendrapur of Netrakona and Vabokhali of Mymensingh under OFRD, Mymensingh; Saghata, Gaibandha and in the farmer's field of Basantopur, Godagari under OFRD, Rajshahi during Rabi season of 2021-22 to evaluate the performance of BARI developed high yielding foxtail millet varieties. The experiment was laid out in RCB design with six dispersed replications. The grain yield of BARI Kaon-1 was 1.65 t ha^{-1} while BARI Kaon-2 ranged from 1.71 to 2.30 t ha^{-1}, BARI Kaon-3 ranged from 178 to 1.84 t ha^{-1} and BARI Kaon-4 gave 1.94 to 2.45 t ha^{-1}. Among the tested varieties BARI Kaon-4 produced the maximum grain yield with higher gross return and gross margin at all the tested locations.

On farm trial of proso millet varieties in the char land and high barind tracts

A field trial was conducted at Khabuliar char Sonatola, Bogura and in the farmer's field at FSRD site, Basantopur, Godagari, Rajshahi during *Rabi* season of 2021-2022 to evaluate the performance of improved proso millet varieties under farmers' field condition. The experiment was laid out in RCB design with six dispersed replications. Proso millet var. BARI Cheena-1 gave higher grain yield (2.42 t ha^{-1}) over the local variety (1.73 t ha^{-1}) in Bogura with higher gross margin (Tk. 83100 ha^{-1}) over local cultivar. In High Barind Tract, seven lines viz. BD-777, BD-791, BD-1399, BD-1402, BD-1411, BD-1446, BD-1447 along with BARI Cheena-1 and a local variety as check were tested. Proso millet is a short duration crop and matured within 61 to 68 days. One thousand grain weight was ranged from 4.13 to 4.65g. Among the tested genotypes, BD-1446 produced the maximum grain yield (1.60 t ha^{-1}) followed by BD-1402 (1.54 t ha^{-1}) and BD-1411 (1.51 t ha^{-1}) and the lowest in BARI Cheena-1 (1.26 t ha^{-1}).

Adaptive trials with BARI barley and oat varieties in char areas

The trial was conducted at MLT sites Saghata, Gaibandha to observe the performance of barley and oat varieties in the char areas during the Rabi sesson of 2021-22. The experiment was laid out in RCB design with six dispersed replications. Two barley varieties viz., BARI Barley-7 and BARI Barley-9, and one oat variety BARI Oat-1 were tested. BARI Barley-9 produced the maximum grain yield (2.38 t ha^{-1}) followed by BARI Barley-7 (2.13 t ha^{-1}). The grain yield of BARI Oat-1 ranged from 0.9 to 1.0 t ha^{-1} with an average of 0.95 t ha^{-1}. Farmers in the char area showed interest to grow BARI Barley-7, BARI Barley-9, and BARI Oat-1. They demanded

timely supply of the seeds to cultivate BARI barley and oat varieties in the next growing sesson.

On farm trial of advanced lines of rapeseed

The trial was conducted in the farmer's field of Pabna, Tangail and Mymensingh during Rabi season of 2021-22 to evaluate the yield performance of some advanced lines of short duration mustard which could be fit in the existing cropping pattern. The experiment was laid out in RCB design with three dispersed replications. At Pabna, three lines viz. BC-100614(3)-1, BC-100614(8)-4 and BC-100614(4)-7 along with BARI Sarisha-14 as check were studied. At Tangail, three advanced lines viz. BC-100614(3)-1, BC-100614(4)-7, BC-100614(8)-4 and BARI Sarisha-14 was used as check. At Mymensingh, advanced lines viz. BC-100614(3)-1, BC-100614(8)-4, BC-100614(4)-7 and BARI Sarisha-14 as check were evaluated. Mustard line BC-100614(4)-7 exhibited significantly higher seed yield (1.22 t ha^{-1}) while the lowest seed yield (1.01 t ha^{-1}) of BARI Sarisha-14 was found at Pabna. Higher gross return (Tk. 125280 ha^{-1}) and gross margin (Tk. 66550 ha^{-1}) were also obtained from BC-100614(4)-7. At Tangail, the maximum seed yield was obtained from BC-100614(8)-4 (1.43 t ha^{-1}) followed by BC-100614(4)-7 (1.41 t ha^{-1}) and BARI Sarisha-14 (1.40 t ha^{-1}) whereas the lowest from BC-100614(3)-1 (1.37 t ha^{-1}). The highest gross return and gross margin (Tk.109970 ha^{-1} and Tk.62650 ha^{-1}) were also obtained from BC-100614(8)-4. At Mymensingh, the highest seed yield (2050 kg ha^{-1}) was obtained from BC-100614(4)-7 which was statistically similar with BC-100614(8)-4 (1925 kg ha^{-1}). The lowest seed yield was obtained from BARI Sarisha-14 (1600 kg ha^{-1}) followed by BC-100614(3)-1 (1675 kg ha^{-1}). The highest gross return (Tk.164000 ha^{-1}) and gross margin (Tk.119650 ha^{-1}) were recorded in BC-100614(4)-7.

Performance of selected mustard varieties under salinity condition in coastal area

The experiment was conducted in the farmer's field at MLT site, Koyra and Dacope, Khulna during Rabi season in 2021-2022 to evaluate the performance of mustard varieties against salinity. Seven mustard varieties viz. BARI Sarisha-11, BARI Sarisha-14, BARI Sarisha-16, BARI Sarisha-18 (canola type), BAU Sarisha-1 (canola type), BAU Sarisha-2 and BAU Sarisha-3 were evaluated. The experiment was laid out in RCB design with three dispersed replications. Crops at Dacope site damaged due to heavy rainfall at vegetative stage. At Koyra, the maximum seed yield was obtained from BARI Sarisha-11 (1.72 t ha^{-1}) which was statistically similar to BARI Sarisha-16 (1.65 t ha^{-1}) and the lowest from BARI Sarisha-14 (1.32 t ha^{-1}). Farmers preferred both BARI Sarisha-11 and BARI Sarisha-16 for their higher seed yield but due to longer field duration they chose BARI Sarisha-14 among the tested varieties.

On-farm trial of soybean varieties under rainfed condition

The experiment was conducted at farmer's field in Bhola sadar and Doulatkhan upazilla in Bhola district during Rabi season of 2021-2022 to select suitable soybean variety for char lands under rainfed condition.The experiment was laid out in RCB design with three dispersed replications. Among the tested varieties, the maximum seed yield (1.92 t ha^{-1}) was obtained in BARI Soybean-6 which was statistically identical with BARI Soybean-5 (1.78 t ha^{-1}) while the lowest yield (1.25 t ha^{-1}) was obtained from local variety. The highest gross margin was recorded in BARI Soybean-6 (Tk.62920 ha^{-1}) followed by BARI Soybean-5 (Tk. 55220 ha^{-1}) and the lowest (Tk. 26078 ha^{-1}) from local variety. BARI Soybean-5 and BARI Soybean-6 were much popular among the farmers' of Bhola. These two varieties should be disseminated in larger area including char.

On farm trial of mustard genotype in High Barind Tract (HBT) and Level Barind Tract (LBT)

A field trial was conducted in the farmer's field at FSRD site, Basantapur, Godagari, Rajshahi under High Baring Tract and at MLT site, Joypurhat under Level Barind Tract during Rabi season 2021-2022 to assess the performance of mustard genotypes. The experiment was laid out in RCB design with three dispersed replications. At Rajshahi, two lines were evaluated against a check variety of mustard viz. BJDH-12, JUN-536 and BARI Sharisha-16 were tested. Among the tested genotypes, BJDH-12 gave the maximum seed yield (1.86 t ha^{-1}) followed by BARI Sarisha-16 (1.66 t ha^{-1}) while JUN-536 produced the lowest seed yield (1.63 t ha^{-1}). At Joypurhat, three promising mustard genotypes, i.e. BJDH-11, BJDH-12 and Jun-536 were evaluated against BARI Sarisha-16 used as check. The maximum seed yield of 2.19 t ha^{-1} was recorded in BARI Sarisha-16 followed by Jun-536 (1.91 t ha^{-1}), BJDH-11 (1.75t ha^{-1}), and the lowest (1.63 t ha^{-1})

from BJDH-12. The highest gross return (Tk. 201780 ha^{-1}) and gross margin (Tk. 156437 ha^{-1}) was also obtained from BARI Sarisha-16 followed by Jun-536 but the lowest from BJDH-12.

On farm trial intercropping of chili with groundnut in haor areas

A field experiment was conducted during Rabi season of 2021-22 under MLT site, Moulvibazar. Three intercrop combinations such as 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 a locally popular chilli cultivar was used in this trial. The experiment was setup in RCB design with three dispersed replications. The highest pod yield (2.62 t ha^{-1}) was recorded in T_2 (groundnut+ 1 row chilli at 40 cm spacing). Under the intercrop systems, the yield of chilli 6.48 and 5.97 t ha^{-1} were obtained from treatment T_2 (groundnut+ 1 row of chilli at 40 cm spacing) and treatment T_3 (groundnut + 1 row of chilli at 60 cm spacing), respectively. The highest groundnut equivalent yield (10.84 t ha^{-1}) was also recorded in T_2 (groundnut+ 1 row of chilli at 40 cm spacing) with gross return of Tk. 650400 ha^{-1} and gross margin Tk. 509500 ha^{-1}, respectively. The highest BCR (4.95) was found in treatment T_3 (groundnut + 1 row of chilli at 60 cm spacing) compared to that of treatment T_2 (groundnut+ 1 row of chilli at 40 cm spacing) and sole cropping of groundnut.

Adaptive trial of advanced lines of sesame in Faridpur

The experiment was conducted at the FSRD site Faridpur during Kharif I season of 2021 to evaluate the performance of advanced lines of sesame in the farmer's field. Three advanced lines viz. Ses MR-20, Ses FR-20, Ses 2010-01R along with two check varieties viz. BARI Til-4 and BINA Til-1 were evaluated . The experiment was laid out in RCB design with four replications. The highest seed yield (1.63 t ha^{-1}) was obtained from BARI Til-4 due to maximum number of siliqua $plant^{-1}$ and 1000-seed weight which was similar with Ses MR-20 (1.56 t ha^{-1}) and Ses FR-20 (1.55 t ha^{-1}). The lowest seed yield (1.32 t ha^{-1}) was found in BINA Til-1 due to the lowest number of seed $siliqua^{-1}$. The seed yield of BARI Til-4 (1.63 tha^{-1}) was 5% higher than that of Ses MR-20 (1.56 tha^{-1}) and Ses FR-20 (01.55 t ha^{-1}).

On farm trial of BARI sunflower varieties

The experiment was conducted at Sharashing village under Shibaloya upazila of Manikganj district and MLT site, Barura and Chandina of Cumilla, Kasba of B. Baria and Shahrasti of Chandpur district under OFRD, BARI, Cumilla during the Rabi seasons of 2021-22 in farmers' field to select suitable variety of sunflower and to increase production and farmers income. In Manikganj area, three sunflower varieties viz. BARI Surjomukhi-2, BARI Surjomukhi-3 with a commercial variety Hysan-33 were evaluated. The seeds of Hysan-33 failed to germinate in the field but the performance of BARI varieties were quite good. BARI Surjomukhi-2 gave the highest seed yield (2.10 t ha^{-1}) compared to BARI Surjomukhi-3 (1.85 t ha^{-1}). Higher gross margin (Tk. 26735 ha^{-1}) and BCR (1.18) was also obtained from BARI Surjomukhi-2. In Cumilla region, BARI Surjamukhi-2, BARI Surjamukhi-3 and Hybrid RDS-275 were used. The result revealed that seed yield of BARI Surjamukhi-2 (2.18 t ha^{-1}) was the highest compared to other varieties. The major problem of BARI Surjamukhi-2 and RDS-275 was lodging tendency at the maturity stage when hailstorm was occurred. As the productivity of BARI Surjamukhi-2 was higher it provided higher gross return (Tk. 218000.00 ha^{-1}) and gross margin (Tk. 177500.00 ha^{-1}) among the tested varieties.

On-farm trial of BARI groundnut varieties

The experiment was conducted in the char areas at the MLT site, Bhuapur, Tangail and Daulatkhan and Bhola sadar upazilla under Bhola district during Rabi season of 2021-22 to find out the suitable groundnut variety for the charlands and to popularize the varieties among the farmers. In Tangail areas, five improved lines/varieties of groundnut viz. ICGV-07219, ICGV 36-1, ICGV-06285, BARI Chinabadam-8, and BARI Chinabadam-9 were used. The highest pod yield (2.50 t ha^{-1}) was recorded in ICGV-072019 whereas the lowest pod yield (1.80 t ha^{-1}) was obtained from BARI Chinabadam-8. Higher gross return (Tk. 162500 ha^{-1}) and gross margin (Tk. 114370 ha^{-1}) were was recorded in ICGV-072019 and the lowest gross return (Tk. 117000 ha^{-1}) and gross margin (Tk. 65870 ha^{-1}) from BARI Chinabadam-8. In Bhola district, four BARI groundnut varieties viz. BARI Chinabadam-8, BARI Chinabadam-9, BARI Chinabadam-10, BARI Chinabadam-11 and one local variety were used as check. The highest 100-

kernel weight was recorded in BARI Chinabadam-8 (102.0 g) followed by BARI Chinabadam-10 (99.5 g). The maximum average nut yield (2.14 t ha^{-1}) was recorded in BARI Chinabadam-9 which was statisticallay similar to all tested varieties except the local variety produced the lowest nut yield (1.37 t ha^{-1}). The yield was 56% higher in BARI Chinabadam-9 over the local variety.

On-farm trial of BARI brinjal varieties

The trial was conducted at Ghior upazila of Manikganj, Sadullahpur, Saghata and Sadar Upazilla of Gaibandha district during *Rabi* season of 2021-22 to evaluate the performance of BARI brinjal varieties against local varieties. Three brinjal varieties viz. BARI Begun-4, BARI Begun-10 and a local variety were tested. The experiment was conducted in RCB design with 4 dispersed replications. Out of the tested varieties, commercial hybrid (Lalteer) gave higher yield (40.13 t ha^{-1}) followed by BARI Begun-4 (30.15 t ha^{-1}) and BARI Begun-10 (19.22 t ha^{-1}) in Manikganj. But in Gaibandha, the maximum fruit yield (26.6 t ha^{-1}) was obtained from BARI Begun-10 followed by BARI Begun-8 (18.2 t ha^{-1}). The higher gross return Tk. 328100.00 ha^{-1} and gross margin (Tk. 199559.00 ha^{-1}) were also obtained from Lalteer hybrid followed by BARI Begun-4 (Tk. 328100.00 ha^{-1} and Tk.99559ha^{-1}) in Manikganj. The maximum gross margin (Tk. 116300 ha^{-1}) with higher MBCR (3.7) was recorded in BARI Begun-10 followed by BARI Begun-8 in Gaibandha with the lowest gross margin (Tk. 31200 ha^{-1}) from the local variety.

On-farm trail of BARI hybrid brinjal varieties

The trial was conducted at the FSRD site, Atia of Tangail and MLT site, Koyra of Khulna district during *Rabi* season of 2021-2022. The experiment was laid out in RCB design with six dispersed replications. Two hybrid brinjal varieties viz. BARI Hybrid Begun-3 and BARI Hybrid Begun-4 were evaluated against a local hybrid (Purple King) in Tangail. BARI Hybrid Begun-5, BARI Hybrid Begun-6 and BARI Begun-12 were evaluated in Khulna. The maximum fruit yield was obtained from local variety, Purple King (42.88 t ha^{-1}) followed by BARI Hybrid Begun-3 (42.24 t ha^{-1}) in Tangail. In Khulna, the maximum fruit yield (50.20 t ha^{-1}) was obtained from BARI Hybrid begun-6 followed by BARI Hybrid Begun-5 (48.80 t ha^{-1}) and BARI Begun-12 gave the lowest (38.6 t ha^{-1}) yield.

On-farm trial of BARI country bean varieties in Faridpur

A field experiment was carried out at the FSRD site, Faridpur during Kharif II season of 2021 to evaluate the performance of BARI developed country bean varieties and to popularize the varieties among the farmers. The trial was laid out in RCB design with six dispersed replications. Country bean var. BARI Sheem-1, BARI Sheem-6 and BARI Sheem-8 were evaluated against local variety (Hybrid Rupban). The highest fruit yield (20.35 t ha^{-1}) was recorded in BARI Sheem-6 due to higher number of pod $plant^{-1}$ which was statistically similar with BARI Sheem-1 (19.15 t ha^{-1}) and the lowest in local variety (16.15 t ha^{-1}). The maximum gross margin (Tk. 371700.00 ha^{-1}) and BCR (2.09) was achieved from BARI Sheem-6 because of higher market price than that of local cultivar. The lowest gross margin was calculated from local cultival (Tk. 82150.00 ha^{-1}).

On-farm trial of BARI hybrid pumpkin varieties

The trial was conducted at Dhamrai, Dhaka; Saturia, Manikganj; Cumilla, Brahmanbaria and Chandpur; Tala, Satkhira; Muktagacha and Trishal, Mymensingh and Sreebordi, Sherpur during *Rabi* season of 2021-22 to evaluate the performance of BARI developed pumpkin varieties in farmers' field. Three BARI pumpkin varieties viz. BARI Hybrid Mistikumra-1, BARI Hybrid Mistikumra-2, BARI Hybrid Mistikumra-3 were evaluated against locally available hybrid varieties in different locations. The experiment was laid out in RCB design with six dispersed replications. The fruit yield of BARI Hybrid Mistikumra-1 (19.44-39.30 t ha^{-1}), Hybrid Mistikumra-2 (18.01-48.60 t ha^{-1}) and BARI Hybrid Mistikumra-3 (24.80-46.20 t ha^{-1}) showed better performance over local hybrid varieties at all the tested locations except Dhamrai, Dhaka where local Sweety hybrid gave higher fruit yield (47.72 t ha^{-1}). BARI hybrid varieties produced higher yield in Manikganj and Khulna regions as compared to Mymensingh and sherpur. BARI hybrid varieties produced higher gross margin over local hybrids in all locations except Dhamrai, Dhaka. Market demand was higher in all BARI hybrid Mistikumra varieties due to its medium fruit size. Sweet gourd var. BARI Hybrid Mistikumra-2 and 3 showed better performance regarding yield in the study areas. Therefore, these two varieties can be recommended for large scale extension in the farmer's field at sweet gourd producing areas of Bangladesh.

ON-farm trial of BARI winter tomato varieties

The trial was conducted at Manikganj, Cumilla, Khulna, Gaibandha, Dinajpur and Noakhali during *Rabi* season of 2021-22 to evaluate the performance of BARI winter tomato varieties. Eight BARI 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 local hybrid varieties as check. The experiment was laid out in RCB design with six dispersed replications. BARI Tomato varieties performed better in different locations compared to local varieties. BARI Tomato-14 (54.57 t ha^{-1}) and BARI Tomato-15 (52.29 t ha^{-1}) gave statistically similar yields but BARI Tomato-19 produced significantly higher yield (80.15 t ha^{-1}) at Dinajpur. Higher yield from BARI Tomato-16 was found at Manikganj (75.76 t ha^{-1}) and Dinajpur (62.27 t ha^{-1}) whereas BARI Tomato-17 gave higher yield at Gaibandha (71.60 t ha^{-1}) but lower at Dinajpur (54.20 t ha^{-1}). The maximum fruit yield from BARI Tomato-18 was obtained at Dinajpur (76.68 t ha^{-1}) followed by Gaibandha (72.40 t ha^{-1}) and Manikganj (68.65 t ha^{-1}). The fruit yield of BARI Tomato-20 was comparatively lower than other BARI varieties yielded 49.00 t ha^{-1} at Noakhali, 47.10 t ha^{-1} at Khulna, 39.60 t ha^{-1} at Cumilla and 34.05 t ha^{-1} at Dinajpur. The maximum fruit yield of BARI Tomato-21 was recorded at Manikganj (78.24 t ha^{-1}) followed by Gaibandha (76.50 t ha^{-1}), Dinajpur (75.03 t ha^{-1}), Khulna (73.30 t ha^{-1}), Cumilla (51.90 t ha^{-1}) and Patuakhali (42.59 t ha^{-1}) but the lowest at Noakhali (23.10 t ha^{-1}). The yield of commercial hybrids ranged from 41.40 to 80.12 t ha^{-1} where Lalteer hybrid (80.12 t ha^{-1}) at Manikganj produced the maximum yield followed by Bahoboly (41.40 t ha^{-1}) at Cumilla, Local variety (57.40 t ha^{-1}) at Gaibandha, Bizli Super at Patuakhali (54.71 t ha^{-1}), Rani hybrid (50.65 t ha^{-1}) at Dinajpur and Mintu hybrid (43.20 t ha^{-1}). Higher gross margin was obtained from BARI winter tomato varieties in all the tested locations compared to local varieties except at Patuakhali where local hybrid gave higher gross margin over BARI varieties.

On-farm trial of BARI winter hybrid tomato varieties

The field experiment was conducted at Tangail, Manikganj, Gopalganj, Patuakhali, Munshiganj and Gazipur during Rabi season of 2021-22 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 and BARI Hybrid Tomato-9 against Bipul Plus hybrid at Tangail and Gopalgonj. BARI hybrid Tomato-7 and BARI hybrid Tomato-9 were evaluated with commercial hybrids as check at Manikganj, Munshiganj and Gazipur. BARI Hybrid Tomato-7, BARI Hybrid Tomato-9 were compared with two locally available hybrids viz. Unnayan and Lalpakri at Patuakhali. BARI Hybrid Tomato-7 gave the highest fruit yield at Atia (89.00 t ha^{-1}) and Madhupur (88.00 t ha^{-1}) of Tangail while the lowest (75.00 and 76.00 t ha^{-1}) from Bipul Plus hybrid at both the tested locations of Tangail. At Gopalgonj, Bipul plus hybrid gave higher yield (81.41t ha^{-1}) which was statistically similar to BARI Hybrid Tomato-9 (78.69 t ha^{-1})) but the lowest (69.58 t ha^{-1}) in BARI Hybrid Tomato-5. BARI winter hybrid Tomato-7 produced higher yields (87.73 and 92.03 t ha^{-1}) at Saturia and Shibaloya compared to Unnayan hybrid 75.50 and 89.52 t ha^{-1}, respectively. BARI winter hybrid Tomato-9 gave fruit yields 72.23, 79.20 and 87.53 t ha^{-1} at Ghior, Saturia and Shibaloya, respectively where the maximum yield (91.28 t ha^{-1}) was obtained from Bipul Plus hybrid at Shibaloya of Manikganj. BARI Hybrid Tomato-9 at Patuakhali produced the maximum fruit yield (104.73 t ha^{-1}) followed by BARI Hybrid Tomato-7 (85.60 t ha^{-1}) but lower yields were obtained from Unnayan hybrid (72.44 t ha^{-1}) and Lalpakri hybrid (69.16 t ha^{-1}) at the same location. BARI hybrid Tomato-9 produced higher fruit yields both at Munshiganj (87.00 t ha^{-1}) and Gazipur (70.3 t ha^{-1}) followed by BARI hybrid Tomato-7 producing 69.4 t ha^{-1} at Munshiganj and 58.00 t ha^{-1} at Gazipur but the lowest from local variety 62.2 t ha^{-1} at Munshiganj and 31.3 t ha^{-1} at Gazipur. Higher gross margin was also obtained from BARI varieties due to higher fruit yields and lower price of seed at all the tested locations.

On-farm trial of BARI bottle gourd varieties

The trial was conducted at Satkhira and Bandarban during Rabi season of 2021-22 to evaluate the performance of BARI developed high yielding bottle gourd varieties in the farmer's field. Bottle gourd var. BARI Lau-4, BARI Lau-5 and local variety were included at Sathkhira and BARI Lau-3, BARI Lau-4 and BARI Lau-5 were tested against commercial hybrid variety in the hill valleys of

Bandarban. The experiment was laid out in RCB design with six dispersed replications. BARI Lau-4 gave the highest fruit yield (49.00 t ha^{-1}) followed by BARI Lau-5 (39.17 t ha^{-1}) and the lowest from local variety (26.65 t ha^{-1}) at Satkhira. In the hill valleys of Bandarban, the highest fruit yield was obtained from BARI Lau-4 (34.66 t ha^{-1}) followed by local variety (32.98 ha^{-1})), BARI Lau-5 (22.88 t ha^{-1}) and the lowest from BARI Lau-3 (21.34 t ha^{-1}). The maximum gross margin was also obtained from BARI Lau-4 at all the tested locations.

On-farm adaptive trial of BARI capsicum varieties

The experiment was carried out at charland of Bhola sadar and Daulatkhan under Bhola district and at MLT site, Chandina and Barura of Cumilla and Saharasti of Chandpur during Rabi season of 2021-22 to evaluate the performance of BARI developed capsicum varieties. Three capsicum varieties viz. BARI Mishtimorich-1, BARI Mishtimorich-2 and locally popular capsicum hybrid Maria at Bhola and capsicum hybrid Dream at Cumilla were tested. The experiment was laid out in RCB design with six dispersed replications. Among the tested varieties, Hybrid Maria gave the maximum fruit yield (14.42 t ha^{-1}) followed by BARI Mishtimorich-2 (12.97 t ha^{-1}) and the lowest fruit yield was obtained from BARI Mishtimorich-1 (9.21 t ha^{-1}) at Bhola and the highest yield (22.06 t ha^{-1}) was obtained from BARI Mistimorich-2 compared to local variety and BARI Capsicum-1 at Cumilla region. The highest gross return (Tk. 1009400 ha^{-1}), gross margin (Tk. 680900 ha^{-1}) was found from hybrid variety Maria due to higher yield but the maximum BCR (3.15) were obtained from BARI Mishtimorich-2 due to low cost of seed. At Cumilla, higher gross return (Tk. 1544200 ha^{-1}), gross margin (Tk. 1314200 ha^{-1}) and BCR (6.7) were obtained from BARI Mistimorich-2.

On-farm trial of BARI broccoli variety

The experiment was conducted at Bikrichhara hill valleys of Bandarban sadar and FSRD site, Dharmapur, Subornachar which belong to AEZ 18c (non-saline medium high land adjacent to farmers homestead) during the Rabi season, 2021-22 to evaluate the performance of BARI Broccoli-1 in farmers' field. A hybrid variety (Early You) of broccoli was used as check at Banadarban and Green Magic at Noakhali. The experiment was laid out in RCB design with three dispersed replications. BARI Broccoli-1 gave higher single head weight (228.47 g) and curd yield (11.16 t ha^{-1}) than hybrid variety (222.27 g and 10.20 t ha^{-1}). The highest gross margin (Tk. 341400 ha^{-1}) and BCR (4.25) were found from BARI Broccoli-1 than hybrid variety (Tk. 303000 ha^{-1} and 3.89). At Noakhali, significant variation was observed in single curd weight between hybrid variety (431.8 g) and BARI Broccoli-1(394.6 g). Hybrid variety produced the maximum curd yield (16.5 t ha^{-1}) while 15.3 t ha^{-1} was obtained from BARI Broccoli-1. Higher gross margin (Tk. 355600 ha^{-1}) obtained from hybrid variety compared to BARI Broccoli-1 variety (Tk. 309500 ha^{-1}).

On-farm trial of BARI hybrid bitter gourd varieties

The experiment was conducted at MLT site, Chandina and Debidwer of Cumilla, Saharasti of Chandpur and Kasba of B. Baria during *Kharif-1* season of 2021 to evaluate the performance of BARI developed newly released high yielding hybrid bitter gourd varieties BARI Hybrid Korola-2 and BARI Hybrid Korola-3 against commercial hybrid bitter gourd (Tia). The experiment was laid out in RCB design with six dispersed replications. The highest fruit yield (18.42 t ha^{-1}) was obtained from Hybrid Korola-Tia compared to BARI Hybrid Korola-2 and BARI Hybrid Korola-3 at Cumilla region. The highest gross return (Tk. 1105200.00 ha^{-1}) and gross margin (Tk. 980200.00 ha^{-1}) were also found in hybrid Korola-Tia compared to BARI Hybrid Korola-2 and BARI Hybrid Korola-3.

On-farm trial of BARI sponge gourd variety

The trial was conducted at MLT site, Debidwer of Cumilla during *Kharif-1* season of 2021-22 to evaluate the performance of BARI developed high yielding sponge gourd variety. BARI Dhundul-2 was tested against commercial Dhundul (Mahi) in farmer's field. The experiment was laid out in RCB design with six dispersed replications. Commercial hybrid Mahi gave the higher fruit yield (25.44 t ha^{-1}) compared to BARI Dhundol-2 (23.65 t ha^{-1}). The gross return (Tk. 356160.00 ha^{-1}) and gross margin (Tk. 269160 ha^{-1}) were also higher in Mahi compared to BARI Dhundol-2 (Tk. 331100.00 and Tk. 246100.00 ha^{-1}).

On-farm trial of BARI lemon varieties in the hilly areas of Bandarban

The experiment was conducted at farmer's field of hill slopes of Bandarban sadar during Rabi season of 2021-22 to evaluate the performance of BARI lemon

varieties and to select suitable variety for hilly areas of Bandarban. Vegetative data were collected immediate after planting on 27 September, 2021 and 18 May, 2022 to evaluate annual increment. The investigation revealed that vegetative growth of lemon varieties varied significantly. Overall tree volume was found high in Chaina-3 seedless Lebu throughout the year (921.33%) followed by BARI Lebu-1 (751.81%) and BARI Kagaji Lebu-1 showed the least increment (289.23%) in the first year. The highest increment percentage in plant height was observed in BARI Lebu-2 (61.41%) followed by Chaina-3 seedless lebu (107.82%) and lowest increment in BARI Kagaji Lebu-1 (68.23). Flower initiation just have started in different lemon varieties. First flowering in BARI Lebu-3 and BARI Lebu-4 was observed on 1st May followed by Chaina-3 seedless Lebu and Thai seedless Lebu on 2nd week of May. Reproductive parameters and yield data will be collected as the growth progress.

Performance of BARI mango varieties in the hilly areas of Bandarban

The trial was conducted at farmer's field of hill slopes of Bandarban sadar during *Rabi* season of 2021-22 to evaluate the performance of BARI mango varieties along with other popular commercial varieties to find out suitable variety for hilly areas of Bandarban. Mango saplings were planted on 11 July, 2021 with a spacing of 6m×6m. Vegetative data were collected immediate after planting on 11 July, 2021 and 18 May, 2022 to evaluate annual increment. The investigation revealed that vegetative growth of mango varieties varied significantly for all the parameters. Overall tree volume rises more in BARI Aam-4 throughout the year (776.92%) followed by BARI Aam-11 (707.69%) whereas BARI Aam-10 showed the least increment (90.91%) in first year. Highest increment percentage in plant height, stem girth and canopy were observed in BARI Aam-4 (61.41%), BARI Aam-3 (135.60%) and BARI Aam-11 (140.23% in North-South and 156.38% in East-West direction), respectively. Reproductive parameters and yield data will be collected from the following year.

Adaptive trial with newly released potato varieties in different locations

A set of trials were conducted at farmers' fields in sixteen different locations (Chandpur, Faridpur, Gaibandha, Khulna, Kishorganj, Manikganj, Mymensingh, Norshingdi, Rangpur, Tangail, Kushtia, Sherpur, Sylhet, Rajshahi, Gopalganj and Bhola) under the supervision of the On-Farm Research Division (OFRD), BARI during the Rabi season of 2021-22 to evaluate the performance of the 10 (Ten) high yielding potato varieties and to know farmers' preference 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-50, BARI Alu-56, BARI Alu-57, and BARI Alu-62 were used across the locations of Bangladesh. In all sites, trials were laid following RCB design with four to five dispersed replications. The yield performance of most of the varieties appeared to be promising in the tested locations. Among the tested potato varieties, BARI Alu-41 produced the highest average tuber yield (36.80 t ha^{-1}) followed by BARI Alu-40 (35.39 t ha^{-1}) and BARI Alu-62 (34.67 t ha^{-1}) whereas the lowest in BARI Alu-37 (31.19 t ha^{-1}). Considering the location, the highest tuber yield (40.96 t ha^{-1}) was recorded in Kishoregonj, followed by Rajshahi (39.51 t ha^{-1}) and Sylhet (38.10 t ha^{-1}) whereas lower yields were recorded in Khulna (28.08 t ha^{-1}), Faridpur (28.80 t ha^{-1}) and Bhola (28.98 t ha^{-1}). No variety was found tolerant to Late Blight and the foliage infestation was wide-ranged from 0-45% across the locations among the tested varieties. The average foliage infection by late blight was the highest in BARI Alu-37 (25.1%) and the lowest in BARI Alu-48 (14.04%). In the case of locations, the average highest late blight infestation was recorded in Gaibandha (29%) and the lowest in Mymensingh with a value of 6%. On the contrary, the virus infection was the maximum in BARI Alu-36 (1.56%), similar to BARI Alu-41 (1.54%) and BARI Alu-50 (1.51%) and the lowest in BARI Alu-47 and BARI Alu-56 (0.84%). The average highest virus infection was recorded in Rangpur (2.29%) and the lowest in Rajshahi (0.06%). The average highest gross return (Tk. 605940 ha^{-1}) and gross margin (Tk. 390690 ha^{-1}) were recorded in Mymensingh and the lowest gross return (Tk. 318030 ha^{-1}) and gross margin (Tk. 181330 ha^{-1}) in Gaibandha. The variation was observed mainly due to the variation of the local market price of potato across the locations.

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, Lalmonirhat, Kurigram, Rangpur, and Rajshahi during the Rabi season of

2021-22 to evaluate the field performance of BARI released three late blight resistant Potato varieties (BARI Alu-46, BARI Alu-53, and BARI Alu-77) and to know farmers' judgement about the varieties. The experiment was laid out in RCB design with four dispersed replications. Among the tested varieties BARI Alu-46, BARI Alu-53 and BARI Alu-77 performed better in all the locations and gave 46, 42, and 34% higher tuber yield than the check variety (BARI Alu-25). These two varieties showed less than 0-5% late blight infection in the foliage. Regarding Common Scab susceptibility, its severity was very low (<3%). Farmers' decision about potato varieties varied with locations mostly for yield performance and skin color. According to farmers' judgment the popular var. BARI Alu-46, BARI Alu-53, and BARI Alu-77 were highly resistant to the late blight of potato disease, which reduced the cost of production without hampering tuber yield. In all the locations, farmers choose BARI Alu-53 considering yield, the skin color of the tuber, market demand, and cost-benefit analysis.

Promotion and dissemination of newly released climate-smart potato varieties

BARI released three climate-smart potato varieties viz. BARI Alu-72, BARI Alu-73, and BARI Alu-78 were evaluated at the farmer's fields in the Khulna and Bhola to observe their yield performance in the southern districts of Bangladesh. Soil Salinity was recorded for the locations of Khulna and Bhola was non-Saline. The experiment was laid out in RCB design with four dispersed replications. The average soil salinity levels ranged from 1.85 to 8.11 dSm^{-1} in all locations. Among the varieties, BARI Alu-78 (31.41 t ha^{-1}) was the average highest yielder followed by BARI Alu-72 (26.71 t ha^{-1}) and the lowest yield was obtained from BARI Alu-73 (25.32 t ha^{-1}). In all locations, BARI Alu-78 performed better due to its higher adaptability to heat and saline conditions. Higher average gross return and gross margin were accounted from BARI Alu-78 for its higher yield.

Adaptive trials with mukhikachu varieties in different locations

The experiment was conducted at six locations such as Narsingdi, Kushtia, Jashore, Mymensingh, Sherpur, and Kishoreganj under OFRD during the Kharif season of 2019-20 to evaluate the performance of three Mukhikachu varieties namely, BARI Mukhikachu-1, BARI Mukhikachu-2 and local variety used as check under farmers' field and to popularize among the farmers. The experiment was laid out in RCB design with six dispersed replications. The average maximum corm yield (25.95 t ha^{-1}) was produced by BARI Mukhikachu-2 followed by BARI Mukhikachu-1 (24.31 t ha^{-1}) whereas the lowest corm yield (23.61 t ha^{-1}) was found in local variety. In terms of location, the average highest corm yield was recorded in Kustia (40.59 t ha^{-1}), followed by Mymensingh (29.70t ha^{-1}), Sherpur (28.31 t ha^{-1}) and the lowest corm yield was recorded in Jashore (10.43 t ha^{-1}). The highest gross return (Tk. 814500 ha^{-1}) and gross margin (Tk. 627180 ha^{-1}) were found from the local variety. The lowest gross return (Tk. 206520 ha^{-1}) and gross margin (Tk. 93840 ha^{-1}) was obtained from the local cultivar in Kishoreganj.

Adaptive trials with newly released panikachu varieties in different locations

The experiment was conducted at the MLT site of Magura, and Kishoregonj under OFRD during the Kharif season of 2020-21 to evaluate the performance of eight panikachu varieties/genotypes and to popularize the varieties among the farmers. Eight panikachu varieties/genotypes viz, BARI Panikachu-1, BARI Panikachu-2, BARI Panikachu-3, BARI Panikachu-4, BARI Panikachu-5, BARI Panikachu-6, PK 179 and PK 183 along with local varieties were tested at farm level. The experiment was laid out in RCB design with six dispersed replications. The stolon yield of the Panikachu varieties ranged from 4.80 to 23.20 t ha^{-1}, where the highest was observed in BARI Panikachu-1 (23.20 t ha^{-1}) and the lowest in BARI Paniikachu-6 (4.80 t ha^{-1}) in Magura. Considering rhizome yield, the highest was observed in BARI Panikachu-4 (40.80 t ha^{-1}) in Magura and the lowest in BARI Paniikachu-1 (16.89 t ha^{-1}) in Kishoreganj. In Magura, the highest gross return (Tk. 1076000 ha^{-1}), gross margin (Tk. 847700 ha^{-1}), and MBCR (61.2) were obtained from BARI Panikachu-1. Similarly, in Kishoreganj, the highest gross return (Tk. 954850.00 ha^{-1}) and gross margin (Tk. 735350.00 ha^{-1}) were obtained from the BARI Panikachu-1 and the lowest gross return (Tk. 329300.00 ha^{-1}) and gross margin (Tk. 109800.00 ha^{-1}) were obtained from BARI Panikachu-5.

On-farm trial with BARI released varieties of panikachu

The trial was conducted at MLT site of Tishal under OFRD, BARI, Mymensingh during the Kharif

season of 2021 to evaluate the performance of seven Panikachu varieties i.e. BARI Panikachu-1, BARI Panikachu-2, BARI Panikachu-3, BARI Panikachu-4, BARI Panikachu-5, BARI Panikachu-6 and a local variety. The experiment was laid out in RCB design with six dispersed replications. The highest average stolon yield (24.3 t ha^{-1}) was obtained from BARI Paniikachu-1 and the lowest (7.2 t ha^{-1}) in BARI Paniikachu-5. The highest rhizome yield (62.5 t ha^{-1}) was found in BARI Panikachu-6 and the lowest (20.6 t ha^{-1}) in BARI Paniikachu-1. The highest gross return (Tk. 954850.00 ha^{-1}) and gross margin (Tk. 735350.00 ha^{-1}) were also obtained from the BARI Panikachu-1 and the lowest gross return (329300.00 Tk. ha^{-1}) and gross margin (Tk. 109800.00 ha^{-1}) from BARI Panikachu-5.

Adaptive trial of promising sweet potato varieties in different locations

Field trials were conducted in Jamalpur and Kishoreganj during 2021-22 to evaluate the comparative performance of sweet potato varieties and to know the farmer's opinion about these cultivars in the respective locations. The experiment was laid out in RCB design with six dispersed replications. In Jamalpur, four sweet potato varieties viz. BARI Mistialu-12, BARI Mistialu-15, BARI Mistilu-16, and BARI Mistialu-17 whereas in Kishoreganj three sweet potato varieties viz. BARI Mistialu-12, BARI Mistialu-14 and BARI Mistilu-17 were used. The root yield of sweet potato varieties ranged from 21.15 to 31.60 t ha^{-1}, where BARI Mistialu-12 produced the highest average root yield (31.60 t ha^{-1}) in Jamalpur and the lowest average tuber root yield obtained from BARI Mistialu-17 in Kishoregonj (21.15 t ha^{-1}). Among the BARI released sweet potato varieties, BARI Mistialu-12 produced the highest tuberous root yield (30.05 t ha^{-1}) and the lowest average root yield (23.10 t ha^{-1}) in BARI Mistialu-16. The highest gross return (Tk. 437000 ha^{-1}) and gross margin (Tk. 286430 ha^{-1}) were calculated from BARI Mistialu-15 in Jamalpur.

On-farm trial of BARI released sweet potato varieties

On-Farm trials of sweet potato varieties were conducted at farmers' field of Kushtia, Tangail, Mymensingh and Bhola during 2021-22. The objective of the trial was to popularize BARI-released sweet potato varieties. The experiment was laid out in RCB design with four dispersed replications. The tested varieties were BARI Misti Alu-4, BARI Misti Alu-8, BARI Misti Alu-10, BARI Misti Alu-11, BARI Misti Alu-12, BARI Misti Alu-14, BARI Misti Alu-15, BARI Misti Alu-16, and BARI Misti Alu-17. The varieties had different skin and flesh colors, which attracted farmers. Most of the farmers chose BARI sweet potato varieties depended on the market price. Farmers at Kushtia preferred BARI Misti Alu-4, BARI Mistialu-8, and BARI Mistialu-15 at Tangail; BARI Mistialu-12, BARI Mistialu-14 and BARI Mistialu-17 at Mymensingh, and BARI Mishtialu-8 and BARI Mishtialu-10 at Bhola for their higher yield, attractive color, good market demand and also delicious to eat.

Participatory variety selection of blackgram

The field trial was carried out at the farmer's field of FSRD site, Basantopur, Godagari, Rajshahi (High Barind Tract-HBT), Sonatola Upazila under Bogura and Saghata under Gaibandha during kharif-2 season 2021 to select suitable blackgram variety under drought prone area. Six genotypes of blackgram viz. BBLXK2-12005-5, BBLXK2-12002-4, BBLXK2-12005-6, BBLXK2-04001-1, BBLXK2-08008-2, BBLXK2-12002-2 and two check varieties viz. BARI Mash-3 and BARI Mash-4 were tested in the farmer's field. At Godagari, genotypes BBLXK2-12002-4 gave the maximum seed yield (1.28 t ha^{-1}) followed by BBLXK2-12005-5 (1.24 t ha^{-1}) and the minimum seed yield obtained from BARI Mash-4 (0.93 t ha^{-1}) and BBLXK2-12005-6 (0.95 t ha^{-1}). At Bogura, the maximum seed yield (2.11 t ha^{-1}) was obtained from BARI Mash-4 followed by BBLXK2-12002-2. Other accessions like BBLXK2-12005-5, BBLXK2-12002-4, BBLXK2-12002-2 and BARI Mash-4 have statistically similar yield potentials. The lowest yield (1.05 t ha^{-1}) was recorded in BBLXK2-04001-1. At Gaibandha, the highest yield (1.54 t ha-1) was obtained from E5 (BBLXK2-04001-1) line similar to E6 (BBLXK2-08008-2-1) with seed yield of 1.49 t ha^{-1} whereas the lowest yield was observed in the check varieties. However, among the 6 new lines, E5 (BBLXK2-04001-1) and E6 (BBLXK2-08008-2-1) showed the best yield performance with number of pods $plant^{-1}$ (41 to 42) and 100-seed weight (4.87 g).

Yield performance of BARI released blackgram varieties in char land areas of Rajshahi region

A field trial was conducted in the charland area of Charkhari, Jagati, Premtoli, Godagari, Rajshahi

during the kharif-2 season of 2021 to find out the suitable blackgram varieties. The experiment was laid out in RCB design with four dispersed replications.Two blackgram varieties viz. BARI Mash-3 and BARI Mash-4 and a local variety (Thakrikali) were used as check. BARI Mash-3 produced the maximum seed yield (1.58 t ha-1) followed by BARI Mash-4 (1.31 t ha^{-1}) and local variety (Thakrikali) (1.14 t ha^{-1}). The yield performance revealed that blackgran var. BARI Mash-3 and BARI Mash-4 appeared to be promising in the charlands of Premtoli, Godagari, Rajshahi.

