

# BARI Annual Report 20 22-23



**Bangladesh Agricultural Research Institute**



# BARI Annual Report 2022-23



Bangladesh Agricultural Research Institute

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# Foreword



Agriculture is still the main driving force of the economy of Bangladesh. After independence, the Father of the Nation Bangabandhu Sheikh Mujibur Rahman realized that the development of agriculture would not be possible without modernization of agricultural system. Today's Bangladesh Agricultural Research Institute (BARI) is the outcome of the visionary thoughts of Bangabandhu who conferred class one job status to the agriculturists for attracting talent manpower in agriculture sector. Following the ordinance issued by Bangabandhu in 1973, BARI was established as an autonomous multi crop research organization in 1976 to feed a burgeoning population of the country. Since establishment, BARI has been contributing to the national agriculture enormously developing sustainable crop production technologies as well as high yielding varieties. The major research areas include development of improved varieties 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.). Moreover, advanced research works are conducted for the generation of crop production technologies on soil, water and crop management, insect pest and disease management, farming system, post-harvest handling, development of energy efficient farm machinery, socio-economic research.

However, the present annual report is a comprehensive but brief overview of the activities and achievements of BARI of the previous year. In particular, this annual report includes the major findings of the experiments conducted by the scientists of different Crop Research Centers and Research Divisions and Regional Stations of BARI during the year 2022-23. But it is really very difficult to accommodate entire findings of all the studies conducted in such a single volume. Therefore, like previous years, only the major findings of the studies have been incorporated in this report. The readers can get brief information of major research areas of BARI in a single volume. If anyone becomes interested to have detailed information, then it would be better to consult with respective Centers, Divisions and or Regional Reports.

I express my heartfelt thanks and gratefulness to the scientists, editors, and associates who have worked hard for the preparation, compilation and editing of this report to make it a real document for the stakeholders. I also appreciate for the enormous contributions of researchers, scientific assistances, lab & field stuffs, labours for their untiring efforts in conducting research works successfully. It will be highly appreciated if this valuable report becomes useful to the scientists, teachers, students, policymakers, and other stakeholders who have engaged in agricultural research and development, for the generation of technologies and