Adaptive trial of different varieties of mungbean in coastal area

The experiment was conducted at Keoyabunia, Amtoli, Borguna during late Rabi season of 2021-22 to evaluate the performance of some mungbean varieties in coastal area. The experiment was laid out in RCB design with four dispersed replications. Four mungbean var. BARI Mung-6, BARI Mung-8, BINA Mung-7 and BINA Mung-8 were evaluated. The growth parameters and yield contributing characters of mungbean plant were found significantly different among the varieties. The maximum seed yield (1.71 t ha^{-1}) was obtained from BARI Mung-6 followed by BINA Mung-8 (1.21 t ha^{-1}) and BINA Mung-7 (1.18 t ha^{-1}). The lowest seed yield (1.06 t ha^{-1}) was obtained by BARI Mung-8. The maximum gross return (Tk. 110500 ha^{-1}) was obtained from BARI Mung-6 as well as gross margin (Tk. 68950 ha^{-1}) and BCR (2.65) from same variety. The lowest economic return was recorded from BARI Mung-8 (Tk. 68900 ha^{-1}) and BCR (1.66). BARI Mung-6 was found the most productive variety under the coastal area.

On farm trial of lentil varieties in Dinajpur

The experiment was conducted at farmer's field of MLT site, Raniganj under Sadar upazila of Dinajpur during Rabi season of 2021-2022 to observe the performance of BARI released lentil variety in Dinajpur region. The experiment was laid out in RCB design with four dispersed replications. Four BARI released lentil varieties viz. BARI Masur-5, BARI Masur-7, BARI Masur-8, BARI Masur-9 were tested. Both BARI Masur-8 and BARI Masur-9 were found to be promising in the tested location. Among the tested varieties, BARI Masur-8 gave the highest seed yield (1.88 t ha^{-1}) followed by BARI Masur-9 (1.63 t ha^{-1}). The highest gross margin (Tk. 87900 ha^{-1}) was obtained from BARI Masur-8 and (Tk. 67900 ha^{-1}) from BARI Masur-9. So, both the varieties could be extended in the farmers' field in Dinajpur region.

On-farm trial of chickpea varieties

A field trial was conducted in the farmer's field of MLT site, Saghata, Gaibandh; stable charland of Bonogram, Chilmari, Kurigram and and at the Agricultural Research Station, Dinajpur during Rabi season of 2021-22 to evaluate the performance of Chickpea varieties. The experiment was laid out in RCB design with four dispersed replications. Three chickpea var. BARI Chola-9, BARI Chola-10, and BARI Chola-11 were evaluated at Dinajpour whereas four varieties of chickpea viz. BARI Chhola-5, BARI Chhola-9, BARI Chhola-10, and BARI Chhola-11 were tested in Rangpur and Dinajpur. At Gaiband, BARI Chola-9 produced the maximum seed yield (1.96 t ha^{-1}) followed by BARI Chola-10 (1.80 t ha^{-1}) due to the maximum 100-seed weight (21.4 g) and number of pods $plant^{-1}$ (57). The lowest seed yield (1.15 t ha^{-1}) was produced by BARI Chola-11 due to the less number of pod $plant^{-1}$ (43) as well as 100-seed weight (18.2 g). At Rangpur, BARI Chhola-9 gave maximum seed yield (1.38 t ha^{-1}) followed by BARI Chhola-10 (1.29 t ha^{-1}) and BARI Chhola-5 (1.25 t ha^{-1}). The maximum gross return (Tk. 105750 ha^{-1}) and gross margin (Tk. 56535 ha^{-1}) were obtained from BARI Chhola-9. At Dinajpur, BARI Chickpea 9 gave maximum seed yield (2.43 t ha^{-1}) followed by BARI Chickpea 5 (1.82 t ha^{-1}) and the minimum seed yield (0.97 t ha^{-1}) from BARI Chola-10 among the tested varieties.

Regional yield trial of chickpea

The field trial was carried out at the farmer's field of FSRD site, Basantopur, Godagari, Rajshahi during rabi season 2021-22 to select suitable chickpea variety through regional yield trial (RYT) under drought prone area. Four genotypes of chickpea viz. BCX-09010-9, BCX-13005-8, BCX-13005-3, BCX-13002-2, and two varieties BARI Chola-5 and BARI Chola-10 as check were tested. Among the tested genotypes, BCX-13002-2 gave the maximum seed yield (1.86 t ha^{-1}) followed by BCX-13005-3 (1.79 t ha^{-1}) and the minimum seed yield was obtained from BARI Chola-10 (1.13 t ha^{-1}). The performance of chickpea var. BARI **c**hola-5, line BCX-13002-2 and BCX-13005-3 appeared to be promising at FSRD site, Basantopur, Godagari, Rajshahi during the study period.

Preliminary yield trial of chickpea

The field trial was carried out at the farmer's field of FSRD site, Basantopur, Godagari, Rajshahi during *rabi* season 2021-22 to select suitable chickpea genotype through regional yield trial (RYT) under drought prone area. Ten genotypes of chickpea viz. ICCV-181632, ICCV-181633, ICCV-181635, ICCV-181636, ICCV-181634, ICCV-181650, ICCV-181652, ICCV-181630, ICCV-181624, ICCV-181627 and two BARI released varieties BARI Chola-5 and BARI Chola-10 as check were tested in the farmer's field. Among the tested genotypes, ICCV-181635 gave the maximum seed yield (1.67 t ha^{-1}) followed by BARI Chola-5 (1.56 t ha^{-1}) and minimum seed yield from ICCV-181650 (0.71 t ha^{-1}) due to minimum pods $plant^{-1}$. Among other genotypes, ICCV-181624 gave the seed yield 1.54 t ha^{-1}, BARI Chola-10 gave 1.52 t ha^{-1}, ICCV-181634 gave 1.50 t ha^{-1}, ICCV-181636 gave 1.47 t ha^{-1}, ICCV-181627 gave 1.43 t ha^{-1}, ICCV-181633 gave 1.34 t ha^{-1} and ICCV-181630 gave 1.26 t ha^{-1}. The performance of chickpea genotypes ICCV-181635, var. BARI **c**hola-5 and line ICCV-181624 appeared to be promising among the genotype/lines tested at FSRD site, Basantopur, Godagari, Rajshahi during the study period.

Evaluation of grasspea genotypes for char areas of Gaibandha

The trial was conducted with nine promising lines viz. E2 (114509), E3 (116610), E4 (116820), E5 (114585), E6 (66054), E7 (114505), E8 (116755), E9 (11506) and E10 (11690) along with two check varieties of Grasspea viz. BARI Khesari-3 and BARI Khesari-5 in charland of Saghata, Gaibandha during 2021-22. The maximum seed yield (1.56 t ha-1) was obtained from the E7 (114505) genotype followed by E9 (1.53 t ha-1) and E6 (1.51 t ha-1). The lowest yield (1.26 t ha-1) was recorded from E3 (116610). However, out of the 9 advanced lines, three lines such as E7, E9 and E6 showed similar yield performance compared to both the checks var. BARI Khesari-3 and BARI Khesari-5.

Adaptive trial of different genotypes of cowpea in coastal area

The experiment was conducted at Keoyabunia, Amtoli, Borguna during Rabi season of 2021-22 to evaluate the performance of cowpea genotypes in coastal area. The experiment was laid out in RCB design with four dispersed replications. Two cowpea genotype/variety viz. BARI Felon-1 and Local Felon (Bhola) were evaluated. BARI Felon-1 gave the better performance in respect of growth and yield parameters. Higher seed yield (1.72 t ha^{-1}) was obtained from BARI Felon-1 whereas lower seed yield (1.08 t ha^{-1}) was recorded in Local Felon (Bhola). The maximum gross return (Tk. 86000 ha^{-1}, gross margin (Tk. 41625 ha^{-1}) and BCR (1.94)) was obtained from BARI Felon-1. Lower gross margin was obtained from Local Felon (Tk. 64800 ha^{-1}) and BCR (1.46). BARI Felon-1 was found to be high yielding and profitable for the coastal area.

On farm trial of onion varieties

A field trial was conducted at Bogura and Gopalganj during the *Rabi* season of 2021-2022 to evaluate the performance of BARI onion varieties under farmers' field condition. The experiment was laid out in RCB design in six dispersed replications. BARI Piaz-6 gave the maximum bulb yield (16.10 t ha^{-1}) followed by BARI Piaz-4 (14.67 t ha^{-1}) and BARI Piaz-1(13.96 t ha^{-1}) in charland area of Sonatola, Bogura. Higher gross margin (Tk. 477250 ha^{-1}) was also obtained from BARI Piaz-6 followed by BARI Piaz-4 and BARI Piaz-1. At Gopalganj, the highest bulb yield (17.9 t ha^{-1}) was found in BARI Piaz-4 followed by local variety Red-King (16.8 t ha^{-1}) whereas the lowest bulb yield (12.2 t ha^{-1}) was recorded in BARI Piaz-1. The highest gross return (Tk. 447500 ha^{-1}) and gross margin (Tk. 2286210 ha^{-1}) were also found from BARI Piaz-4 in Gopalganj.

Adaptive trial of summer chilli varieties in Faridpur

The trial was conducted at the Farming System Research and Development (FSRD) site, OFRD, BARI, Faridpur under AEZ-12 during the kharif I season of 2020 and 2021 to find out the suitable chilli varieties and to increase the productivity. The experiment was laid out in RCB design in seven dispersed replications. BARI released chilli var. BARI Morich-2 was evaluated in the trial with two local cultivar Sholakundu and Khalkhula. The average maximum green fruit yield was obtained from BARI Morich-2 (6.94 t ha^{-1}) followed by local Khalkhula variety (6.42 t ha^{-1}) and the lowest from local Sholakundu (6.35 t ha^{-1}). The yield of BARI Morich-2 was 8% higher than Khalkhula. The highest gross margin ((Tk. 443743 ha^{-1})) and BCR (3.16) was also obtained from BARI Morich-2 due to the highest yield.

On-farm trial of BARI developed garlic variety

The experiment was conducted at Jashore, Manikganj, Gopalganj and Madaripur during the *Rabi* season of 2021-2022 to evaluate the performance of garlic var. BARI Rosun-1, BARI Rosun-2, BARI Rosun-3 and BARI Rosun-4 in the farmers' field. The experiment was laid out in RCB design with six dispersed replications.The maximum clover yield was observed in BARI Rosun-2 followed by BARI Rosun-1, BARI Rosun-3 and BARI Rosun-4 in Jashore. Although BARI Rashun-3 gave the maximum clove yield (7.89 t ha^{-1}) but it was statistically similar with BARI Rashun-4 (7.07 t ha^{-1}) and Local variety (6.80 t ha^{-1}) in Manikganj. In Gopalganj, BARI Rashun-3 also gave the highest yield (9.25 t ha^{-1}) might be due to its higher number of cloves and maximum weight of single bulb compared to other varieties. The lowest bulb yield (7.10 t ha^{-1}) was found in BARI Rashun-1. The maximum bulb yield (14.46 t ha^{-1}) was recorded in local variety followed by BARI Rashun-5 (11.50 t ha^{-1}) while the lowest yield (8.52 t ha^{-1}) was obtained from BARI Rashun-1 in Madaripur.

On-farm trial of BARI turmeric varieties in Narsingdi

The trial of turmeric varieties were conducted at the farmers' field of Shibpur, Narsingdi during the *Rabi* season 2021-2022 to select a suitable turmeric variety for this area. Two BARI developed turmeric varieties such as BARI Halud-4, BARI Halud-5 and local variety were tested. The experiment was laid out in RCB design with six dispersed replications. The highest finger yield was found from BARI Halud-4 (28.7 t ha^{-1}) and the lowest yield (14.5 t ha^{-1}) was obtained from local variety (Rangila). Among the tested varieties, BARI Halud-4 gave the highest gross return (Tk. 430500 ha^{-1}) and gross margin (Tk. 296750 ha^{-1}) compared to other varieties.

Project IV: Integrated Farming

Integrated farming research and development for livelihood improvement in the plainland ecosystem

Livelihood improvement is a very complex system and an individual's livelihood involves the capacity to acquire necessities in order to satisfy the basic needs. The program was undertaken during 2018-19 to 2020-21 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. It was conducted at 5 Farming Systems Research and Development (FSRD) Sites viz., Ajoddhapur (Rangpur), Gangarampur (Pabna), Sholakundu (Faridpur), Atia, Delduar (Tangail) and Tarakandi (Sherpur). The activities persistently continued during the year of November 2018 to October 2021. Farmers were selected from marginal, small and medium farmers group considering homestead vegetables and fruits, field crops, poultry and livestock, fisheries and off-farm component of farming systems. All components were brought under improved technological intervention. The average homestead size was 0.05, 0.14, 0.09, 0.13 and 0.07 ha at FSRD site Rangpur, Pabna, Faridpur, Tangail and Sherpur, respectively. Over the location, the average vegetables produced per homestead 629 kg after intervention (AI), which was only 167 kg before intervention (BI). The average vegetables consumption during AI was 254 g $head^{-1}day^{-1}$, which was 279% higher than BI. The average fruits produced per homestead 502 kg, which was only 279 kg during BI. The average consumption of fruits was also increased (Avg. 84%) during AI. The daily nutritional requirements of a family members were supplemented considerably especially carotene and Vit-C through more consumption of vegetables and fruits from the homestead gardening. Animal product from fish, chicken, pigeon, Turkey and livestock also could help to minimize the protein deficiency. Fruit tree management was created a good impact on farm households and 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. The average crop land size was 0.43, 0.84, 0.64, 0.61 and 0.54 ha^{-1} in Rangpur, Pabna, Faridpur, Tangail and Sherpur area, respectively. Two or three crops-based 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 of 51.39 and 29.99 t ha^{-1}, respectively. In livestock component, after deworming and vaccination, the frequency of major diseases of cattle were reduced to 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 farmers. 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, production of farmyard manure (3050 kg homestead^{-1}) and vermicompost (320 kg homestead^{-1}) and their utilization, and also green fodder production (53 t ha^{-1}) were created a good impact among the farm families. The average pond size was 0.04-0.06 ha over the locations. Seasonal fish culture with carp polyculture in seasonal pond was found promising than monoculture of Tengra, Pabda and Shing. 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). 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 (64-753%), where total gross margin increased 63-277% per farm. The activities (seed and seedling collection, production and distribution/sell) of Local Service Provider (LSP) was found promising for home gardening, vaccination and other activities at FSRD site, Ajoddhapur, Rangpur where about twenty three thousands seedlings of different crops could be produced and supplied or sell among the neighbor farmers by LSP. Partial integration among the farm components was found as a cost saving technology.

Livelihood improvement of farmers through integrated farming system research and development of drought and rainfed ecosystem

Prolonged drought, high temperatures, irregular rainfall distribution owing to climate change, soil acidity, and low soil fertility are all key factors that affect agricultural performance in drought and rainfed ecosystems. Due to the growing human population and shrinking agricultural land, it is vital to utilize an integrated strategy to manage all of the resources of poor farm households. From 2019 to 2022, integrated farming activities were carried out at the Farming Systems Research and Development (FSRD) Sites of Basantapur (Rajshahi), Amnura (Chapainawabganj), Chanduria (Rajshahi), Jiarokhi (Kushtia), and Kamalbazer (Sylhet) in order to develop integrated farming technologies, fine-tune NARS institutes' technologies, integrate component technologies with efficient use. The systems; i) Homestead production system, ii) Crops and cropping system, iii) Poultry and Livestock production system, iv) Fisheries production system, and v) Off-farm activities were among the research topics. In each site, two communities have been considered for FSRD activities. Sixty (60) farm homes were chosen from all sites, with twelve (12) from each system. Farmers need-based technologies were acted upon among small, marginal, and medium-sized resource-poor farmers based on the PRA and baseline survey data. The production of year-round domestic vegetables and fast-growing fruits was begun. For each site, two enhanced cropping patterns have been chosen. The initiative has included fodder production, a deworming and immunization program, and fish (carp polyculture) culture. All aspects of integrated farming, including vegetables, fruits, cereal crops, livestock, fish, and off-farm activities, were improved technologically, and as a result, income from these areas grew. At the FSRD sites of Basantapur, Amnura, Chanduria, Jiarokhi, and Kamalbazer, the average homestead size was 0.05, 0.05, 0.04, 0.13, and 0.07 ha, respectively. After intervention (AI), the average annual vegetable production per household increased to 645 kg, up from 85 kg before intervention (BI). During AI, vegetable production climbed by 659 percent compared to BI. During AI, the average vegetable consumption was 209 g head^{-1}day^{-1}, which was 465 percent greater than during BI. Due to poor management, the average fruit produced per homestead was 389 kg, down from 108 kg during BI. Fruit consumption increased significantly (avg. 197%) during AI compared to BI. Existing fruit tree management and new plantation have had a positive influence on farm households: around 1186 fruit trees have been brought under pest management, and a total of 4312 saplings of various fruits have been distributed over the locations. In Basantapur, Amnura, Chanduria, Jiarokhi, and Kamalbazer, the average crop land size was 0.91, 1.06, 0.61, 0.61, and 0.54 ha, respectively. In the case of field crops, farmers achieved higher yields and economic returns from their alternative or improved cropping pattern, which included improved variety(s) and better management practices. The improved cropping pattern increased rice equivalent yield by 50-100

percent over the existing pattern. For irrigated Barind, Mustard (BARI Sarisha-17/14)- Boro (BRRI dhan81) and T. Aman rice (BRRI dhan49) is recommended and Lentil, (BARI Masur-8) -Fallow-T. Aman rice (BRRI dhan51) can be a potential planting pattern for the rainfed Barind area. Similarly, Mustard (BARI Sarisha-18)-T. Aus (BRRI dhan82)-T. Aman (BRRI dhan87) for level Barind tract; Lentil (BARI Masur-8)-Sesame (BARI Til-4)-T. Aman (BRRI dhan75) for High Ganges River Floodplain (Kustia) and Potato (BARI Alu-41)-T. Aus (BRRI dhan65)-T. Aman rice (BRRI dhan57) for Eastern Surma Kushiyara Floodplain (Sylhet) can be recommended. BARI Hybrid Tomato-11 produced a better fruit output (38 t ha^{-1}) and gross margin in the production program (Tk. 1470000 ha^{-1}). Furthermore, BARI Masur-8 and BARI Sarisha-17 are gaining popularity due to their high financial returns. The frequency of key cattle diseases (Anthrax, FMD, and BQ) was reduced below 5% in the livestock component through deworming and immunization. Farmers were interested in cattle fattening programs since a 6-month program resulted in a notable growth in body weight (45-55 percent) and a greater gross margin (Tk. 25000 $cattle^{-1}$). After vaccination, poultry mortality is reduced by 76-88 percent. Moreover, the production and use of farm yard manure (FYM) is continuing among farm families. Green fodder (Napier grass) production continues on the homestead's pond bank, roadside, and fallow space. Farmers rarely use their seasonal ponds in a scientific way. They were placed under best management practices as a result of the project. Over the location, the average pond size was 0.03-0.05 ha. At the farmer level, carp polyculture yielded a reasonable gross margin (Tk. 8000-15000 $pond^{-1}$). Farmers also made some extra money from off-farm activities (Tk. 25000-35000 $household^{-1}$). Women's participation in agricultural activities was found to be exceptional, which could help to improve gender equity within the family. On a custom hiring basis, local service providers (LSP) provided seeding services for crops under the conservation agriculture system. According to the findings of FSRD operations, adopting an integrated farming program at FSRD sites has created an opportunity to improve the livelihood of resource-poor farmers.

Improvement of farm productivity through intervention of improved agricultural technologies in char land eco-system

Char is 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 famer'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 are carried out in Char land ecosystem of Mymensingh and Bogura from the year of 2018-19.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 (av163%)by all families included in this system. Average intake of fruits per year was also increased (av 195%) 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 improve variety (s) better management approaches. Two improved cropping pattern viz. Mustard**-**Boro**-**T.aman and Potato**-**Boro**-**T.aman trials were conducted in FSRD site, Char Kharicha and Char Anondipur,

Mymensingh and one improved cropping pattern Mustard-Boro-T.aus-T.aman trials were conducted in FSRD Site, Sonatola, Bogura. 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. Mortality of poultry reduced *(64-88%)* after vaccination. Among the seasonal fish culture mono sex tilapia culture gave higher gross margin *(a*v Tk. 10363/pond*)* 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 both char land ecosystem as well.

Project V: Socioeconomic studies

Case study of farm machinery in char areas of Mymensingh district

The study aimed at exploring farmers' perception towards farm mechanization and finding out its relationships with the selected characteristics of the farmers. Problems faced by the farmers in farm mechanization and their corresponding solutions were also explored. Data were collected by using a pre-tested interview schedule at Sadar upazila of Mymensingh district from randomly selected 60 respondents by using simple random sampling method during February to March 2022. Farmers' attitude towards farm mechanization was the focus issue of the study and was measured by Likert scale. The observed score of farmers' attitudes towards farm mechanization ranged from 13 to 59 with the mean score of 33.33. Among the farmers, 40.0 percent belonged to neutral attitude category while 31.66 percent belonged to unfavorable and 28.33 percent to the favorable attitude category. Two out of eight selected characteristics of the farmers viz, educational qualification and extension media contact had significant positive relationships and annual income had negative significant relationship with their attitude towards farm mechanization. Rests of the characteristics had no significant relationship with the focus issue. Based on Problem Facing Indices (PFIs), the top ranked problem in relation to farm mechanization is machinery use is not profitable (PFI 143) and the top ranked solution suggested by the farmers in relation to farm mechanization is government subsidy in heavy farm machineries. Different agricultural development organizations should recognize the existing problems of farm mechanization and step forward for solving these problems.

Socioeconomic study of floating agriculture in haor area of Kishoreganj

The aim of this study was to examine the profitability analysis and economic viability of vegetables production on the floating bed in Kishoreganj district of Bangladesh. The study area was selected purposively and 30 households (HHs) were surveyed through purposive sampling technique from a population of 45 households. From the results of the primary data, it was found that majority of the farmers were relatively younger and middle aged and were in a position to put more physical effort for floating garden in the study area. Agriculture is the main occupation of 92% of the farmers who are involved in floating farming. On an average, gross return of the demo farmer was calculated at Tk. 30690 per year for three bed (each bed size was 30 feet long and 4.5 feet wide) which was 64% higher than non-demo farmers' of Tk.18645 and total cost was estimated at Tk. 17180 and Tk. 11010 in demo and non-demo farmers, respectively. Gross margin was estimated at Tk. 13510 in demo farmers which was 77% higher than non-demo farmers. Benefit cost ratio was 6% higher in demo farmers than that of non-demo farmers due to use modern variety and improved management.

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PLANT PATHOLOGY

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Screening of new bio-fungicides 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. Good number pathogens play the vital role for mortality of the plant and yield losses of lentil. Foot and root rot of lentil caused by soil borne pathogens *Sclerotium rolsfii* and *Fusarium oxysporum* Schlecht is one of the major and destructive disease of lentil. Biorational based disease management approach is considered the most important one. Biological control using bio-fungicides is considered to be eco-friendly and cost effective. Therefore, the present study has been taken to screen the available new bio-fungicides against foot and root rot disease of lentil. The field experiment was conducted in the field of Plant Pathology Division, BARI during 2021-22 cropping season to observe the efficacy of eight different new bio-fungicides viz. Clybio, Tricost, Bio-cure F, Sting, Bio-Allin, Bio-Scion, Decoprima and Lycomax (Soil Recharge) and one seed treating fungicide Provax 200 WP against foot and root rot disease of lentil caused by *Sclerotium rolsfii* and *Fusarium oxysporum*. The present study revealed that soil amendment with bio-fungcides have significant effect for reducing seedling mortality and increasing plant growth parameter as well as increasing yield of lentil under field condition. The reduction of seedling mortality was from 41.68% to 66.67% and increased yield range from 16.26-17.52% due to application of bio-fungicides as compared to control. Seed treatment with Provax 200WP reduced 70.83% seedling mortality and increased 17.07% yield of lentil compared to control.

Screening of new bio-fungicides against seedling disease caused by *sclerotium rolfsii* of barley

Md. Iqbal Faruk

There are many biotic and a biotic factors responsible for low yield of barley in Bangladesh. Among the factors, diseases play an important role. At least 17 important diseases of the crop have been recorded in the country where seedling disease caused by *Sclerotium rolfsii and Fusarium oxysporum* is a major one. Biological control using antagonistic microbes alone, or as a supplement of the minimizing of chemical pesticides in the integrated plant disease management system, has become more important and alternative methods for management of disease of many crops especially disease caused by soil borne pathogens. Therefore, the present study has been taken to screen the available biofungicides against major soil borne pathogen S. *rolfsii* and *Fusarium oxysporum* of barley. The field experiment was conducted in the field of Plant Pathology Division, BARI during 2021-22 cropping season to observe the efficacy of eight different new bio-fungicides viz. Monex, Bio-Lead, Bio-cure B, Bio Viride 1 WP, Bio-Anvir, Bio-Derma, Decoprima and Lycomax (Soil Recharge) and one seed treating chemical fungicide Provax 200WP against seedling blight disease of barley caused by *Sclerotium rolsfii* and *Fusarium oxysporum*. Results from this study revealed that all the bio-fungicides are effective against seedling disease of barley caused by soil borne pathogen *S. rolfsii* and *F. oxysporum*, and increasing the plant growth parameters such as shoot height, shoot weight, root length and root weight as well as yield of barley compared to control. Application of different bio-fungicides reduced 32.33%-58.33% seedling mortality and increased 33.98-46.84% yield of barley compared to control. Seed treatment with Provax was also found similar effect for

decreasing seedling mortality and enhancing plant growth and yield of barley.

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, vermi-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/m^2 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 47.37% to 66.91% 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 13.25% to 27.76% 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 new bio-fungicides against powdery mildew disease of pumpkin

Md. Iqbal Faruk

Pumpkin (*Cucurbita moschata*, Cucurbitaceae) is a popular vegetable in many tropical and sub-tropical countries including Bangladesh. Powdery mildew disease caused by *Erysiphe cichoracearum* is common and devastating some times in pumpkin. Use of chemical fungicides to control the disease always poses a serious health hazards and environmental pollution. Hence, attempts were made to identify effective new bio-fungicide(s) against powdery mildew disease of pumpkin. The experiments were conducted in the field of Plant Pathology Division, BARI during 2021-22 cropping season to observe the efficacy of different new bio-fungicides viz. Clybio, Bio-Libas, Magic guard, Bio-Scion, Bio-Viron, Bio-Shield, Fizimite and Dynamic against powdery mildew disease caused by *Erysiphe cichoracearum* of pumpkin. After initiation of powdery mildew disease, all bio-fungicides as well as chemical fungicide were sprayed 3 times at 5-7 days interval. From these study, it was revealed that all bio-fungicides gave appreciable reduction powdery mildew disease incidence and severity as well as increasing the yield of pumpkin. Application different bio-fungicides reduced 50.01% to 68.75% powdery mildew disease incidence and 51.85% to 61.73% powdery mildew disease severity compared to control. Application chemical fungicide reduced 68.75% powdery mildew disease incidence and 64.19% disease severity. Yield of pumpkin was higher 26.12% to 39.72% compared to control due to application of bio-fungicides and application chemical fungicide increased 25.12% yield over control. From the present study it may be concluded foliar application of bio-fungicides are the effective for reducing powdery mildew diseases and increasing the yield of pumpkin.

Screening of new bio-fungicides 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 The root-knot disease caused by *Meloidogyne incognita* is highly damaging and yield reducing factor of tomato throughout the country. A number of approaches for controlling root-knot nematodes include application of nematicide, organic soil amendments, cultural management, physical methods like soil solarization and biological measures are being used. Bio-pesticide formulated from different biological control agents like *Trichoderma* spp, *Pacecilomyces lilacinus, Pasturia penetrans and Pseudomonas aeruginosa are used*

for management of root knot nematodes. However, in spite of the wide distribution of root-knot nematode on many crops in Bangladesh, little work has been done on the management of root-knot nematode in the country and so far, no efforts have been made to exploit bio-pesticides for the control of root-knot nematode. Therefore, this encouraged to undertake the present investigation with the objective of investigating the effect of bio-fungicide 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. Nematox 1% WP, Tricost, Biolead, Bio-cure F, Bio Nematon, Bio Viride, Bio-Allin, Bioderma, Bio-Scion, Decoprima, Lycomax (Soil Recharge) and Clybio and one chemical) Rugby 10 against root knot nematode of tomato caused by *Meloidogyne incognita*. Root knot nematode infested pot soils were treated with those bio-pesticides as well as chemical nematicide Rugby 10G. The present study revealed that all bio-pesticides gave higher plant growth parameters such as shoot and root growth of tomato. The bio-fungicides did not showed significant effect on the gall formation exccept Bioderma, Decoprima and Lycomax (Soil Recharge) bio-fungicides which had significant effect on the reduction of gall formation of root knot nematode in tomato roots but did not reduced appreciable level (more than 80%) root knot disease severity. Application Rugby 10 drastically reduced the root knot nematode disease of tomato.

Screening of new bio-fungicides against bacterial wilt and root-knot nematode of tomato

Md. Iqbal Faruk

Tomato *(Lycopersicon esculentum* L.) is one of the important and popular vegetables in 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 country. The wide and indiscriminate use of chemical has been the cause of the appearance of resistant micro-organisms over and over, leading to the occurrence of emerging food borne diseases and also degrading to the environment, other beneficial soil micro flora and human health. As a result, the interest to obtain alternative management options against the disease is to be sought. In these circumstances, the present investigation was taken to investigate the effect of bio-pesticides on bacterial wilt and 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. Clybio, Bio-derma, Monex, Bio-cure B , Sting, Bio-Allin, Bio-Scion, Decoprima and Lycomax (Soil Recharge) were tested against bacterial wilt caused by *Ralstonia solanacearum* and root knot nematode of tomato caused by *Meloidogyne incognita* of tomato. Root knot nematode infested pot soils were treated with those bio-pesticides as well as stable bleching powder. Bacterial inocula were added in the pot soil twice 15-20 days and 25-30 days after seedling transplanting. The present study revealed that bacterial wilt disease was not observed in all the treatment including control. In case of root knot nematode none of bio-pesticides gave appreciable reduction (more than 80%) of gall development on roots but had effect on the growth of plant parameters such as shoot and root growth of tomato. Among the treatments, application of Lycomax (Soil Recharge) bio-fungicide reduced 46.16% of root knot nematode disease severity followed by Decoprima, Bio-Scion and Sting bio-fungicides with the reduction of 44.92%, 22.91% and 18.17%, respectively compared to control.

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 2021-22 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 bio-rational based integrated management package against diseases of betel vine

Md. Iqbal Faruk and Jahan Al Mahmud

Betel vine (*Piper betel* L.) belongs to the family Piperaceae, the deep green heart shaped leaves, are popularly known as *Paan*, is an important cash crop in Bangladesh. Bangladesh is the second largest grower of betel vine on about 14,000 hectare and total annual production is about 72,500 tons. The betel vine is highly susceptible to diseases, pests and some natural climates. Disease is one of the most important barriers for betel vine cultivation in Bangladesh. Among the diseases of betel vine, foot and root rot of betel vine caused by *Sclerotium rolfsii* Sacc. and leaf rot caused by *Phytophthora parasitica var. piperina* are the most devastating diseases which decrease the production of betel vine to a great extent. Biological control of plant disease using antagonist biological control agent has now become one of the most exciting and rapidly developing areas in plant pathology because it has great potential to solve many agricultural and environmental problems. On the basis of above facts the present investigation has been undertaken to develop bio-rational based integrated management technology against foot and root rot/vine rot and leaf rot diseases of betel vine. The experiments were conducted in the farmer field at Kushtia during 2020-21 and 2021-22 cropping seasons to observe the efficacy of integration of different bio-fungicides viz. Lycomax, Decoprima and Dynamic against foot & root and vine rot of betel vine caused by *Sclerotium rolfsii* Sacc and leaf spot caused by *Phytophthora parasitica var. piperina* of betel vine. All bio-fungicides were sprayed 3 times at 5-7 days interval. From this study, it was revealed that integration of different bio-fungicides gave drastically reduction of foot & root rot and vine rot disease incidence was from 73.26%-91.63% and 71.72% to 87.71% as well as leaf spot disease incidence was from 88.49% to 91.93% and 86.68% to 91.34% during 2020-21 and 2021-22 cropping seasons, respectively. Integration of different bio-fungicides also gave 37.28% to 39.70% and 37.68% to 40.21% higher yield as compared to control in 2020-21 and 2021-22 cropping season, respectively. Among the treatment integration of Decoprima and Lycomax with foliar application with Dynamic gave the highest reduction of foot & root and vine rot and leaf spot diseases as well as the highest yield of betel vine compared to other treatments including control. Integration of Decoprima with Dynamic or Lycomax with Dynamic or Decoprima and Lycomax with with Bordeaux mixture also gave appreciable reduction of the diseases and increasing the yield of betel vine.

Survey of major diseases of cashew nut and coffee at hilly areas in Bangladesh

M. I. Faruk, M. M. Islam, M. S. Akter, M. A. Hossain and M.M.Rahman

Cashew nut (*Anacardium occidentale* L.) is cultivated in more than 32 countries throughout the world. Coffee (*Coffea arabica and Coffea robusta) belongs* to the family Rubiaceae, which is widely distributed throughout the tropical region. Unfortunately, cashew nut and coffee are threatened by many biotic and abiotic constraints resulting in

significant yield losses. Among biotic constraints, diseases are the most damaging and compromise the cashew nut and coffee yield in terms of quality and quantity. Indeed, more than 12 diseases were reported to infect cashew tree worldwide. But there is no researches have done about diseases of cashew nut and coffee in Bangladesh. Therefore, the present investigation has been taken to know the present status of major diseases of Cashew nut and Coffee at hilly areas in Bangladesh. A survey was conducted to assess the diseases of Cashew nut and Coffee, and the identification causal pathogen(s) associated with diseases in the hilly areas of Bangladesh. We surveyed Hill Agriculture Research Station, Raikhali and Khagrachari as well as farmer field at Ruma Upozilla, Bandarban. Higher incidence of leaf spot/blight and stem blight disease of coffee was observed in the all the surveyed location. Lower incidence of fruit drop of coffee and leaf spot disease of Cashew nut were also observed. The isolated causal pathogen is Pestalocia sp. On the basis of the present study it was concluded that Leaf spot/blight and Stem blight disease coffee especially Coffea robusta variety are major problem. Fruit rot disease was also observed. In case of Cashew nut leaf rust, leaf spot and fruit rot disease was recorded. This is the first report of Coffee and Cashewnut disease in Bangladesh. This program will be continued in the next year.

Figure 1. Diseases symptom of Coffee plant at different location

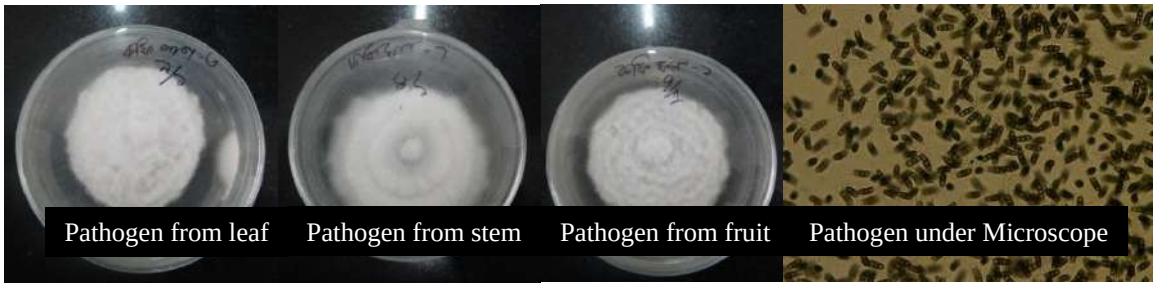

Figure 2. Isolated pathogens from Coffee leaf, stem and fruit, and pathogen under Microscope

Figure 3. Disease symptom of leaf spot of Cashewnut, isolated pathogens in PDA and under Microscpope

Figure 4. Disease symptom of Die back, Fruit rot and leaf rust of Cashewnut at Hill Agriculture Research Station, Raikhali

Survey on pre and post-harvest diseases of onion in bangladesh

M. Monirul Islam, K.M. Alam, K.M. Khalequzzzaman, M.I.Faruk, and M.M.Rahman

Onion (*Allium cepa* L.) is one of the most important spices in Bangladesh. At present the shortage of onion in Bangladesh is about 8-10 lakh metric tons per year. But, onion is prone to different pre- and post-harvest diseases and cause severe yield loss every year. A survey on purple blotch, black mould and soft rot diseases of onion was conducted at Faridpur, Rajbari, Bogura, Magura, Pabna, Lalmonirhat and Gazipur districts during 2021-2022 cropping season to find out the present status of important pre- and post-harvest diseases of onion. From the survey it was found that purple blotch, black mould and soft rot diseases of onion are predominant in all surveyed locations. The highest incidence of purple blotch disease 76% was found in Rajbari district and the lowest incidence of purple blotch disease 52% was rcorded in Magura district. The maximum incidence of black mould disease 27% and soft rot disease 24% were found in Gazipur and Lalmonirhat, respectively. The minimum incidence of black mould disease 17 % and soft rot disease 13% were found in Magura.

Screening of onion varieties and lines against purple blotch disease

M. Monirul Islam, K.M. Alam, K.M. Khalequzzzaman, M.I.Faruk, and M.M.Rahman

Onion is the major spices crop in Bangladesh. Purple blotch caused by *Alternaria porri* is the most important and devastating disease of onion. It causes upto 100% annual loss in severe cases. But there is no resistant variety of onion in Bangladesh against purple blotch disease. A screening experiment was conducted with 36 varieties and lines of onion viz. AB1(BARI Piaz 1), AB2(BARI Piaz 4), AB3(BARI Piaz 6), AB4(379), AB5(409), AB6(411), AB7(414), AB8(422), AB9 (423), AB10 (425), BP2-NB1, BP3-NB2, ON 0326-NB3, ON 0322-NB4, ON 0357-NB5, ON 0374-NB6, ON 0375-NB7, AC Bog 413-AF1, AC Bog 419-AF2, AC Bog 421-AF3, AC Bog 422-AF4, AC Bog 423-AF5, AC Bog 426-AF6, AC Bog 430-AF7, AC Bog 431-AF8, AC Bog 425, AC Bog 429, AC-GAZ-01, PC-GAZ-03, PC-GAZ-03, PC-GAZ-04, AC-GAZ- 378, AC-GAZ-379, AC-GAZ-380, AC-GAZ-384 and AC-GAZ-387 to search the purple blotch disease resistant variety of onion at the field of Plant Pathology Division, BARI, Gazipur during 2021-2022 cropping season. From the experiment, it was found that the highest disease incidence 74% was found in AB8(422) and the lowest disease incidence 5% was found in AC-GAZ-384. The maximum disease severity 4 was found in AB1(BARI Piaz 1), AB2(BARI Piaz 4), AB3(BARI Piaz 6) and AB8(422), respectively. The minimum, disease severity 1 was found in AC-GAZ-384, AC-GAZ-380, AC-Bog426-AF6, ON 0374-NB6, ON 0326-NB3 and AB4(379), respectively.

ManaGement of bacterial wilt disease of GinGer tHrouGH pHysical seed sortinG

M.M.Islam, M. I. Faruk, K.E. Jahan and M.M.Rahman

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. Effect of six different categories of ginger seed viz. 5% seed infection, 10% seed infection, 20% seed infection, 100% seed infection, Farmers saved seeed and healthy seed on germination, incidence of bacterial wilt and yield were studied at experimental field of Plant Pathology Division, BARI, Gazipur during the cropping season 2021-2022. All those categories of seeds had significant effect on seed germination, disease incidence and yield of the crop. Healthy seed showed the highest germination percentage (93%) and yield (18.20 t/ha) with lowest disease incidence (9%). The highest disease incidence (82%) with lowest percentage of germination (61%) and the lowest yield (1.98 t/ha) were observed in 100% seed infection. The yield was decreased with the increased of percent seed infection.

Effect of fungicides in controlling phomopsis blight and fruit rot disease of brinjal

M.M.Islam, M. I. Faruk and M.M.Rahman

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. Phomopsis blight and fruit rot disease reduced the yield and quality of brinjal. So, the present research work was done with 8 different treatments viz: T_1 = Solo Plus (1g/L), T_2 = Carben (1g/L), T_3 = Blastin (0.5g/L), T_4 = Kemo Zole (1ml/L), T_5= Sascozim (1g/L), T_6= Tebben 50 WP (1g/L), T_7= Autostin(1g/L) and T_8=Control having three replications to find out the effective fungicide(s) in controlling phomopsis blight and fruit rot disease of brinjal in Plant Pathology field of BARI, Gazipur during the cropping season 2021-22. All the fungicides had significant effect on reduction of disease incidence compared to control. Carbendazim group of fungicides was found better in controlling phomopsis blight and fruit rot of brinjal compared to other group of fungicides. Same trend was observed in case of phomopsis blight and fruit rot disease reduction of brinjal.

Evaluation of funGicides in controllinG powdery mildew of pumpkin

M.M.Islam, M. I. Faruk and M.M.Rahman

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. The efficacy of ten different 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 1 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 was tested against the powdery mildew disease of Pumpkin in Plant Pathology field of BARI, Gazipur during the cropping season 2021-22. All the fungicides had significant effect on reduction of disease incidence compared to control. The lowest disease incidence 7.50% was found in Agistar 35 SC preceded by 8.00% in Tahoe. The highest disease incidence 56 % was found incontrol treatment followed by 24.00% in Campride 30WP. The maximum disease reduction of powdery mildew 86.11% in Agistar followed by 85.71% in Tahoe, 84.00% in Armada and 83.92% in Antivo (80%) were found over control treatment, respectively.

Management of purple blotch disease of onion seed crop through fungicides

Purple blotch of onion 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 against purple blotch disease; the only alternative is to reduce the damage by using fungicides. The experiment was conducted at the field of Plant Pathology Division, Bangladesh Agricultural Research Institute, Gazipur and SRC, Bogura during cropping season 2021-22 to identify the effective fungicide(s) in controlling purple blotch disease of onion causing *Alternaria porri*. Ten fungicides viz. Seednil 72 wp @ 2gm/L, Coli 50 SC @ 1ml/L, Miravis Duo 20SC @ 1ml/L, Kingcen @ 2gm/L, Limin 72 WP @ 2g/L, Synblast 5wg @ 0.5 ml/L, Rovral 50 wp @ 2gm/L, Sunzoxy 32.5 SC @1ml/L, Jodha 45 SC @ 1ml/L and Cymozeb 72 WP @ 2g/L were used in the experiment having 3 replications. Miravis, Rovral, Sunzoxy and Coli were effectively

control the purple blotch disease of onion in both the locations where Miravis was showed the best performance to control the purple blotch disease and to increase the yield of onion.

Effect of bio-fungicide in controlling purple blotch disease of onion

M.M.Islam, K.M. Khalequzzaman, K. M. Alam. I. Faruk and M.M.Rahman

Purple blotch disease which is caused by *Alternaria porri* is the most devastating disease of onion. The pathogen *Alternaria porri* destructs the leaf tissue which hinders the stimulus for bulb initiation and delay in bulbing and maturation. The losses about 50-100% due to purple blotch of onion. Indiscriminate use of chemical fungicides often leads to serious environmental problems and cause health hazards. So, it is necessary to substitute the use of chemicals with bio-rational/ecofriendly approach in controllig the disease. The present experiment was conducted to find out the efficacy bio-fungicide in controlling purple blotch disease of onion. Effect of bio-fungicide (Deccoprima) with five doses viz. Decoprima @1g/L, Decoprima @1.5 g/L, Decoprima @2 g/L, Decoprima @2.5 g/L and Decoprima @3 g/L including a control treatment having three replication was evaluated in the experimental field of Plant Pathology Division, BARI, Gazipur during cropping season 2021-22. Onion variety BARI Piaz-4 was used in the experiment. Decoprima @ 3g /L showed the lowest incidence of purple blotch disease 27.80 % preceded by 28.00 % and 29.00% in Decoprima @ 2.5g /L and Decoprima @ 2.0g /L, respectively. The highest disease incidence of purple blotch 72.00% was observed in control treatment. The highest 61.38% disease decreased was found in Decoprima @ 3g /L followed by 61.11% in Decoprima @ 2.5g /L and 59.72% in Decoprima @ 2g /L, respectively. The lowest disease decreased 16.66% was measured in Decoprima @ 1g /L. The maximum yield 18.50 t/ha was recorded in Decoprima @ 3g /L and the mimum yield 4.90 t/ha was recorded in control treatment.

Effect of fungicides in controlling purple blotch disease of onion

Onion (*Allium cepa* L.) is an important spices crop of Bangladesh. But it suffers from many diseases both in the field and storage. Purple blotch caused by *Alternaria porri* is one of the most serious disease prevalent all over the country of the crop among the diseases. It decreases the production of onion to a great extent. The experiment was conducted at Plant Pathology Field, Bangladesh Agricultural Research Institute (BARI), Gazipur and Spices Research Centre, Shibgonj, Bogura during 2021-22 cropping season for management of the disease. Seven fungicides viz. Indofil, Amister Top, Cupravit, Score, Tilt, Rovral and Autostin was evaluated against the disease. Rovral, Amister Top, Score 250EC and Tilt 250EC were showed the better performance in reducing the purple blotch disease of onion over control. Same trend of results of the experiment was observed in case of bioassay of fungicides. The highest yield of onion was found in treatment seven i.e Rovral followed by Amister Top and the lowest yield was recorded in control treatment both in Bogura and Gazipur.

Management of foot rot and wilt disease of chilli

M. S. Rahman, M. I. Faruk and M. M. Rahman

Chilli (*Capsicum annum* L.) is one of the major spices and condiments having export potential, grown throughout the world. Foot rot and wilt disease caused by *Fusarium sp.* is considered to be the major soil born disease causes severe yield loss and quality of chilli. The experiment was conducted to find out an effective management option against the disease. BARI Marich-1 was planted at the research field of Plant Pathology Division, BARI Gazipur on December 2021 comprising six treatment with three replications. Significant variation of disease incidence was found in different treatments. Disease incidence ranged from 1.0 to 30.00 % in different treatments. The lowest disease incidence was found 10.00 in treatment T_4 (Soil drenching with Aoutostin1 gm/L) and T_5 (Use of Trico-compost 4 t/ha). The highest yield (12.15 t/ha) was recorded from T_5 followed by T_4 (11.55 t/ha). The reduction of disease incidence was found 66.66 % in treatment T_4 and T_5 and maximum increase of yield 42.95 was found in treatment T_5 followed by T_4. Both the treatments T_5 and T_4 were considered as the best management option on the basis of minimum disease incidence and higher yield. However, these treatments may be used as effective options for management of foot rot and wilt disease of chilli caused by *Fusarium* Sp.

Validation of integrated management package against cmv of chilli (*capsicum annum* l.)

M.S. Rahman, M. I. Faruk and M. M. 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 December 2021 with three replications. Significant variation of disease incidence and severity was found in different management packages. Disease incidence and severity ranged from 15.0 to 34.50 % and 1.5 to 3.5 in different management packages. The lowest disease incidence and severity was found 14.00 and 2.0 respectively in treatment package T_1 (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 T_2 (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 16.50 and 2.0 respectively. The highest yield (13.50 t/ha) was recorded from T_1 followed by T_2 (13.25 t/ha). The reduction of disease incidence was found 56.52 % and 52.17 % in treatment T_1 and T_2 respectively and maximum increase of yield 32.35 and 29.90 % was found in the same management packages. Both the packages T_1 and T_2 were considered as the best management option on the basis of minimum disease incidence, higher yield and Marginal benefit cost ratio (1: 3.40 & 1: 2.81), respectively. Marginal cost benefit analysis indicated that the two management packages (T_1 & T_2) were economically viable and cost effective. However, these management packages could be used as effective options for management of CMV infecting chilli in Bangladesh.

Screening of cucumber germplasm against *cucumber mosaic virus* (CMV)

M.S. Rahman, M. S. Akhter and M.M. 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 germplasm/cultivars were evaluated against CMV in field condition during the year of 2021-22. Out of 15 germplasm/cultivars, no variety/cultivar showed highly resistant response against the virus. Among the tested germplasm three germplasm Cu02, Cu03 and Cu08 showed mild mosaic symptom on few leaves having disease incidence 15.20 %, 15.50 % and 16.25 % respectively were graded as resistant and germplasm, Cu07, Cu12 and Cu14 showed similar symptoms having 25.00-27.35 % incidence were graded as moderately resistant. The germplasm Cu01, Cu09, Cu11 and Cu13 showed vein clearing and mild mottling (35.50 to 38.00 % infection) were considered as moderately susceptible and Cu04, Cu05, Cu06, Cu10 and Cu15 (43.50 to 56.30 %. infection), were considered as susceptible.

Evaluation of selected okra lines resistant to *okra yellow vein mosaic virus* (OKYVMV)

M.S. Rahman, M. I. Faruk and M. M. Rahman

Okra (*Abclmoschus esculentus*) is an important commercial vegetable crop grown throughout the world. It is commonly known as lady's 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 check variety against OYVMV during the year of 2021-22. The selected resistant varieties/lines OK-01 showed resistant where OK-02 and OK-03 (Narsingdi lokal) showed tolerant response against OYVMV. The check variety (BARI Derosh-1) showed moderately susceptible reaction against the virus. It was also found that the virus is not seed transmitted.

Integrated management of white mold disease of red salvia and marigold

M. Mynul Islam, Most. Arifunnahar, Mohammad Hossain Sarker and Md. Matiar Rahman

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). A package 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. Result revealed that integrated management significantly reduces disease incidence compared to untreated plants in marigold. However, treatment was non-significant in red salvia. Plant showed disease symptoms at vegetative stage and the highest disease incidence (5.9% in red salvia and 80% in marigold) was recorded at flowering stage in untreated plots.

Development of bio-rational management package for fusarium wilt and sigatoka diseases of banana

M. Mynul Islam, M. H. Rahman, M. I. Faruk, J. A. Mahmud and M. N. Islam

The experiment was conducted at Regional Horticulture Research Station, Bangladesh Agricultural Research Institute, Shibpur, Narsingdi during the period from April, 2021 to May, 2022. The study was aimed to find out the effective management package against Fusarium wilt and sigatoka diseases of banana. Four treatments combinations and farmer's practices were compared. Among the tested treatments, T1 (BARI Tricho-compost + Sucker treatment with Dynamic + Alternate foliar spray with Dynamic and chemical fungicide) and T4 [Decoprima (bio-fungicide) + Soil recharge + Alternate foliar spray with Dynamic and chemical fungicide] had maximum reduction of Fusarium wilt disease incidence (100%) at 180 DAP. In case of sigatoka, the highest disease severity of 26.67% was recorded in T1 treated plants at 180 days after planting and the lowest was in T3 [Decoprima (bio-fungicide)+ Alternate foliar spray with Dynamic and chemical fungicide] treated plants. The highest yield (11 kg per bunch) was found in T4 treated plants. The lowest yield (6.40 kg per bunch) was recorded in T5 (Farmers practices) treated plants.

Prevalence of *ralstonia solanacearum* on cold storage and field potato

M. Mynul Islam, M. M. H. Tipu, F. E. Elahi, M. I. Faruk and M. M. Rahman

The experiment was conducted at Plant Disease Diagnostic Laboratory (PDDL), Plant Pathology Division, BARI during 2021-2022. Potato tubers from cold storage and potato plants from different fields were collected from Bogura and Debigonj. The collected samples were sterilized, plated on TZC and SMSA media. After purification and isolation of bacteria, DNA was extracted and PCR was conducted using Primers 759 and 760. A total of 36 samples were tested. Among them, 26 samples were tubers collected from cold storage and 10 plant sample from field. All the 26 potato samples of cold storage were negative to *R. solanacarium*. However, among the 10 plant samples, 70% were positive to *R. solanacearum* and 30% were negative.

Molecular and biochemical approach for the detection of *ralstonia solanacearum* form potato

M. Mynul Islam, F. E. Elahi, M. M. H. Tipu, M. I. Faruk , Mushfiqur Rahman and M. M Rahman

The experiment was conducted at newly Plant Disease Diagnostic Laboratory (PDDL), Plant Pathology Division, BARI, Gazipur during 2021-2022. *Ralstonia solanacearum* is a quarantine pathogen and has significant importance to crop production and export. The pathogen causes brown rot in potato tubers and wilt in plant. Different semi-selective media, biochemical and molecular tests were conducted to confirm and validated detection process of *R. solanacearum*. KOH for gram negative test, biovar test for carbon utilization, TZC and SMSA media for selective growth, amplification of IpxC gene and multiplex PCR for phylotyping was done. The amplified DNA was sequence for confirmation of species. After conducting all the tests, it was confirmed that the isolated bacterium was pathogenic *R. solanacearum* of race 3 biovar 3 phylotype II.

Survey on occurrences of bacterial wilt disease of Bt-brinjal in Bangladesh

K. Jahan, M. S. Akhter, M. S. Rahman, M. M. Karim, N. Islam, M. Arifunnahar, M. I. Faruk and M. M. Rahman

The present study was an effort to find out the occurrence of the bacterial wilt disease in transgenic brinjal plants. Bacterial wilt is one of the key hindrances for brinjal production. The survey for bacterial wilt disease incidence was conducted in major Bt Brinjal growing areas of Gaibandha, Rangpur, Pabna, Bogura and Joypurhat districts. Total 16 fields cultivated with Bt brinjal-1 and 4, were surveyed during 2021-2022 cropping season. From all the surveyed fields, data were collected on % Wilt Incidence. During survey, it was observed that Bt Brinjal-4 were cultivated in most of the locations; except two fields in Ghagorduar, Bogura, where BARI Bt Brinjal-1 was cultivated. In Gaibandha district, three fields were surveyed. Only

Bt Brinjal-4 was cultivated in these fields and the bacterial wilt incidence ranged from 12.36 to 59.96% for Bt Brinjal- 4. In Rangpur, one field with Bt brinjal-4 surveyed from Rangpur Sadar. After 84 days of transplantation 6.92% wilt incidence was recorded. In Bogura, five fields from Ghagorduar under Shibgonj upazilla were surveyed. Among the 5 fields, three fields cultivated with Bt Brinjal-1, where 4.55-6.67% disease incidence recorded from 2 fields; no wilt incidence observed in one Bt brinjal-1 planted field after 31 days of transplantation. Only two fields cultivated with Bt Brinjal-4 and 6.67-8.89% disease incidence were observed. In Pabna, one field with Bt brinjal-4 was observed from Poilanpur, Pabna Sadar, where 3.85% wilt incidence was recorded. In Joypurhat, six fields cultivated with Bt Brinjal-4 were surveyed. The disease was observed in all the surveyed areas and incidence ranged from 3.03 to 7.50%.

Identification of the citrus tristeza virus genotypes and their interactions on different citrus species

Ms Akhter, Ms Rahman, M M H Tipu, Ke Jahan, M M Islam, Mi Faruk and Matiar Rahman, M G Kibria, Mm-E-Rahman

Citrus is an important fruit crop in Bangladesh. Now a day's citrus cultivation in Bangladesh is severely hampered by yellowing and decline disease. Viral disease of citrus is severe threats to citrus cultivation globally and recently Citrus tristeza virus (CTV), the causal agent of tristeza disease has been identified in Citrus medica in Bangladesh. The molecular characterization of the Bangladeshi CTV isolates revealed that the Bangladeshi CTV isolates closely related to the Resistance Breaking (RB) genotypes. The characteristics symptoms induced by CTV, yellowing and stem pitting also observed in Citrus reticulata and Citrus sinensis.

Studies on symptomatic variability of prsv-p

M.S. Akhter, M.S. Rahman, M.M. Karim, M.M.Rahman

Papaya ringspot virus (PRSV) is a predominant virus in Bangladesh which produced several variable symptoms in papaya. Our serological and molecular results suggested that PRSV is producing eight different symptoms in field condition which are regarded as the biotypic variant of PRSV-P in Bangladesh. We did not find others papaya infecting RNA viruses i.e Papaya leaf distortion mosaic virus (PLDMV) or Papaya mosaic virus (PMoV) singly or mixed infection with PRSV by molecular detection. On the other hand, we observed severe leaf curl symptom (upward and downward curling) in papaya. We analyzed eight symptomatic leaf curl samples and found synergistic interactions with PRSV and multiple geminivirus species. The host virus interactions are now in progress in Plant Pathology, Division, BARI.

Survey and identification of watermelon diseases in Bangladesh

M.S. Akhter, M.M. Alam, M.S. Rahman, M.M. Karim, K-E-Jahan, M.N. Islam, M.M Rahman (Ppd); M.G. Kibria, Rars Barishal; Amir Faisal, Ofrd Noakhali & M. Z. Ferdous, Ofrd, Rangpur

A survey was conducted for identification of watermelon diseases in Nothern part of Bangladesh in 2018-19 and 2021-22 cropping season. Two viral diseases has been identified using molecular tools. Among the viral diseases watermelon bud necrosis virus (WBNV), Groundnut bud necrosis virus which are the member of Orthotospovirs consider as the major threats to watermelon production in Bangladesh. On the other hand, the mosaic disease having the low frequency compared to Tospovirus.

Isolation, identification and molecular characterization of causal organisms of chilli anthracnose

M. M. Karim, M. N. Islam, K. E. Jahan, M. S. Akhter, M. I. Faruk and M. M. Rahman

The experiment was conducted during the year 2021-22 in Plant Pathology Laboratory, BARI, Gazipur. Samples of chilli anthracnose were collected from for different upazilas of three different districts of Bangladesh. They were Sadar and Jhikargacha upazilas of Jessore; Sadar upazila of Magura; and Kotchandpur upazila of Jhenaidah. From all three upazilas of Jashore and Magura, only Colletotrichum capsici was identified as a causal organism of chilli anthracnose. On the other hand, C. capsici and Colletotrichum gloeosporioides both were identified from Jhenaidah district.

Identification of associate pathogens of imported vegetable seeds in Bangladesh

M. M. Karim, M. N. Islam, K. E. Jahan, M. S. Akhter, M. I. Faruk, and M. M. Rahman

The experiment was conducted during the year 2021-22 in Plant Pathology Laboratory, BARI,

Gazipur. Imported seeds of cauliflower, cabbage, broccoli, cucumber, radish, tomato, sweet gourd, bottle gourd, okra and brinjal were collected from Jashore and Bogra districts of Bangladesh. Overall quality of imported vegetable seeds from Japan, Thailand and South Korea were better compared to seeds from India. No microorganism involvement was observed in all the seed samples imported from Japan and South Korea. All the seeds from Thailand also showed no microbial association except cauliflower. Different microorganisms were detected from maximum seed samples imported from India also showed very lower rate of germination.

Evaluation of new fungicides against early blight of tomato

M. Arifunnahar, K.M. Alam, M.N. Islam, R. Momotaz, M.M. Karim, M.B. Anowar, M.M. Islam, M.I. Faruk and M.M. Rahman

Tomato (*Lycopersicon esculentum* Mill.) is the most important remunerable solanaceous vegetable crop all over the world including Bangladesh. Alternaria leaf blight of tomato caused by Alternaria solani is a soil inhabiting air-borne pathogen responsible for leaf blight, collar and fruit rot of tomato disseminated by fungal spores. It is an important disease of tropical and sub-tropical areas. The efficacy of some fungicides were tested against early blight of tomato at Plant Pathology Division of Bangladesh Agricultural Research Institute (BARI) during 2021- 2022 cropping season. A total of twenty five new fungicides were tested in 2 sets with control against early blight disease of tomato. 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 treatments reduced the disease severity as compared to untreted control. The lowest disease incidence was observed in code 538 treated plot and the highest disease incidence was found in Control treatment. For set 1 the lowest percentage disease index (15.67) was recorded in code 590 sprayed plot and the highest PDI (87.00) was observed in Control treatment. Percent disease reduction ranges from 31.03% to 79.69% while the lowest disease reduction was recorded from T_2(code 92) treatment and the highest disease reduction and yield (29.37 ton/ha)was found from T_{13}(code 590) over Control. For set 2 the lowest disease incidence was observed in T_7 (code 722) and the highest disease incidence was found in Control treatment. The lowest percentage disease index (15.87) was recorded in code 629 sprayed plot followed by treatment T_4 (code 536).The highest PDI (84.00) was observed in Control. The lowest disease reduction was recorded from T_{10} (code 763) treatment and the highest disease reduction was found from T_5 (code 629) over Control. The higher yield (21.17 ton/ha) was obtained from T_5 (Code 629) where lower was from control.

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

In Bangladesh chilli is very important spice crop. Anthracnose disease of chilli caused by Colletrotrichum capsici is a serious threat for green and red chilli production. It is necessary to control the disease. So, the efficacy of twenty new fungicides were tested to see the efficacy against Anthracnose of chilli at Plant Pathology Division of Bangladesh Agricultural Research Institute(BARI) during 2020- 2021 cropping season. There were eight fungicides in set 1 and thirteen fungicides in set 2 with control. BARI morich 1 was used in the experiment. There was no disease was found for the experiment. So no disease data was recorded. The highest yield (2.49 ton/ha) was obtained from Code 215 for where lowest was recorded from control treatment for set 1. In case of set 2 experiment the maximum yield (2.78 ton/ha) was found in T_7(Code 246) and and minimum was from T_2 treatment i.e., 1.93ton/ha.

Survey, isolation and identification of major diseases of flowers (gerbera, tuberose and gladiolus)

M. Arifunnahar, K..M.Alam, M.N.Islam, R.Momotaz, Mm.Karim, M.B.Anower, M.I.Faruk and M.M.Rahman

Different cut flowers like gerbera, tuberose and gladiolus are very important ornamental flowers all over the world including Bangladesh. Disease diagnosis is very necessary for the commercial production of flowers to avoid disease infection. From this viewpoint survey was carried out in Jashore, Gazipur and Savar during 2021-2022 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 oxysporum*, *Colletotrichum* sp, *Botrytis cinerea*, and *Pestalotia* sp were isolated from the infected plant parts of gerbera, tuberose and gladiolus which were caused leaf spot, leaf blight, wilt and yellowing and tuber rot diseases respectively.

Collected from different solanaceous and cruciferous crops of Gazipur

Ferdous-E-Elahi, K. M. Alam, and M. Mynul Islam

From September 2021 to April 2022, leaf spot infected solanaceous and cruciferous crops (tomato, cabbage, mustard and broccoli) leaves were collected from the experimental fields of Bangladesh Agricultural Research Institute (BARI), Gazipur. The fungus was successfully isolated on potato dextrose agar (PDA) medium. These fungal isolates were proved by Koch's postulates to be the causal agent of leaf spot of cruciferous and solanaceous crops. The fungal culture morphology was identical to Alternaria brassicae For the more confirmation of fungi, amplified internal transcribed spacer (ITS) region of rDNA have been sent for sequencing. Only based on morphology, the fungus was identified as Alternaria brassicae.

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 worldwide distributed seed borne pathogen. In order to evaluate the risk of seed transmission, it is necessary to know the relationship between seed contamination and disease outbreak. However, 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). So, this current study was carried out in October 2021 to April 2022 to know the causal agent of black rot of cabbage through 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. 16s rDNA of the bacterial isolates were amplified by using the primer pair 8F and 1492R. The amplified products have been sent for sequencing. Based on the morphology, biochemical and physiological properties all the isolates are tentatively identified as the genus *Xanthomonas*.

Survey, isolation and identification of plant-parasitic nematodes of different fruits of Bangladesh

Ferdous-E-Elahi and M. I. Faruk

From December 2021 to April 2022, suspected nematode infected soil and root samples of banana, strawberry, papaya and orange with rhizospheric soil were collected from Gazipur, Sherpur and Sylhet districts. The nematodes were isolated through Baermann-funnel technique and Cobb's extraction methods. Based on the morphology of the nematodes, they were identified as *Hoplolaimus* sp., *Helicotylenchus* sp., *Meloidogyne* sp., and *Pratylenchus* sp.

***In vitro* evaluation of antifungal activity of cinnamon powder against *aspergillus sp*.**

M M H Tipu, M Mynul Islam, F-E Elahi, M M Rahman

An experiment was conducted at Plant Pathology Division, BARI under laboratory condition during 2021-2022 to evaluate the antifungal activity of cinnamon powder. There were six treatments comprising five different concentrations and control. Cinnamon powder suspension with a concentration of 1.00% and 2.00% suppressed mycelial growth of *Aspergillus niger* completely (100%). Therefore, we suggest using 1.00% of cinnamon powder suspension for controlling *Aspergillus niger* to reduce management cost. Our findings will be useful to conduct further research on post-harvest management of common fruits against *Aspergillus niger*.

Effect of *trichoderma harzianum* on survival of sclerotia of *sclerotinia sclerotiorum* in soil

M M H Tipu, M Mynul Islam, F-E Elahi, M I Faruk

An experiment was conducted at Plant Pathology Division, BARI under laboratory condition during 2021-2022 to evaluate the antagonistic effect of Trichoderma harzianum 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.

Efficacy of new fungicides in controlling alternaria blight disease of mustard

M M H Tipu, M M Rahman

An experiment was conducted at the field of Plant Pathology Division, BARI during 2021-2022 to find out effective chemical fungicide for controlling alternaria blight disease of mustard. Four different fungicides were tested along with control (water spray). All the fungicides showed excellent result compared to control the disease effectively.

Evaluation bio-fumigation with mustard to control bacterial wilt in tomato

M M H Tipu, M Mynul Islam, F-E Elahi, M M Rahman

An experiment was conducted at the pot-house of Plant Pathology Division, BARI during 2021-2022 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.

Efficacy of different new fungicides in controlling sigatoka disease of banana

M. N. Islam, M. M. Karim, M. I. Faruk and M. M. Rahman

The experiment was conducted at Anontobala, Shibgonj, Bogura district during 2021-2022 cropping season to evaluate the efficacy of thirteen foliar new fungicides viz. Positive 30SE, Sting, Bio-Libas 0.8% SC, Jodha 45 SC, High Power conazole 28 SC, Fence 32SC, CMZ 72 WP, Remove 75% WP, Traxo -75 WP, Si-licar 50 WP, Metop 60WG, Rumion 40 WP, Caroline -50 DF and control against Sigatoka disease of banana caused by Cercospora musae. All the fungicides performed better over the control (unspray) treatment to manage the disease as well as increased all parameters related to yield attributes. The lowest PDI (7.1) was recorded in Techvo Bio-Libas 0.8% SC (Physcion 0.8%) treated plot followed by Sting (*Bacilus Subtilis*) (7.7) and the highest (84.5) in control treatment. The highest yield (54.0ton/ha) was recorded in Bio-Libas 0.8% SC and the lowest (27.5ton/ha) was in control. Among the fungicides Bio-Libas 0.8% SC, Sting, and Fence 32SC showed the best performance in reduction of disease severity over control.

Demonstration on integrated management of fusarium wilt and nemic disease of banana

M. N. Islam, M. M. Karim, M. I. Faruk and M. M. Rahman

The demonstration was conducted to assess the performance of developed technology of Plant Pathology Division on Fusarium wilt (panama) and Nemic disease of banana during September 2021 to June 2022 at Ghagurduar, Shibgonj, Bogura districts under the supervision of Plant Pathology Division, BARI, Gazipur. Three treatment were used; one was developed technology that is T_1=Planting of healthy sucker +Application of Vermi-compost 2kg/plant +Sucker treatment with Autostin 2gm/L of water +Application of Rugby 5G 50gm/plant +Soil drenching with Autostin 3-4 times just after disease initiation and T_2= Clybio 5ml/L of water and T_3=Farmers' practice. Among the treatment, T_2 treatment showed no disease incidence while T_1 and T_3 treatment observed 6.45%, and 44.45% disease incidence respectively. Treatment T_2 that is Clybio perform better in panama and Nemic disease management over T_1 and T_3 treatment respectively.

***In vitro* screening of endophytic microorganism against wilt disease causing pathogen *nalanthamala psidii* of guava**

K. M. Alam

Endophytic microbes influence the resistance of the host plant. An experiment was carried out in Laboratory, Plant Pathology Division, BARI during 2022. Endophytic microbes were isolated from more than 5 years aged healthy guava plant. Dual culture method was applied to observe the interaction between endophytic microbes and *Nalanthamala psidii*. 28 fungus and 5 bacteria were evaluated in dual culture. Seven isolates showed growth inhibion of NP on PDA. The highest growth percent and inhibition zone against NP were produced by Iso16 and Iso13, respectively.

Selection of resistant guava seedlings against *nalanthamala psidii* wilt disease pathogen

K. M. Alam, M. Arifunnaher

An experiment was carried out in 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 sown 749 seedlings were tested within a year. 100% seedlings

first lot died within year and 94.5, 77.1 and 45% seedlings of 2nd, 3rd and 4th lot, respectively already died due to post-inoculation of *Nalanthamala psidii* NPB-001. Among the survived seedlings, 11 seedlings survived almost one year.

Evaluation of microbial products for controlling fusarium wilt of chickpea

K. M. Alam, M. Arifunnaher

Fusarium is soil-borne pathogens and are very difficult to control by any chemical means. An experiment was carried out to during 2020-2021 to mitigate wilt disease of checkpea by using microbial products. BARI Chola 5 was used for evaluation of four microbial products, namely Decoprima (Trichoderma sp. + Geobacillus + Steptomyces), Biofungicide (BAU), five biologiacal agents T. erinaceum, Acremonium cavaraeanum, Trichoderma viride, Pseudomonas fluorescence and Bacillus sp. Significant difference was obtained among the microbial products for disease incidence and yield. . Decoprima and T. erinaceum were the best microbial products for soil treatment to control fusarium wilt disease of chickpea.

Survey of major diseases of selected fruits and vegetables in northern region

M.M.E Rahman, M. Musfiqur Rahman, M.S. Huda, M. Afroz and A.K.Saha

Diseases of some exotic fruits and commercially grown fruit and vegetables were being considered as important bottle neck for production these crops in the country. A total of 12 different fruits and vegetables like malta, dragon, mango, custard apple, coconut, date palm, pomegranate, cabbage, watermelon, melon, brinjal and bottle gourd were surveyed in Northern region of the country to know their current disease status. Depending on nature of the disease and type of the crop, disease incidences and severity ranged from 1 to 50% and low to high, respectively. Some new diseases were recorded in some selected commercially important fruits and vegetables. Some minor diseases were observed to become severe threat in some areas during survey period.

Screening of mustard varieties/lines against alternaria blight and white mold (sclerotinia sclerotiorum) disease

M.M.E Rahman, H. Rashid, S. Nahar and A.K.Saha

Alternaria blight (*Alternaria brassicae*, A. *brassicicola* and A. *raphani*) and white mold (*Sclerotinia sclerotiorum*) are considered the most important diseases of mustard. Varying level of disease resistance was recorded against Alternaria blight of mustard. No entry was observed either immune or resistant against Alternaria blight. Among the 80 entries, a total of 19 entries showed moderately susceptible and rests of the entries were found susceptible to highly susceptible. On the other hand, white mold disease was escaped by all entries.

Efficacy of fungicides against white mold of sunflower

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

A total of fourteen different fungicides from different groups were tested for controlling white rot disease caused by *Sclerotinia sclerotiorum*. All the fungicides significantly suppressed the disease over control. A range of 52.06 to 83.56% and 62.49 to 93.75% diseases suppression occurred in Alternaria blight and white mold disease, respectively. Among the fungicides, Amistar Top (Azoxystrobin + Difenoconazole) was found to control white mold disease significantly (93.75%). Moreover, Rovral (Iprodione), Scor (Difenoconazole) and Nativo (Tebuconozole + Trifloxystrobin) were also found to control the disease effectively considering both the diseases.

Efficacy of new fungicides in controlling late blight of potato

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

The experiment was conducted at RARS, BARI, Burirhat, Rangpur during rabi season of 2021-22 to evaluate nineteen new fungicides against late blight of potato under natural inoculum pressure. More than 80% disease suppressions were observed due to the spray with 302, 345, 377, 380, 384, 389, 390, 401, 428 and 455 encoded fungicides. Among the fungicides, 428 coded fungicide most 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 and 2021-2022 cropping seasons. Only six different used chemicals viz. Stable

bleaching powder @ 2 g/lit. water, Cupraxet 345 SC (Try basic $CuSO_4$) @ 2 g/lit. water, Blitox (Copper Oxy-Chloride) @ 2 g/lit. water, Bactaf 50 SP (Chloro Iso Bromine Cynuric Acid 50%) @ 2.0 g/lit. water, Bactroban 20 WP (Bismerthiazol 20%) @ 2 g/lit. water, Timsen™ (n-alkyl dimethyl benzyl amonium chloride 40% + Stabilized urea 60%)) @ 1 g/lit. water, significantly reduced incidence and severity of common scab in both the years. Out of them, Timsen™ was the best one (Disease incidence <6% and severity <1.20) followed by Blitox, Stable bleaching powder and Cupraxet 345 SC in controlling disease also produced good tuber yield (35.0 t/ha).

Validation of fungicidal management technology against foliar diseases (purple blotch, stemphylium leaf blight and botrytis leaf blight) of onion

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

Validation trial was conducted at RARS, BARI, Burirhat, Rangpur to confirm the efficacy of selected fungicidesand its' combination like Rovral 50 WP (Iprodione 50%) @ 2 g + Headline™ TM @ 2.5 g / lit. water, Amister Top (Azoxystrobin 20% + Difenoconazole 8%) @ 1 ml / lit water and Luna sensation (Fluopyram 25% + Trifloxystrobin 25%) @ 1 ml/lit. water for controlling foliar diseases of onion during 2021-2022 cropping season. All the tested fungicides significantly managed foliar diseases of onion and increased yield over control. Out of them, Luna sensation (Fluopyram 25% + Trifloxystrobin 25%) @ 1ml/liter water was the best for controlling diseases (96% disease reduction over control) and the highest bulb yield 18.0 followed by Rovral 50 WP (Iprodione 50%) @ 2g + Headline™ TM. (Pyraclostrobin 6.7% + Dimethomorph 12%) @ 2 g / lit. water and Amister Top (Azoxystrobin 20% + Difenoconazole 8%) @ 1 ml / lit water.

Yield loss assessment of lentil varieties due to stemphylium blightdisease

M. R. Humauan, B. Akhter, M. S. Hossain and D. Sarkar

The experiment was conducted at RARS, Ishurdi, Pabna during Rabi season of 2021-22 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 ml/l 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 due to stemphylium blight ranged from 10.27% - 46.85%. The highest yield loss 46.85% was found in BARI Masur-1 followed by BARI Masur-4 (42.05%) and BARI Masur-5 (41.53%) while the lowest loss (10.27%) was recorded in BARI Masur-9. The highest yield (3250.67 kg/ha) was found in sprayed plots of BARI Masur-8 while the lowest (1205.67 kg/ha) was recorded in unsprayed plots of BARI Masur-9.

Screening of lentil lines against stemphylium blight disease

M. R. Humauan, B. Akhter, M. S. Hossain and D. Sarkar

The experiment was conducted at the experimental field of RARS, Ishurdi, Pabna during rabi season 2021-22 to find out the resistant sources against stemphylium blight disease of lentil. Thirty lentil lines viz. BD-3946, BD-3984, and BD-3972, BD-3995, BD-3978, BD-3977, BD-3963, BD-3956, BD-3958, BD-3968, BD-3965, BD-3936, BD-3988, BD-3970, BD-3950, BD-3975, BD-3955, BD-3974, BD-3983, BD-3964, BD-3943, BD-3944, BD-3976, BD-3971, BD-3967, BD-3985, BD-3954, BD-3957, BD-3937, BD-3945 and one check variety BARI Masur-1 were used in this experiment. Among the tested entries 10 lines showed resistant, 14 showed moderately resistant, 6 lines showed moderately susceptible and rest one check variety BARI Masur-1 showed susceptible reaction against Stemphylium blight disease. The highest yield (1897 kg/ha) was observed in genotype BD-3972 which statistically identical to BD-3936 (1760 kg/ha), where the lowest yield (994 kg/ha) was recorded in BD-3977.

Screening of pumpkin lines against powdery mildew disease

M. R. Humauan, B. Akhter, M. S. Hossain and D. Sarkar

The experiment was conducted at the experimental field of RARS, Ishurdi, Pabna during rabi season 2021-22 to find out the resistant sources against powdery mildew disease of pumpkin. Eleven pumpkin genotypes viz. cm-005, cm-016, cm-018, cm-019, cm-020, cm-022, cm-024, cm-025, cm-027, cm-032 and cm-034 were used in this experiment. Ten Pumpkin genotypes showed moderately resistant reactions and one genotype showed moderately

susceptible reactions against powdery mildew disease. The highest weight of fruits per plant (16.11 kg) was recorded in genotype cm-005 and the lowest (8.17 kg) was found in cm-022 which statistically identical to cm-019 (9.37 kg). The highest yield (53.71t/ha) was found in genotype cm-005 while the lowest (27.24 t/ha) was recorded in cm-022 which statistically similar to genotype cm-019

Effect of sowing date and fungicide spray on the incidence of sclerotinia stem rot and yield of sunflower

M. R. Humauan, B. Akhter, M. S. Hossain and D. Sarkar

The experiment was conducted at RARS, Ishurdi, Pabna during Rabi season of 2021-22 to find out the actual scenario for sclerotinia rot disease development in different sowing times. Seeds of BARI Shurjomukhi-3 were sown on different dates viz. November 01, 10, 20, 30, December 10, 20 and 30 in 2021. Among the sowing dates first disease symptoms observed between January 10 to March 14, 2022 when crop attained 59 to 74 days old. The highest disease incidence (81.80%) was recorded in Nov. 10 sowing date. Second highest incidence (76.25%) was recorded in Nov. 01 sowing date and they differed significantly with rest sowing times and the lowest incidence (2.93%) was found in Dec.30 sowing date. It was found that disease incidence (%) became lower from delayed sowing. The highest yield (1478.30 kg/ha) was obtained in Dec.10 sowing date which statistically identical to Nov.30 (1382.10 kg/ha) and Nov.20 (1345.80 kg/ha) while the lowest yield was fond in Nov. 10 (366.70 kg/ha) and Nov. 01 (385.40 kg/ha).

Management of leaf spot disease of aloe vera

B. Akhter, M. R. Humauan, M. S. Hossain and D. Sarkar

A field experiment was conducted at Regional agricultural Research Station Ishurdi, Pabna during Rabi season of 2021-2022 to find out the effective treatments against leaf spot disease of Aloe vera. Seven different fungicides viz. T_1= Autostin (Carbendazim) @ 0.2%, T_2= Rovral (Iprodione) @ 0.2%, T_3= Folicure 250 EC (Tebuconazole) @ 0.1%, T_4= Score 250 EC (Difenoconazole) @ 0.2%, T_5= Indofil M 45 (Mancozeb) @ 0.2%, T_6= Calcium carbonate @ 6.25 %, T_7= Soil application of Dolomite @ 750 kg/ha and one unsprayed control were used in this experiment. The lowest severity of leaf spot (2.00%) was recorded from T_6= Calcium carbonate @ 6.25 % treated plots and the highest severity of leaf spot (58.67%) was found in control plots. Leaf spot reduction over untreated control ranged from (23.30-96.59 %) among the tested treatments. The maximum disease reduction over untreated control (96.59%) for leaf spot was found in T_6= Calcium carbonate @ 6.25 % treated plots. The highest plant height (52.07cm) was recorded in T_6= Calcium carbonate @ 6.25 % treated plots where the lowest plant height (44.80cm) was found in control plots.

Validation of score and rovral against alternaria leaf spot and flower blight disease of marigold

B. Akhter, M. R. Humauan M. S. Hossain and D. Sarkar

A validation trial was conducted at Regional agricultural Research Station Ishurdi, Pabna during Rabi season of 2021-2022 to validate the effectiveness of score and rovral against Alternaria leaf spot and flower blight of marigold. Two varieties like hybrid and Local marigold were used in the study. Two fungicides viz T_1= Rovra l50 WP@ 0.2%, T_2= Score 250 EC @ 0.2% and unsprayed Control were used in this experiment.The lowest severity of flower blight (3.67) was recorded in T_2 x V_1 (Score 250 EC x Hybrid) which statistically identical to T_1 x V_1 (4.67), T_1 x V_2 (5.67) and T_2 x V_2 (6.00), whereas the highest was found in T_3 x V_1 (Control x Hybrid).The lowest severity of leaf spot (2.33 %) was observed in T_1 x V_1 (Rovral 50 WP X Hybrid) and T_2 x V_1 (Score 250 EC X Hybrid) which statistically similar to T_1 x V_2 (3.33) and T_2 x V_2 (3.67). The highest severity of leaf spot (66.67%) was recorded in T_3 x V_1 (Control x Hybrid).The highest number of fresh flower/ ha (1473438) was found in T_1 x V_2 (Rovral 50 WP x Local) and (1469792) was in T_2 x V_2 (Score 250 EC x Local), whereas the lowest (67708) was recorded in control plots T_3 x V_2 (Control x Local) which statistically identical to T_3 x V_1 (Control x Hybrid). The lowest number of infected flower/ ha (20313) was recorded in T_2 x V_1 (Score 250 EC x Hybrid) which statistically similar to T_1 x V_1 (28125), T_1 x V_2 (36458) and T_2 x V_2 (40104), whereas the highest (1335417) was found in T_3 x V_2 (Control x Local).

Survey of aloe vera plant diseases

B. Akhter and M. R. Humauan

A comprehensive survey was conducted in thirteen 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 2021-2022. Thirty 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 and leaf blight diseases of Aloe vera are predominant. Plant sample (leaf) was 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 in this year no root disease was found in any farmers fields like previous year.

Development of bio-agent based management practice against foot and root rot of lentil

M. B. Anwar, M. S. Ali and M. M. Hossain

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2021-22 to find out the effective bio-control agent against foot and root rot disease of lentil. Nine different bio-control agents such as bio-derma powder, geoderma powder, tricost powder, lentil rhizobium, bacillus, tricho-compost, bio-derma solid, tricho-leachate and soil recharge (Lycomax) are evaluated in thid study. Among the bio-control agents, the lowest seedling mortality (20.59 %) was recorded from T_5 (Bacillus) which was statistically similar to T_6 (Tricho-compost and T_9 (Soil recharge) treated plots and the highest (86.32 %) was recorded in T_{10} (control) plot. The highest yield (1454 kg/ha) was found in T_5 (Bacillus) treated plot followed by T_6 (Tricho-compost and T_9 (soil recharge) treated plot and the lowest (630 kg/ha) was found in T_{10} (control) plot.

Effect on planting time and spray schedule for controlling purple blotch of onion

M. B. Anwar, M. S. Ali and M. M. Hossain

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2021-22 to find out optimum planting time and actual spray schedule for controlling purple blotch disease of onion. There were three planting time such as 15th November 2021, 15th December 2021 and 15th January 2022 and four subplot treatments such as three times spray started at 30 DAP, 40 DAP, 50 DAP and 60 DAP. Among the treatments, the lowest disease severity (2.00) was observed from MP1 x SP2 (sowing date at 15th November 2021 and spray started at 40 DAP) which were statistically similar with those of MP1 x SP3 and MP1 x SP4 and the highest disease severity (5.00) was recorded from MP3 x SP4 plots where planting date was 15th January and spray started at 60 DAS. The highest yield (17.75 t/ha) was found in MP1 x SP2 which was statistically similar to MP1 x SP3, MP2 x SP1 and MP2 x SP4, respectively and the lowest (5.03 t/ha) was found in MP3 x SP4 followed by MP3 x SP3.

Validation of score and rovral against alternaria leaf spot and flower blight disease of marigold

M. B. Anwar, M. S. Ali and M. M. Hossain

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2021-22 to find out the effective chemical fungicides against alternaria leaf spot and flower blight disease of marigold. Two marigold varieties such as hybrid (Inca) and local were evaluated in this study. For the varieties, the lowest disease incidence and disease severity was found in T_1 (Rovral 50 WP) treated plot and the highest disease incidence and disease severity was found in T_3 (control) plot.

Effect of plant activators on fusarium wilt of chilli under field condition

M. B. Anwar, M. S. Ali and M. M. Hossain

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2021-22 to find out the effective plant activators against fusarium wilt disease of chilli. Four plant activators such as Salicylic acid, Ascorbic acid, Benzoic acid and KH_2PO_4 were evaluated in this study. Out of four plant activators, the highest disease incidence (45.00) was recorded in T_5 (Control) plot and the lowest disease incidence (18.33) was recorded in T_1 (Salicylic acid) treated plot. The highest yield (12.00 t/ha) was found in T_1 (Salicylic acid) treated plot and the lowest (5.00 t/ha) was found in T_5 (control) plot.

Survey and identification of major diseases of vegetable crops in saline area

M. S. Ali, M. B. Anwar and M. M. Hossain

A comprehensive survey was conducted in three upazilla of Satkhira District districts of the saline region to identify the vegetable diseases and existing management practices during Rabi 2021-22. About 30 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.

Evaluation of new fungicides against early blight of tamato

M. B. Anwar, M. S. Ali and M. M. Hossain

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2021-22 to find out appropriate new chemical fungicides for controlling early blight of tomato. Fifteen new fungicides were evaluated in this study. Among the fungicides, the lowest disease severity (2.00) was recorded in T_{10} (566), T_1 (19) T_2 (109) and T_{14} (621) treated plot, which was statistically similar with T_{15} (619) and T_9 (546) treated plot. On the other hand, the highest disease severity (5.00) was found in T_{16} (control) plot. The hightest reduction (86.66%) of disease severity over control was found in T_{10} (566) and T_1 (19) treated plot and the lowest (46.66%) was found in T_{13} (590) treated plot. The highest yield was recorded (35.80 t/ha) in T_{10} (566) treated plot followed by T_1 (19), T_2 (109), T_{14} (621), and T_{15} (619) treated plot, respectively and the lowest (10.12 t/ha) in T_{16} (control) plot.

Evaluation of new fungicides for controlling purple blotch disease of onion

M. B. Anwar, M. S. Ali and M. M. Hossain

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2021-22 to find out the effective new chemical fungicides against purple blotch disease of onion. Fifteen new fungicides were evaluated in this study. Among the fungicides, the lowest disease severity (2.00) was recorded in T_1 (104) T_2 (145) T_3 (236) T_{10} (662) and T_{14} (729) treated plot. On the other hand, the highest disease severity (5.00) was found in T_{16} (control) plot. The hightest reduction (84.58%) of disease severity over control was found in T_1 (104) treated plot and the lowest (54.18%) was found in T_{12} (687) and T_{13} (712) treated plot. The highest yield (15.49 t/ha) was recorded in T_1 (104) treated plot followed by T_3 (236) and T_2 (145) treated plot and the lowest (7.69 t/ha) in T_{16} (control) plot.

Efficacy of different new fungicides in controlling sigatoka disease of banana

M. S. Ali, M. B. Anwar and M. M. Hossain

This experiment was conducted at farmer's field of Modonpur, Monirampur, Jashore district during rabi 2021-22 to find out the effective new chemical fungicides against sigatoka disease of banana. Twenty new fungicides were evaluated in this study. Among the fungicides, the lowest disease severity (2.66) was recorded in T_5 (528) and T_2 (281) treated plot which was statistically similar with T_4 (482), T_9 (585), T_{16} (642), and T_{18} (703) treated plot. On the other hand, the highest disease severity (6.00) was found in T_{21} (control) plot. The hightest reduction (88.89%) of disease severity over control was found in T_5 (528) treated plot and the lowest (57.78%) in T_1 (63) treated plot. The highest yield was recorded in (48.00 t/ha) T_5 (528) treated plot and the lowest (20.00 t/ha) was recorded in T_{21} (control) plot.

Efficacy of new fungicides in controlling powdery mildew of sweet gourd

M. S. Ali, M. B. Anwar and M. M. Hossain

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2021-22 to find out the effective chemical fungicides against powdery mildew disease of sweet gourd. Fourteen new fungicides were evaluated in this study. Among the fungicides, the lowest disease severity (1.00) was recorded in T_1 (197), T_4 (222), T_7 (431), T_{11} (723) and T_{12} (725) treated plot. On the other hand, the highest disease severity (3.00) was found in T_{15} (control) plot. The hightest reduction (83.33%) of disease severity over control was found in T_1 (197) treated plot and the lowest (64.46%) in T_9 (463) treated plot. The highest yield was recorded in (25.30 t/ha) T_1 (197) treated plot followed by T_{10} (487), T_{12} (725), T_4 (222), T_{11} (723), T_7 (431) and T_6 (387) treated plot, respectively and the lowest (12.93 t/ha) in T_{15} (control) plot followed by T_5 (376), T_9 (463), T_3 (127) and T_{14} (385) treated plot, respectively.

Study of propiconazole degraded bacillus velezensis bari/hat/gl6 for suppressing lasiodiplodia theobromae in mango

M. T. Hossain, M. M. Rahman and Z. A Firoz

Stem end rot of mango caused by Lasiodiplodia theobromae is the major economical devastating postharvest and field disease in mango growing areas. Still to date there is no successful eco-friendly remedy to control the disease. Our farmers had been using Triazole fungicide, propiconazole group especially, Tilt-250 EC during the last decade. But, Tiazole fungicide, which inhibits the demethylation, is serious harmful in human body. Now-a-days, it is a demand to be safe and enjoy with the safe agriculture. Endophytic Bacillus species with plant growth promoting activities have been used during the last decade for safe agriculture as an ecofriendly bio-control measures. Therefore, in lieu of propiconazole the basic experiment has been conducted having with the eco-friendly antagonistic endophytic novel Bacillus velezensis GL6 at Regional Agricultural Research Station, Hathazari, Chattogram to control the stem end rot as well as degrade the propiconazole properties. Out of three antagonistic species, Bacillus velezensis GL6 is the best to degrade the propiconazole properties. Three concentrations of Bacillus velezensis GL6 were used compared with Tilt-250 EC. The concentration (1×10^7 CFU/ml) of Bacillus velezensis BARI/HAT/GL6 could change the color of Tilt within 6 hr. It also showed -.68 ±0.01 to 0.48 ± 0.01 absorbance by 600 nm web length by deleting the concentration of Tilt-250 EC in without media and with media condition respectively. It seems strain BARI/HAT/GL6 has positive effect to degrade the propiconazole.A very clear and distinct inhibition zones were observed at in vitro cell bioassay, indicating strong antagonistic strain GL6. It revealed significantly (Tukey HSD, $P<0.01$) lower disease severity by 1.5 ± 0.3, than the control, Tilt-250 EC and hot water by 4.0 ± 0.5, 1.75 ± 0.2 and 3.0± 0.4, respectively in the mango fruit (postharvest condition) after pathogen inoculation. However, strain GL6 showed significantly consistent disease suppression 2.67 times to stem end rot compared to control

The efficacy test of bacillus based products (EMOS) for controlling greening disease of sweat orange

M. T. Hossain, M. M. Rahman and Z. A Firoz

Greening disease for sweet orange is a serious threat over the world. Generally, the chemical pesticides have been being used for controlling the vector, insects. But still no date, there is no successful findings to control the greening pathogens Liberibacter sp. as well as greening disease. However, from the last decade, Bacillus species and their formulated products have been being used in agriculture for many aspects over the world. This approach is totally rudimentary in our country. The activity using the endophytic novel Bacillus species to control greening disease of sweet orange, BARI Malta 1 is the first study in our country. The in vitro and in vivo study had been conducted successfully at the Regional Agricultural Research Station, Hathazari, Chattogram to get the successful grafting projection without infection of greening disease by the Bacillus oryzicola YC7007 and B. siamensis YC7012 since 2017. YC7007 (2.0×10^7 CFU/ml) revealed significantly ($P<0.01$) lower greening disease severity by 1.4 ± 0.1 and 0.9 ± 0.2 than the control by 2.86 ± 0.3 and 2.1 ± 0.2 in the BARI Malta 1 by root stocks with rough lemon and kalamunchi respectively. In the Pummelo root-stock, Bacillus siamensis YC7012 showed the best performance in respect to free infection of greening disease by 1.56 ±0.2 scaling compared with control by 2.69 ± 0.2. In the seedling stage at nursery bed, YC7007 revealed significantly ($p <0.01$) lower greening disease index by 0.78 ±0.14 compared with control by 3.8±0.12.Depending on our data, EMOs made by the strain YC7007 and GL6 revealed significantly ($P<0.01$) lower greening disease severity by 1.26 ± 0.2, than the control by 2.52 ± 0.3 in the BARI Malta 1 by root stocks with rough lemon at 3 years old plant.

The efficacy test of EMOS (bacillus oryzicola yc7007 and bacillus velezensis bari/hat/gl6) for controlling bacterial wilt in solanaceous vegetable

M. T. Hossain, M. Alam and Z. A. Firoz

Bacterial wilting of *solanaceous* crops like eggplant, tomato and pepper is a serious threat over the world. Still there is no successful remedy for controlling the bacterial wilt in solanaceous crops. However, probiotic Bacillus species and their formulated products had been being used to the agriculture with the many aspects over the world from the last decade. This approach is very rudimentary in our country. The activity of the formulated EMOs (Effective Microbial Organisms) by using the endophytic novel Bacillus oryzicola YC7007 and B. velezensis GL6 to control

bacterial wilt in solanaceous crops is the first study in Bangladesh to our knowledge. The in vitro antagonistic activities by formulated product of EMOs and their active inocula levels had been scrutinized against the bacterial pathogen *Ralstonia solanacearum* for controlling bacterial wilt since 2016 in very susceptible BARI Bt Begun 2, Strain YC7007 and GL6 did quorum having with the 2.0×10^7 CFU/ml or CFU/gminocula that suppressed the wilt and promoted the plant growth compared with control. Bacterial wilt of the solanaceous crops especially on eggplant (very susceptible variety BARI Bt Begun 2), tomato (BARI Tomato 15) and chili pepper (very susceptible variety Haldamorich) was successfully controlled in vibo at RARS, Hathazari. Granular EMOs were scrutinized by one time drenching as a basal dose and formulated powder EMOs were conducted by three time sprayings to the rhizosphere till to droplet. There was no diseases at 2-MAT (Months after transplanting) in the treated plot. Granular form for basal application, EMOs (1×10^8 CFU/g) and powder form formulated bacterial product (1×10^9 CFU/g) together revealed significantly (Tukey HSD, $P<0.05$) lower disease severity by 1.2 ± 0.3, than the control by 2.59 ± 0.3 in the BARI Bt begun 2 at 3-MAT. However, EMOs revealed significantly (Tukey HSD, $P<0.05$) lower disease severity by 0.56 ± 0.07 and 0.3 ± 0.3 than the control by 1.03 ± 0.1 and 1.83 ± 0.1 at BARI Tomato 15 and Halda morich respectively at 4-MAT out of 0-5 disease rating scales. EMOs showed significantly consistent disease suppression 70-84 % in the BARI Bt Begun 2 and BARI Tomato 15respectively at 4-MAT to bacterial wilt compared to control. 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. We concluded that EMOs products are key vital biological products to Ralstonia solanacearum for controlling bacterial wilt in solanaceous crops.

Management of powdery mildew of pumpkin on floating bed cum trellis

M.G. Kibria, M.M.R. Talukder and M.R. Uddin

The floating experiment was conducted at RARS, Rahmatpur, Barishal during 2021-22.management of powdery mildew of pumpkin was evaluated by chemicals and Bio fungicide viz; Tilt 250 EC @ 0.05%. Thiovit 80w @ 0.2%, Biodeoma @ 0.3% and control. From this experiment it was observed that spraying of thiovit @ 0.2% and Bioderma (0.3%) can effectively control the powdery mildew of pumpkin.

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 Barishal (Wazirpur, Babugonj and Banaripara), Jalakhathi (Binoikathi and Gava Ramchandrapur) and Pirojpur Districts. Respondents in different Upazilla recorded all the disease with the highest incidence being Greening (85%), followed by dieback (80%), Sooty mold (45%), Canker (35%) and Gummosis (40%).

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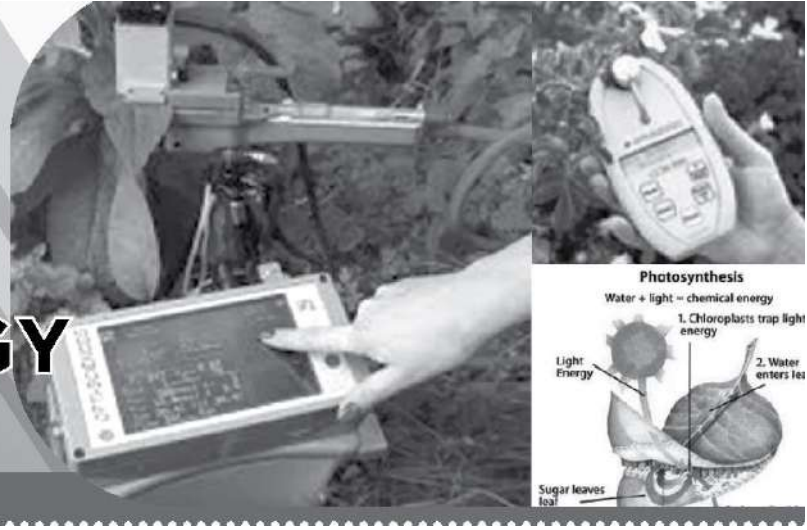


Novel bacillus strain *Y007* ameliorates salinity stress in tomato plant

I. M. Ahmed, F. Ahmed, A.F.M Shamim Ahsan and A. H. M. M. R Talukder

An experiment was conducted at the Pot house of Plant Physiology Division, BARI Gazipur during *rabi* season of 2021-2022. Four treatments, namely T_1= Control, T_2= Novel bacillus (NB), T_3= Salinity, T_4= NB+salinity were used in the study. The experiment was laid out in RCBD with 8 replications. Plastic pot (top dia: 25 cm, bottom dia: 18 cm and height 25 cm; 12 kg soil) was filled up with soil and cowdung (4:1). Three seedlings (30 days old) of BARI tomato-7 were transplanted in plastic pots on 29 November, 2021. Fertilizers were applied 90-12-40-1-2-2-1 kg/ha N-P-K-S-Mg-Zn-B. 1/2 N and half of K along with full amount of other fertilizers were be applied as basal. Remaining N and K was top dressed in 2 equal splits at 25 & 50 DAT. Irrigation was done as and when required for maintaining adequate soil moisture. After 10 days of transplanting, plants were thinned to one plants in each pot. Leaf samples were collected at 55 DAT for leaf chlorophyll estimation and biochemical analysis. Plants from three pots were sampled for dry matter measurement. Plant parts were dried in an oven for 72 hours at 70°C and dry weight was recorded. Exposure to salinity (120 mM) for 21 d significantly inhibited biomass accumulation and net CO_2 assimilation (Pn) which was attributed by both stomatal and nonstomatal factors. Salinity significantly increased malondialdehyde (MDA) and H_2O_2 accumulation in leaves. The elevation in contents of phenol, flavonoid and DPPH (1,1-diphenyl-2-picrylhydrazyl) activity were also observed in salinity relative to control in the tomato genotypes. Importantly, application of NB (novel bacillus) significantly increased Pn, but decreased H_2O_2 and MDA contents over salinity alone. Taken together, our results suggested an enhanced coordinated detoxification and degradation of salinity in NB treated plants, while NB application could be an approach to enhance plant tolerance against salinity stress via in planta detoxification.

Effect of potassium on dry matter, starch and reducing sugar of potato processing variety

I. M. Ahmed, F. Ahmed, S.N. Mahfuza, A.F.M Shamim Ahsan and A. H. M. M. R. Talukder

An experiment was conducted at the Pot house of Plant Physiology Division, BARI Gazipur during rabi season of 2021-22 to assess the comparative effect of sources and rates of K fertilizer on potato yield and quality. BARI Alu-28 was used in the experiment. The experiment was laid out in RCBD with 6 replications. Plastic pot (top dia: 120 cm, bottom dia: 90 cm and height 42 cm; 25 kg soil) was filled up with soil and cowdung (4:1). Potassium nutrient was applied at the rate of 0, 100, 150, 200 kg ha^{-1} from two sources of sulfate of potash (SOP) and muriate of potash (MOP) as basal. Nitrogen, 150 kg ha^{-1} and phosphorus, 45 kg P ha^{-1}, gypsum 20 kg S ha^{-1} were applied. Full amount of TSP, gypsum and 50% of urea were applied as basal during pot preparation and the remaining amount of urea was side dressed at 30 days after planting. Three tuber seeds (about 50 g) were planted on 29 November to a depth of 6 cm soil in each pot. Intercultural operations were done as and when necessary. Irrigation was done as and when required for maintaining adequate soil moisture. One destructive sampling was performed at 60 days after planting and yield components included the plant height, stolon and tuber number, leaf area and total fresh weight were recorded from the three plants. Significant increase in tuber yield was observed with 150 kg ha^{-1} K from both the sources over control. Increase in tuber yield with 200 kg ha^{-1} K was statistically non-significant compared to 150 kg ha^{-1}

in case of muriate of potash (MOP), however significant result observed over sulfate of potash (SOP). Importantly, the dry matter and specific gravity were more affected with MOP than SOP. The quality parameters like dry matter, specific gravity and starch contents were improved with SOP application. So that, SOP plays very important role in contributing to yield attributes and quality, such as sugar, specific gravity and total yield of tubers.

Effect of elevated temperature on flowering, seed yield and quality of onion

I. M. Ahmed, F. Ahmed, A. H. M. M. R. Talukder, S.N. Mahfuza, A.F.M Shamim Ahsan and B. Ahmed

An experiment was conducted at the Pot house of Plant Physiology Division, BARI Gazipur during rabi season of 2021-22. Five treatments, namely T_1= open field (control), T_2= Inside polythene chamber from 20 days after transplanting (DAT) to 35 DAT, T_3= Inside polythene chamber from 35 DAT to maturity, T_4= Inside polythene chamber from 20 DAT to maturity and Inside polythene chamber from transplant to maturity (T_5) were used in the study. The high temperature was imposed by using transparent white polythene chamber (4m × 3m). Daily air temperature was monitored using maximum and minimum thermometer inside and outside of the chamber. Inside the chamber minimum temperature was 1 to 3 °C higher (depending on time of day) than outside while maximum was 4 to 6°C higher. The experiment was laid out in randomized complete block design with 10 replications. Plastic pot (top dia: 25 cm, bottom dia: 18 cm and height 25 cm; 12 kg soil) was filled up with soil and cowdung (4:1). Ten seedlings (40 days old) of BARI Piaj-1 were transplanted in plastic pots on 18 December, 2021. Fertilizers were applied 90-45-120-30-3-1.4 kg/ha 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 & 50 DAT. Other than control, flowering initiation to 15 days under poly tunnel (T_3) treatments produced the maximum viable pollen. The highest seed yield (6.89 g plant^{-1}) was obtained from T_1 and lowest (1.95 g plant^{-1}) from T_2. Similar trend was observed in case of percent germination. It revealed that during flowering time higher temperature have negative impact on seed yield and quality, moreover fluctuating temperature may have harmful effect on seed yield and quality of onion.

Phytochemical accumulation in *bt*-brinjal cultivar at variable planting dates

S.N. Mahfuza, I.M. Ahmed, F. Ahmed, A.F.M Shamim Ahsan and A.H.M. Motiur Rahman Talukder

The experiment was carried out at the research field of Plant Physiology Division, BARI, Joydebpur, Gazipur, during *rabi* season of 2021-22 to assesses the phytochemical accumulation of eggplant in relation to planting time-based temperature. The experiment was laid out in randomized complete block design with three replications. The treatments included two brinjal varieties *viz*, BARI Brinjal-4 (Kajla) and BARI Bt Brinjal-2 under three planting dates December 11, December 21 and December 31. The unit plot size was 4.2 m × 2.4 m. Thirty days old seedlings were transplanted with a spacing of 100 cm × 75 cm. Well decomposed cowdung was applied @ 10 t ha^{-1} before land preparation. Fertilizers were applied @ 150-50-125-40-2 kgha^{-1} of N, P, K, Zn, B in the form of area, triple super phosphate (TSP), muriate of potash (MOP) and gypsum, Boron 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 30 days after planting. Weeding, irrigation, earthing-up and other intercultural operations were done as and when necessary. Plant parts were dried in an oven for 72 hours at 80^{oC} and dry weight was recorded. Harvesting time significantly influenced the antioxidant activities in eggplant; the lowest DPPH free radical scavenging activity and highest glycoalkaloids, flavonoid and phenolic contents were observed at 31 December sowing. Planting time-based temperature variation influenced the DPPH free radical scavenging activity, glycoalkaloids, flavonoid and phenolic content of both Brinjal cultivar, however they were under safe limit. Simultaneously, yield contributing characters and yield of both brinjal cultivar was also hampered by planting time-based temperature variation.

Morpho-physiological evaluation of selected tomato variety under drought condition

S.N. Mahfuza, A.F.M.S Ahsan, M.A Goffar (HRC), I.M. Ahmed and F. Ahmed

Tomato needs enough irrigation based on climatic conditions and soil type as they are succulent

plants. On the other hand, most commercial tomato cultivars are drought sensitive at all stage of plant development. Morpho-physiological evaluation of selected tomato variety under drought condition was done at the vinyl house of Plant Physiology Division, BARI, Gazipur, Bangladesh during the December, 2021 to April 2022. Sandy loan soil was collected from Kodda area Gazipur. 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. The soil was acidic in nature (pH 6.1). Fertilizer at the rate of 90-12-40-1-2-2-1 kg/ha N-P-K-S-Mg-Zn-B (FRG, 2018) in the form of Urea, Ttriple super phosphate, Muriate of potash, Gypsum, Zinc sulphate and Boric acid were incorporated in the soil. Scanty rainfall, low humidity and clear sunny days were the characteristic features of the growing season. Four selected BARI tomato varieties (BARI Tomato-17, BARI Tomato-19, BARI Tomato-20 and BARI Tomato-21) were used in this experiment. Twenty-five days old seedling were transplanted in each pot on 05 December 2021. Drought treatment was imposed during early flowering stage. This experiment included the following 4 treatments: (1) control (95-100 % FC) (2)75-80 % FC (3) 55-60 % FC (4) and 35-40 % FC. The experiment was done in RCBD with six replications. Soil moisture was measured using a TDR (Time Domain Reflectometer) every alternate day. Plants were sampled after end of treatment for measurement of photosynthetic activities, physiological parameters, plant height, yield contributing characters. Results showed that Biomass accumulation, photosynthetic activity, Relative water content, MDA content, $O_2^{\bullet-}$ and H_2O_2 accumulation, Total chlorophyll content plant^{-1} and yield contributing characters as indices of drought stress tolerance, BARI Tomato-21 is more tolerant to drought stress, than BARI Tomato-17, BARI Tomato-19 and BARI Tomato-20.

Screening of linseed accessions against drought stress under laboratory condition

S.N Mahfuza, A.F.M.S Ahsan, I.M. Ahmed, A.H.M.R Talukder and F. Ahmed

Drought stress is one of the most important environmental stresses limiting growth and productivity of plants. Drought can significantly influence plant performance and survival and can lead to major constraints in plant functioning, including a series of morphological, physiological and metabolic changes.Thirty-five linseed accessions were screened under three drought levels 0% PEG (distilled water as control), 10%, and 15% PEG 6000 solution in petri-dishes to see the effect of osmotic stress on their germination and seedling growth during *rabi* season of 2021-22. The seeds of the linseed accessions were collected from the PGRC, BARI, Gazipur and the experiment was conducted in Plant Physiology laboratory of Plant Physiology Division, BARI, Gazipur. PEG 6000 solutions were prepared according to weight by volume i.e. to prepare 10% PEG solution, 100 g of PEG was dissolved in 200 ml of distilled water and total volume was raised up to one liter. Similarly, to prepare 15 % PEG solution, 150g of PEG was dissolved in 200 ml of distilled water, respectively, and total volume was raised up to one liter. Fifteen healthy and equal-sized seeds of the accessions were selected and then surface sterilized with 70% ethanol solution for 3 minutes followed by washing several times with sterile distilled water. Seeds were then put in sterilized 9 cm petri-dishes containing germination paper moistened with 10 ml of the different PEG-6000 solutions or distilled water to provide appropriate moisture stress for seed germination. The petridishes were put in a hood to avoid the loss of moisture through evaporation. Distilled water and PEG were added regularly when required. Germinated seeds were first counted after 72 hours and then counted every day at the same time for 14 days. A seed was considered to have germinated when both the plumule and the radicle emerged > 0.5cm. After 14 days, the shoot and root length of five randomly selected seedlings from each replicate were measured following a draftsman ruler (Azhar and Mc Neilly, 1987). Experiment was laid out in CRD with four replications. Germination percentage, root length, shoot length, fresh and dry weight were significantly found to be affected by drought. The accessions BD-10698, BD-10700, BD-10701, BD-10706, BD-10710, BD-12093, BD-12094 and BD-12102 could be selected as relatively drought tolerant accessions on the basis of relative values of root length, shoot length and dry matter.

Physiological and biochemical response of salinity tolerance in selected tomato hybrid

A.F.M.S Ahsan, M.A Goffar, I.M. Ahmed, S.N Mahfuza, A.H.M.M Rahman and F. Ahmed

An experiment was conducted at Plant Physiology Division, BARI, Gazipur to compare the salinity tolerance in the reproductive stage, 5 selected tomato hybrids (P_1×P_2, P_1×P_3, P_1×P_6, P_2×P_3, and P_5×P_6) and three checks hybrid Tomato (BARI Hybrid Tomato-5, BARI Hybrid Tomato-6 and BARI Hybrid Tomato-7) were evaluated under two salinity levels (no saline and 150 mM NaCl) in the hydroponic culture during *rabi* season of 2021-22. The seeds of the tomato entries were obtained from the Olericulture Division of HRC, BARI, Gazipur and propagated in the hydroponic site of Plant Physiology Division, BARI. 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 vermi-compost) 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 160 L container. 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 140 L/min). Thirty days old seedlings (homogenous) were transplanted in three other hydroponic containers, containing ½ strength modified Hoagland solution. Salinity treatment was imposed on 20 DAT (days after transplant) and the desired NaCl concentrations had been reached in each container within the next nine days, and the seedlings were grown up to maturity. Treatments in the experiment were arranged in a factorial CRD, with six replications. However, a set of control plants were simultaneously grown in non-salinized solution throughout the experimental period for comparison. Salinity level was maintained by monitoring with the help of EC meter (soil probe; HI 993310, Hanna, Romania). Salinity was initiated at the early flowering stage and maintained up to the maturity stage. Irrespective of the genotypes, under salinity treatment physiological parameters as well as fruit yield were greatly affected. Leaf relative water content (RWC), cell membrane stability index (CMSI), photosynthetic pigments, gas exchange parameters (Pn, Gs, Ci and Tr) was reduced due to salinity stress, which ultimately reduced fruit yield irrespective of the tomato hybrids. However, malondialdehyde (MDA) content was increased by the salinity but its value was significantly lower in P_5×P_6 which was identical with P_2×P_3 hybrid. Sodium (Na+) and potassium (K^+) ion content and their ratios (K^+/Na^+) in leaf tissue were significantly affected by salinity with significant variability in hybrids. Among the hybrids, P_5×P_6 and P_2×P_3 showed higher K^+/Na^+ ratio in leaf, which indicate higher tolerance to salinity compared to others at 150 mM NaCl salinity. These hybrids also showed lower ROS (H_2O_2 and O_2•−) generation in 150 mM NaCl salinity stress compared to other tomato hybrids. These results suggested that P_5 P_6 and P_2×P_3 hybrids can be regarded as suitable materials for developing saline tolerant hybrid tomato varieties.

Screening of sweet-pepper advanced lines against salinity at seedling stage

A.F.M.S Ahsan, A.K.M Quamruzzaman, A.H.M.M Rahman and F. Ahmed

A hydroponic experiment was conducted in a rooftop of Plant Physiology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh during the November, 2020 to January, 2022. Sweet pepper genotypes collected from Olericulture Division of HRC, BARI, Gazipur. Eight sweet pepper advance line were used in this study. Healthy and equal-sized seeds of each genotype 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 vermi-compost) and were kept in a growth shade with a moist cover. Seedling emergence took between ten days. After emergence, seedlings were thinned to five seedlings 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 160 L container. At the fourth leaf stage, uniformly healthy plants were selected and transplanted to 60L reservoir containers containing 40L basal nutrient solution (mgl^{-1}): KNO_3, 6.5 mM; Ca $(NO_3)_2.4H_2O$ 4.0 Mm as stock solution A, $NH_4H_2PO_4$ 100 µM, $MgSO_4.7H_2O$, 2.0 mM as stock solution B, $MnCl_2.4H_2O$, 0.5 µM; $ZnSO_4.7H_2O$, 0.2 µM; $CuSO_4.5H_2O$, 0.02 µM; H_3BO_3, 4.6 µM; $(NH_4)_6Mo_7O_{24}.4H_2O$, 0.1 µM. The container was covered with 40 small pots and placed in a net house. A seed was carefully with the tweezers and placed it coleoptile facing up, about 2-3cm deep in the center of the pot and cover gently with a layer of small clay beads. A label was increased into the pot. Repeat for all pots. The pH of the solution was adjusted to 6.0 ± 0.1 with NaOH or HCl as required. All solution was changed weekly. Salinity was supplied to 15 DAT, adding it incrementally by 40 mM NaCl per day to reach a final concentration of 80 and 120 mM. Control plants were grown under the same conditions, minus the NaCl. The nutrient solution was aerated with pumps every 30 min interval. The experiment was done in RCBD with five replications. Three weeks after the treatment (45 DAT), treated and control plants were assessed for various physiological traits. Salinity stress significantly increased Na^+ and K^+ content, however decreased K^+/Na^+ ratio in all advanced line, while the leaf K^+/Na^+ ratio was the strongest determinant of salinity tolerance. On the basis of seedling traits, ion content and gas exchange parameters, two advanced lines of sweet pepper i.e., P_7 and N_6 may be considered as relatively salt tolerant genotypes.

Screening of mungbean genotypes against salinity in laboratory condition

B. Ahmed, F. Ahmed and A. H. M. M. R. Talukder

The experiment was conducted from November 16, 2021 to February12, 22 at Plant Physiology Laboratory, Plant Physiology Division, BARI. Seventeen locally collected and longtime growing Mungbean genotypes (G-4, G-5, G-9, G-10, G-13, G-14, G-15, G-44, G-48, G-49, G-51, G-56, G-60, G-75, G-77, G-94, and G-97) were used in the study. The experiment assessed the germination and seedling growth of mungbean genotypes at different NaCl salinity levels at Petri dishes. The NaCl concentrations were used 0 (control/ no salt), 5 and 15 dS/m. The salt solution was prepared with calculated amount of NaCl in distilled water. Subsequently, plants were transferred to hydroponic culture in a Hoagland solution (The Hoagland solution: tap water ratio was 1:10 (w/w)) for an additional quantity. The P^H of solution was maintained 6-7. Petri dishes were used in the experiment with a diameter of 10cm and arranged in a CRD with three replications. Each pot was supplied with 500ml of the respective treatment solution. Seeds were sown on the plastic Petri dishes having blotting paper. The germination count was taken after 24 hours of sowing of seeds. A seed was considered to have 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. Germination percentage (GP), root length (RL), shoot length (SL) and drymatter/plant were significantly found to be affected by salinity. The mungbean genotypes G-40, and G-36 showed better performance at 150 mM (15 ds/m).

Screening of sunflower genotypes against waterlog

B. Ahmed, A.H.M Motiur Rahman and F. Ahmed

The experiment was conducted at Plant Physiology research field of BARI, Joydebpur, Gazipur, during the period from November 2021 to March 2022. The experiment was laid out in a RCB design with three replications. The soil was silty clay loam in texture belonging Chhiata series (AEZ-28) of Grey Terrace soil having low organic matter (0.97%) and deficient in total nitrogen (0.056%), available phosphorus (12 ppm), exchangeable potassium (0.17 meq/100 g soil) and available sulpher (10 ppm). Twenty-one genotypes collected from PGRC was used in this experiment. Unit plot size was 5 m x 4.5 m. Seeds of sunflower were sown in line with spacing of 50 cm x 25 cm. The experimental plots were fertilized by N_{92} K_{75} P_{40} S_{30} Zn_4 B_1 Kg/ha 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). In case of 12 hrs waterlogging condition, BD-9368 gave the highest pant height and in 24 hrs waterlogging condition, BD-9381 showed the highest plant height (171.2 cm). The highest Head diameter (17.87 cm) was recorded from sunflower genotype BD- 9361 at control condition while the lowest head diameter (6.7cm) was found in BD-9392 at 24 hrs waterlogging. The maximum yield (2.1 t/ha) was recorded from BD-9361 at control, while the minimum yield (1.2 t/ha) was recorded from BD-9399) at 24 hrs waterlogging level on sunflower genotypes. For confirmation it is needed to continue the experiment next year.

Evaluation of selected grass pea genotypes against salinity stress

B. Ahmed, F. Ahmed and O. A. Fakir

The experiment was conducted in on-station of Agricultural Research Station (ARS), Benarpota, Satkhira during *rabi* season, 2021-22. The objective of the study was to evaluate the salt tolerance of grasspea genotypes 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 experiment was laid out in RCBD with three replications. The unit plot size was 3 m × 2 m. 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. During seed sowing the salinity of the soil was tested and it was found in the range of 2.20 to 10.37 dS/m. Seeds were sown on 08 December, 2021. Before sowing seeds were treated with Provax-200 WP at the rate of 2.5 g/kg of seed and seeds were sown continuously in line maintaining 40 cm row to row spacing. Weeding and thinning were done as and when necessary. No insect and disease were seen at standing crop. The crop was harvested on 16 March, 2022 at maturity stage. The highest seed yield was obtained from BD-4774 (1402 kg/ha) while BD-5880 gave the lowest yield (1100 kg/ha). During crop growing period soil salinity ranged from 2.20 to 10.37 dS/m.

Effect of sowing date on phenology, growth and yield of chickpea (*Cicer arietinum*)

A.H.M.M.R. Talukder, I.M. Ahmed, F. Ahmed

The study was carried out at the research field of Plant Physiology Division, BARI Gazipur-1701, during *rabi* season (November to April) of 2022 to study the effect of climatic variability results of variable sowing dates (SD) on growth and yield of chickpea and to generate basic data for crop model (DSSAT/APSIM). The study area was located in between 23°53' and 24°21' N latitudes and in between 90°09' and 92°39' E longitudes. The experiment was designed in RCB, arrangement with three replications. As treatment variety BARI Chola-5 & BARI Chola-11 were sown on three different dates: 20 November, 30 November, and 14 December, 2022. Each experimental unit was 3 m × 4 m with eight rows at equal spacing of 40 cm from each other. Seeds were sown @ 35 kg ha^{-1} and each experimental unit needs 25 g seeds. Before sowing, seeds and soils were treated with Povax 200-EC (@ 2.5 g powder kg^{-1} seed) and furadan 3G (@ 5 kg ha^{-1}) to prevent seed and soil borne diseases correspondingly. The soil was nourished with fertilizer @ 90-40-55-10 kg ha^{-1} N-P-K-S- in the form of urea, triple super phosphate, muriate of potash, gypsum respectively. All amounts of fertilizers were applied during final land preparation just before sowing of seeds. With good tilth condition, furrows were made with hand rakes for sowing. Seeds were sown continuously in line maintaining spacing 30 cm between lines. After sowing, seeds were covered with soil and lightly pressed by hand. For confirmation of uniform germination, light watering was done in the furrows by a cane. Sowing dates had significant difference ($P \leq 0.05$) on crops growth and yield *viz.* plant height, Leaf Area Index (LAI), Total Dry Matter (TDM) production, yield contributing traits and seed yield. The variety BARI Chola-5 produced the maximum number of pod $plant^{-1}$ (128.0), 500-seed wt. (71.0g), seed yield; 1.70, stover yield, 1.85 t ha^{-1} while BARI Chola-11 also contributed notably in producing pod $plant^{-1}$ (85.0), 500-seed wt. (118.3g), seed yield; 1.80 t ha^{-1} stover yield; 1.97 t ha^{-1} when sown on early sowing window November 20. Both studied varieties produced the minimum seed and stover yield under latest sown condition. BARI Chola-11 showed superiority in yield than BARI Chola-5.

Growth, reproductive efficiency and yield of mungbean as influenced by sink manipulation

A.H.M Motiur Rahman Talukder, F. Ahmed, I.M. Ahmed

An experiment was undertaken in pot house of Plant Physiology Division, BARI, during *Kharif I* season,

2022, to observe sink manipulation impacts on growth reproductive efficiency and yield of Mungbean. Geographically the study area was located in between 23°53' and 24°21' N latitudes and in between 90°09' and 92°39' E longitudes and 25 km north of capital city of Bangladesh. This study was laid out in RCBD with ten replications and each pot represented one replication. Mother seed of trial variety BARI Mug-8 were collected from Pulse Research Centre (24° 8'N latitude and 89° and 5' 0" E longitude) BARI, Ishurdi, Pabna- 6600. To realize the objective deflowering on five levels were employed *viz*. (i) control (no deflowering); (ii) Deflowering at 40 days after sowing (DAS); (iii) Deflowering at 45 DAS; (iv) Deflowering at 50 DAS, (v) Deflowering at 55 DAS. However, in order to make the treatment application easier, 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 each 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. Each pot received double rate of 1.5-2-1.44-1.08-1-0.1-0.125 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 2×10^6 kg soil in root zone of crop. The pots had the enough perforation system at the bottom for the drainage of water. Seven to ten healthy, bigger and equal-sized mungbean seeds were chosen for planting and treated with Provax 200 EC @ 2.5 g kg^{-1} seeds. Finally, following to uniform emergence two seedlings in each pot was maintained. To predict the growth data, randomly selected three pots were sampled for dry matter measurement at different days after sowing. Sampled plants were separated in to leaf, stem, root based on plant growth stages. Results revealed that, with the pendant of deflowering pod length, number of seeds pod^{-1}, seed weight of five pods, 100-seed weight were reduced while number of pods plant-1were increased and there was a positive response on seed yield (g $plant^{-1}$). Deflowering at different reproductive phase after sowing resulted in a 6.0–29.9% reduction in seed yield compared with control plants and deflowering at 55 DAS decreased the minimum seed yield by 6.0% over control. Considering relative yield and yield reduction point, 50- or 55-days onsets flower following sowing could be considered for obtaining the Mungbean yield with the sacrificing minimum seed yield.

Dormancy breakdown and germination acceleration of BARI Alu-62 through chemical treatments

A.H.M. Rahman Talukder, F. Ahmed, I.M. Ahmed

To observe the dormancy breakdown and germination acceleration of BARI Alu-62 through chemical applications, the study was conducted at the Research field of Plant Physiology Division, BARI, Joydebpur, Gazipur, during *rabi* season of 2020-21. Tuber seed of potato variety BARI Alu-62 were collected from Breeder seed production center (26˚27'12" N latitude and 88°45'33" E longitude) BARI, Debiganj, Panchagarh-5020. The seeds' mucilaginous pulp of seeds was removed by rubbing them with sandy soil and then washing them with tap water. Air dried, cleaned seeds were stored in the paper bag for 2 weeks at the room temperature before use. To observe the dormancy breakdown and germination acceleration, tuber seeds were 24 hours soaked in control (soaked in water), singly GA_3 (0.1%), singly and KNO_3 (1.0%), combination of GA_3 (0.1%) × KNO_3 (1.0%). The experiment was laid out in RCB with three replications and three sowing dates were randomly distributed in each of the three blocks. Fertilizers were applied as per the general recommendation of FRG (2015). 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 emergence and maturity date was established when about 90% of the plants emerged and the leaves of plants turned yellow respectively, from the observations of 2 to 3 days intervals. To observe the stolon formation, four plants from each plot two or three times in a week from about two weeks after emergence were dug up and were analyzed. Data on dry matter was estimated at different DAPs and total tuber yield t ha^{-1} from 1.2 m × 3.5 m area was taken at harvest as the sum of marketable and non-marketable tuber yields. The combined application of GA_3 and KNO_3 accelerated

dormancy breakdown and germination (%). The treatment consisted of singly GA_3 (0.1%) and combined application of GA_3 and KNO_3 resulted in earliest seedling emergence (14-15 days), maximum seedling emergence (78-80%), and subsequent seedling growth e.g. highest leaf area, and TDM, yield and yield contributing traits. However, maximum plant height was observed under GA_3 (0.1%) and a combination of GA_3 and KNO_3 treatment. In conclusion, the combination of GA_3 (0.1%) and KNO_3 (1.0%) can be used for dermoney break down and enhancing germination of tuber seeds of BARI Alu-62.

Induction of seed dormancy in groundnut by foliar application of growth regulators

A.H.M Motiur Rahman Talukder, I.M. Ahmed and F. Ahmed

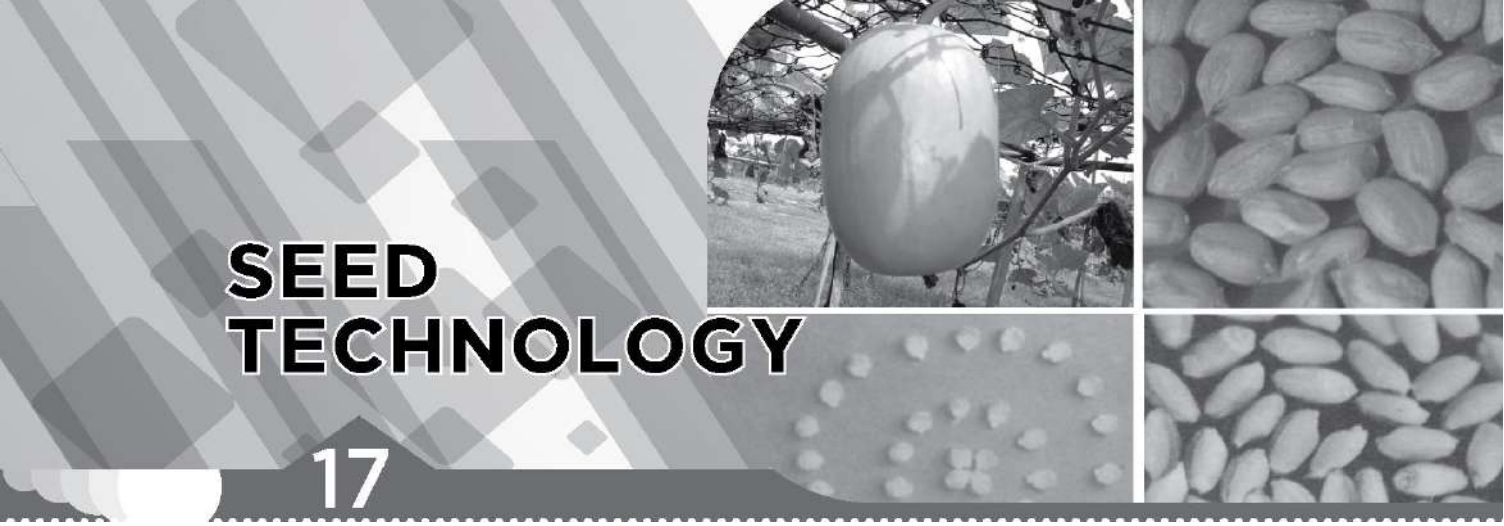
A study was conducted to find out suitable and most favorable dose of growth regulators that inhibit sprouting of groundnut seeds in field at maturity. The study area was located in between 23°53' and 24°21' N latitudes and in between 90°09' and 92°39' E longitudes and 25 km north of capital city of Bangladesh. In pot condition this study was carried out during winter (*rabi*) 2021-22 season in RCBD with 15 replications and each pot was considered as one replication. Conveniently to do the study, a total of 90 pots (26 cm top diameter, 20 cm base diameter, and 25 cm height) (15 pots treatment^{-1}) were organized in the pot house, with 15 pots placed in six 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 @ 36-36-45-36-2-1.4-0.4 kg ha^{-1} of N-P-K-S-Zn-B-Mo were applied in the form of urea, triple super phosphate, muriate of potash, zypsum, zinc sulphate and boron respectively. Each pot received double rate of 1.0-1.83-1.80-2.0-1.0-1.0-0.008 g urea, triple super phosphate, muriate of potash, zypsum, zinc sulphate, Boron and Molybdenum respectively as a basal dose with calculation of one hectare cultivated field contained 2×10^6 kg soil in root zone of crop. The pots had the enough perforation system at the bottom for the drainage of water. BARI-Chinabadam-9 was used as a Groundnut variety which was sown on 17 November, 2021and before sowing, seeds were treated with provax 200-EC @ 2.5 g powder for kg^{-1} seed. Most healthy and bigger sized 7-10 seeds were sown in pot^{-1} and seeds were covered with soil and lighlty pressed with hand. Subsequent to germination and emergence basically establishment of seedling two populations in pot^{-1} was maintained and intercultural operations were done to ensure normal growth and development of crop. Two irrigations were applied at 10 and 15 days after sowing. Phenological events *viz*., days to germination, emergence, flower initiation, 50% floral initiation and 100% floral initiation were recorded. To induce dormancy, foliar sprays of maleic hydrazide (MH) @ 500 ppm, 1000 ppm and 1500 ppm & ABA 250 ppm and 500 ppm were sprayed to crops two times @ 60 and 90 DAS accordingly 17 January, 2022 and 17 February, 2022. However, there were six treatments involving two types of chemicals, maleic hydrazide (MH) and (ABA) with spray solution of different concentrations along with a control. 150 mg, 300mg, 450mg of maleic hydrazide (MH) and 75, 150 mg of ABA chemical was dissolved in 300 ml of distilled water to prepare a solution of MH 500 ppm, MH 1000 ppm and MH 1500 ppm and ABA 250 ppm and ABA 500 PPM concentrations, respectively. In case of control, only distilled water was used for foliar spray. At maturity, plants from 7 pots of each treatment will be lifted at maturity for plant height, yield contributing traits, seed yield and germination and vigor index test will be performed. The plants in other 3 pots of each treatment will be left for fifteen (15) days with regular watering for in situ germination of pods. After fifteen (15), the pods will be lifted and same as above mentioned activities will be performed for the justification of treatments validity. It was found that two foliar sprays of MH and ABA did not show effective result in inducing dormancy in the resultant seeds from in situ germination.

Estimating leaf area in BARI developed promising mungbean varieties by non-destructive linear measurement

A.H.M Motiur Rahman Talukder, F. Ahmed, I.M. Ahmed

To develop non-destructive linear measurement method for calculating the leaf area of mungbean, a study in pot house and research field of Plant Physiology Division, BARI was carried out in *Kharif I* season between mid-March to Mid-June

of 2022. The study area was located in between 23°53' and 24°21' N latitudes and in between 90°09' and 92°39' E longitudes and 25 km north of capital city of Bangladesh. In pot condition, this study was laid out in RCBD with 15 replications and each pot was considered as replications while in field same statistical design was followed with three replications. Genetically diversified seeds of three mungbean varieties *viz.*, BARI Mug-6, BARI Mug-7 and BARI Mug-8 were used and collected from Pulse research sub-station, BARI, Gazipur. However, to execute the objective a total of 45 pots (26 cm top diameter, 20 cm base diameter, and 25 cm height) (Fifteen pots variety^{-1}) were organized in the pot house, with 15 pots were placed in three 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. Each pot received double rate of 1.5-2-1.44-1.08-1-0.1-0.125 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 2×10^6 kg soil in root zone of crop. The pots had the enough perforation system at the bottom for the drainage of water. In a correction factor techniques leaf area did not differ significantly within the varieties and sampling stage. So, a single regression equation Y = 1.602X + 11.57, r2 = 0.895 was developed. While, X=L×W. L and W are the maximum length and width of terminal leaflets of trifoliate leaf, respectively. Y= leaf area of trifoliate leaf. But on the other hand, leaf morphology (shape and size) varied for the genetic variability. So, we developed contrasting equation irrespective of BARI developed Mungbean varieties *viz*. BARI Mug-6; BARI Mug-7 and BARI Mug-6; to estimate the leaf area of trifoliate leaflets from the produced length and maximum width of the terminal leaflets. Irrespective of varieties, generated equation for BARI Mug-6; Y=1.4907x + 23.577; BARI Mug-7; Y= 1.6727x + 7.6618; BARI Mug-8; Y= 1.5843x + 12.181.



SEED TECHNOLOGY

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 maintaining 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 BARI Piaj-6 was used. 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 non-significant 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 (Tk. 1213500 ha^{-1}) and gross margin (Tk. 1091430ha^{-1}) of onion (var. BARI Piaj-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 $kgha^{-1}$ of NPKSZnB, respectively) gave the highest seed yield (689 $kgha^{-1}$) of onion (var. BARI Piaj-4) which was 26.42% higher than used inorganic fertilizer only.

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 to find out a suitable vermicompost treatment for better seed germination and seedling emergence under drought stress condition. The experiment was carried out in a factorial completely randomized design. The seeds of onion were imposed by five levels of priming viz., untreated control, 5% VCP (vermicompost priming), 10% VCP, 15% VCP, and hydro-priming. 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% coupled with 10% PEG 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%) under drought stress condition.

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 factorial completely randomized design. Onion seeds (var. BARI Piaj-4) were imposed by five levels of priming viz., untreated control, 5% VCP (vermicompost priming), 10% VCP, 15% VCP, and hydro-priming, 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 (GA_3)

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 GA_3 on growth, seed yield and quality seed production of onion and also to find out the suitable GA_3 concentrations. The experiment was laid out in RCBD with four treatments combinations *viz.* T_1= Control (0.0 ppm GA_3), T_2= 100 ppm GA_3, T_3= 200 ppm GA_3, and T_4= 300 ppm GA_3. The bulbs were soaked in treatment wise concentrations of the GA_3 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 GA_3 at 300 ppm compared to the control. Average of two years studied, the maximum no. of leaves 38, no. of branch per plant 5.3, no. of umbel per plant 6.2, seed weight per umbel 1.92g and seed yield 782 kg ha^{-1} were obtained from onion bulbs soaked with 300 ppm concentrations of the GA_3 in tray for 48 hours before sowing in the field where in control plot seed yield was 510 kg ha^{-1}. So, it was concluded that onion bulb treated with 300 ppm GA_3 before 48 hours sowing for high quality seed production, growth and yield of onion seed of BARI Piaz-1.

Hybrid seed production of BARI Hybrid Mistikumra-1

S.A. Bagum and A. K. 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 was harvested 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 combinations; five fermentation duration viz., F_1=Control (0 hrs), F_2= 8hrs, F3= 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 was 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 ga_3 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 GA_3 for better growth, seed yield and quality of garden pea. The plant growth regulator (GA_3) was applied as foliar application at 15, 30 and 45 DAS. Looking to the result, it was noticed that the GA_3(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 GA_3 at 200 ppm can be recommended to BARI Motorshuti-3 for obtaining better yield attributes and seed quality.

Effect of ga_3 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 (GA_3) 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= GA_3 (50 ppm), H_2= GA_3 (100 ppm), H_3= GA_3 (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 GA_3 100 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 vigour index (10884) were also noticed from GA_3 100 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 (15.986g), germination (88.00 %), and seedling vigour index (10883). So the treatment GA_3 (100 ppm) at pod formation stage was found suitable for seed yield (2.67 t ha^{-1}) 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 (T_4) removal of lateral vines up to 1.5 m.Among the treatments, (T_4) 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 micronutrient priming 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 and 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 25ºC 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 ±1 C° and 100% relative humidity. These artificially aged seeds were compared to control (un-aged 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 indicated better germination as the imbibition of water is an essential part of germination. A high correlation between EC measurements and germination was found; which indicated 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 °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 were increased after 2 months of storage and then decreased gradually with storage duration up to 6 months.

Documentation of indigenous storage practices of pulse seed

M. S. Rahman, M. S. Rahman, P. C. Sarker and A. K. Choudhury

Storage of pulse seed is a crucial postharvest operation. But storage practices vary over local natural resources, climate and culture of the society. This study assessed indigenous storage system of pulse seed in selected six pulse growing districts of Bangladesh. Data were collected from 180 sample farmers through survey method and multistage stratified random sampling technique was followed to select these farmers. It was observed that farmers mostly cultivated mungbean, grass pea, lentil, chickpea, blackgram and pea of which mungbean, lentil and grasspea covered 84% of the total pulse crop cultivation. Sun drying was found to be the mostly practiced traditional seed drying system accounted for 100% of the respondents. A number of storage materials were used in the survey areas of which plastic drum was found to be the mostly adopted storage materials. Survey farmers were found to treat seed before storing for future use. Overall, 42% of the total surveyed farmers used neem leaves as treating materials while 24% did not apply any treatment. This indigenous methods of storage can protect pulse seeds from damages and enhances use of locally available cheaper materials for the farmer.

Efficacy of rodenticide baits with decreased concentration of bromadiolone and brodifacoum

A T M Hasanuzzaman and M S Alam

The efficacy of low-dose (25ppm) anticoagulant based rodenticide bait compared to high-dose (50ppm) anticoagulant based rodenticide bait evaluated in *Bandicota bengalensis*, the common rodent species of Bangladesh. The composition of low-dose (25ppm) brodifacoum is 0.0025% brodifacoum, 0.001% denatonium benzoate and non-active substances (up to 100%). Choice feeding test was conducted for this study. Rat consumed lower amount of low-dose (25ppm) brodifacoum (0.89g/rat/day) and low-dose (25ppm) bromadiolone (1.31g/rat/day) whereas the rat consumption of commonly used high-dose (50ppm) bromadiolone (lanirat) was 4.78 to 6.08 g/rat/day. In laboratory condition, the low-dose (25ppm) bromadiolone showed 50% success in rodent control whereas low-dose (25ppm) brodifacoum showed only 40% success.

Evaluation of some plant oils as repellent against rodents

A T M Hasanuzzaman and M S Alam

Three plant oil viz. eucalyptus (*Eucalyptus saligna*), neem (*Azadirachta indica*) and mehogoni (*Swietenia mahagoni*) were evaluated as rodent repellent. Three outdoor rodent enclosures, were considered as three observations were used for each planned 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. Wheat grain was used as rat bait. Rodent repellency of specific plant oil at several distances was tested in each enclosure in a multi-choice situation. The positions of the bait stations in each set were changed every day to avoid rodents developing place preferences and to control for any effect of position on choice of bait station but the distances from the odor source were maintained strictly. Repellency effect of the oils was assessed based on food consumption.

Eucalyptus and neem 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 (0-2.90 g/rat/day) of oil source compared to 6m distance (1.98-12.42 g/rat/day). Up to 3 observational days, at 1m distance of eucalyptus oil source, rat consumed 1.25-2.24 g/rat/day where as it was 1.30-1.69 g/rat/day for neem oil. But in case of mehogoni oil source, significant differences were found in mean daily rat food consumption at up to 1m and 6m distance for one day only. The two plant oil viz. eucalyptus, and neem oil can repel rat from their food for up to three days. Highest repellency was observed in shortest distance of oil source.

Modification and evaluation of indigenous trap for controlling field rat

A T M Hasanuzzaman and M S Alam

Comparative efficacy of newly designed kill trap and commonly used live and kill trap were evaluated at outdoor rat enclosure and field. 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. Field test was conducted in different research field of BARI. For this experiment, up to seven active burrows were selected for each type of trap. The burrows with rat inside and having fresh soil at the opening including some symptoms of new activities were identified and marked as the “active burrows”. The presence of rat inside the burrow was ensured by using tracking

tiles. 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% and 32% respectively whereas commonly used kill trap showed only 28% success. In field, the average success of newly designed snap trap and live trap was 43.9% and 38% respectively whereas commonly used kill trap showed 28.05% 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 (bamboo 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 writing paper (49.43%) wrapped poison baiting which was statistically similar with bamboo leaf (45.71%) and butter paper wrapping (31.50%). Lowest success was found in case of para film (29.71%) wrapped poison baiting.

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 Cumilla district during 2021-22. Four upazillas of Cumilla 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 Cumilla district. Scientists of Vertebrate Pest Division took the farmers' 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.

All the upazilla of Cumilla district farmers reported two types of squirrels which were brown and striped whereas brown was pre-dominant in Cumilla. According to the farmers' opinion, vegetables and fruit crops were frequently damaged by the squirrels. Most affected vegetable crops were bean (50%) followed by bottle gourd (40%) Ridge gourd (18.33%) and pumpkin (16.67%). Among the fruit crops maximum damage was found in coconut (44.16%), followed by Guava (46.7%) ber (28.3%), betelnut (29.16%) and and mango (22.5%). 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 all stage (26.67%) 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 (46%) followed by snap trapping (29%) and poison (12%).

Bird damage and bird species diversity in sunflower field

M S Alam and A T M Hasanuzzaman

The efficacy of different combinations of repellent against pest birds of sunflower was studied at Gazipur and farmers field of Amtoli, Barguna during rabi 2021-22. The experiment was conducted at BARI central research field, Gazipur and farmers' field of Amtoli, Barguna during rabi season of 2021-22. In this study different type of repelling techniques and netting were used as mechanical repellent against bird pests. Four treatments were used viz. multicoloured reflecting ribbon, plastic bottle windmill, four side netting and untreated control (without netting). 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 54.5% head damage and 62.5% plant damage were happened by the birds whereas, the lowest head and plant damage were recorded in plastic bottle windmill (17%) and four side treated plot (25%) respectively in Gazipur. The lowest head and plant damage were recorded in plastic bottle windmill 14.33% and 30% respectively, the highest was recorded in control plot (24.33 and 46.67% respectively) at Amtoli, Barguna. Yield was also recorded higher in plastic bottle windmill treated plot (2.0 t/ha) compared to other treatments. Fourteen bird's species were recorded in sunflower belonging to 14 families and 6 orders during the study periods from dawn to dusk. Passeriformes was the most dominant order (57%) represented 6 families and species followed by order Collumbiformes (2 families 2 species). However, the species richness and diversity of bird species were obtained higher in morning (14) and noon (9) than afternoon (7).

Optimization of processing parameters for frozen tender jackfruit

M.G.F. Chowdhury, A.A. Sabuz, M.H.H. Khan, M. M. Molla and S. Pervin

The present study aimed at processing tender jackfruit as fresh like vegetable meat, and stored at frozen condition applying different postharvest pretreatment as such, (T_1) 0.3% citric acid (CA) + 1% $CaCl_2$; (T_2) 0.3% ascorbic acid (AA) + 1% $CaCl_2$; (T_3) 0.3% KMS + 1% $CaCl_2$; (T_4) 0.3% CA + 0.3% AA + 1% $CaCl_2$; (T_5) 0.3% CA + 0.3% KMS + 1% $CaCl_2$; (T_6) 0.3% AA + 0.3% KMS + 1% $CaCl_2$; (T_7) 0.3% AA + 0.3% KMS + 0.3% CA + 1% $CaCl_2$, and (T_8) water soaking. After the pretreatment, jackfruits were stored at -10°C and different quality parameters were studied over 180 days at 60 days' intervals. Results revealed that moisture and total acidity content in all samples were slightly increased throughout the storage period. The bioactive compounds such as ascorbic acid, beta-carotene, and total phenolic contents were significantly decreased with the storage period increased. All pretreated frozen tender jackfruit showed potent antioxidant properties where treatments T_6 and T_7 showed more antioxidant capacity. The physical observation for external color, flavor and texture revealed that these parameters were not significantly changes up to 120 days of storage except in some samples where slight brownish color was developed. Moreover, all samples were in edible stage after 180 days of storage with some decrement of nutritional quality. In conclusion based on the overall findings of this study, tender jackfruit pretreated with T_5 (0.3% CA+ 0.3% KMS+1% $CaCl_2$), T_6 (0.3% AA+0.3% KMS+1% $CaCl_2$), and T_7 (0.3% AA+0.3%KMS+0.3% CA+1% $CaCl_2$) could be stored at frozen condition for longer storage without appreciable quality change.

Standardization of packages for vacuum fried jackfruit chips

M.G.F. Chowdhury, M.H.H. Khan, M.M. Molla, S. Pervin and A.A. Sabuz

The objective of this study was to standardize the packaging material best suited for the storage of vacuum fried jackfruit chips. For this five different packages (high-density polyethylene, double layer aluminium foil, single layer aluminium foil, polypropylene, and metalax foil packet) have been used in this study. The study was conducted for 120 days from the initial processing day. The results revealed that the moisture content varied irregularly from 2.43 to 4.44% (wb) at the beginning and ranged between 2.88-5.60% (wb) after 120 days of storage for different packages. The acidity content slightly increased throughout the storage period. All packaged chips retained a significant amount of antioxidant properties although their values decreased over the storage period. Also, the bioactive compounds like ascorbic acid, total carotenoids, and total phenolic content become decreased for all packages used during the storage period. The color properties indicated that the yellowish color becomes faded, however, vacuum fried jackfruit chips packed in double-layer aluminium foil and metalax foil keep the nutritional quality as well as the color properties. The consumer perception taste revealed excellent score and acceptability of the vacuum fried jackfruit chips packaged in high-density polyethylene, double layer aluminium foil, and metalax foil packet Therefore, for the storage of vacuum fried jackfruit chips, it is recommended to use double-layer aluminium foil and metalax foil packages.

Development of a suitable packet for keeping vacuum fried jackfruit chips

M.G.F. Chowdhury, M.H.H. Khan, M. M. Molla, A.A. Sabuz and M.M. Kamal

The aim of the study was to fabricate a suitable packet for keeping vacuum jackfruit chips on the basis of existing packaging materials of fried chips product available in the market. The length and width of the proposed packet were selected from the existing information of the packet available in the market. To sustain the new product on market, it is required to choose an attractive packet in proper way. Predicting the opportunity, a market survey was conducted with the help of Postharvest Technology Division of BARI, Gazipur to analyze the existing chips packet and its physical appearance with properties and quality and then suggest a new one for fabricating jackfruit chips packet for the stakeholders. Packet thickness varied as per the product specification. The tensile strength was recommended among seven best samples according to the laboratory test result. The packet should able to show the highest tensile strength such as 39.47 N/mm^2 with lowest elongation such as 14.08 mm before bursting. The study showed that the suitable packet thickness should be recommended a range 63-65 µm for four layers including print ink where the length and width might be with a range 19-21 mm and 15.5-16.5 mm, respectively. The permissible moisture content should be maintained between 0.8% and 2.3% for the average weight of the chips packet (50 g or more). The size of the packet can be modified maintaining the same ratio of the design and fulfilling the design criteria.

Optimization of processing parameters for freeze dried chips from jackfruit

M.G.F. Chowdhury, M.H.H. Khan, M.M. Molla, S. Pervin, A.A.Sabuz and M.Kamal

The aim of the study was to optimize the freeze-dried jackfruit chips processing to produce quality jackfruit chips. 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 treated with 5, 10, 15% maltodextrin and 40% sugar solution, then packaged in high density polyethylene (HDPE) packet (~60 micron) and frozen at -18ºC for 24-36 hours. After that the frozen slices were dried in freeze dryer at -53ºC for 72 hours (main drying 36 hours, final drying 36 hours) at 0.0010 mbar pressure. The dried chips were packaged in metalex foil (~50 micron) packet without nitrogen gas and sealed for storage at ambient temperature (26±2ºC & 75±5% RH). The changes of physicochemical properties for different maltodextrin and sugar concentration as well as consumer preference test were evaluated by expert panelists. According to the sensory panelists judgement, initially jackfruit chips coated with 10% maltodextrin and then dried in freeze-drier exhibited better quality in terms of overall acceptability score (7.10) (moderately to like very much). 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 freeze dried jackfruit chips and thus mitigate the postharvest losses by extending the shelf life and marketability.

Effects of frying temperature and time on physicochemical changes and shelf life of vacuum fried chips from giant taro

M.G.F. Chowdhury, M.H.H. Khan, M. M. Molla and A.A. Sabuz

The aim of the study was to optimize the vacuum fried taro chips processing to produce quality taro chips at suitable frying temperature and time. Taro chips were prepared from matured taro. The harvested matured giant taro was cut and then packaged in high density polyethylene (HDPE) packet (~60 micron) and frozen at -18ºC for 24 - 48 hours. Then the frozen slices were fried instantly using BARI Vacuum Frying Machine at 100,110 and 120ºC for 12, 14 and 16 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±2ºC & 75±5%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 at 110ºC for 14 minutes. The highest overall acceptability score (8.12 out of 9) was also gained by the110ºC for 14 minutes. The study will generate the information to the food processors and product development sectors to find out proper temperature and frying time for processing of good quality vacuum fried taro chips. Thus the developed technology will contribute to mitigate the postharvest

losses of taro by extending the shelf life and marketability.

Comparison of cooking methods and oils on physicochemical, nutritional, minerals and bioactive compounds of mixed vegetables

M.M. Molla, M.H.H. Khan, A. A. Sabuz, M.G.F. Choudhury and S. Pervin

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 different edible oils viz. soybean oil, mustard oil, extra virgin coconut oil and extra virgin olive oil on the nutritional, physicochemical, minerals and phytochemical compounds under different cooking conditions. Results revealed that steam cooked 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 (26.90±0.10 %) whereas the low fat content is found by the other edible oils. The low fat content was recorded by the traditional and steam cooked vegetables without oil. The highest crude fiber (5.68±0.20 to 6.48±0.02) was documented by the steam cooked vegetables as compared to traditionally cooked vegetables. The highest crude protein content was found by the traditionally cooked vegetables using mustard oil. The lower carbohydrate (49.42±0.03 %) content was recorded by the steam cooked vegetables using extra virgin olive oil. Most of the minerals especially human body essential Ca, Mg, Fe, Cu and Zn found notable in traditionally cooked and steam cooked vegetables using mustard oil and extra virgin olive oil. The leading phytochemical compounds ß-carotene was found by the steam cooked vegetables using mustard oil. The highest anthocyanin and ascorbic acid was found by the steam cooked vegetables without oil. Total carotenoid and total phenolic content was dominant in the steam cooked vegetables using extra virgin coconut and extra virgin olive oil. Highest lycopene was noted by the traditionally cooked vegetables using extra virgin coconut oil. However, the findings obtained from this study confirm that except soybean oil, all the edible oils used in this study retained more bioactive compounds and essential minerals although no oil is good for the better dietary life style. Only limited amount of oil may be required for the more functioning of vitamin A, D, E and K.

Key words: Cooking process, Cooking oil, Crude fat, Carbohydrate content, minerals content, phytochemical compounds.

The nutritional, physicochemical, minerals and bioactive compounds analysis of selected BARI Mosur (lentil) varieties

M.M. Molla, M.H.H. Khan, A.A. Sabuz, M.G.F. Chowdhury, S. Pervin, M.S. Zaman, R. Podder And P. Bhowmik

Fresh lentils contain huge amount of bioactive compounds, antioxidant activity, amino acid, vitamins and minerals profile but during dehulling, milling and flouring most of them are going to nutritionally loss. Hence, the first attempt has been taken to collect the BARI Mosur (lentil) varieties and their bioactive compounds, antioxidant activity, amino acid, vitamins and minerals profile analysis under both fresh and dehulled lentils. The selected fresh BARI Mosur (lentil)-3, BARI Mosur (lentil)-6, BARI Mosur (lentil)-7, BARI Mosur (lentil)-8 and BARI Mosur (lentil)-9 were collected from the Pulse Research Center (PRC), BARI, Ishurdi, Pabna. After collection, these five fresh varieties were incorporated for its analysis of physicochemical, nutritional, minerals, phytochemicals and energy value. All the analysis was performed by internationally recognized method using HPLC and Double Beam Spectrophotometer. Then the obtained data has been varified with reputed national and international journals and books. Results revealed that BARI Mosur-3 and BARI Mosur-6 is the lycopene rich. BARI Mosur-3 found superior of energy value. BARI Mosur-8 was observed rich source of β–carotene, total phenol, Fe and Zn. BARI Mosur-9 was documented as the rich source of anthocyanin and ascorbic acid.

Effect of moisture content on the processing and quality of BARI Mosur (lentil) chips using single screw extruder

M.M. Molla, M.H.H. Khan, A.A. Sabuz, M.G.F. Chowdhury, S. Pervin, M.S. Zaman, R. Podder and P. Bhowmik

The study was conducted to find out the proper moisture level and barrel temperature of the single screw extruder for developing lentil chips. The single screw extruder was installed successfully in the postharvest Technology Division of BARI. The initial trial based 10%, 20%, 30% and 40% moisture

was conducted to develop lentil chips.Then the product was evaluated by the sensory evaluation through formation of 30 judgment panel. Then the product was packed into metalex and polypropylene pouches for storage studies under the room temperature. Results revealed that the uncontrolled moisture content increased the barrel temperature and pressure of the single screw extruder. The increased barrel temperature (more than 140ºC) reduced the feed rate and finally burned the product. However, the moisture level 10% (T_1) and 20% (T_2) assisted to produce the quality lentil chips initially.

Key words: moisture level, barrel temperature, barrel pressure, product quality

Effect of vegetable pomace on the formulation of probiotic pickle

M.M. Molla, S. Pervin, A.A. Sabuz, M.G.F. Chowdhury and M.H.H. Khan

The present investigation was carried out to assess the lactic acid bacteria during fermentation of the selected vegetables and after fermentation, to develop probiotic pickle using the fermented vegetables. The sauerkraut method and three acidic media viz. lactic acid, glacial acetic acid and apple cider vinegar was used to ferment the vegetables. The 5% acidic media was used to ferment the vegetables. After pre-processing, all the vegetables were fermented and the relevant data was recorded at on the day of fermentation and after 30 days of interval during fermentation. Results exposed that the TSS, total acid and pH values were increased with the advancement of fermentation periods. The vitamin-C content was decreased dramatically with increasing fermentation time. But the highest vitamin-C values were retained by the apple cider vinegar due to its pH value maintained at lower than 5. The study will be continued for its application to produce probiotic bacteria enriched vegetable pickles.

Key words: Fermentation, Vitamin-C, TSS, Acidity, pH and Probiotic bacteria.

Comparative study of domestic and internationally produced jam and jelly in terms of their physicochemical, nutritional, color, texture and sensory evaluation

M.M. Molla, M.H.H. Khan, A.A. Sabuz, M.G.F. Chowdhury and S. Pervin

The study was performed to collect the domestic and overseas jam and jelly from the local and city market of Bangladesh and evaluate their physicochemical and nutritional composition, color, softness, hardness and sensory evaluation. Domestically produced jelly and jam was compared to the internationally produced jelly and jam highlighting their softness, spread ability, color, flavor, taste and sugar content. Study shows that jelly sample J_5 (guava natural jelly) and the jam sample Ja_2 (PHTD Bael jam) and Ja_7 (PRAN mixed fruit jam) was acceptable by the sensory evaluator. Considering the color index, the jelly J_5 (guava natural jelly) and the jam Ja_3 (PHTD bael jam) and Ja_4 (PHTD jackfruit jam) was the region of 90º performed as red color. Texture study confirmed that jelly J_2 (RESCO brand guava jelly) and J_3 (Ahmed Food products produced guava jelly) was more softness than other samples. Physicochemical and nutritional study shows that the highest TSS (66.26ºB), ß-carotene (12.18 mg/100 g), total sugar (34.31%) and reducing sugar (28.66%) found in Malaysian jelly as compared to others. Highest moisture (36.50%), vitamin-C (22.63 mg/100 g) and energy content (5.62 Kcal/g) was recorded by the guava natural jelly than others. In case of the collected jam, highest TSS (75.30ºB), total sugar (39.88%) and reducing sugar (33.36%) found in the PHTD developed pineapple jam. The highest TSS might be contributed to gain more hardness of the PHTD developed pineapple jam although it was the rich source of ascorbic acid. Highest energy values (7.43 Kcal/g) were observed by the sample Ja_5 (Foster clarks mixed fruit jam, made by Italy). The results of this study will contribute to improve and up calling the PHTD of BARI developed products, small and commercial manufacturer products.

Keywords: nutrition, color, texture, sensory evaluation.

Extraction of annatto color and evaluation their microbial and antimicrobial activity before applying in food processing

M.M. Molla, A.A. Sabuz, M.H.H. Khan, M.G.F. Chowdhury, S. Pervin, S. Brahma and M.S. Uddin

Preservatives are natural or synthetic substances that are added to fruits, vegetables, prepared food items, cosmetics and pharmaceuticals in order to increase their shelf life and maintain their quality and safety by inhibiting, retarding or arresting their fermentation, acidification, microbial contamination and decomposition. Adulteration in foods is a serious problem nowadays and is considered an alarming issue to ensure safe food consumption for all ages of people. Due to the consumption of synthetic foods, people suffer from different diseases; even in some

cases, they do not recover using synthetic medicine. In recent years, public concern about synthetic pigments and preservatives' safety has led to increasing interest in developing natural food colorants and preservatives from plant tissues, especially from some edible sources. Therefore, the aimed of the present study was to extract natural color from the annatto and develop annatto powder using freeze dryer for its further application into food processing industry like jam, jelly, marmalade etc processing. Annato (Bixa orrelana L.) has been renowned as a tropical plant rich in carotenoid pigments such as nonpolar bixin and polar norbixin. The extraction was carried out by maceration for 10 mins using distilled water as the extraction solvent at various pH and extraction temperatures. The variations of solvent pH used in this research were below 7 and above 7 following three extraction temperatures viz. 70, 80, and 90ºC. The potential of annatto extract as an antimicrobial agent was tested by analyzing the extract's ability to inhibit pathogens and its physicochemical, phytochemicals and nutritional compounds. The extracted powder was evaluated for its microbiological as well as carcinogenesis viz. mycotoxin, aflatoxin and Antimicrobial activity. Results revealed that the Annatto powder was rich source of ascorbic acid (45.25 mg/100 g), ß-carotene (269.25 mg/100 g) and free from carcinogenesis. Therefore, it could have recommended that the extracted powder could be utilized in the food processing industry.

Key words: Color extraction, phytochemical composition, carcinogenesis evaluation, antimicrobial activity.

morphological, physicochemical, nutritional, minerals and bioactive compounds analysis of fresh figs (*Ficus carica* L.) indigenous to Bangladesh

M.M. Molla, M.G.F. Chowdhury, S. Pervin, A.A. Sabuz, M.H.H. Khan and M.H. Patwary

The aim of the present study was to collect the round and oval shape fresh fig fruits (Ficus carica L.) for its morphological, physicochemical, nutritional, minerals, color and bioactive compounds analysis. The maximum fruit breadth, stem length and stem breadth was noted in oval shape fig fruit as 3.26 cm, 2.40 cm and 0.45 cm respectively. The maximum fruit length was observed in round shape fig fruits (3.86 cm). The highest fruit and seed weight was calculated as 35.34 g and 11.09 g in the oval shape fruit. The lowest fruit and seed weight was recored in round shape fruit and calculated as 28.87 g and 10.26 g respectively. The highest edible portion was observed in the round shape fruits as 98.35% with its minimum non-edible portion (1.65%). The oval shape fig fruits irradiated green-colored than the round shape fig fruits. The moisture content of the fresh fig fruits were recorded as 80.01±0.78 % and 80.50±1.00 % respectively. The a_w of the round and oval shape fresh fig fruits were calculated as 0.61 and 0.59 respectively. The highest values of bioactive compounds viz. vitamin-C, ß-carotene, TSS and pH were possessed by the fresh oval fig fruits and documented as 26.57±0.47 mg/100 g, 7.49±0.19 mg/100 g, 14.15±0.14 and 5.18±0.05 respectively. However, the results confirmed that oval shape fig fruits retained more morphological, physicochemical, nutritional, minerals, color and bioactive compounds than the round shape fresh fig fruits.

physico-chemical characteristics of plum in various concentrations of sodium chloride and sucrose during preservation

S. Pervin, M.H.H. Khan, M.G.F. Chowdhury, M. Molla and A. Ahmed Sabuz

The study was conducted to find out the effect of sucrose-sodium chloride concentrations on plums in order to examine the shelf life of plums under ambient conditions. There were five treatments with different sucrose-sodium chloride solutions for the experiments. The stored plum pH, acidity, β-carotene, vitamin C, TSS and sugar data were analyzed for up to six months; It was found that under ambient conditions the plum pH was decreased but acidity, β-carotene, vitamin C, TSS and sugar content were increased at 5% NaCl treated plum during storage. As the conclusion, when using 5 percent concentrations of sodium chloride in plum; for each quality parameter of the stored plum, a smaller decrease and increase was found than for the other treated sample under ambient conditions.

Changes in the quality characteristics during storage of plum jam and its optimal preparation conditions

S. Pervin, M.H.H. Khan, M.G.F. Chowdhury, M. Molla and A. Ahmed Sabuz

The research was evaluated the processing method of plum jam to get the diverse uses of the plum with five treatments. The prepared jam was stored for twelve months in glass container. The pH was increased slightly where the acidity was decreased.

The intensity of the light-yellow color of the jam was gradually increased and turned light red in color in storage. No microbial growth of the plum jam was observed for any treatment up to nine months, but an acceptable non-pathogenic germ count was identified in various treated jam after twelve months. The relative sensory assessment of the plum jam is evaluated and resulted in the maximum overall acceptance of 8.0 for treatments T_5 (100% sucrose in plum) followed by treatments T_4 with a rating of 7.0. The results showed that considering various quality parameters of the jam; the best recipe was to use plums with 100% sucrose.

Effects of different sanitizers on the nutritional quality and shelf life of fresh-cut moringa sticks

M.G.F. Chowdhury, M.H.H. Khan, A.A. Sabuz, M.M. Molla and M. Alam

This experiment was conducted to evaluate the effects of different sanitizers and storage temperatures on the quality and shelf life of fresh cut moringa sticks. Four different treatments of tap water wash (control), hot water treatment (60°C for 1 min), 0.2% calcium chloride wash and 0.01% calcinated calcium treated fresh-cut moringa sticks with two storage condition of ambient temperature (27±1°C & 75±5% RH) and refrigerated temperature (4±1°C) were selected for the study. Moringa stick were peeled and cut into almost uniform size and shape and then washed with different sanitizer (400-500 g stick/L solution) for five minutes and then preserved in film packet at different storage temperatures for physiochemical quality evaluation. After 3 weeks storage, the hot water treated fresh-cut products exhibited better nutritional quality among the treatments in refrigerated storage temperature. Most of the panelists preferred fresh-cut moringa sticks treated with hot water at 60°C for one minute and stored at refrigerated temperature (4±1°C) more than 3 weeks in terms of appearance (7.60), off flavor (7.20), shrinkage (7.60) and overall acceptability (7.47).

Determination of microbial hazards in fresh-cut fruits and salad vegetables used in street food vendor, hotels and restaurant at Rajshahi and Khulna

A.A. Sabuz, M.H.H. Khan, M.G.F. Chowdhury and M.M. Molla

This study was conducted to identify and quantify the hazardous agents (microbial load) in fresh-cut fruits and salad vegetables collected at Rajshahi and Khulna district. Different fresh-cut fruits and salad vegetables such as guava, tomato, cucumber and carrot were collected from various hotels, restaurants and street vendor. All samples were analyzed to detect the existing different microbial agents such as *Salmonella spp*., *Escherichia coli* (*E. coli)*, 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 all samples were observed colony forming unit (cfu/g) but *Escherichia coli* (*E. coli*) and *Salmonella spp*. were absent. The study suggests that restaurant owners, hotel owners and street food vendor should be maintained the water quality (microbs free water), personal and utensils hygiene during preparation and serving the food to the consumers.

Optimization of processing technique for roasted jackfruit seed maintaining nutritional quality

A.A.Sabuz, M.G.F. Chowdhury, M.H.H. Khan, M.Miaruddin and M.M. Molla

Mature and full ripe jackfruit was collected from local cultivar to investigate and optimize the roasting time and temperature combination. Full ripe bulbs were first separated from the fruit and seeds were collected from the inside of the bulb. After washing with clean tap water seeds were dried in sun at ambient condition until surface water removed. The experiment was laid out with Complete Randomized Design (CRD). All the seeds were treated as roasted at 150^0 C for 10 minutes (T_1), roasted at 150^0 C for 20 minutes (T_2), roasted at 200^0 C for 10 minutes (T_3), roasted at 200^0 C for 20 minutes (T_4), roasted at 250^0 C for 10 minutes (T_5), and roasted at 250^0 C for 20 minutes (T_6). Roasted seeds were then evaluated by forming ten judgment groups using 9-hedonic scale to determine their optimum time and temperature combination for roasting. According to panel test result T_4 (200^0C for 20 minutes) scored highest overall acceptability (8.2) and regarded as best considering the quality parameters of roasted jackfruit seed.

Development of value added ready to serve (RTS) sapota powder through fortification by ascorbic acid and β-carotene

M.H.H. Khan, M.M. Molla, A. A. Sabuz, M.G.F. Choudhury, S. Pervin, P.C. Sarker and A.K. Choudhury

This study aimed to develop a process for the development of ready to serve (RTS) sapota powder through fortification. The fortified sapota powder was stored at room temperature for storage stability and further nutritional evaluation. Results obtained from 150 days studies showed that sapota powder fortified with L-ascorbic acid and combination of L-ascorbic acid and β-carotene was excellent with retention of the primary quality attributes of ascorbic acid and β-carotene. The sapota RTS powder fortified with L-ascorbic acid and combination of L-ascorbic acid and β-carotene was acceptable by the sensory evaluation of the panel members in terms of their color, flavor, appearances, sweetness and overall acceptability. No microbial count was recorded up to 120 days (4 months) and 150 days (5 months) of storage. A negligible amount of microbial count was recorded after 150 days of storage but it was within acceptable limit. Therefore, the developed RTS sapota powder could be used as an alternative of synthetic TANG health drink for better sustainability school going children.

BIOTECHNOLOGY

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Micropropagation and Regeneration Protocol Development

Development of an *in vitro* propagation protocol for gerbera

M.M. Khatun, N. Bilkish and M.A.Y. Akhond

An attempt was made to develop a micropropagation protocol of gerbera. Capitulum 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. Capitulum 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 (24 days) and maximum shoot (88) was observed in red cultivar from 2 mg/l BAP + 0.5 mg/l IAA treatment combination. The maximum root number (4.42) was obtained from ½ MS medium supplemented with IBA in T4 treatment. For *ex vitro* establishment, well developed plantlets were transferred to greenhouse in four different potting media. Highest percent (93.33) of plantlets survived in PM2 potting media which comprised of equal part of soil and cocodust mixture.

Micropropagation of lilium *(Lilium longiflorum)*

M. M. Khatun and S. C. Halder

The aim of this study was to establish a micropropagation protocol for BARI Lilium-1 using nodal explant for continuous *in vitro* multiplication. The MS medium supplemented with eight different concentrations and combinations of BAP, NAA, IAA and IBA were used for bulblets and plantlets formation. The highest number of shoots (31.66 shoots/explant) and highest shoot length (11.49 cm) was obtained from 1.0 mg/l both of IAA and IBA. The early shoot initiation was noticed in 2.0 mg/l both of IAA and IBA treatment combination. For *ex vitro* establishment, well developed plantlets were transferred to greenhouse in potting media comprised of one part of soil and 2 parts of cocodust mixture. The plantlets were normally acclimatized, grown well and 93% of them were survived. Therefore, the tissue culture technique was suitable propagation method for producing new bulbous plantlets of BARI Lilium-1.

Tissue culture propagation of BARI strawberry varieties for field evaluation

M.M. Khatun and M.A.Y. Akhond

Shoot tip and node explants of BARI Strawberry-2 were cultured on MS medium supplemented with different concentrations and combinations of BAP, Kn and GA_3. Five different treatments were tested for shoot formation and elongation. Minimum days (2-5 days) required for shoot initiation in 1.0 mg/l BAP + 0.5 mg/l Kn + 1.5 mg/l GA_3 treatment combination using shoot tip explants. For shoot elongation, 1.0 mg/l BAP + 0.5 mg/l Kn + 1.5 mg/l GA_3 was found most suitable. In rooting, 0.5 mg/l BAP + 0.5 mg/l Kn + 1.5 mg/l GA_3 treatment combination produced maximum roots. For *ex vitro* establishment, 100 percent plantlets were survived in potting media with soil and cocodust mixture at 1: 1 ratio.

Large-scale production of BARI released banana varieties through tissue culture

S. C. Halder, M. M. Khatun and M. A.Y. Akhond

Sword suckers of different banana varieties developed by BARI were collected from Regional Horticulture Research Centre, Sibpur, Narsingdi. Shoot tips were separated from those suckers and cultured on different shooting and rooting medium for *in vitro* production. The BARI Kola-3 gave better result than the other released banana varieties. The survival percentage of BARI Kola-3 was 80% and number of shoots per explant was 8.8.

***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 shahi papaya from immature seeds. Different concentrations of 2, 4-D were used for callus formation. In regeneration, four different treatments were used. The highest percentage of explant produced callus (55%) in 14 mg/l 2, 4-D treatment. In regeneration, highest shoot length (6.75 cm), higher leaf number (8.51), higher root number (4.94) and maximum root length (3.32 cm) was observed in 0.06 mg/l both of BAP + NAA and 3.7 mg/l GA_3. For *ex-vitro* establishment, the highest plantlets survived (65%) in potting media with soil, cocodust and vermiculite mixture at 1: 1: 1 ratio. 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. Embryonal axes and single cotyledonary nodes of BARI Mung-7 were used as explants source. There were four different treatments which consisted of different concentrations of BAP and NAA for shoot regeneration. Shoot bud initiation started at 7-15 days after inoculation of explant in 1.0 mg/l BAP + 0.018 mg/l NAA treatment. The highest responsive explants (86%) and maximum shoot number (3.34) was found in 2.0 mg/l BAP + 0.018 mg/l NAA treatment. The length of shoot was higher in T_1 treatment (2.23 cm).

***In vitro* regeneration of country bean (*Lablab purpureus* L. Sweet)**

M.M. Khatun, M.K. Hasan, N. Bilkish and M.A.Y. Akhond

A study was undertaken to develop an efficient regeneration protocol for country bean. Single cotyledonary node explants and embryo section of BARI Sheem-8 was used as explants source. There were four treatments which consisted of different concentrations of BAP and NAA for shoot regeneration. Shoot bud initiation started at 5-6 days after inoculation of explant in 4.0 mg/l BAP + 0.5 mg/l NAA and 4.0 mg/l BAP treatment. The highest responsive explants were found in 4.0 mg/l BAP + 0.5 mg/l NAA treatment using both single cotyledonary node (57%) and embryo section (100%) explants.

***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 2.5 mg/l BAP + 1.00 TDZ showed better response for the formation of shoot and 1.00 mg/l IBA for root formation in different varieties. Rooted plantlets were acclimatized under greenhouse conditions with 48-65% success and produced viable seeds.

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 locations of the country and a mother orchard was established at research field of Biotechnology Division, BARI, Joydebpur, Gazipur. Shoot tips of 'Amritsagar' banana (Gafargaon & Kapashia) were cultured on MS medium supplemented with BAP. 'Amritsagar' banana collected from Gafargaon and Kapashia were found to be better than other varieties.

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 analyzed 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 from 26 of the samples. Phylogenetic analysis of the 26 isolates based on the CP gene

showed two major clusters having high polymorphism among the virus isolates.

Identification of abiotic stress tolerant genes from sorghum through biochemical and molecular techniques

K. Nahar, F. Ahmed, M. R. Ahmed and M. A. Y. Akhond

Salinity is a major constraint for agricultural productivity. The current study was designed to explore the variations and determine the performance of target traits to identify salt tolerant sorghum genotypes under saline condition. Various growth parameters and biochemical indicators of 7 sorghum genotypes were evaluated under non stressed and salt stressed conditions. Plant growth-related traits including shoot length, leaf number and dry weight of root and shoot were examined and found that leaf number was increased in G4, G11 and G12 by 8.5, 9.3, and 1.6%, respectively than the non-stress condition. Shoot length of G12 was increased by 11.8% under salt stress than that of the normal condition. Among the genotypes, the longest shoot was produced by G10 in both non-stress and salt stress conditions. The maximum root and shoot dry weight was produced by G12 under stress condition. Sorghum genotypes G4 and G12 exposed to salinity exhibited more photosynthetic rate and total conductance to Co_2. Expression of oxidative stress indicators like H_2O_2, Malondialdehyde (MDA), electrolyte leakage (EL) was reduced in G11 and G12 genotypes under salt stress. Higher amount of total phenolics and flavonoids were produced in G4, G11 and G12 indicating higher tolerance ability of these genotypes under salt stress condition. Therefore, the genotypes G4, G11 and G12 were regarded as potential source of salt tolerant genes for development of salt tolerant crop variety.

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 developing 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 were 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. The presence of the transgenes in regenerated plants were confirmed by PCR.

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. To fulfill the objectives of the experiment, eggplant and mustard microspores were isolated from various sizes of flower buds to correlate their developmental stage with bud size. Isolated microspores were stained with DAPI solution and observed under epifluorescence microscope to determine the developmental stages. Four pollen-specific promoters from Tomato LAT52, LAT56, LAT59 and Tobacco NTN19 genes, respectively were cloned into plasmid vector pCAMBIA1301 using standard protocols. Different stages of flower buds of eggplant and mustard harbouring male gametophytes at mid uninucleate stage were identified. Four pollen-specific promoters had also been cloned. Results obtained in this experiment could lead the way for an optimized system for gametphyte-mediated transformation for crop plants in future.

Validation/On-Farm Trials

Validation trial of tissue cultured plantlets of BARI strawberry varieties under field conditions

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 2021 to April 2022. Tissue cultured plantlets of BARI Strawberry-2 and BARI Strawberry-3 were used in this study. Node and shoot tip explants of BARI Strawberry-2 and BARI Strawberry-3 were cultured in MS medium

supplemented with different concentrations and combinations of BAP, Kn and GA3. Plantlets were produced from those media and they were transplanted in the field. BARI Strawberry-2 plantlets performed better in all morphological traits studied except plant height at 80 days after planting where the highest plant height (18.55 cm) was recorded from BARI Strawberry-3. In yield contributing characters, the higher fruits/plant (36), single fruit weight (17.00 g) and fruit yield/plant (613.13 g) was observed from BARI Strawberry-2 plantlets. Results also revealed that the higher yield could be obtained using tissue cultured plantlets as planting material.

FtFBP Research Activities

Sustaining of Bt eggplant in Bangladesh by implementing effective stewardship

M. K. Hasan, A. Saha, A. K. M. Quamruzzaman, M. S. Alam, M. Z. Ferdous and M. A. Y. Akhond

The overall aim of the stewardship approach was to maximize the benefits, and minimize any risk, and make the technology durable. To sustain the first GE crop Bt brinjal in the long run some activities like maintenance and purification of the Bt Brinjal varieties/lines, breeder seed production, monitoring, Bt trait assessment and expression, refuge management motivational tour, updating the Bt Apps were carried out. Shiny and oval shaped fruits were selected in case of BARI Bt Begun-3 and seed kept separately. Total 75 Kg breeder seeds of BARI Bt Begun-4 were harvested in this year. Presence of Bt gene in the Bt Brinjal plants in different seed sources were assessed by qualitative ELISA test and all the plants showed positive results. In a motivational tour in Joypurhat, participants were pleased to see the performance of Bt Brinjal. Field level biosafety committee visited the Bt Brinjal field and found that border crops (Non-Bt) were infested by BSFB but Bt Brinjal plants were not infested.

DNA profiling of elite eggplant cultivars by molecular markers

M. K. Hasan, M. N. Amin, A. Saha, K. Nahar, A.K.M. Quamruzzaman and M. A. Y. Akhond

Twenty-four elite cultivars of brinjal (*Solanum melongena* L.) genotypes were selected for DNA profiling. The concentration of DNA of the genotypes varied from 47.4 to 313.7 ng/µl. The absorbance at 260nm/280nm of DNA samples ranged from 1.71 to 1.85 indicated its good quality of DNA purity. The experiment was not yet completed.

Study on relative bacterial wilt tolerance of Bt eggplant varieties and their non-Bt parent lines

A. Saha, K. Nahar, M.K. Hasan and M.A.Y. Akhond

Twenty seven representative bacterial samples from *Ralstonia solanecearum* affected brinjal fields were collected from 8 different locations of Bangladesh during July 2021 to May 2022 for studing the diversity of the bacteria available in Bangladesh. From the collected wilted plants bacteria was isolated by collecting the bacterial ooze in autoclaved distill water from the infected stem. Then the bacteria was cultured in TZC media and pure culture of virulent strains was done by morphological identification in TZC media in 28^{o}C.Liquid culture of the virulent strains was done in CPG liquid media in continuous shaking in 28^{0} c in incubator. Then the bacterial samples were preserved in 40 percen glycerol stock solution in -80^{o}C for further molecular and genomic study. All the bacterial isolates collected from Rangpur(4), Gaibandha(4) and Jashore(4) were successfully isolated and cultured, but 3 samples from Bogura, 6 samples from Gazipur, 1 samples from Kishorganj, and 3 samples from Chattogram did not show typical symptom of virulent *R. solanacearum* strain in culture media, so they were not allowed for further procedure.

Confined field trial of transgenic 3R-gene late blight resistant potato

M.M. Khatun, S.C. Halder, M.M. Begum, P. Wharton, K. Hokanson, M.A.Y. Akhond (PI) and D. Douches (PD)

Tubers 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. The tubers were obtained from greenhouse grown plant in contained trial which was conducted in the greenhouse of Biotechnology Division, BARI in 2021. The tubers were again planted in greenhouse for seed multiplication. The field trial permission was not approved by NCB in due time so, the tubers were maintained in the greenhouse for seed multiplication and used for next potato growing season for confined trial. The plants were at matured stage and harvesting will be done within one month.

Physical Aspects of Soil Management

Determination of crop coefficient values of Sweet pepper and estimation of leaching loss of nutrients through Lysimeteric study

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 and 2021-2022. The objective of the study was to find out the location specific crop coefficient (Kc) values for sweet pepper 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 T_1: Irrigation up to FC at 5 days interval, T_2: Irrigation up to FC at 10 days interval, T_3: Irrigation up to FC at 15 days interval and T_4: Irrigation up to FC at 20 days interval. As such, 11, 8, 6 and 4 irrigations were needed for T_1, T_2, T_3 and T_4, respectively. The experiment was conducted in completely randomized design with 3 replications. The highest sweet pepper yield (26.1 t ha^{-1}) was obtained from T_2, which was significantly higher to other treatments. Therefore, Kc values were calculated from the best performed treatment, T_2. The estimated average Kc values for sweet pepper during rabi season found to be 0.43, 0.82, 94.0 and 0.86 for initial, crop development, mid-season and late season stages, respectively. Thus the values determined from this study may be recommended for Bangladesh and similar climate elsewhere to estimate crop water requirement for sweet pepper. Significant amount of plant nutrients (K, Ca, Mg, S, Zn and B) was lost through leaching. The loss of Ca, Mg and S found to be a great concern. This should be taken into account for ensuring crop nutrition and minimizing ground water pollution.

Synchronization of different aged compost to crop demand, nutrient release and their contribution to the production of Red amaranth

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 2021-2022 to understand the release of nutrients for crops and their contribution to growth and yield. Red amaranth cv. BARI Lalshak-1 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 T_1: 30 days aged compost,T_2: 45 days aged compost,T_3: 60 days aged compost, T_4: 75 days aged compost and T_5: only chemical fertilizers. 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 red amaranthus were collected during the crop growing season and after harvesting. Necessary sample were also collected periodically to determine the microbial-respiration of soil during the experimental period. Yield and its component of red amaranthus were significantly affected by the different aged compost. The organic amended performed in the sequence: 75 DOC>60 DOC>45 DOC>30 DOC. The increases of yield in 75 DOC, 60 DOC, 45 DOC and 30 DOC were 98.6, 79.7, 60.8 and 54.0%, respectively higher than yield obtained with only chemical fertilizer. A significant increase in yield, individual plant weight, plant height and number of leaves plant-1of red amaranth was obtained with organic amended treatments relative to only chemical fertilizer application. The hetero-tropic respiration (CO_2 emission) was found higher in soils under75 DOC at 21 days after seed sowing which might be due to synchronization with crop nutrient

demand. However no discreet decision can be drawn unless the experiment continues for more years.

Effect of conservation tillage and phosphorus on the productivity of Gardenpea-Maize-T.aman rice cropping pattern and soil physico-chemical properties

M.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 2020-2021to 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 forms application of phosphorus such as granular dose (basal) (P_1), powder doses (basal) (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 grain yield than conventional tillage (CT) for maize ($p \leq 0.05$) 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 maize and T. aman ($p \geq 0.05$). Strip tillage with phosphorus combinations comparatively gave more moisture and field capacity than conventional tillage with phosphorus combinations and vice-versa for bulk density. OM, N, P, K, S and Zn increased but pH remain more or less same and B content decreased compare to initial soil. The 10th crop garden pea damaged at flowering condition due to heavy rain for cyclone Jaoyad. The 11th crop maize was harvested during report writing.

Effect of crop establishment practices and IPNS based nutrient management on Cabbage-Indian spinach-T.aman cropping system and soil physico-chemical properties

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, 2020-2021 and 2021-2022 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 physic-chemical properties 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 fertilizer, IPNS and 100% chemical fertilizers in a split plot design with 6 treatments and 3 replications. Strip tillage gave better yield for cabbage and for T.aman but vice-versa for Indian spinach. IPNS package gave the maximum yield for Indian spinach, and cabbage where 100% Organic fertilizer gave the maximum yield for T.aman under Cabbage- Indian spinach-T. aman cropping pattern. CO_2 emission was more in conventional tillage than strip tillage during cabbage growing period. 100% organic fertilizer treatment emitted more CO_2 than IPNS and 100% chemical fertilizer and IPNS emitted less CO_2. Strip tillage gave more field capacity, soil moisture and less bulk density than conventional tillage. Organic based nutrient package gave more moisture, field capacity and less bulk density than chemical fertilizer. Organic based nutrient package increased OM, N and Zn than chemical fertilizer treatment. In case of Organic based treatment pH, P, K and S increased but more or less remain same for chemical based fertilizer compare to initial soil. B decreased compare to initial soil. The 8th crop Indian spinach is on field and harvesting going on during report writing.

Requirement of nitrogen for Mustard-Okra-T.aman cropping system based on conservation agricultural practices

M.J. Alam, A.T.M.A.I. Mondol and H.M. Naser

A field experiments on Mustard-Okra-T.aman rice cropping pattern was conducted in Grey Terrace soil of Joydebpur under AEZ-28 during rabi2021-2022 to investigate the rate of nitrogen fertilizer for the intensive mustard-okra- T. aman cropping system under CA practices, to evaluate the effet of nitrogen and tillage on soil physico-chemical properties and to assess the system productivity. There were 3 types of tillage such as strip tillage (ST), zero tillage (ZT) and conventional tillage (CT). In addition, nitrogen management practices such as 100% nitrogen (N_1), 125% nitrogen (N_2), 75% nitrogen (N_3) and 50% nitrogen (N_4) in a split plot design with 12 treatments and 3 replications. Mustard was the first crop and 125% nitrogrn doses gave the maximum result than other doses. The second crop okra harvesting going on during report writing.

Effect of minimum tillage and crop residue retention on soil physico-chemical properties and crop yields under a rice-based cropping system

N. Salahin, N.U. Mahmud, M.J. Alam and K.U. Ahammad

An experiment was conducted at Regional Agricultural Research Station (RARS), Jashore during 2016-2017 to 2021-2022 cropping years to observe the effects of tillage and residue retention on soil physico-chemical properties and crop yields along with to assess the system productivity in rice-based cropping system. Two tillage practices such as, T_1: conventional tillage (CT) and T_2: minimum tillage (MT) were assigned in main plot and two levels of residue retention such as R^+: 30 cm crop residue retention/incorporation of wheat and rice and full straw retention of mungbean and removal of crop residue. Tillage practices had significant effect on the grain yield of T. Aman rice in the 2021 cropping year and higher grain yield was obtained from conventional puddling system than that of minimum tillage system. The MT and CT gave statistically similar mungbean and wheat yield as well as rice equivalent yield. After 15th crop harvest, conservation agriculture showed soil properties improvement over conventional agriculture system.

Requirement of potassium fertilizer under conservation agriculture practices in the intensive Wheat Mungbean-T. aman cropping system

N. Salahin, N.U. Mahmud, 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, T_1: conventional method (excessive tillage + residue removal) and T_2: conservation agriculture (minimum tillage + residue retention) were assigned in main plots whereas four K fertilizer rates were applied as K_1: 75% of recommended rate of K (RDK), K_2: 100% of RDK, K_3: 125% of RDK and K_4: 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.

Chemical Aspects of Soil Management

Nutrient management for sustaining soil fertility and yield of Wheat-Mungbean-T.aman cropping pattern

M.M. Masud, N.U. Mahmud, N. Salahin, R. Sen 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^{-1}1) of RARS, Jashore from 2000-2021. 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 13.21 t ha^{-1}yr^{-1} was obtained from T1 treatment (125% RD). Lowest total rice (system) yield of 7.00 t ha^{-1}yr^{-1} was obtained from control i.e. native fertility treatment (T6). Highest gross margin

of 123309 tk. ha^{-1} yr^{-1} was also obtained from T1 treatment (125% RD). The highest benefit cost ratio of 1.88 was found in T1 (125% RD) treatment.

Nutrient management for sustaining soil fertility and yield of Mustard-Mungbean-T.aman cropping pattern

M.M. Masud, N.U. Mahmud, N. Salahin, R. Sen and H.M. Naser

A long term field trial on Mustard-Mungbean-T.aman cropping pattern has been conducted from 2000-2021 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 with three replications. The combined effect of 120-54-70-40-3 $kg\ ha^{-1}$ of NPKSZnB (T5) produced the highest seed yield (1.53 t ha^{-1}) of mustard. The residual effect of 120-54-70-40-3 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 14.85 t ha^{-1} yr^{-1} was obtained from T_5 treatment. The lowest total rice (system) yield of 8.58 t $ha^{-1}yr^{-1}$ was obtained from control i.e. native fertility treatment (T8). The highest gross margin of 1,36,37 tk ha^{-1} yr^{-1} and BCR of 1.85 obtained from T5 treatment. It was observed that a total amount of 1346, 285, 1242, 211 and 11 kg ha^{-1} of NPKS and Zn were removed from the soil by sixteen 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 sixteen cropping cycles were ploughed down after grain harvest.

Long-term integrated nutrient management for sustaining soil fertility and yield of Maize-Mungbean-T. aman cropping pattern

M.R. Khatun, M.M. Masud, M.M. Sultana, I.S.M. Farhad, A. Barman. and H.M. Naser

A long-term field experiment on Maize-Mungbean-T.aman cropping pattern was conducted in the Grey Terrace Soil (AEZ-28) of Gazipur during the year of 2008-2022 with the objectives of finding out suitable fertilizer combination for sustainable yield of the pattern, monitoring soil health as affected by chemical fertilizers and organic manures and to make a balanced sheet of each nutrient. There were six treatments viz. T1: Native fertility, T2: 75% of Soil Test Based (STB) chemical fertilizer+ 5 t ha^{-1} CD, T3: 100% of STB chemical fertilizer, T4: 100% of STB chemical fertilizer + 5 t h^{a-1} CD, T5: 100% of STB chemical fertilizer + 3 t ha^{-1} PM and T6: 75% of STB chemical fertilizer. The experiment was laid out in RCB design with four replications. Data revealed that the T5 treatment produced the highest yield of maize grain consistently in fourteen cropping cycle. The legume component (mungbean) produced over 1 t ha^{-1} grain and added over 13 t ha^{-1} green biomass. The third crop (T.aman rice) also produced the highest grain yield in the T5 treatment. The yields of maize and rice were statistically similar to all other fertilizer treatments. The native fertility treatment produced the lowest yield. This trend of influence was consistent for almost all the yield contributing characters of maize and T. aman rice. N, K and S balances were found negative whereas P balance was found positive except T1 treatment (native fertility).

Effect of crop residue and their biochars on Maize yield

M.M. Masud, M.M. Sultana, A. Barman, M.R. Khatun, I.S.M. Farhad and H.M. Naser

A study was conducted on the effects of crop straw and its derived biochars on maize (BARI Khoi bhutta) yield at Central research field, BARI, Gazipur under Grey Terrace Soil (AEZ 28) from 2018-2021. Three crop straws (i.e. groundnut straw, chickpea straw and mustard straw) and their derived biochars were used where cowdung used as comparison. The experiment consisted of eight treatments laid out in randomized complete block design with three replications. The changes of soil properties like pH, organic matter content and soil health effect on yield and yield components of maize were investigated. Results indicated biochar, especially those were high in pH, enhanced soil pH (>0.2 units, $p < 0.05$), whereas reduction and or unaffected soil pH was observed among treatments with crop straws. The organic matter content increased with the application of crop straws and biochars as well as cowdung. After three years study, result showed that biochar treated soil increased and last in soil ranges from (0.21 to 0.27 unit) but crop straw increased only 0.04 units.

Initially, carbon stock increased average 28% by using crop straw and crop straw derivate biochar increased average 75% from initial soil organic carbon where chickpea straw biochar increased greater (77%). The carbon content decreased almost full from CD and crop straw treated soil but biochar amended plot decreased a little form first year to third year. Greater nutrient uptake by maize were observed with the treatment receiving biochar compared to crop straw as well as cowdung and no amendment plot, respectively. The lowest uptake of nutrient element was recorded in treatment receiving amendment plot (100% RDCF). The incorporation of biochar not only neutralizes soil acidity, but can also improve soil fertility and carbon stock into the soil. Three years average results on the yield parameters of the BARI Khoi bhutta showed that crop straw increased the grain yield from 4.55 t ha^{-1} to 4.67 t ha^{-1} where crop straw biochar increased 5.12 t ha^{-1} to 5.60 t ha^{-1}, where 4.53 t ha^{-1}yield obtained from RDCF with cowdung 5 t ha^{-1}, that is 20% higher yield produced from RDCF treatment. Crop straw biochar enhanced the yield up to 45% from RDCF and 25% from crop straw but statistically higher yield in chickpea straw biochar (CSB) treated plot. The overall result indicated that RDCF with 10 t ha^{-1} CSB out of three crop straw biochars showed more effective for Khoi butta yield and improve soil fertility.

Nutrient management for a rooftop garden

A. Barman, I.S.M. Farhad, M. Sultana, R. Khatun, M.M. Masud, R. Sen and H.M. Naser

The study has been conducted in Gazipur (rooftop of Soil Science Division) during the year of 2020-2021 and 2021-2022. 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. T_1 = 100% STB, T_2 = T_1 + 1 kg kitchen waste (decomposed) 6 kg^{-1} soil, T_3 = 80% of T_1 + 2 kg kitchen waste (decomposed) 6 kg^{-1} soil, T_4 = T_1 + 1 kg cowdung 6 kg^{-1} soil, T_5 = 80% of T_1 + 2 kg cowdung 6 kg^{-1} soil, T_6 = T_1 + 1 kg vermicompost 6 kg^{-1} soil, T_7 =80% of T_1 + 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.T_1 = 1 kg kitchen waste for 1 kg soil, T_2 = 1 kg kitchen waste for 2 kg soil, T_3 = 1 kg cowdung for 1 kg soil, T_4 = 1 kg cowdung for 2 kg soil, T_5 = 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 flowers; and influence of different ratio of soil and organic materials on the growth and yield of Bitter gourd 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, T_7 treatment (80% of T_1 + 2 kg vermicompost 6 kg^{-1} soil) showed best performance followed by T_3 treatment (80% of T_1 + 2 kg kitchen waste 6 kg^{-1} soil) for maximizing the yield of vegetables, fruits and flowers grown on the rooftop garden. In case of 2nd experiment, T_5 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 growth and yield of Bitter gourd for rooftop garden. The lowest yield was recorded from the T4 treatment (1 kg cowdung for 2 kg soil).

Efficacy of different form of urea on nitrogen availability and yield of Maize

R. Sen, M.M. Masud, A. Barman and H.M. Naser

The experiment was conducted at BARI, Gazipur during rabi season of 2021-22 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. T_1: N-control, T_2: RD of nitrogen (225 kg ha^{-1}) in the form of Prilled urea, T_3: 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 three replications. The highest yield (10.75 t ha^{-1}) of maize was obtained from T3 treatment (200 kg N as USG) which was very close to T_4 treatment (10.69 t ha^{-1}). The lowest yield (6.48 t ha^{-1}) of maize was noted in N-control treatment (T_1). The actual nitrogen add (130 kg ha^{-1}), nitrogen uptake (162 kg ha^{-1}) and nitrogen balance (-33 kg ha^{-1}) by maize was highest in T_3 the treatment. If 1 kg extra nitrogen applied, 21.34 kg extra maize grain yield over N-control was observed in T_3 treatment. If 1 kg extra nitrogen applied, 0.32 kg extra nitrogen uptake by maize over N-control was observed in T_3 treatment. Cost and return analysis revealed that highest gross margin (72153 tk. ha^{-1}) as well as MBCR of 7.0 was obtained from T_4 treatment (Neem coated urea applied maize plot). BCR in prilled urea and USG applied maize were 6.9 and 5.2, respectively.

Nutrient management of sesame in Barishal region

M.R. Islam and M.R. Uddin

A field experiment was conducted at Regional Agricultural Research Station, Rahmatpur, Barishal during April 2021 to June 2021 to develop nutrient management package for sesame in this region and to increase the yield of sesame through fertilizer management practice. The crop variety was BARI Til-4. There were five treatments viz. T0: Native fertility, T_1:50:20:40:10:1:2 kg/ha NPKSZn & B (FRG-2018), T_2: Farmers practice (40:15:20 k/ha NPK), T_3: 75% of T_1+ CD 5t/ha, T_4: 125% of T_1, which were replicated for four times. Cowdung was used with chemical fertilizers for T_3 treatment. Chemical fertilizers had showed significant influences on plant height (cm), shoot and root dry weight, number of pod/plant, as well as yield of sesame. The highest seed yield was obtained from T_4 (901.50 kg ha^{-1}) treatment which was statistically similar with T_1 (887.25 kg ha^{-1}) treatment and significant over T0 (608.0kg ha^{-1}) and T2 (649.50 kg ha^{-1}) treatments. Use of chemical fertilizer found better in sésame cultivation in Barishal region (Non–calcareous Grey Floodplain Soils under AEZ-13).

Effect of kitchen waste compost on soil carbon accumulation and Tomato yield

M. Yasmin, F.S. Shikha, M.A. Rahman, R. Sen and H.M. Naser

Two years field study was conducted on the effect of kitchen waste compost on tomato yield and carbon accumulation in soil at Regional Agricultural Research Station (RARS), Jamalpur, Bangladesh under Old Brahmaputra Floodplain (AEZ-9) during rabi season of 2020-21 and 2021-22.The objectives was to evaluate the effect of kitchen waste compost for better yield of tomato and to improve the stock of organic carbon in soil. The experiment was laid out in a randomized complete block design (RCBD) with 3 replications and BARI tomato-21 was used as test crop. There were seven treatments comprising T_1 = 100 % RDCF (control), T_2=100 % RDCF + Kitchen Waste Compost @ 2.5 t ha^{-1} , T_3 = 100 % RDCF + Kitchen Waste Compost @ 5 t ha^{-1}, T_4 = 85% RDCF + Kitchen Waste Compost @ 2.5 t ha^{-1}, T_5 = 85% RDCF + Kitchen Waste Compost @ 5 t ha^{-1} , T_6 =70% RDCF + Kitchen Waste Compost @ 2.5 t ha^{-1} and T_7 = 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 sole application of chemical fertilizers. The highest average tomato fruit yield (68.46 t ha^{-1}) was found in T_3 treatment (100 % RDCF + Kitchen Waste Compost @ 5 t ha^{-1}). T_1 treatment (100% RDCF) produced tomato yield of 55.82 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 average tomato yield of 52.73 t ha^{-1} was recorded in the T6 (70% RD + Kitchen Waste Compost @ 2.5 t ha^{-1}) treatment. Soil organic matter and N, P, K contents of post-harvest soils were improved in integrated treatment compare to sole chemical treatment. Integrated treatment also increased organic carbon content, carbon stock and carbon accumulation in soil. So, application of100% recommended dose of chemical fertilizer with kitchen waste compost @ 5 t ha^{-1} can be practiced for achieving higher tomato yield as well as economic benefit and keeps the soil and environment free from pollution.

Nutrient management through compost and Tricho compost on the growth and yield of Garlic in Jamalpur

F.S. Shikha, M. Yasmin , M.A. Rahman, R. Sen and H.M. Naser

A field trial was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2020 - 2022 to develop an optimum and economic tricho compost dose for maximizing the yield of garlic. There were five treatments comprising T_1 = 100% NPKSZnB (STB), T_2 = Cowdung (3 t/ha.) + IPNS basis NPKSZnB , T_3 = Tricho compost (4 t/ha.) + IPNS basis NPKSZnB, T_4 = Tricho compost (2 t/ha. + IPNS basis NPKSZnB) and T_5 = Native fertility. The highest average yield (9.41 tha $^{-1}$) was obtained from T_3 (Tricho compost (4 t/ha.) + IPNS basis NPKSZnB) treatment which was followed by T_2 (Cowdung (3 t/ha.) + IPNS basis NPKSZnB.) treatment and the lowest (4.62 t ha $^{-1}$.) from T_5 (Native fertility) treatment. The highest individual bulb wt. (20.77 g) was obtained from the T_3 (Tricho compost (4 t/ha.) + IPNS basis NPKSZnB) treatment) treatment which was statistically identical with T_2 (Cowdung (3 t/ha.) + IPNS basis NPKSZnB) treatment. The lowest individual bulb wt. (7.38 g) was obtained fromT5 (Native fertility) treatment. Considering economics of the different treatments, the highest gross return

(282300 TK ha^{-1}), gross margin (160200 TK ha^{-1}) and BCR (2.31) were obtained from T3 treatment i.e., tricho compost (4 t/ha.) along with chemical fertilizer. The lowest gross return (138600 TK ha^{-1}) was found from T_5 i.e., native fertility treatment. From the trial, it can be concluded that tricho compost along with IPNS based chemical fertilizers is the best treatment.

Nutrient management through organic manuring and biofertilizers on the yield of Onion and soil health improvement

F.S. Shikha, M. Yasmin, M.A. Rahman, R. Sen and H.M. Naser

A field trial was conducted during the period of 2020-21 and 2021-22 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 cultivation. There were six treatments comprising T_1 = 100% NPKSZnB (STB), T_2 = Tricho compost (5t/ha.) + IPNS basis NPKSZnB, T_3 = Tricho compost (5t/ha.) + IPNS basis NPKSZnB +AM, T_4 = 100% NPKSZnB (STB) + AM, T_5 = Tricho compost (5t/ha.) + AM, T_6 = Native fertility. The highest average bulb yield (22.65 tha^{-1}) of onion was obtained from T_3 (Tricho compost (5t/ha.) + IPNS basis NPKSZnB +AM) treatment. The lowest average bulb yield (9.14 tha^{-1}) obviously recorded from control (T6) treatment. The highest bulb wt. (62.05 g) was obtained T_3 (Tricho compost (5t/ha.) + IPNS basis NPKSZnB +AM) treatment and lowest (40.54 g) was obtained from T_6 (native fertility) treatment. The highest root colonization and no. of spore population (80%) and (353) respectively was observed in the trial treated with tricho compost-AM combined application, while the lowest values (30%) and (70) respectively were recorded in the control trial. The pH of post-harvest soil was affected by different treatments and ranged from 7.1 to 7.4. The macronutrient and micronutrient uptake significantly increased over STB fertilizer dose by the application of tricho compost and AM along with STB fertilizer dose. Maximum organic carbon (0.82%) was found from application of tricho compost and AM with STB fertilizer and minimum (0.73%) in control treatment. Soil total nitrogen varies from 0.041% to 0.047%. Likewise, remarkable increases of P and K in the T_3 in comparison to the control. The soil organic carbon stock and carbon accumulation values (17.34 t ha^{-1} and 1.35 t ha^{-1}) respectively are higher recorded in T_3 (Tricho compost (5t/ha.) + IPNS basis NPKSZnB +AM) treatment and the lower values were recorded in T_5 and control treatment. Considering economics of the different treatments, the highest gross return (679500 TK ha^{-1}), gross margin (530420TK ha^{-1}) and BCR (4.56) were obtained from T_3 treatment i.e., tricho compost (5t/ha.), AM along with chemical fertilizer. The lowest gross return (274200 TK ha^{-1}) was found from T_6 i.e., native fertility treatment and lowest BCR (2.51) was obtained in T6 treatment. From the trial, it can be concluded that tricho compost and AMF inoculant along with IPNS based chemical fertilizers is the best treatment.

Effect of integrated nutrient management on the yield and nutrient uptake of Foxtail Millet

I.S.M. Farhad, F.S. Shikha, H.M. Naser, R. Sen, M.M. Masud, M.M. Sultana and A. Barman

A field experiment was conducted at Central Research Farm, BARI, Gazipur and Regional Agricultural Research Station (RARS), Jamalpur during Rabi season of 2019-22 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. T_1 = Soil test based fertilizer dose for HYG, T_2= IPNS with 5.0 t ha^{-1} cowdung, T_3 = IPNS with 5.0 t ha^{-1} compost, T_4 = IPNS with 1.5 t ha^{-1} vermicompost, T_5 = IPNS with 3.0 t ha^{-1} poultry manure and T_6 = Native fertility 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 (2.38 t ha^{-1} and 2.26 t ha^{-1} at Gazipur and Jamalpur, respectively) was recorded in IPNS with 1.5 t ha^{-1} vermicompost treated plot (T_4) while the lowest grain yield (1.23 and 1.19 t ha^{-1} at Gazipur and Jamalpur, respectively) was observed in T_6 (Native fertility) treatment. The uptake of nutrients by foxtail millet was highest in the treatment T_4 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 (132010 Tk. ha^{-1} and 126060 Tk. ha^{-1} at Gazipur and Jamalpur, respectively), net return

(73700 Tk. ha^{-1} and 68545 Tk. ha^{-1} at Gazipur and Jamalpur, respectively) as well as BCR (2.26 and 2.19 at Gazipur and Jamalpur, respectively) were obtained from T_4 treatment (IPNS with 1.5 t ha^{-1} vermicompost) whereas the lowest gross return (70400 Tk. ha^{-1} and 68020 Tk. ha^{-1} at Gazipur and Jamalpur, respectively), net return (27300 Tk. ha^{-1} and 25720 Tk. ha^{-1} at Gazipur and Jamalpur, respectively) and BCR (1.63 and 1.60 at Gazipur and Jamalpur, respectively) were obtained from T_6 (Native fertility) 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.

Effect of different form and doses of urea fertilizer on nitrous oxide emission, nitrogen use efficiency and yield of Cauliflower

M.R. Khatun, R. Sen, A. Barman, M.M. Masud, M.M. Sultana 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 & rate of urea, ii) to find out the yield and yield components of cauliflower as influenced by different form & rate of urea and iii) to analyze cost and return of cauliflower produced from different form & rate of urea. There were ten treatments viz. T_1: 100 kg N ha^{-1} in the form of Prilled Urea (PU), T_2: 140 kg N ha^{-1} in the form of Prilled Urea (PU), T_3: 180 kg N ha^{-1} in the form of Prilled Urea (PU), T_4: 100 kg N ha^{-1}in the form of Neem Coated Urea (NCU), T_5: 140 kg N ha^{-1} in the form of Neem Coated Urea (NCU), T_6: 180 kg N ha^{-1} in the form of Neem Coated Urea (NCU), T_7: 100 kg N ha^{-1} in the form of Urea Super Granules (USG), T_8: 140 kg N ha^{-1} in the form of Urea Super Granules (USG), T_9: 180 kg N ha^{-1} in the form of Urea Super Granules (USG), T_{10}: N-control. P, K, S, Zn & B were applied @ 60, 90, 20, 3 & 1.5 kg ha^{-1}. The tested crop and variety was cauliflower (Snow white). The experiment was laid out in RCB design with three replications. The highest yield of cauliflower (42.44 t ha^{-1} was observed in T_9 treatment (180 kg N ha^{-1} as USG applied) which was very close to the yield of 42.04 t ha^{-1} and it was found in T_6 treatment (180 kg N ha^{-1} as NCU applied). The lowest yield (12.57 t ha^{-1}) of cauliflower was noted in N-control treatment (T10). Highest agronomic use efficiency of nitrogen (166) was obtained from T9:180 kg N ha^{-1} as USG treated plot. Highest yield increase over control (238%) was also obtained from T9:180 kg N ha^{-1} as USG treated plot which was very close to T6 treatment (180 kg N ha^{-1} as NCU treated plot) yield increase about 234%.Cost and return analysis revealed that the highest gross margin(3,32,019/- Tk ha^{-1}) as well as BCR (4.76) was obtained from T6 treatment (180 kg N ha^{-1} as NCU applied).

Effect of different organic manures on carbon accumulation in soil and yield of crops in Mustard-Mungbean-T.aman cropping pattern

M.R. Khatun, A. Barman, I.S.M. Farhad, M.M. Masud, M.M. Sultana and H.M. Naser

A field experiment on effect of different organic manures on carbon accumulation in soil and yield of crops in Mustard-Mungbean-T.aman rice cropping pattern was conducted at Gazipur (AEZ-28) during the year of 2020-22 with the objectives: to increase soil organic carbon, improve soil fertility and increase sustainable yield of the crops. There were nine different treatments viz. T_1: 5 t ha^{-1} VC + IPNS, T_2: 7.5 t ha^{-1} VC + IPNS, T_3: 5 t ha^{-1}Bioslurry + IPNS, T_4: 7.5 t ha^{-1}Bioslurry + IPNS, T_5: 5 t ha^{-1} Compost + IPNS, T_6: 7.5 t ha^{-1} Compost + IPNS, T_7: 5 t ha^{-1} PM + IPNS, T_8: 7.5 t ha^{-1} PM + IPNS, T_9: Native fertility. The experiment was laid out in RCB design with three replications. Tested crops and varieties were mustard (var. BARI Sarisha-17), mungbean (BARI mung 6) and T. aman (BRRIdhan 75). Data revealed that the yield contributing characters and grain yield of mustard, mungbean and T. aman was significantly influenced by different IPNS treatments. The highest grain yields of mustard (1.88 t ha^{-1}), mungbean (1.45 t ha^{-1}) and T. aman (5.31 t ha^{-1}) was found in T_4 treatment where 7.5 t ha^{-1}Bioslurry with IPNS basis inorganic fertilizers was applied. Total rice equivalent yield of the crops (12.7 t ha^{-1}) was also highest in T_4 (7.5 t ha^{-1} Bioslurry + IPNS) treatment. Cost and return analysis showed that, the highest gross return (2,54,800/- Tk ha^{-1}) and highest gross margin (1,34,637/- Tk ha^{-1}) were noted in T_4 (7.5 t ha^{-1} Bioslurry + IPNS) treatment but the highest BCR (2.18) was found in T_3 (5 t ha^{-1}Bioslurry + IPNS) treatment.

Effect of vermicompost on Groundnut yield and soil fertility in Charland

M. Yasmin, F.S. Shikha, M.A. Rahman, R. Sen and H.M. Naser

The experiment was conducted at farmers' field of Nouvanger char, Jamalpur Sadar, Jamalpur during the

rabi season of 2020-2021 and 2021-2022.The objectives was to find out the effect of vermicompost with chemical fertilizer on groundnut yield, to increase soil fertility and to improve the stock of organic carbon in soil. The experiment was laid out in a randomized complete block design (RCBD) with 3 replications and BARI Chinabadam - 9 was used as test crop.There were seven treatments comprising, T_1 = 100 % RDCF(control), T_2 = 100 % RDCF + vermicompost @ 1 t ha^{-1}, T_3 = 100 % RDCF + vermicompost @ 3 t ha^{-1}, T_4 = 85% RDCF + vermicompost @ 1 t ha^{-1}, T_5 = 85% RDCF + vermicompost @ 3 t ha^{-1}, T_6 = 70% RDCF + vermicompost @ 1 t ha^{-1}and T_7 = 70% RDCF + vermicompost @ 3 t ha^{-1}. Two years average data revealed that, combined application of vermicompost and chemical fertilizer increased groundnut yield and BCR as compared to sole application of chemical fertilizers. Among the treatments, T_5 (85% RDCF + VC @ 3 t ha^{-1}) produced the highest average nut yield (2.16 t ha^{-1}) which was 19.33 % higher over 100% RDCF dose. On the other hand, groundnut yield was gradually decreased with decreasing chemical fertilizers. The lowest average groundnut yield of 1.55 t ha^{-1} was recorded in the T_6 (70% RD + vermicompost @ 1 t ha^{-1}) treatment. Soil organic matter and N, P, K contents of post-harvest soils were improved in integrated treatment compare to sole chemical treatment. Integrated treatment also increased organic carbon content, carbon stock and carbon accumulation in soil. 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.

Effect of co-composting biochar on Cabbage-Indian spinach-T.aman productivity

M.M. Masud, R. Sen, M.M. Sultana, I.S.M. Farhad and H.M. Naser

A field study was conducted at BARI research field under Grey Terrace Soil (AEZ-28) from 2021-22 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. In this year, three crops harvested and found that, yield was increased by amending organic compound. The greater rice equvalant yield (REY) was found in T_4 treatment (80% RDCF with 5 t ha^{-1} co-composting biochar (COMBI). Compare to control, more than 133% REY increase by using 80% RDCF with 5 t ha^{-1} COMBI. Application of 5 t ha^{-1} organic compound, i.e. compost, Biochar and COMBI the increment varied from 9 to 24 percent REY where COMBI gave the greater yield. In addition, 15% REY was increase when COMBI 3tha^{-1} applied into soil. The highest gross margin was obtained from T4 treatment with a BCR 6.99 but we do not add organic compound price in this year. 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 -8). For more confirmation, the trial need to continue in a same plot without any destroys.

Nutrient management of Onion to reduce storage rots

M.M. Sultana, G.M.M Bari, M.M. Masud, R. Sen and H.M.Naser

A field experiment in a randomized complete block design with three replications was conducted on onions (*Allium cepa* L.) (var. BARI Piaj-4) at Lakkha Research Station, Bangladesh Agricultural Research Institute (BARI), Rajshahi during the *rabi* season of 2021-2022to investigate the nutrient management of onion to reduce storage rots. The five rates of soil amendments were: T_1= 100 % RD (FRG 2018), T_2 = N60P30K80S20 Ca0Mg0 kg/ha, T_3 = N80P50K100S30 Ca30Mg100 kg/ha, T_4 = N100P70K120S40 Ca60Mg200 kg/ha, T_5 = No application (control). Results revealed that the T_1 (100% RD) produced the highest yield (17.33 t ha^{-1}) and the lowest yield (7.53 t ha^{-1}) in native fertility treatment (T_5). Disease incidence was recorded from storage of onion bulbs were found maximum in T_1 and minimum amount was found in T_5.

Development of fertilizer recommendation for Chilli with Onion intercropping system

I.S.M. Farhad, H.M. Naser, R. Sen, M.M. Masud, R. Khatun, M.M. Sultana and A. Barman

An experiment was conducted at Central Research Farm, BARI, Gazipur during Rabi season of 2021-22 to develop a fertilizer recommendation for chilli

with onion intercropping system. Six treatment combinations viz. T_1= 100% RDCF of chilli + 0% RDCF of onion, T_2= 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 (12.21 t ha^{-1}) and onion (8.18 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 (22.02 t ha^{-1}) followed by T5 (21.97 t ha^{-1}).The highest net return (432028 Tk. ha^{-1}) as well as BCR (4.69) were obtained from T_5 treatment (100% RDCF of chilli +40% RDCF of onion) whereas the lowest net return (366661 Tk. ha^{-1}) as well as BCR (4.30) were observed in T_1 treatment (100% RDCF of chilli + 0% RDCF of onion). Though T6 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, H.M. Naser, R. Sen, M.M. Masud, R. Khatun, M.M. Sultana and A. Barman

A field experiment was conducted at Central Research Farm, BARI, Gazipur during Rabi season of 2021-22 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=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 (15.40 t ha^{-1}) was recorded in T_3 treatment (100% RDCF + Kitchen waste compost @5.0 t ha^{-1}) whereas the lowest curd yield (5.31 t ha^{-1}) was observed from T_6 (Native fertility) treatment. The uptake of nutrients by brocolli was highest in the treatment T3 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 (462000 Tk. ha^{-1}), net return (291202 Tk. ha^{-1}) as well as BCR (2.70) were obtained from T3 treatment (100% RDCF + Kitchen waste compost @ 5.0 t ha^{-1}) whereas the lowest gross return (159300 Tk. ha^{-1}), net return (28700 Tk. ha^{-1}) and BCR (1.21) were obtained from T_6 (Native fertility) 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 brocolli cultivation at Gazipur district of Bangladesh.

Integrated potash management for Mustard

M. Yasmin, F.S. Shikha, M.A. Rahman, R. Sen and H.M. Naser

The experiment was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2021-22. The objectives were to evaluate the effect of integrated potash management for better yield of mustard and to increase potassium uptake. The experiment was laid out in a randomized complete block design (RCBD) with 3 replications and BARI Sarisha^{-1}4 was used as test crop. There were six treatments comprising T_1 = control, T_2= STB fertilizer dose, T_3 = STB+ rice husk ash @1 t ha^{-1}, T_4 = STB + rice husk ash @ 2 t ha^{-1}, T5 = STB + rice straw compost @ 3 t ha^{-1}and T_6 = STB+ rice straw compost @ 5 t ha^{-1}. Among the various treatments, the highest seed yield (1448 Kg ha^{-1}) of mustard was obtained from treatment T4 receiving STB fertilizer dose with rice husk ash @ 2 t ha^{-1} and the lowest yield (568 Kg ha^{-1}) was noted in control treatment. Cost and return analysis revealed that the highest gross margin (Tk 116820 ha^{-1}) as well as BCR of 2.87 were recorded from T_4 (STB + rice

husk ash @ 2 t ha^{-1}) treatment. Results also demonstrated that, use of organic amendment such as rice husk ash, rice straw compost in integrated potash management practices also increased the potassium uptake and improved post-harvest soil K status over control or sole STB fertilizer dose. The overall results indicated that integrated potash management package of STB with rice husk ash @ 2 t ha^{-1} is more effective than other packages in respect of yield, economic return, nutrient availability and soil health.

Application of vermiwash on growth and quality of Tomato

M. Yasmin, F.S. Shikha, M.A. Rahman, R. Sen and H.M. Naser

The experiment was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2021-2022 to investigate the effect of vermiwash on growth, yield and quality of tomato and to find out suitable foliar dose of vermiwash for optimizing the yield of tomato. There were five treatments comprising T_1= Chemical fertilizer (CF) (control), T_2= CF + foliar spray of 10 % vermiwash, T_3 =CF + foliar spray of 20 % vermiwash, T_4= CF + foliar spray of 30 % vermiwash, T_5= CF + foliar spray of 40 % vermiwash. Nutrients of the treatments were formulated through IPNS system. Results revealed that, vermiwash treated tomato plants showed better growth and yield parameters than the control plants. The highest average tomato fruit yield (70.51t ha^{-1}) was found in T_3 treatment i.e., foliar spray of 20% concentration of vermiwash and the lowest (61.82 t ha^{-1}) came from control. On the other hand, nutritional quality (moisture content, TSS, lycopene, β carotene and vitamin C) 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 tomato.

Development of fertilizer recommendation for Groundnut- Linseed intercropping system

F.S. Shikha, M. Yasmin, M.A. Rahman, R. Sen and H.M. Naser

A field trial was conducted at Regional Agricultural Research Station (RARS), Jamalpur during the period of 2021-2022 to develop a suitable and economic fertilizer dose for maximizing the yield for groundnut with linseed intercropping system. There were seven treatments comprising T_1 = 100% RDCF of groundnut+ 0% RDCF of linseed, T_2 = T_1 + 10% RDCF of linseed, T_3 = T_1 + 20% RDCF of linseed, T_4 = T_1 + 30% RDCF of linseed, T_5 = T_1+ 40% RDCF of linseed, T_6 = T_1 + 50% RDCF of linseed and T_7= T_1 + 60% RDCF of linseed. Significantly the highest yield (1.83a $tha^{-1}$for groundnut and 1.17a t $ha^{-1}$for linseed) was obtained from T6 (T1 + 50% RDCF of linseed) treatment which was statistically identical with T_5 (T_1 + 40% RDCF of linseed) treatment for groundnut and T5 and T4 for linseed. The lowest yield (0.81 tha^{-1} and 0.55 t ha^{-1} for groundnut and linseed respectively) from T_1 (100% RDCF of groundnut+ 0% RDCF of linseed) treatment. The highest net return (163735 tk ha^{-1}) was obtained from T_6 = T_1 + 50% RDCF of linseed treatment which was followed by T_5 = T_1 + 40% RDCF of linseed treatment (147705 tk ha^{-1}). But the highest BCR (2.31) was obtained from T_6 = T_1 + 50% RDCF of linseed treatment which was followed by T_5 = T_1 + 40% RDCF of linseed treatment (2.20) and the lowest net return (13800 tk ha^{-1}) from T_1 = 100% RDCF of groundnut+ 0% RDCF of linseed treatment. Although the highest groundnut equivalent yield (2.80 t ha^{-1}) was obtained from T_6 (T_1 + 50% RDCF of linseed) treatment, BCR was higher than T_7 (T_1 + 60% RDCF of linseed) treatment due to higher cost of inorganic fertilizers.

Development of fertilizer recommendation for Knolkhol Maize intercropping system

R. Sen, I.S.M. Farhad, H.M. Naser, M.M. Masud, R. Khatun, M.M. Sultana and A. Barman

An experiment was conducted at Central Research Farm, BARI, Gazipur during Rabi season of 2021-22 to develop a fertilizer recommendation for maize with knolkhol intercropping system. Seven treatment combinations viz. T_1 (100% RDCF of Maize + 0% RDCF of Knolkhol), T_2 (100% RDCF of Maize + 10% RDCF of Knolkhol), T_3 (100% RDCF of Maize + 20% RDCF of Knolkhol), T_4 (100% RDCF of Maize + 30% RDCF of Knolkhol), T_5 (100% RDCF of Maize + 40% RDCF of Knolkhol), T_6 (100% RDCF of Maize + 50% RDCF of Knolkhol) and T_7 (100% RDCF of Maize + 60% RDCF of Knolkhol) were tested. The experiment was laid out in randomized complete block design with 3 replications. Both maize and knolkhol significantly influenced by different treatment combinations. Significantly the highest yield of maize (8.86 t ha^{-1}) and knolkhol (32.17 t ha^{-1}) were obtained from T_7 treatment (100% RDCF of Maize

+60% RDCF of Knolkhol) which was statistically similar with T_6 treatment (100% RDCF of Maize +50% RDCF of Knolkhol). Maize equivalent yield progressively increases with the increase of inorganic fertilizers. The results showed that T_7 provided the highest MEY (30.30 t ha^{-1}) followed by T_6 (30.13 t ha^{-1}). The highest BCR (3.87) were obtained from T_6 treatment (100% RDCF of maize +50% RDCF of knolkhol) whereas the lowest BCR (3.16) were observed in T1 treatment (100% RDCF of maize + 0% RDCF of knolkhol). Though T7 treatment gave higher yield over all the treatments yet it showed lower BCR compared to T6 treatment due to higher cost involvement for inorganic fertilizer.

Integrated nutrient management of year round four Vine crops modal for a intensive rooftop garden

A. Barman, I.S.M. Farhad, M.M. Sultana, R. Khatun, M.M. Masud, R. Sen and H.M. Naser

The study was conducted in Gazipur (rooftop of Soil Science Division) during the year of 2021-2022. The experiment activities include Integrated Nutrient Management of year round 4 vine crops modal for a intensive rooftop garden based research which have 5 treatments viz. T_1 = 100% STB (Soil Test Based Fertilization), T_2 = 80% of T_1 + (1:3) Kitchen waste compost and soil, T_3= 80% of T_1 + (1:3) Cowdung and soil, T_4= 80% of T_1 + (1:3) Vermicompost and soil& T_5 = absolute control. Prior to setting the experiments initial soil samples as well as organic fertilizers were analyzed and nutrient statuses were determined. Vegetables (Bottle gourd) performed better in T_4 treatment (80% of T_1 + (1:3) Vermicompost and soil) compared to others in the experiments related to integrated nutrient management for growth and yield of Bottle gourd on rooftop garden. The lowest yield was recorded from the control treatment.

Study on soil properties variation through the soil profile in saline areas of seven upazilas of Satkhira district

O.A. Fakir, R. Sen, J. Alam and H.M. Naser

The spatial variability of salt accumulation through the soil profile was studied at seven locations covering seven upazila of Satkhira: Satkhira Sadar, Kolaroa, Assasuni, Tala, Kaligonj, Debhata and Shymnagar. Three locations were randomly selected from each upazila. From each location, soil samples were collected from five soil depths at D_1 = 0-7 cm, D_2 = 8^{-1}5 cm, D_3 =16-23 cm, D_4 =24-31 cm and D5 =32-39 cm. The highest value of EC was found to be 7.92 dSm^{-1} in Shymnagar at 16-23 cm Soil depth and the lowest 0.42d dSm^{-1} in Tala upazila for the same soil depth. In case of soil depth 24-31 cm and 32-39 cm, the highest value of EC was found to be 8.74 and 9.82 dSm^{-1}respectively in Shymnagar while the lowest soil salinity for the same depths were observed in Tala upazila. All the soil depth mean pH value was neutral to slightly alkaline except in Debhata which was strongly alkaline. Most of the soils under study had very high to medium organic matter content that decreased significantly with increasing depths in various land uses. The highest value of sulphur was found 87.80 ppm in Satkhira Sadar at 0-7 cm soil depth and the lowest value was 37.09 ppm in Kolaroa at 24-31 cm soil depth. The results clearly reveal that the top soil of Saline areas is very much sensitive to salt stress and for studied chemical properties.

Utilization of banana peel fertilizer on increasing Tomato yield and improving soil fertility

M.R. Khatun, R. Sen, M.M. Masud, M.M. Sultana, A. Barman and H.M. Naser

Banana peel is an organic waste, which has nutrients that are useful for plants. A pot experiment on utilization of banana peel fertilizer on increasing tomato yield and improving soil fertility was conducted in the net house of Soil Science Division, BARI, Joydebpur, Gazipur during the year of 2021-2022with the objectives: i) to find out the effect of banana peel fertilizer on tomato yield, ii) to find out the nutrient uptake and to increase soil fertility by the application of banana peel fertilizer. There were six treatments viz. T_1: 100% RDCF, T_2: 100% RDCF + 10% Banana peel fertilizer, T_3: 100% RDCF + 20% Banana peel fertilizer, T_4: 80% RDCF + 10% Banana peel fertilizer, T_5: 80% RDCF + 20% Banana peel fertilizer, T6: Native fertility. The tested crop and variety were tomato (BARI tomato 16). The experiment was laid out in CRD design with four replications. Growth and yield of tomato were significantly influenced by different treatments. The highest yield of tomato (58.2 t ha^{-1}) was observed in T_3 treatment (100% RDCF + 20% Banana peel fertilizer) which was very close to the yield of 53.5 t $ha^{-1}$and it was found in T_2 (100% RDCF + 10% Banana peel fertilizer) treatment. The lowest yield (5.5 t ha^{-1}) was noted in control

treatment (T_1). Highest yield increase over control (91%) was also obtained from T_3: 100% RDCF + 20% Banana peel fertilizer treated pot which was very close to T_2 treatment (100% RDCF + 20% Banana peel fertilizer treated pot) yield increase about 90%. Nutrient uptake was also influenced by banana peel with chemical fertilizers treatments. NPKS uptake in tomato was highest by T_3 treatment.

Sustainable substrate composition as influenced by organic amendment on Dragon fruit in an extensive green roof

M. A. Rahman, F.S. Shikha, M. Yasmin and H.M. Naser

Green roof substrates are an artificial mixture of compounds designed to provide proper conditions for plant growth. A study was done to assess the improvement of soil-substrate properties and dragon fruit growth and yield at the rooftop of the laboratory building in Regional Agricultural Research Station (RARS) under Jamalpur Sadar upazila. There were nine treatment combinations- control (only farm soil), and the rest eight organic amendments (biochar and vermicompost). The rates of biochar and vermicompost were 0, 30 and 40% of the total substrate volume. The results demonstrate that substrate moisture content, plant canopy and plant dry matter content increased in biochar and vermicompost treated soil over non amended soil. It appeared that substrate moisture content was increased with the increase of the rate of biochar and vermicompost. Crop response study showed that the use of 30% biochar plus 30% vermicompost with farm soil produced a significantly higher plant canopy and plant dry matter content over the treatments. The use of biochar and vermicompost with farm soil produced a 12-73 % at North-South and 32- 53 % at East-West direction plant canopy and that was 1-87 % for dry matter content.

Fertilizer requirements for double rice cropping (T. Aus –T. aman rice system) pattern on saline soils at South Coastal region of Bangladesh

S. Akhter and M.F.A. Anik

A field experiment was conducted during kharf-I and kharif-II season 2020-2021in the farmers field at khatail, Dacope, khulna under the supervision of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to find out the best fertilizer doses for cultivating T.aus-T.aman rice cropping pattern and also monitor the soil fertility status. The experiment was laid out in RCBD with three replications. There were six treatments viz. T_1: 0 (control), T_2: 100% RD (STB), T_3: 120% RD of NPZn (STB), T_4: 120% RD of N (STB), T_5: 120% RD of P (STB) and T_6: 120% RD of Zn (STB). In comparison to all other treatments, yield contributing traits and rice yield performed better in plots which were treated with 120% of recommended dose of NPZn. In the T.aus-T.aman rice cropping pattern, the 120% recommended dose of NPZn applied plots produced the highest grain and straw yield (Grain 5.28 t/ha and 5.44 t/ha., Straw 6.89 t/ha and 6.92 t/ha)compared to all other treatment combinations. Harvest Index (%) was also higher in the same treatment in both T.aus and T.aman rice cultivation. In terms of all parameters of the rice-rice cropping pattern, the T_1 (Control) treatment performed worst in the south coastal region of Bangladesh.

Development of functionalized biochar and their characterization

M.M. Masud, A. Barman, S. Mia and H.M. Naser

Fertilizer use efficiency in agricultural systems of Bangladesh is often quite low due to low reactive surfaces of our soils. An increment in soil reactive surfaces can increase nutrient use efficiency while nutrient binding directly to reactive surfaces could further enhance it. Biochar, a pyrolysized biomass, can be used for developing such reactive surface blended fertilizer. In this experiment, biochar enriched fertilizers will be tailored blending function specific biochars with nutrients. To achieve these objectives, we first developed technologies to produce biochar with variable surface charges (positive, neutral and negative). Next, different biochars (pre-doped, post-doped, normal biochar) were produced following the developed methods while normal biochar was modified using chemical with hydrogen peroxide and biological with composting and incubation with soil inoculants and nutrients. The produced biochars were then characterized using Fourier Transform Infrared Spectroscopy (FTIR), cation exchange capacity (CEC), potentiometric charge determination and nutrient concentration analysis. Based on the results, several biochars were selected for biochar enriched N and composite fertilizer preparation. Next, a pre-trial was made to determine the formulation composition using different ratios of biochar, nutrient and additives. The quality (firmness and stability) of the pellets are examined and best mixing ratio was selected.

Modeling climate change impact on agriculture and developing mitigation and adaptation strategies for sustaining agricultural production in Bangladesh

S. Akhter, R. Sen, M. Haque

Climate change is a concern for future agriculture in Bangladesh. Frequencies of extreme climate events are increasing and damaging agricultural sectors severely. It requires understanding such events and mapping out the risks and impact of climate change (CC) on agriculture, nature and extent of climate variability/CC and vulnerability of crops and natural resources for adaptation. The "Modeling Climate Change Impact on Agriculture and developing mitigation and adaptation strategies for sustaining agricultural production in Bangladesh (MCCA) project is working on this aspect which is being funded by KGF, Bangladesh. A group of scientists from BARI, BRRI, and BSMRAU together with KGF were involved in implementing the activities of CRP-II of KGF for three years (2015-2018). Now, this project was extended from December 2020-November 2023 as the 2nd phase. It is a collaborative project involving two NARS Institutes including BARC, BARI and BRRI; two universities including BAU and BSMRAU. The KGF funding project MCCA is being coordinated by BARC. Soil Science Division, BARI leads the Objective -4 of the project. Under this objective, some activities were done to fulfill the objectives.

Validation of crop intensification technologies for improving system productivity, soil health and farm income in South Central Coastal region.

S. Akhter, F. Alam and A. Barman

This coordinated project of NATP-2 (PBRG 051) was implemented jointly by Soil Science Division (SSD) and Oilseed Research Center (ORC), Bangladesh Agricultural Research Institute (BARI) collaborated with Agrarian Research Foundation (ARF) component started from January, 2019. Three components were conducted research on validation of crop intensification of three major cropping pattern in which two cropping pattern were executed in Goplalganj (Goplalganj Sadar, Kasheani upazilla), Madaripur (Madaripur sadar, Kalkini upazilla), Pirojpur (Pirojpur Sadar, Vandaria), and another one pattern was executed in Barishal (Babugonj, Gouronodi), Bagerhat (Bagerhat sadar, Mollarhat) and Jhalakati (Jhalakati Sadar, Rajapur upazilla) for the target of improving system productivity, soil health and farm income.The baseline survey was completed for existing crops practiced by the local farmers. After baseline survey, three crop based cropping pattern were introduced like Mustard-Mungbean-T.aman and Kheshari-Gimakolmi-T.aman at Goplalganj, Madaripur and Pirojpur region against the existing two or single crop based cropping pattern like Rabi-Jute-Fallow or Rabi-Fallow-T.aman or Rabi-Boro-Fallow or Boro-Fallow-Fallow. In Barishal, Bagerhat and Jhalakati location, the cropping pattern was Sweet gourd-Sesame-T. aman. By June 2022, the Soil Science Division, BARI component conducted experiments starting with the mungbean and gimakolmi crops in Kharif^{-1} season and harvested with good yield. From the first and second year trial, it was observed that IPNS based fertilizer application performed better than farmers practice with BARI Gimakolmi^{-1} yield 15% higher than local varieties. Among the mungbean varieties, BARI-Mung-6 yield better than BINA Mung-8 and BARI Mung-8. The second crop T. aman in both the cropping pattern was transplanted in last week of July 2019 and harvested at full maturity in October 2019. Among the three T. aman rice varieties, the variety BRRI dhan71 resulted better than BRRI dhan57, and BRRI dhan75 in all fertilizer levels. Among the three Mustard varieties, the variety BRRI mustard^{-1}7 resulted better than others variety and among the three khesari, Till and sweet gourd variety BARI Khesari-3, BARI Till-3 and BARI Hybried mistikumra-3 resulted better than others variety in all fertilizer levels. Highest total rice (system) yield of was obtained from IPNS based fertilizer management. Also highest gross margin and BCR were obtained from IPNS based fertilizer management.

Micronutrient Aspects of Soil Management

Nano scale zinc oxide particles for improving yield and quality of Tomato

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 Zn on the yield of tomato (*Lycopersicon esculentum* Mill.) at Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, located at 23º59′26″ N and 90º24′52″ E. The micronutrients zinc (Zn) in the form of ZnO nanoparticles and zincsulphate heptahydrates ($ZnSO_4.7H_2O$) were applied as foliar spray at two different stages of

plant growth i.e (i) before flower initiation; (ii) after fruit set when it becomes approximately marble sized. Significantly higher yield (94.5 and 94.2 t ha^{-1}) was produced, when plants were treated with $ZnSO_4$. $7H_2O$ @ 150 ppm and ZnO nano particles @ 15 ppm, respectively. Minimum fruit yield (78.2 t ha^{-1}) was produced by untreated plants - control. Comparatively lower yield was recorded in plants which sprayed with ZnO nanoparticles @ 10 ppm, (85.3 t ha^{-1}) than that of plants sprayed ZnO nanoparticles @ 15 ppm. Zinc supplied to the soil boosted yields, however they were lower than Zn nutrients foliar applied either ZnO nanoparticles or $ZnSO_4$, $7H_2O$. The increment of yield were 9.08 to 20.8, 0.34 to 6.18 and 1.37 to 7.63%, respectively over control, soil application ZnO nanoparticles and soil application of $ZnSO_4$, $7H_2O$. The treatment with 15 ppm of ZnO nanoparticles produced the highest levels of TSS (5.17 °Brix) and beta-carotene (23.3 $mg100g^{-1}$). Nanotechnology has provided better results than conventional method.

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 (cv. BARI Karola-4) at Soil Science Division, BARI, Joydebpur, Gazipur during kharif-I 2021 - 2022. The objectives of the study was to study the effect of B on number of flower setting and yield of bitter gourd; and to find out the optimum level of B for maximizing the yield and quality of bitter gourd. Design of the experiment was RCB with 3 (three) replications. The micronutrient boron (B) in the form of boric acid (H_3BO_3) having 17% boron were applied. The treatment combinations were T_1: Control, T_2: RDF (STB), T_3: 1.0 Kg B ha^{-1} + NPKSZn (STB), T_4: 1.5 Kg B ha^{-1} + NPKSZn (STB) and T_5: 2.0 Kg B ha^{-1} + NPKSZn (STB). The yield and yield contributing character of bitter gourd were significantly influenced by B application. All yield parameters showed higher tendency in T_4 treatment accept flower sheddings. The highest yield (24.52 t ha^{-1}) was observed in T_4 (1.5 Kg B ha^{-1}) treatment and it was significantly higher than control plants. Highest lowering of flower shedding (50.21%) was also observed in T_4 (1.5 Kg B ha^{-1}) treatment and it was higher than control plants. Nutrients concentration in bitter gourd was also influenced by B. P and K concentration was increased non-significantly while N concentration was increased significantly. The concentration of Zn was increased up to a certain level of B (1.5 kg ha^{-1}) then decreased. Nutrients uptake was maximum in the treatment where 1.5 Kg B ha^{-1} was added except K uptake. K uptake was maximum in T_5 treatment which was similar where 1.5 Kg B ha^{-1} was added. Application of B is effective for flower shedding, 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 the foliar application of B on reproductive growth of sunflower (cv. BARI Surjamukhi-3) at Soil Science Division, BARI, Joydebpur, Gazipur (AEZ-28) during rabi 2021 - 2022. The objectives of the study was to determine the effect of foliar spray of B on yield contributing characters of sunflower and to find out the optimum rate of B for maximizing the yield and quality of sunflower. The experiment was laid out in RCBD replicated thrice. The micronutrient B in the form of boric acid (H_3BO_3) having 17% B were applied at 20-25 and 40-45 days after sowing (DAS). The treatment combinations of foliar spray of B were T_1: control (spray with distilled water), T_2: 50 mg L^{-1} B, T_3: 100 mg L^{-1} B and T_4: 150 mg L^{-1} B. The yield and yield contributing character of sunflower were significantly influenced by foliar application of B. All parameters showed higher tendency in T_4 treatment except number of empty seeds $head^{-1}$. The highest seed yield (2.27 t/ha) was observed in T_4 (150 mg L^{-1}B) and it was significantly higher compared with untreated plants. Lowest empty seed% (19.99%) was observed in T_4 (150 mg L^{-1}B) treatment. Foliar application of B is effective on reproductive growth of sunflower in the study area of Grey Terrace Soil of Gazipur (AEZ-28).

Effect of seed priming on yield and nutrient uptake of Cauliflower

S. Sultana, M. Akter, M.B. Banu 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 2021-2022.A field experiment on

effect of seed priming on yield and nutrient uptake of cauliflower was conducted in Grey Terrace Soil to determine concentration of seed priming on growth, yield and quality of cauliflower. There are six treatments viz. T_1: Control (without priming), T_2: Hydro priming (Seed soaked with distilled water), T_3: Seed soaked with 0.5% zinc, T_4: Seed soaked with 0.01% boron, T_5: Seed soaked with 0.5% zinc and 0.01% boron and T_6: Seed soaked with sand matrix. The experiment was RCB design with three replications. The combined use of micronutrients (Zn,B) seed priming gave the highest yield (56.8 t ha^{-1}). The same trend was observed in the yield contributing characters of cauliflower. The untreated treatment produced the lowest yield (25.4 t ha^{-1}). The highest zinc and boron uptake was found in T_5 treatment (seed soaked with zinc and boron).Quality characters like TSS, ascorbic acid and β carotene content also found high in combined use of seed priming treatments. The combined application of boron and zinc (0.01% + 0.5) for seed priming was the most effective treatment technique for cauliflower production.

Foliar application of manganese on growth and yield of Groundnut

S. Sultana, M. Akter, M.B. Banu 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 2021-2022.A field experiment on effect of foliar application of manganese on growth and yield of groundnut was conducted in Grey Terrace Soil to determine the effect of manganese on growth, yield and quality of groundnut (BARI chinabadam 9). There are five treatments viz. T_1: Control, T_2: Foliar spray of 0.02% Mn, T_3: Foliar spray of 0.04% Mn, T_4: Soil application of Mn 0.5 kg ha^{-1}, T_5: Soil application of Mn 1.0 kg ha^{-1}. The experiment was RCB design with three replications. The highest nut yield (2.59 t ha^{-1}) was found in T_3 treatment. The same trend was observed in the yield contributing characters of groundnut. The untreated treatment produced the lowest yield (1.72 t ha^{-1}). Crude oil and protein% and micronutrient content also high in foliar treated treatments. The highest content of Mn, Fe, Zn and B was found in T_3 treatment (0.04% foliar applied Mn). Foliar application of manganese is an effective technology for increasing the yield and quality of groundnut.

Determination of critical limit of zinc for Chickpea

M. Akter, S. Sultana, M.B. Banu and H.M. Naser

A pot experiment was conducted to determine the critical limit of zinc for chickpea cultivation at the net house of Soil Science Division of Bangladesh Agricultural Research Institute, Gazipur during Rabi season of 2021-2022 grown in twenty soils collected from the five AEZs such as Tista Meander Floodplain (AEZ-3), Karatoya –Bangali Floodplain (AEZ-4), High Ganges River Floodplain ($AEZ^{-1}1$), Low Ganges River Floodplain ($AEZ^{-1}2$) and Madhupur Tract (AEZ-28). The experiment was laid out in a factorial and completely randomized design with two levels of Zn (0 and 5 ppm) applied to 20 different soil samples using three replications. The available Zn content of soils was estimated by the extraction method as 0.005 M Diethylene Triamine Pentaacetic Acid (DTPA). The amount of DTPA extractable Zn in different soils ranged from 0.50–3.1 mg kg^{-1}. The soils contained pH 4.27-7.57 and organic matter $0.67^{-1}.87$ %. The soil available Zn was negatively and significantly correlated with soil pH, Ca and Mg. However, the point below which chickpea shows Zn deficiency were 0.63 mg kg^{-1} in soils and 25.3 mg kg^{-1} in plant tissue as determined by Cate and Nelson's graphical procedure.

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 2021-2022. 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 and find out the boron use efficiency of mungbean. 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. Maximum seed yield was observed in T_4 treatment (1.60 t ha^{-1}) by the application of 1.5 kg B ha^{-1} as compared to the other treatment. Highest boron uptake (0.026 kg ha^{-1}), highest B use efficiency

(agronomic efficiency 280 and recovery efficiency 0.008) were found in the treatment having B at 1.5 kg ha^{-1} but highest B concentration (16.3 ppm) was found in 2 kg ha^{-1} B rate. BARI Mung 8 was performed better with application of 1.5 kg B ha^{-1} as compared to the other treatment.

Effect of foliar application of zinc in Sweet orange

M.M.H. Bhuiyan, M.A. Siddiky, M.O. Kaisar and H.M. Naser

Afield experiment was carried out to determine the efficiency of foliar application of Zn on sweet orange yield at Regional Agricultural Research Station, BARI, Cumilla in 2020-21. The experiment was laid out in Randomized Block Design (RCBD) with 4 treatments and three replications. Observations were recorded on the growth and yield parameters of sweet orange. The treatments were Zn @ 0, 500, 1000, and 1500 mg per liter. The results revealed that there were significant variations in the growth and yield of sweet oranges due to the foliar application of zinc. The values of vegetative growth parameters like plant height, fruit length, and diameter showed a non-significant effect by treatments but canopy volume, fruit number per plant, and individual fruit weight showed significant effect by the treatments. The chemical parameters of fruit like TSS (%) also showed a non-significant effect by foliar spray. But the fruit yield was influenced by the treatments and the highest yield (12.5 kg $tree^{-1}$) was recorded with Zn @1500 mg per liter and the lowest yield was noted in the control treatment i.e. Zn @ 0 mg per liter.

Effect of boron fertilization on Lentil in Barishal region

M.R. Islam, M.R. Uddin and H.M. Naser

A field experiment was carried out at Regional Agricultural Research Station, Rahmatpur, Barishal during November 2020 to March 2021 and November 2021 to March 2022 to develop proper dose of boron fertilizer for lentil production 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,T_2: 1.5 kg B/ha, T_3: 2.0 kg B/ha, 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, pods weight /plant, pod yield/ plant, stover yield, as well as seed yield of BARI Masur-8. The highest seed yield (1960 kg ha^{-1}) was observed in T_2 ($B_{1.5}$) treatment in 2020-2021 which was statistically identical to all other treatments except control and T_4 ($B_{2.5}$) treatment, but in 2021-2022 year, the highest seed yield (1459 kg ha^{-1}) was obtained from T_1 ($B_{1.0}$) treatment which was statistically significant with all other treatments except T_2 ($B_{1.5}$) treatment in Barishal region, (Non–calcareous Grey Floodplain Soils under AEZ 13).

Microbiological Aspects of Soil Management

Assessment of Arbuscular mycorrhizal association in some fruits and field crops

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

Rhizospherie soils including fine roots of some field crops were collected from Pabna region during 2021-2022 for counting Arbuscular Mycorrhiza (AM) spore population and determining colonization (%) in their roots. The spore numbers of 100-gram rhizosphere soil were recorded ranging from 74.60 (Black cumin) to a maximum of 192.0 (Linseed). A considerable variation was observed in average spore numbers recorded in different field crops. Among the field crops, the highest root colonization (50.0%) was found in potato and linseed and lower colonization (10.0%) was found in some of the crops like cabbage, lentil, garlic etc.

Collection, isolation and screening of indigenous rhizobial strains for different legumes

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

Nodules were collected from different legume crops grown under different locations in Bangladesh during 2022-2022. Eight legume crops namely grasspea, lentil, chickpea, mungbean, gardenpea, groundnut, soybean, and cowpea were selected for collecting nodules from different locations. Grasspea from five, lentil from eight, chickpea from seven, mungbean from one, gardenpea from two, groundnut from three, soybean from four and cowpea from three locations. Culture and sub-culture were done and preserved in the laboratory.

Study on microbial population status in rhizosphere soils of different crops of some AEZs of Bangladesh

M.E. Ali, M.F.A. Anik, 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, Free living 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 (6.6×10^9 g^{-1} soil) was recorded in the rhizosphere soils of cabbage and the lowest number of total bacterial colony (1.0×10^7 g^{-1} soil) was observed in the the rhizosphere soils of bitter gourd and bottle gourd. The highest Rhizobium (9.2×10^8 g^{-1} soil) was found in the rhizosphere soils of Wheat and the lowest population (6.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Chilli. A free living bacterium was grown in N free media and colonies were counted. The highest free-living bacterial population (5.4×10^9 g^{-1} soil) was found in the rhizosphere soils of Bean and the lowest population (1.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Wheat and onion. Phosphate solubilizing bacteria was grown in Pikovskaya's media and PSB colonies were counted. The highest PSB population (1.6×10^9 g^{-1} soil) was found in the rhizosphere soils of Tobacco and the lowest population (1.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Cauliflower. Actinomycetes were grown in Actinimycetes agar media and colonies were counted. The highest Actinomycetes population (8.0×10^7 g^{-1} soil) was found in the rhizosphere soils of Bean and the lowest population (1.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Tobacco. Fungus was grown in PDA media and colonies were counted. The highest fungal colonies (5.3×10^8 g^{-1} soil) was found in the rhizosphere soils of Tobacco and the lowest population (2.0×10^5 g^{-1} soil) was observed in the rhizosphere soils of Sugarcane and Sunflower.

Effect of Azotobacter on the growth and yield of Chilli

M.E. Ali, M.F.A. Anik and H.M. Naser

The experiment was carried out during Robi season of 2021 - 2022 in 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 Chilli. The experiment was designed in RCBD with 6 treatments and 4 replications. Chilli (BARI morich-2) 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 cfu g^{-1} inoculant. There were six treatments viz. T_1: 100% N of Recommended Dose, T_2: 90% N + Azotobacter inoculum, T_3: 80% N + Azotobacter inoculum, T_4: 70% N + Azotobacter inoculum, T_5: Azotobacter inoculum and T_6: Control. Results of the experiment revealed that highest fruit yield of chilli (12.52 t ha^{-1}) found in T_3 treatments which was statistically identical with T_1 (12.27 t ha^{-1}) and T_1 (12.06 t ha^{-1}) treatment. This result suggested that use of azotobacter inoculum in combination with reduced dose of N fertilizer was beneficial for chilli and onion and we could reduce 20% of nitrogenous fertilizer.

Response of Lentil varieties to elite strains of *Rhizobium*

M E Ali, F. S. Shikha, M. Yasmin and M. A. Rahman

Field experiment was conducted at research field of Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute, Jamalpur, during 2021-2022 with the objectives to study the response of Rhizobium inoculation with different varieties of BARI released lentil. Four varieties of lentil viz. BARI Masur-6, BARI Masur-7, BARI Masur-8 and BARI Masur-9 and rhizobial inoculum (Rhizobium strain $RLc^{-1}04$) were used in this experiment. Unit plot size was 4 m x 3 m. The experiment was designed in randomized complete block having 3 replications in each treatment. Each variety was tested with/without Rhizobium inoculation. Inoculated plants gave significantly higher nodule number, nodule weight, shoot weight and seed yield compared to non-inoculated plants. Among 4 varieties, BARI Masur-8 produced the highest nodule number and nodule weight. The interaction effect revealed that the highest seed yield of 1.02 t ha^{-1} was recorded by inoculated BARI Masur-8.

Validation of bio-fertilizer on different legume crops

M.E. Ali, M.S. Rahman, M.M Rahman, J.A. Mahmud, M.F.A. Anik, M. Rahman and H.M. Naser

Field experiments by Rhizobium biofertilizer were carried out during rabi 2021-2022 at Kumerkhali, Kushtia on lentil, and On farm Research Station, Sherpur on Groundnut with the objectives i) to evaluate the response of pulse and oilseed legume to Rhizobium biofertilizer under farmers' field

condition, and ii) to motivate uses of biofertilizer instead of N-fertilizer for pulse and oilseed legume cultivation. The experiment was laidout in RCBD with 4 dispersed replications. Unit plot size was 15 m × 10 m. Three fertilizer treatments viz. T_1: 22-42-20-5 kg P-K-S-Zn ha^{-1}, T_2: 22-42-20-5 kg P-K-S-Zn ha^{-1} + Rhizobium Inoculum and T_3: 50-22-42-20-5 kg N-P-K-S-Zn ha^{-1} was studied (N dose were different in respect of crops). BARI Masur-8 of lentil and BARI Chinabadam-9 of groundnut and peat based rhizobial inoculum (strain BARI RLc^{-1}04 for lentil and strain BARI RAh-803 for groundnut) @ 1.5 kg ha^{-1} were used in demonstration trial. Experimental result revealed that application of biofertilizer along with PKSZn produced higher seed yield and yield attributes of lentil at Faridpur lentil and groundnut at Jamalpur. It is evident from the experiment that application of biofertilizer instead of applying nitrogenous fertilizer can achieve the higher yield of lentil at farmers' field in Faridpur and groundnut in Jamalpur. Higher BCR was noted in T_2 treatment where *Rhizobium* plus chemical fertilizers (PKSZn) were used.

Effect of different biofertilizer on yield of Onion

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

The experiment was carried out during Rabi season of 2021-2022 in the research field of Soil Science Division, BARI, Joydebpur, Gazipur to find out the effect of different biofertilizer inoculum along with different doses of N & P fertilizer on the yield of Onion. The experiment was designed in RCBD with 9 treatments and 4 replications. Onion (BARI piaj-4) was used as a test crop. Liquid azotobacter and phosphate solubilizing bacterial (PSB) inoculum was used in this experiment. The population density of Azotobacter and PSB inoculum were more than 10^8 cell ml^{-1} liquid inoculant. Arbuscular mycorrhiza (AM) was used in the seed bed while producing seedling There were nine treatments viz. T_1 : 100% NPKSZn of RD (Recommended Dose), T_2 : 80% N + *Azotobacter inoculum*, T_3 : 80% P + *PSB inoculum*, T_4 : 50% P + *AM inoculum*, T_5 : 80% NP +*Azotobacter* + *PSB*, T_6 : 80% N+ 50% P +*Azot.*, T_7 : 50% P + *AM+PSB*, T_8 : 80% N+ 50% P + Azot. +*AM+PSB and* T_9: Control. Results of the experiment revealed that the highest bulb yield of onion (23.77 t ha^{-1}) was found in T_7 (50% P + *AM+PSB*) treatments which was statistically identical with all other treatments except control. This result suggested that use of azotobacter PSB and AM inoculum in combination with reduced dose of N and P fertilizer was beneficial for onion in the Grey Terrace soils of Gazipur (AEZ 28) and we could reduce 20% of nitrogenous and 50% of phosphatic fertilizer.

Effect of Arbuscular mycorrhizal fungi and phosphorus on Broccoli

M.E. Ali, F. Alam, M.F.A. Anik, M. Rahman and H.M. Naser

A field experiment was conducted at Central Farm, Soil Science Division, Bangladesh Agricultural Research Institute, during rabi season of 2021-2022 with the objectives to study the effect of combined use of arbuscular mycorrhizal fungi and phosphorus on growth and yield of broccoli, 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 broccoli seedlings. The treatment combinations were: T_1P_1U: 0% P × without AM, T_2P_2U: 50% P × without AM, T_3P_3U: 100% P × without AM, T_4P_1AM: 0% P × with AM, T_5P_2AM: 50% P × with AM, T_6P_3AM: 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), number of leaf ($plant^{-1}$), curd height (cm) and curd circumstances (cm) were non-significant. The plant that received AM in nursery bed produced higher curd yield than without AM in all phosphorus levels of broccoli. The highest broccoli curd yield 29.40 t ha^{-1} 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.

Effect of Arbuscular mycorrhizal fungi, biochar and vermicompost on Maize (*Zea mays*) in saline soil

M. Rahman, M.E. Ali, 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 growth

parameters, biomass, colonization, and yield characters of maize in 8 dS m^{-1} saline soil. The experiment was carried out under pot culture conditions in the net house of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur in 2022. The experiment was designed in CRD with eight treatments and four replications. The ten treatments were T_1 : Control, T_2 : Arbuscular mycorrhiza (AM), T_3 : Biochar @10 t ha^{-1}, T_4 : Vermicompost@ 3 t ha^{-1},T_5 : AM + Biochar @ 5 t ha^{-1}, T_6 : AM + Biochar @ 10 t ha^{-1}, T_7 : AM + Vermicompost @ 3 t ha^{-1}, T_8 : AM + Vermicompost @ 6 t ha^{-1}, T_9 : Biochar @ 5 t ha^{-1} + Vermicompost @ 3 t ha^{-1} and T_{10} : AM + Biochar @ 5 t ha^{-1} + Vermicompost @ 3 t ha^{-1}. The result showed that AM + Vermicompost @ 3 t ha^{-1} treatment produced the highest growth parameters, biomass, colonization, and yield characteristics of maize in 8 dS m^{-1} saline soil, and the control treatment produced the lowest growth parameters, biomass, colonization, and yield characters of maize in saline soil. It was noticed that AM + Vermicompost @ 3 t ha^{-1} treatment (T7) produced the highest kernel yield (101.25 g pot^{-1}, 91.94% higher over control) of maize which was significantly different from the rest of the treatments. Therefore, the combination mentioned above could sustain soil health, and ensure better growth and productivity in a saline environment compared to the other mixes.

Effect of Arbuscular mycorrhizal inoculation on Maize at different salinity levels

M. Rahman, M.E. Ali, M.F.A. Anik and H.M. Naser

Arbuscular mycorrhizal (AM) fungi increase host plants' tolerance to the different salinity levels. A pot experiment was carried out in the net house of Soil Science Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, in 2022. The study's objectives were to evaluate the potentiality of arbuscular mycorrhizal inoculation on the plant height, leaf number, root colonization, spore population, yield, and yield attributes of maize 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 plant height, leaf number, root colonization, spore population, yield and yield attributes decreased significantly. It was observed that 0 dSm^{-1} + AM treatment produced the highest ear weight (101.75 g pot^{-1}) and kernel yield (58.50 g pot^{-1}) of maize. In contrast, 8 dSm^{-1} treatments produced the lowest ear weight (51.75 g pot^{-1}) and kernel yield (31.25 g pot^{-1}) of maize. The study indicates that mycorrhizal inoculation could reduce the harmful effects of salinity on the host plants, thus increasing plant survival and allowing the plants growth under extreme conditions.

Effect of biofertilizer, biochar and chemical fertilizers on yield and qualitative properties of Groundnut

M. Rahman, 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 groundnut yield and qualitative properties during the rabi season of 2021-2022. The crop variety was BARI Chinabadam-8, and the Rhizobium strain was BARI RAh-229. There were nine treatments, viz. T_1: Control (non-inoculated and non-fertilized), T_2: Biochar @ 5 t ha^{-1}, T_3: Biochar @ 10 t ha^{-1}, T_4: Biochar @ 5 t ha^{-1} + IPNS based NPKS, T_5: Biochar @ 10 t ha^{-1} + IPNS based NPKS, T_6: Biochar @ 5 t ha^{-1} + *Rhizobium* + IPNS based PKS, T_7: Biochar @ 10 t ha^{-1} + *Rhizobium* + IPNS based PKS, T_8: 100% NPKS, T_9: *Rhizobium* inoculant + 100% PKS which were replicated three times. The peat-based rhizobial inoculum was used at a 1.5 kg ha^{-1} as seed inoculant. The result showed that the highest nut yield (2.42 t ha^{-1}, 49.4% higher over control) and stover yield (4.09 t ha^{-1}) were observed in T_7 (Biochar @ 10 t ha^{-1} +*Rhizobium*+IPNS based PKS) treatment which was identical with the T_6 (Biochar @ 5 t ha^{-1} +*Rhizobium*+IPNS based PKS) treatment having nut yield and stover yield 2.40 t ha^{-1}(48.2% higher over control) and 3.81 t ha^{-1}, respectively. So, we can 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 Grasspea varieties

M.F.A. Anik, M.E. Ali, M. Rahman and H.M. Naser

A field experiment was conducted at central farm of Bangladesh Agricultural Research Institute (AEZ-28) during rabi season 2021-2022 to evaluate the effects of biofertilizer and chemical fertilizer on soil microbial population status, nodulation pattern, nodule initiation date and yield of grasspea 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% PKSZnB, *Rhizobium* + 100% PKSZnB, 100% NPKSZnB and three varieties were BARI khesari-3, BARI khesari-5 and BARI khesari-6. Unit plot size was 3 m x 2 m. There were 9 treatment combinations. Basic doses of fertilizers were $15^{-1}1$-20-7^{-1-1} 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 $RLs^{-1}0$) @ 1.5 kg ha^{-1} was used for seed inoculation. Peat based rhizobial inoculum was used containing about 10^8 cells g^{-1} inoculum. From the investigated study, BARI khesari-5 has the greater ability to produce maximum number of nodule than all other varieties. In this experiment we found that grasspea varieties required $16^{-1}7$ days for their first nodulation. The nodulation pattern trend was BARI khesari-5> BARI khesari-6> BARI khesari-3 at Gazipur during 2021-2022. 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 73 days of grasspea seeds sowing specially at BARI khesari-5 varieties. 100% NPKSZnB and *Rhizobium* + 100% PKSZnB treated plot performed better than 100% PKSZnB treated plot. In respect of variety, BARI khesari-5 gave better results than others. Combined effects of fertilizer doses and varieties, *Rhizobium* + 100% PKSZnB with BARI khesari-5 and 100% NPKSZnB with BARI khesari-6 significantly gave the highest straw yield and seed yield at Gazipur. In case of microbial population status, *Rhizobium* + 100%PKSZnB treated plot showed the maximum number of populations in Gazipur during 2021-2022. *Rhizobium* + 100% PKSZnB and 100% NPKSZnB with BARI kheasri-5 and BARI khesari-6 showed the maximum nutrient uptake from soil. All the nutrients during grasspea production exhibited the negative apparent nutrient balances at Gazipur during 2021-2022.

Isolation of Phosphate Solubilizing Bacteria (PSB) and their efficacy on the growth of Barley

M.F.A. Anik, M.E. Ali, M. Rahman and H.M. Naser

A pot experiment was conducted during rabi season 2021-2022 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. T_1= Control, T_2= PSB isolate I (AEZ-29), T_3= PSB isolate II (AEZ-03), T_4= PSB isolate III ($AEZ^{-1}1$) and T_5= PSB isolate IV (AEZ-09). The four isolated PSB strains containing about 10^8cells g^{-1} inoculum. Among five different treatment combinations, T_4 (PSB isolate III, $AEZ^{-1}1$) performed better than others. The germination percentage (97.16%) and seedling vigor index (3588) exhibited the better results significantly in T_4 treatment. In different growth parameters of barley like plant height (75.94 cm), root length (21.53 cm), root weight (397.52 mg), no. of tiller per hill (2.30), no. of spikes per hill (2.13), no. of kernel per spike (45.83), spike length (15.40 cm) and no. of filled kernel per spike (41.03) also showed the superior results in the same treatment. The PSB isolate III, $AEZ^{-1}1$ (T_4) revealed the maximum 1000-kernel weight (33.75 gm), seed yield per 10 plants (33.88 gm) and straw yield per 10 plants (54.99 gm), respectively. In respect of nutrient content, the seed and straw of barley showed the maximum amount of N (2.43 and 1.42%), P (0.69 and 0.51%), K (0.91 and 2.48%) content in the T_4 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 (3.0×10^5 per gm soil) was also produced in the T_4 treatment. The worst performance was recorded in the T_1 (Control) treatment in case of all parameters of barley production.

ENTOMOLOGY

Integrated pest management

Field evaluation of some new bio-pesticides against fall armyworm attacking maize

N. K. Dutta, M. A. Sarkar, K. Begum and A. K. M. R. H. Ferdous

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: T_1: *Celastrus angulatus* 1% EW (Bio-Chamak) @ 2.5 ml/ litre of water; T_2: *Bacillus thuringiensis* var. Kurstaki (Bio-Bt-K) @ 1 g/litre of water; T_3: *Metarhizium anisopliae* (Lycomax) @ 1 g/litre of water; T_4: Azadirachtin 0.03% (Nimbicidine) @ 4 ml/litre of water; T_5: Bt+Spinosad (Minchu Plus) @ 2 ml/ litre of water, and T_6: 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

M.A. Sarkar, N.K. Dutta, A.K.M.R.H. Ferdous, K. Begum and D. Sarker

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: T_1 = 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, T_2 = 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, T_3 = 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, T_4= 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 T_5= 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

M.A. Sarkar, N.K. Dutta, K. Begum, A.K.M.R.H. Ferdous and D. Sarkar

The experiment was conducted at BARI, Gazipur, during rabi 2020-21 to evaluate different IPM

packages against pod borer infesting chickpea. The packages were: T_1 = Pheromone mass trapping + Spraying of spinosad 2.5 SC (1.2ml/ litre of water); T_2 = Pheromone mass trapping + Spraying of Minchu plus (Bt-Kurstaki + spinosad) @ 2.0 ml/litre of water; T_3 = Pheromone mass trapping + Spraying of Bio-chamak 1% EW (*Celastrus angulatus*) @ 2.5ml/ litre of water; T_4 = Farmers' practice: Spraying of Nitro 505 EC (cypermethrin + chlorpyriphos) @ 2 ml/litre of water, and T_5= 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

M.A. Sarkar, K. Begum, A.K.M.R.H. Ferdous and N.K. Dutta

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: T_1 = *Verticillum lecani* (Bio Catch 1.15% WP) @ 6.0 g/L of water; T_2 = *Metarhizium anisopliae* (Bio Magic 1.15% WP) @ 6.0 g/L of water; T_3 = *Beauveria bassiana* (Bio Power) @ 6.0g/L of water; T_4 = *Bacillus thuringiensis* var. Kurstaki (Bio Fighter) @ 2.5g/ L of water; T_5 = *Bacillus thuringiensis* var. Kurstaki (Biocure) @ 1.0g/L of water; T_6 = *Metarhizium anisopliae* (Lycomax 2.0% WP) @ 1.0 gl/L of water; T_7 = *Beauveria bassiana* from Russle IPM @ 1.0 g/L of water; T_8 = Afidopyropen 5% (Sefina 5 DC) @ 2ml/l of water; T_9= Farmers' practice: spraying with thiamethoxam (Actara 25 WG @ 0.2g/L of water) & T_{10}=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

N.K. Dutta, M. A. Sarkar, K. Begum, A.K.M.R.H. Ferdous and A.K.M.Z. Rahman

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:T_1= Spraying Bio-chamak 1% EW (*Celastrus angulatus*) @ 2.5 ml/litre of water; T_2= Spraying Biomax M 1.2 EC (Abamectin) @ 1 ml/ litre of water ;T_3= Spraying Fizimite (10% Sodium lauryl ether sulfate) @1 ml/ litre of water;T_4= Spraying Bioclean (D- limonene) @ 1 ml/ litre of water;T_5= Spraying Imitaf 20 SL (Imidacloprid) @ 0.5 ml/ litre of water;T_6= 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

N.K. Dutta, M.A. Sarkar, A.K.M.R.H. Ferdous, K. Begum and M. Afroze

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: T_1= 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;T_2=

Package (2): Sanitation + 4 sprays of bio-pesticide Antario (Bt+ Abamectin) @ 1g/ litre of water at fortnightly interval;T_3= Package (3): Sanitation + 4 sprays of bio-pesticide Biocure (*Bacillus thuringiensis*) @ 1g/ litre of water at fortnightly interval;T_4= Package (4): Sanitation + 4 sprays of bio-pesticide Biotrin (Matrine) @ 1.5 ml/ litre of water at fortnightly interval;T_5= 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; T_6= 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

M. K. Uddin and N. K. Dutta

Field experiments were conducted for developing management approach against fruit borer, *Deudorix isocrates* attacking wood apple at experimental field Horticuture Fruit Research Station, BARI, Gazipur, and Breeder Seed Production Centre, Debigonj, 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: T_1= Sanitation+ polythene bagging when the fruits were at marble stage, T_2= Sanitation + bio-pesticide Minchu plus (Bt+Spinosad) @ 2 ml/ litre of water, T_3= Sanitation +spraying of Spinosad (Success 2.5SC) @ 1.2 ml/L of water, T_4= Sanitation +spraying of Azadirachtin (Fytomax 3 EC) @ 1.0 ml/litre of water, T_5= Spraying of Emamectin benzoate (Proclaim 5SG) @ 1.0 g/litre of water, T_6= 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

A.K.M. Z. Rahman, N.K. Dutta, M.K. Uddin and D. Sarker

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: T_1= Spraying of Bioclean @1.0 ml/L of water; T_2= Spraying of Fizimite @ 1.0 ml/L of water; T_3= Spraying of Biotrin @ 1.5 ml/L of water; T_4= Spraying of Fytoclean 7.5 ml/L of water; T_5= Spraying of Bio-chamak @ 2.5 ml/L of water;T_6= Spraying of Fytomax @ 1 ml/L of water; T_7= Spraying of Confidor 70 WG @ 0.2 g/L of water; T_8= 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

K. Begum, M. A. Sarker, M. K. Uddin and N.K. Dutta

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 m^2 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

K. Begum, M. A. Sarker and N.K. Dutta

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 8.67days.

Pesticide Toxicology

Study on residue degradation of newly registered along with some commonly used insecticides in selected vegetables under supervised field trial

M. S. Ahmed, Afroza Begum, M. D. H. Prodhan, Merina Afroze and N. K. Dutta

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

M. S. Ahmed, M. D. H. Prodhan, Afroza Begum, Marina Afroze and N. K. Dutta

The study was conducted to detect and quantify the left over residue of four commonly used pesticides (lambdacyhalothrin, 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), lambdacyhalothrin (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

M.D.H. Prodhan, Marina Afroze, Afroza Begum, M.S. Ahmed and N. K. Dutta

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

M.D.H. Prodhan, Marina Afroze, Afroza Begum, M.S. Ahmed and N. K. Dutta

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

M.D.H. Prodhan, Marina Afroze, Afroza Begum, M.S. Ahmed and N. K. Dutta

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 actamiprid 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

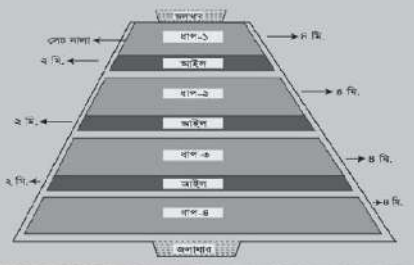
Afroza Begum, M. S Ahmed, M.D.H. Prodhan, Marina Afroze and N. K. Dutta

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

Marina Afroze, M. D. H. Prodhan, Afroza Begum, M.S. Ahmed and N. K. Dutta

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%% ≥ 80% AI, one brands contained 65% AI, one brands contained only 5% AI while two brands found without any AI.



HILL AGRICULTURE

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Varietal Development Activities

Jackfruit: Ten jackfruit germplasm were evaluated at the fruit farm of HARS, Khagrachari during the year 2021-2022 with the objective to identify superior small sized jackfruit germplasm with high yield potentiality and edible qualities. Yield and yield components of the jackfruit germplasm were studied. Number of fruits per plant ranged from 59 to102. 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. TSS (%) content of the fruits varied from 16 to 24.5% where AH Kha-007 produced the highest TSS (%) (24.5 %). The highest fruit yield (Kg/plant) was found in AH Kha-006 (387.6 Kg/plant). The edible portion varied from 36.65% to 52.67% where AH Kha-005 showed the highest (52.67 %) edible portion.

Mango: An experiment was conducted for the evaluation of Kanchamitha mango germplasm (MI Kha 001) at Hill Agricultural Research Station, Khagrachari during 2021-2022. The full blooming period was of January. The tree habit was spreading to intermediate type. Harvesting period was 14 to 19 May, 2022. Total Soluble Solids (TSS) (%)was recorded 100%. Edible portion was found (78.12%). Overall growth conditions of the germplasm were found satisfactory. Considering the fruit characters and edible quality MI Kha 001 would be considered as a promising mango variety as unripe condition.

Ber : A study was conducted at Hill Agricultural Research Station in Khagrachari hill district with thirty one local ber genotypes during 2017 to March 2022. Average individual fruit weight ranged from 6 g to 18 g. The genotype ZM Kha 013 produced the highest individual fruit weight (18g) and lowest in ZM Kha 021 (6g). Fruit weight of different ber genotypes ranged from 66-178g. The genotype ZM Kha 023 produced the highest fruit weight (178 g) and lowest in ZM Kha 021 (6 g). Edible portion (%) ranged from 64.89% (ZM Kha 005) to 79.85% (ZM Kha 023). TSS (%) of ber genotypes varied from 16.8% respectively ZM Kha 008 and 26.0% ZM Kha 026.

Sweet orange: 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 ranges from February to March. Harvesting time was late November-December in case of CS Kha-001. All the germplasm produced profuse fruits. No. of fruits per plants was the highest (220 no.) in BARI Malta-1 while the lowest (135 no.) was in CS Kha-002. Individual fruit weight was also varying from 135.33-165.67g. The biggest (165.67g) fruit were recorded in CS Kha 002 and the smallest (135.33g) was observed in BARI Malta-1. Weight of fruits per plant was the highest (27.53 kg) in BARI Malta-1while in case of CS Kha-001 it produces yield of 29.98 kg/plant and the lowest (22.67 kg/plant) was 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.

Pummelo: The study was conducted at the Hill Agricultural Research Station, BARI, Khagrachari during the year 2017-2018, 2018-2019, 2019-2020, 2020-2021&2021-2022. One off-season pummel germplasm (CG Kha 001) was selected for the evaluation along with a normal season (control). Mainly year round bearing occurred in that germplasm. Maximum numbers of mature (37) and

immature (62) fruits were found in the month of October and June respectively. Average fruit weight was 1.50 kg. The maximum edible portion was obtained (40.73%) and the highest TSS (100%) (10.8%). The average number of fruits per month (19.58) 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.

Coffee: The experiment was carried out at the existing plantation of Hill Agricultural Research Station at Khagrachari during 2019-20 to identify high yield potentiality and better quality coffee beans. 20 (twenty) genotype of Coffea canephora (syn. Coffea robusta) commonly known as robusta coffee from the existing coffee orchard of HARS. The average height of evaluated line (CC Kha 001) was medium (4.27 m) and regular bearing evergreen shrub or small tree. The average length and width of leaf was 21.72 cm and 9.99 cm respectively with average 1.22 cm of leaf petiole length. The average length and width of individual fruit was 1.36cm and 1.19 cm respectively. Harvesting duration of fruit was mid January to March. The seed colour of evaluated coffee plant (CC Kha 001) was greenish brown with roundish shape. The average length and width of individual seed was 1.11cm and 0.97 cm respectively.

French bean: The experiment was conducted at Hill Agricultural Research Station, Khagrachari, hill District during 2021-22 to find out the suitable french bean lines to release as a variety. Here BARI Jharsheem-2 used as check variety. Of these, 50% flowering ranged from 44-54 days, the ranged of plant height 31.8-292.5 cm, pod length13.2-16.6 cm, pod weight 0.91-1.50g, Green pod per plant 1160.7-2465.7, pod yield (t/ha) 11.14-16.4kg. The highest individual pod weight (15.2 g) was found in PVRai001 followed by PVRai003 (8.4 g) and the lowest (6.8 g) was found in PVRai003.

Turmeric: 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 statisticaly 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 identical 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 identical to CL Kha 006, CL Kha 002 possessed the highest finger breadth (2.73 cm) which was statistically identical 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 the highest (430.83 g) in CL Kha 002.

Adaptive trial

Demonstration of hybrid maize-pea intercropping: A field experiment was conducted at farmer's field of hill valleys in Khagrachori during the Rabi season; 2021-2022 to evaluate the potentiality of BARI developed intercrop technologies. Four developed intercrop technologies were evaluated against sole hybrid maize. There treatments were viz. T_1: Hybrid maize +3 rows pea T_2: Hybrid Maize normal row+ 2 rows pea T_3=Hybrid maize + single row pea. T_4=Sole Hybrid maize. Yield of hybrid maize was not reduced significantly but considerable yield of companion crops were realized in intercrop situation. Among intercrop technologies, two rows pea + hybrid maize was the best in terms of maize equivalent yield (15.57 t/ha) followed by hybrid maize + 3 rows pea. Similar trend was observed in case of gross return and gross margin. The results revealed that all the intercrop technologies are suitable for farmers' field. Among those 2 rows pea + hybrid maize ranks first and hybrid maize + 3 rows pea ranks second over sole crops.

Intercropping of Chili with Maize: An intercropping experiment was conducted at farmers' field at hill valleys in Khagrachori during the Rabi season, 2021-2022 to verify the potentiality of hybrid maize-chili intercropping system. Two treatments *viz*., T_1: (Improved practice) Maize + one row chili and T_2: (Farmers practice) Sole Maize were used for the experiment. Grain yield of hybrid maize reduced in intercropping systems but the reduction was not significant. But the highest maize equivalent yield (12.97 t/ha), gross return (Tk 262000/ha) and benefit cost ratio (2.91) were recorded in maize + 1 row chili planting system. The results revealed that intercropping system is suitable

and profitable for the farmers' field of hill valleys in Khagrachori.

Maize based intercropping technologies: 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 Khagrachori during the rabi season, 2021-2022. Two treatments viz., T_1: Sole Maize and T_2: 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, gross return and benefit cost ratio (BCR) over sole crops.

Characterization of mustard: This experiment was conducted at the hill valley of Hill Agricultural Research Station, Khagrachari. Quantitative characters showed variation in days to 50% flowering ranged from 38 to 56 days, pod formation ranged from 45 to 61 days, harvesting ranged from 81 to 97 days. Accession BD-7105 showed first flowering and BD-7809 & BD-9292 were late flowering behavior. Accession BD-7125 showed maximum plant height 170.4 cm. The seed of all accessions will store in cold storage of PGRC at Gazipur for further evaluation.

Research Report on Fruit Crops

Performance of BARI developed mango varieties in Chattogram hill tracts

S. P. Chakma, M. Islam, N.U. Ahmed and M. A. Hossain

An experiment was conducted with nine BARI developed mango varieties such as BARI Aam-1, BARI Aam-2, BARI Aam-3, BARI Aam-4, BARI Aam-5, BARI Aam-6, BARI Aam-7, BARI Aam-8 and BARI Aam-9 at hill valley of Hill Agricultural Research Station in Raikhali, Rangamati Hill District during 2021-22 on the existing thirteen years old mango orchard with an objective to verify their performance. The performance of BARI Aam-3 was better compared to other varieties in terms of number of fruits per plant (424), TSS (23%) and yield (18.3 t/ha) followed by BARI Aam-8. BARI Aam-2 were found better as early variety.

Evaluation of mango germplasm for green consumption at hill valley in Chattogram hill tracts

S.P. Chakma, M. Islam, N.U. Ahmed and M. A. Hossain

An experiment was conducted at hill valley of Hill Agricultural Research Station of Raikhali, Rangamati Hill District during 2021-22 to find out the best green mango germplasm. The highest number of fruits per plant (186) was found in MI Rai-008 and the lowest number of fruits per plant (4) was in MI Rai-009. The heaviest individual fruit weight (207 g) with edible portion (78%) were recorded in MIR008 on the other hand lowest fruit weight (111 g) was found in MIR007. The maximum TSS (9%) was found in germplasm MIR006 and MI Rai-008. Germplasm MIR006 and MI Rai-006 were found excellent in organoleptic test.

Evaluation of dragon fruit germplasm in Rangamati hilly area

S.P. Chakma, M. Islam, M.E. Hoque, N.U. Ahmed and M. A. Hossain

An experiment with two germplasm of dragon fruits collected from different parts of the country were conducted at seven years old dragon fruit orchard of Hill Agricultural Research Station, Raikhali, Rangamati. The performance of BARI dragon fruit-1 was better compared to HU Rai-001 and HU Rai-002 in terms of individual fruit weight (344 g), TSS (%) (13) and yield (33 t/ha).

Evaluation of dwarf coconut in hilly area of Rangamati

S.P. Chakma, M. Islam, M.E. Hoque, N.U. Ahmed and M. A. Hossain

An experiment on the evaluation of dwarf coconut in hill valley was conducted at the fruit orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill district during 2021-22. The average plant height was recorded 594 cm and 671 cm in Vietnam Xiem Blue and Kerala hybrid, respectively, after five years of plantation. The vegetative growth rate higher in Kerala hybrid coconut than Vietnam Xiem Blue coconut. Both lines started fruiting but dropped down at baseball size.

Evaluation of eggfruit in hilly area

S.P. Chakma, M. Islam, M.E. Hoque, N.U. Ahmed and M. A. Hossain

An experiment on the evaluation of eggfruit or tiesa in hill valley was conducted at Hill

Agricultural Research Station, Raikhali, Rangamati Hill district during 2021-22. Based on maximum number of fruits per plant (150), individual fruit weight (182 g), fruit size (8 cm x 6.6 cm), pulp thickness (1.5 cm), edible portion (80%) and yield (27 kg/plant), PC Rai-001 found as superior line.

Evaluation of jabuticaba in hilly area

S.P. Chakma, M. Islam, M.E. Hoque, N.U. Ahmed and M. A. Hossain

An experiment on the evaluation of jabuticaba in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill district during 2021-22. The maximum individual fruit weight (8.3 g), fruit size (26 mm x 25 mm) and yield (14 kg/plant) were observed in PC Rai-005 which had a good taste and TSS (%) (15).

Collection and evaluation of coffee germplasm

S.P. Chakma, S. Marma, M. Islam, M.E. Hoque, N.U. Ahmed 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 2021-22. Maximum plant height (180 cm), base girth (13 cm), canopy size (170 cm x 160 cm) and leaf size (16 cm x 8 cm) were observed in CC Rai-001. The lowest plant height (110 cm), base girth (8 cm), canopy size (120 cm x 100 cm), and leaf size (10 cm x 4 cm) was found in CA Rai-002.

Collection and evaluation of cashew germplasm

S.P. Chakma, S. Marma, M. Islam, M.E. Hoque, N.U. Ahmed and M. A. Hossain

An experiment on the evaluation of cashewnut in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill district during 2021-22. The exotic germplasms showed the superiority over local germplasms among all the growth parameters and cashew nut characters.

Collection and evaluation of avocado germplasm

S.P. Chakma, M. Islam , N.U. Ahmed 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 2021-22. PA Rai-008 had two fruit set to maturity.

Evaluation of star apple germplasm

S.P. Chakma, M. Islam, M.E. Hoque, N.U. Ahmed and M. A. Hossain

An experiment on the evaluation of star apple in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill district during 2021-22. The maximum plant height (240 cm) was recorded in PA Rai-004 germplasm, base girth (22 cm) in PA Rai-003 germplasm and canopy (246 × 250 cm2) was found in PA Rai-004 germplasm. Time of flowering was same for all the genotypes and it was the month of February but no fruit set was occurred.

Baseline study on cashew nut production processing and marketing in Bandarban hill district

M. Jamal Uddin, M. T. Islam, Fahim Arshad. M.A. Hossain and Z. A. Firoz

The study was carried out in 17 paras/villages under four Upazilas in Bandarban hill district with view to document current status of cashew nut production processing and marketing covering 105 samples household for data collection. Multi-stage sampling technique was followed for selecting the specific locations. Results revealed that farmers used less inputs particularly fertilizer during whole production period. The yield was obtained at 0.425 tons/ha irrespective of all locations which are lower than that of global average of cashew nut production (0.750 ton/ha). The gross margin was calculated at Tk.1,48,76.36/ha. The BCR was found to be 2.03 irrespective of all locations indicating that the cashew nut production is profitable. Productivity will increase if the improved production technologies can be adopted and common diseases and pests are controlled. Cultivating more productive varieties in new places the production will be increased manifold. Resulting export opportunities will be increased. Simultaneously, the number of processing factories needs to be increased locally in line with the increase in production. Currently, farmers need hands on training on improved production technologies, post-harvest management, storing and marketing facilities for ensuring fair prices of their produces.

Research report on vegetable corps

Regional yield trial of french bean lines

M. Islam, M.E. Hoque, N.U. Ahmed and M. A. Hossain

An experiment for regional yield trial on french bean lines was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill district during 2021-22 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 40-51 days after sowing, plant height 51-156 cm, pod length 12.24-18.54 cm, pod width 0.73-1.45 cm, green pod per plant 1250-2000, pod yield (t/ha) 10.74-14.6 t/ha. The highest individual pod weight (11.98 g) was found in PV Rai-001 followed by PV Rai-004 (8.1 g) and lowest (6.24 g) was found in BARI Jharsheem-2 (check variety).

Evaluation of exotic cherry tomato germplasm

M. Islam, M.E. Hoque, N.U. Ahmed and M. A. Hossain

The experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill district during 2021-22 with six cherry tomato germplasms to find out the suitable cherry tomato lines to develop as a variety. The earlies flowering (52 DAT), earliest harvest (72 DAT), maximum number of fruits (193.75), pericarp thickness (3.66 cm), Number of fruit/truss (14.56), harvest duration (58 days), yield per plant (2.05 kg) and estimated yield (61.71 t/ha) were observed in SL Rai-002. The average fruit weight was 10.56 g, TSS (%) (5.13) and red in color. This line was superior than other lines based on all the characters.

AGRICULTURAL STATISTICS AND ICT

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Assessment of cropping patterns for sustainable intensification in drought prone ecosystem using remote sensing and geospatial modeling

Suman Biswas, Md Golam Mahboob, Afm Tariqul Islam, Shakhawat Hossain, Md. Hasnain Ahmed, Md. Hasan Rashid

Bangladesh Government has given high priority to sustaining groundwater use for irrigation. Hence, it is 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 modeling can play a vital role to assess cropping patterns and availability of natural resources on the ground and allocate them judiciary for SI in agriculture. Geospatial modeling can help allocate an appropriate cropping pattern based on the best judicial use of available natural resources. Hence, in order to facilitate sustainable cropping intensification in the 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 (2021-22), an extensive survey (6^{th}) was conducted for collecting necessary ground data from the study area. These reference data were pre-processed in the GIS domain and split into 70:30 ratios to train and validate the algorithms for crop type mapping. A crop inventory for the entire Barind Tract region was prepared in previous years according to the methodological framework. Six major crop types, predominant in the area, were chosen for delineation from satellite image classification namely: maize, lentil, mustard, potato, Boro rice, and wheat. A total of 45 sentinel-2A images were available in Google Earth Engine during the dry months (Oct-Mar) of the 2020-21 cropping season. Although the cloud was masked out, these images were filtered to ensure cloud percent was less than or equal to 20 percent. After resampling all the bands into 10 meters, visible, NIR, Red edge, and short-wave IR bands were used to classify crop types along with two vegetation indices NDVI and EVI. Seasonal composite (Oct-Mar) of these bands and indices were derived in GEE based on median statistics. Three machine learning algorithms (Random Forest, CART, and Support Vector Machine) along with different band combinations were experimented with during this reporting period to improve the classification algorithm. Among several experimental trials, Random Forest with scheme 5 band combinations was found to be the best model to classify the crop type of the study area. The classification result showed that rice occupied a maximum area coverage of 22253.46 ha (45.17%) followed by others (14107.45 ha), potato (4588.745 ha), wheat (3326.96 ha), lentil (2535.75 ha), maize (42296.02 ha) and mustard (159.63 ha) accordingly. With respect to the reference data, the overall accuracy and Kappa coefficient of the classified map were found around 86% and 0.81 indicating satisfactory results. The F1 score for all crop types was also satisfactory in RF and scheme 5. Area coverage of the classified crop type map was also compared to the DAE area dataset for the 2020-21 cropping season. The area covered by rice and wheat was relatively better than other classified crop fields. 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, topsoil 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, the digitized land use land cover map of the study area is under development.

Genome-wide analysis of DCL, AGO, and RDR gene families in brassica species (*Brassica rapa* L.) using integrated bioinformatics approaches

Zobaer Akond, Hafizur Rahaman, Monirul Hasan Tipu, Sheikh Hasna Habib, Nurul Haque Mollah

Dicer-Like (DCL), Argonaute (AGO), and RNA-dependent RNA polymerase (RDR) are known as

three major gene families that act as the critical components of RNA interference or gene silencing mechanisms through the non-coding small RNA molecules (miRNA and siRNA) to regulate the expressions of protein-coding genes in eukaryotic organisms. These genes regulate gene expression against different biotic and abiotic stressors during plant growth and development. However, most of their characteristics including evolutionary relationship, domain structures, chromosomal location, functional pathways, subcellular location, 3D protein structures, non-synonymous and synonymous mutation ratio (Ka/Ks) were not rigorously studied. Our analysis identified 4 *BrDCL*, 13 *BrAGO*, and 6 *BrRDR* genes as RNA interference (RNAi) genes from the *Brassica rapa* genome. Phylogenetic analysis of predicted RNAi proteins with the RNAi proteins of *Arabidopsis* showed that the predicted proteins BrDCL, BrAGO, and BrRDR are clustered into four, eight, and five subgroups, respectively. Domain, 3D protein structure analyses showed that these proteins conserve identical characteristics within groups and maintain differences between groups. Non-synonymous/synonymous mutation ratio (Ka/Ks) <1 suggested that these protein sequences conserve some purifying functions. GO analysis implied that several potential biological processes, molecular functions, and pathways are linked to the RNAi mechanisms. Overall results would therefore provide an excellent basis for in-depth molecular investigation of these genes and their regulatory elements for rapeseed-mustard crop improvement against different stressors.

Data science and analytic technology in agricultural production of Bangladesh

Istiak Ahmed, Suman Biswas, Kazi Saidur Rahman, Md. Abdul Monayem Miah

To help policymakers make decisions, this data science and analytic system for agriculture has provided them with a wealth of data and information. As an additional benefit, it can help boost the yield of plants by analyzing environmental conditions (parameters) and so providing clients with relevant information (farmers). In this study, there are several drawbacks. To begin with, clustering did not make use of many parameters. This is due to a lack of data. This study's goal was to gather relevant information about a potato variety released by BARI. Experimentation has revealed that most of the cultivars were published after 2011, with the greatest number of cultivars being released in 2014. In terms of yield, most of the varieties released in the same year are quite normal. The release of just a single variety isn't uncommon. Those years will not be included in this analysis. Most varieties released prior to 2012 are low-yielding, whereas high-yielding cultivars are beginning to be developed in 2012. The high-yielding cultivar, on the other hand, is released irregularly. BARI Potato-74, which was produced in 2017, is among the low-yielding varieties that have been released since 2011. In order to improve crop yields, a trustworthy system must be created that makes use of historical data for analysis and provides more precise results. As a result of this system's clustering, data and analyses are compared and analyzed, including the number of seed, the method of watering, and the type of seed.

Potato yield forecasting using satellite images and crop simulation model under changing climate

Istiak Ahmed, Suman Biswas, AFM Tariqul Islam, Md. Golam Mahboob, Apurba Kanti Choudhury, Md. Abdul Monayem Miah

The Munshiganj District of Bangladesh is well-known for its potato dominance, and this study attempted to evaluate the early yield estimating capacity of remote sensing data for potato crop there. At first, the reflectance is low, but it steadily rises over time. The reflectivity is at its highest point on February 20. Afterwards, it began to decline. The EVI, like the NDVI, follows a similar pattern. Root Mean Square Error (RMSE) is the best model for the minimum, maximum, and standard deviation statistics, SVM (RMSE). In addition, the standard deviation is the best statistic because the RMSE of all models is low compared to the lowest and maximum statistic. The second-place statistic is the maximum statistic, followed by the lowest.

Development and implementation of BARI pension management System

K.S. Rahman, M. S. A. Mridha, I. Ahmed, S. Biswas

The Research titled "Development and implementation of BARI pension management System" is Pension management software for monitoring and controlling Pension at BARI. This Pension Management System software was developed using MySQL database which mainly focuses on basic operations in Pension. This software is a windows-based application for 32-bit windows operating systems, designed to help users maintain and organize employee. This software has been designed to use for both beginners and advanced users.

Training & Communication Wing

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Training & Communication

During 2021-22, 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 all the educational institutions were check 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 Wing arranges seminars and workshops in various fields of agricultural research and related issues. A total of 12 (twelve) seminars and 08 (eight) workshops were organized at BARI during the year 2021-22 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 singed

During the period 2021-22, BARI signed 8 (eight) MoU with 8 (eight) different organizations. All the organizations under 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 activities.

Editorial & 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

A. 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 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 to -

- 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.

B. **Existing facilities:** A total of 86,323 collections are existed till 2021-2022 from the establishment of the library. Information of collected resource materials so far have been properly catalogued, classified and organized. The information on library resource materials are furnished in Table 1.

Table1. Existing collections of BARI Central Library: 86,323

Items	Quantity
Books, Reports, Proceedings, etc.	46,739
Archival collection	2,670
Thesis	893
Periodicals (bound in book form)	4,247
Journal	24,555
Newsletter	663
Bulletin	163
Pamphlets & Booklets	958
Reprint	518
Leaflets	4,917

Table 1 a. List of Books, Reports, Proceedings etc. and Thesis: 288

Items	Purchased	Exchanged	Gift / Complimentary	Total
Books	70	43	52	165
Research reports, project reports & proceedings	-	02	88	90
Thesis (MS & Ph.D)	-	-	33	33

Table 1 b. List of Journal, newsletters and bulleting published :137

Items	Purchase	Exchange	Gift / Complimentary	Total
Journals	-	34	62	96
Newsletters	-	10	12	22
Bulletins	-	-	19	19

Table 2. List of documentation service processed.

SI No.	Procured material processed	No.
01	Document Accessioned	288
02	Catalogued & Classified and pasted with call numbers, book pockets and due slips	258
	Total	**546**

Table 3. Services provided to users

Sl No.	Services provided to the Scientists	Number
1.	Documents Charged/Discharges	200
2.	Users Referenced	570
3.	Photocopies	5,515
4.	Publication Distributed (Journal, Newsletter & Report) in Exchange & Complimentary)	186
5.	Correspondence made	85

Complementary Online Journal

(https://www.research4life.org/)

AGORA

http://www.aginternetwork.org

ID: ag-bgd026

Password: GQ34ACDX

HINARI

http://www.who.int/hinari

ID: BAN053

Password: 70555

BARI Digital Library: BARI Central library has lunched "**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.

Table 4: Type of resources uploaded for BARI Digital Library during 2021-2022.

Sl. No.	Icons	Document uploaded (no.)
1.	BARI Publications	251
2.	Bengali Books	1676
3.	Reference	4816
4.	Booklet	62

Sl. No.	Icons	Document uploaded (no.)
5.	Fiction	12
6.	Center's Publication	219
7.	Divisional Publications	152
8.	Newsletter	45
9.	Report	57
10.	Journal	102
11.	Thesis – MS	335
12.	Thesis –Ph.D	408
13.	Leaflet	304
14.	Personal Publications	167
	Total	**8,606**

Photography Section

Pankaj Sikder and Naznin Akter

Photography Section of BARI is one of the big service provider in research and technology transfer events. The photography section is involve in processing photographs and video clips to ensure effective use of its parent institute and is assigned to support the researchers in print, soft images and electronic form of the important images at the right time. BARI's activities are also regularly uploaded on the official Facebook page and Photo Gallery by this section.

Major functions of photography section:

- To expose, collect, preserve and display photographs of different research activities and events held in BARI.
- To display photographs of visitors, research activities, agricultural fairs, BARI technology village activities, publications and other activities on the central display board.
- To ensure all kind of photographic equipment's information.
- Make video documentary for broadcasting technology based on the scientists demand.
- To arrange and supply the photography news of different programmes for publishing in the newspapers, magazine, journal, TV etc.
- To supply the photographs and news info to the editorial and publication section for newsletter.
- To supply the photographs and news info to the ICT for BARI Facebook and website.
- Coverage the Director General and Directors visit at different stations of BARI.

Considering the above events, a total of 40,516 activities were performed by this section during 2021-2022. Among of them 24,000 were still photograph, 16,500 were photo editing and 16 were video recording are presented in Table 41.

Table 1. Total activities of photography section during 2021-2022

Sl. No	Activities	Number
1	Photograph exposed in Digital Camera	24,000 above
2	Photo Editing	16,500 above
3	Video Recording program	16 above

Planning & Evaluation Wing

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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.

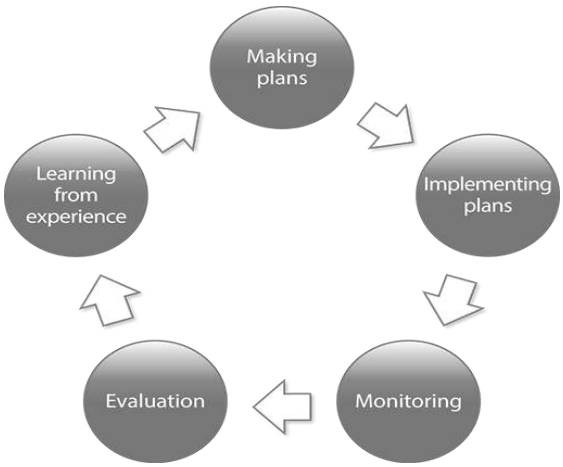


Figure: A Thematic Diagram of Planning & Evaluation Process

Evaluation is a tool or a process which implements during a program's might examine whether the program is successfully recruiting and retaining its intended participants, using training materials that meet standards for accuracy and clarity, maintaining its projected timelines, coordinating efficiently with other ongoing programs and activities, and meeting applicable legal standards. Evaluation during program implementation could be used to inform mid-course corrections to program implementation (formative evaluation) or to shed light on implementation processes (process evaluation).

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 the Wing

Planning and Evaluation Wing playing is a pivotal role for BARI. The activities of planning & evaluation wing of BARI are:

- Preparation and processing of Project Proposal (DPP/RDPP/TAPP)
- Preparation of new skim (Karmasuchi) under revenue budget.
- Preparation of monthly report (IMED-05) and quarterly report (IMED 02 and 03)
- Preparation of project director`s profile (IMED-01)
- Preparation of procurement plan (Works, goods & services), work plan of projects and their subsequent approval by the authority.
- Monitoring and evaluation of development projects including procurement status (tender related activities).
- Preparation of Project Completion Report (PCR).
- Preparation of financial and physical progress report of the project and send to the Ministry of Agriculture
- Co-ordination of Project Implementation Committee (PIC) meeting.
- Co-ordination of planning and development co-ordination committee (P&DC) meetings of BARI
- Liaison with IMED, planning commission and different ministries as and when necessary.
- Performing other activities as directed by the Director General, BARI.
- Participate in the monthly ADP review meeting in Ministry of Agriculture.
- Prepare quarterly / half yearly report according to "Annual Performance Agreement"
- Preparation of budget and report for "Sustainable Development Goals target, 2030".
- Preparation of ADP and RADP for on-going & proposed development projects.
- Preparation of monthly progress report on work plan for prime minister's office and Ministry of Agriculture.
- Preparation of monthly progress report of "Implementation of Guidelines issued by Honorable Prime Minister"
- Preparation of answers to the questions of Jatiya Sangshod (National Parliament).
- Participation in Mid-term budget framework meeting.
- Preparation of Five Year Plan (FYP).
- 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).
- Preparation of Projects for Delta Plan-2100.

Table 1. Post and Position of Planning & Evaluation Wing

Designation	Organogram	Existing
Officer		
Director	1	1
Chief Scientific Officer	1	1
Principal Scientific Officer	3	1
Senior Scientific Officer	2	2
Scientific Officer	3	2
Scientific Officer (Project)	-	1
Sub total	**10**	**8**
Staff		
Steno-Typist	1	0
UDA	1	2
Computer Operator	2	1
LDA cum Typist	4	2
MLSS	2	1
Sub total	**10**	**6**
Total:	**20**	**14**

Table 2. Development projects implemented during 2021-22

(In lakh Tk.)

Sl. No.	Name of the Projects (Implementation period)	Total Project Cost	Allocation of 2021-22	Expenditure up to June 2022 & % of allocation		Cumulative Progress upto June 2022
				Financial	Physical (%)	
1.	Strengthening of Oilseed and Pulses Research and Development in Bangladesh (April 2016 to December 2021) (1st Revised)	2702.39	276.00	276.00	100%	2681.25 (99.22%)
2.	Research, Extension and Popularize of Vegetables and Spices Cultivation on Floating Bed (1st Revised) (July 2017 to June 2022)	3913.03	616.00	616.00	100%	3224.00 (82.39%)
3.	Development and expansion of bio-rational based integrated pest management of vegetables, fruits and betel leaf (1st Revised) (January 2018 to December 2021)	2084.00	382.00	380.52	99.61%	2083.90 (99.99%)
4.	Strengthening of Spices Crop Research in Bangladesh (1st Revised) (October 2017 to June 2022)	10040.00	2225.00	2223.50	99.93%	8573.50 (85.39%)
5.	Establishment of Agriculture Research Station, BARI, Gopalganj and eco-friendly agricultural development project in south-western part through strengthening of research (1st Revised) (July 2018 to June 2023)	14657.00	1884.00	1883.20	99.96%	10901.49 (74.37%)
6.	Smallholder Agricultural Competitiveness Project (SACP) (BARI Part) (July 2018 to June 2024)	1457.97	199.00	198.53	99.76%	804.53 (55.18%)
7.	Upgrading Regional Horticulture Research Station, Cumilla to Regional Agricultural Research Station (1st Revised) (July 2018 to June 2023)	3727.52	914.00	913.80	99.98%	1827.80 (25%)
8.	Farm Machinery Technology Development for Profitable Crop Production (July, 2020- June, 2025)	5600.00	860.00	859.07	99.89%	1313.26 (15.3%)
9.	Enhance Production of Oil Crops Project (BARI Part) (July, 2020- June, 2025)	2044.17	505.00	504.70	99.94%	596.70 (24.7%)

Sl. No.	Name of the Projects (Implementation period)	Total Project Cost	Allocation of 2021-22	Expenditure up to June 2022 & % of allocation		Cumulative Progress upto June 2022
				Financial	Physical (%)	
10.	Conservation of Ground Water and Raising it's Use Efficiency and Productivity in Irrigated Agriculture in Bangladesh (BARI Part) (July, 2020- June, 2023)	206.80	102.00	102.00	100%	116.90 (49%)
11.	Research, Development & Extension of Cashew nut and Coffee (BARI Part) (January, 2021- December, 2025)	5330.75	756.00	721.57	95.45%	743.57 (13.54%)
12.	Strengthening Regional Pulse Research Station, Madaripur and increase production of pulse crops at greater Barishal, Faridpur Region (July, 2021- June, 2026)	16800.00	232.00	228.68	98.57%	228.68 (1.36%)
	Total:	**68563.63**	**8951.00**	**8907.58**	**99.5%**	**25385.58 (49%)**

List of Future Projects in Related to SDGs (2021-2030) & 8th FYP

1. Expansion of homestead gardening, school gardening commercial fruit gardening as a source of nutritional security all year round.
2. Expansion of appropriate post harvest management technologies (Processing, preservation & packaging) to reduce production loss and develop market linkage among the producer and consumer.
3. Production & distribution of good quality seed
4. Increase agricultural productivity or production through modern technology transfer, minimizing yield gap, crop diversification & intensification with high value crop production.
5. Extension of appropriate post harvest management technologies through training and demonstration
6. Increase water use efficiency through improved on-farm water management technologies such as AWD, Dug well, Buried Pipe, Hose Pipe, Raised Bed rice irrigation, Drip & Sprinklers irrigation, Hand shower irrigation, Mulching etc.
7. Introduction of renewable energy to provide irrigation.
8. Research and Extension of Vegetables and Spices Cultivation on Floating Bed
9. Integrated Agricultural Research & Development Project in South West part of Bangladesh
10. Soil management through organic and inorganic amendments
11. Development of climate smart crop varieties and Seed
12. Development of stress tolerant (Salinity, drought, water submergence, cold, heat, etc and diseases, insect resistant) high yielding major crop varieties.
13. Seed production and supply of climate resilient crop varieties.
14. Collection, preservation and maintenance of plant genetic resources for food and agriculture for medium or long-term conservation.
15. Morphological and molecular characterization of the collected genetics resources.

16. Enhancement of pulse research and extension at greater Faridpur and southern region of Bangladesh
17. Strengthening of Spices Crop Research in Bangladesh
18. Tuber Crops Research Strengthening Project
19. Established value chain development for vegetables, fruits by encouraging public-private partnership (PPP)
20. Biotechnological and hybrid research capacity development.
21. Development of Nutrient enriched and Biotic stress tolerant crop varieties
22. Manpower development (PhD, MS, Short/long duration training, etc)
23. Strengthening of ICT for effective and rapid technology transfer.
24. Extension of Biotic stress tolerant crop varieties

Projects beyond 8th FYP Period (2020-2025) aligning with SDGs

1. Development and extension of cereals, vegetables, fruits, pulses, oilseed and tuber crops with nutrient enriched varieties.
2. Extension and expansion of bio-rational based IPM/IDM, INM GAP, Biopesticides approaches and organic agriculture
3. Development of high yielding, hybrid and transgenic crop varieties.
4. Promotion of organic and safe food production for human
5. Enhancement of crop production through Farm Mechanization
6. Enhance Integrated Agricultural Productivity Approach
7. Introduction of water saving technologies such as, drip irrigation, sprinkler irrigation, furrow irrigation, alternate furrow irrigation, deficit irrigation, etc. at farmers levels
8. Improvement and extension of the existing cropping pattern and crop zoning to increase productivity
9. Women empowerment in production, processing & other income generating activities.
10. Expansion of appropriate post harvest management technologies (Processing, preservation & packaging) to reduce production loss and develop market linkage among the producer and consumer.
11. Increase agricultural productivity or production through modern technology transfer, minimizing yield gap, crop diversification & intensification with high value crop production.
12. Production & distribution of good quality seed
13. Increase water use efficiency through improved on-farm water management technologies such as AWD, Dug well, Buried Pipe, Hose Pipe, Raised Bed rice irrigation, Drip & Sprinklers irrigation, Hand shower irrigation, Mulching etc.
14. Development of small farm tools and machinery
15. Introduction of renewable energy to provide irrigation.
16. Popularization/Extension of environment friendly green technologies (e.g. GAP, IPM, INM, AWD, Dry seed bed, bio pesticides, organic agril. etc.)
17. Extension of climate smart soil and fertilizer management and climate smart crop varieties.
18. Emphasis on extension work to mitigate stress condition like drought, salinity, submergences, flooding & other disasters
19. Soil management through organic and inorganic amendments
20. Increase use of rural & urban organic wastages, waste water and crop residues for renewable energy (biogas) and bio-pesticides instead of chemical pesticides.
21. Development of climate smart crop varieties and Seed
22. Development of stress tolerant (Salinity, drought, water submergence, cold, heat, etc and diseases, insect resistant) high yielding major crop varieties.
23. Emphasis on research and development work to mitigate stress, condition like drought, salinity, submergences, flooding & other disasters
24. Seed production and supply of climate resilient crop varieties.

25. Increase use of rural & urban organic wastages, waste water and crop residues for renewable energy (biogas) and bio-pesticides instead of chemical pesticides.
26. Collection, preservation and maintenance of plant genetic resources for food and agriculture for medium or long-term conservation.
27. Morphological and molecular characterization of the collected genetics resources.
28. Biotechnological and hybrid research capacity development.
29. Development of Nutrient enriched and Biotic stress tolerant crop varieties
30. Strengthening research facilities for HQ and outreach stations.
31. Establishment of new research station/centre under.
32. Manpower development (PhD, MS, Short/long duration training, etc)
33. Strengthening of ICT for effective and rapid technology transfer.
34. Strengthening Research-Extension-Education-Farmers linkage among SAARC countries & international organizations.
35. Encourage Public-Private Partnership (PPP) for agricultural development in value chain development/agro-processing/Food processing/farm mechanization.
36. Extension of Biotic stress tolerant crop varieties.

Fund for the Institute was received from development and revenue budget of the Government of Bangladesh. The development budget was made available through the annual development program (ADP) for the on-going development projects under the Institute (Table 2). Out of total ADP allocation of Tk. 9410.32 lakh. The GoB funding was Tk. 9410.32 lakh, which was offered by different aid-giving agencies as Project Aid (PA).

Besides, an amount Tk. 30275.42 lakh was made available from the revenue budget to meet the recurring expenditure of the already complied projects of the Institute (Table).

Table-1: Budget provision of BARI for 2021-2022 (in lakh Tk.)

Total	GOB Head			Project Aid (PA/RPA	Expenditure		Total
	ADP	Revenue	Total		ADP	Revenue	
39818.74	9410.32	30275.42	39685.74	133.00	9537.85	29780.10	39317.95

Table-2: Development Budget (Annual Development Programme) of BARI for 2021-2022 (in lakh Tk.)

No.	Name of Projects & Programs	Total	GOB		PA/RPA	Expenditure		Total
			Revenue	Capital		Revenue	Capital	
A. Development Projects								
1.	Research, Extension and Popularize of Vegetables and Spices Cultivation on Floating Bed	**616.00**	616.00	0	0	616.00	0	**616.00**
2.	Establishment of Agriculture Research Station, BARI, Gopalganj and eco-friendly agricultural development project in south-western part through strengthening of research	**1884.00**	600.00	1284.00	0	596.34	1284.00	**1880.34**
3.	Strengthening of Spices Crop Research in Bangladesh	**2225.00**	730.00	1495.00	0	730.00	1495.00	**2225.00**
4.	Upgrading Regional Horticulture Research Station, Cumilla to Regional Agricultural Research Station	**914.00**	174.00	740.00	0	174.00	739.84	**913.84**
5.	Strengthening of Oilseed and Pulses Research and Development in Bangladesh	**276.00**	77.00	199.00	0	77.00	199.00	**276.00**

No.	Name of Projects & Programs	Total	GOB		PA/RPA	Expenditure		Total
			Revenue	Capital		Revenue	Capital	
6.	Development and expansion of bio-rational based integrated pest management of vegetables, fruits and betel leaf	**382.00**	198.00	184.00	0	198.00	184.00	**382.00**
7.	Smallholder Agricultural Competitiveness Project (SACP) (BARI Part)	**199.00**	66.00	0	133.00	198.58	0	**198.58**
8.	Farm Machinery Technology Development for Profitable Crop Production	**860.00**	257.00	603.00	0	257.00	602.07	**859.07**
9.	Enhance Production of Oil Crops Project (BARI Part)	**505.00**	275.00	230.00	0	275.00	229.70	**504.70**
10.	Conservation of Ground Water and Raising it's Use Efficiency and Productivity in Irrigated Agriculture in Bangladesh (BARI Part)	**102.00**	102.00	0	0	102	0	**102.00**
11.	Research, Development & Extension of Cashew nut and Coffee(BARI Part)	**756.00**	295.00	461.00	0	295.00	461.00	**756.00**
12.	Strengthening Regional Pulse Research Station, Madaripur and increase production of pulse crops at greater Barishal, Faridpur Region.	**232.00**	232.00	0	0	232.00	0	**232.00**
Sub-Total -A Development Projects:		**8951.00**	**3622.00**	**5196.00**	**133.00**	**3750.92**	**5194.61**	**8945.53**

P.T.O

Table-3: Development Budget (Annual Programs) of BARI for 2021-2022 (in lakh Tk.)

No.	Name of Projects & Programs	Total	GOB		PA	Expenditure		Total
			Revenue			Revenue	Capital	
B. Programs								
1.	Increasing Productivity of Horticulture Crops in Fallow Land of Tidal Prone Southern Region through Validation Trials	**71.84**	68.00	3.84	0	68.00	3.84	**71.84**
2.	Production of Safe Fruits and Vegetables and Promotion of Their Exports	**145.00**	145.00	0	0	145.00	0	**145.00**
3.	Documentation of Insect Pests, Development and Dissemination of Integrated Pest Management Technology for cultivating Important Fruits, Betedl Leaf, Betel Nut and Pulse Crops through Safe Food Production in Southern Region of Bangladesh	**69.10**	68.00	1.10	0	68.00	1.10	**69.10**
4.	Adaptive trial, development of production technology and community based pilot production program of summer tomato in Bangladesh	**225.00**	225.00	0	0	225.00	0	**225.00**
5.	Development of Canola Type Rapeseed Variety for Cultivation between T.Aman and Boro Rice	**48.93**	48.93	0	0	48.93	0	**48.93**
6.	Strengthening of Food and Nutrition Security program Through Gene Pool Enrichment, Research, Technology Development and Improved Variety Dissemination of Aroids.	**32.45**	32.45	0		32.45	0	**32.45**
Sub-Total -B Programs:		**592.32**	**587.38**	**4.94**	**0**	**587.38**	**4.94**	**592.32**
Grand Total (A+B):		**9543.32**	**4209.38**	**5200.94**	**133.00**	**4338.30**	**5199.55**	**9537.85**

INFORMATION REPORT

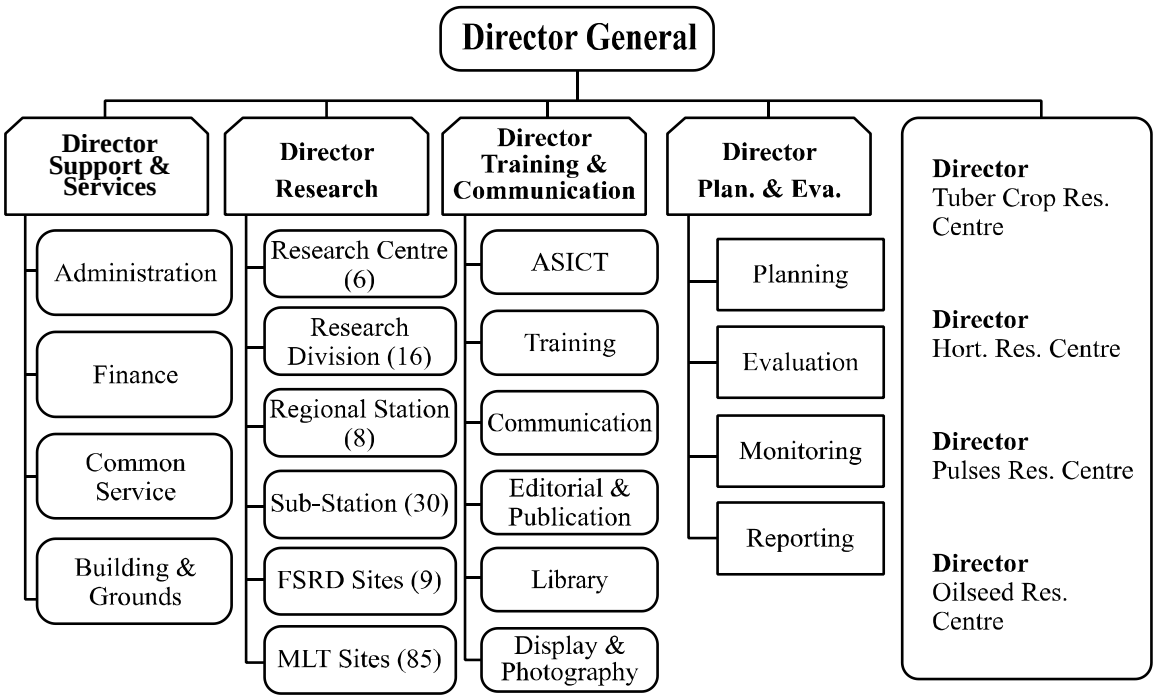
(As per Information Commission Requirements)

Institutional information:

BARI (Bangladesh Agricultural research Institute) is the largest multi-crop research institute conducting research on a wide variety of crops such as tubers, pulses, oilseeds, vegetables, fruits, spices, flowers, cereals, 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 Services Wing, Training & Communication Wing and Planning & Evaluation Wing.

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 Agriculture. 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, agriculture 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 aboard 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/CSO. Each divisional head is assisted by the concerned scientists 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 scientists 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. Abdul Monayem Miah ড. মো. আব্দুল মোনায়েম মিয়া
Designation	: Chief Scientific Officer (CSO)
Phone	: 49270129
Mobile	: 01757-739542
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	: Principal 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. Sayedul Islam মো. সায়েদুল ইসলাম
Designation	: Secretary
Phone	: 55100100
Mobile	: 01316-105956
Email	: secreatary@moa.gov.bd
Website	: www.moa.gov.bd
Office	: Building # 04, Ministry of Agriculture, Bangladesh Secretariat, Dhaka.

Table. Citizen's access to information in 2021-22

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	0**	-	-	-	-	-	-	-

** BARI has provided answers to all 535 questions received through the website and mobile apps.

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www.bari.gov.bd

October, 2022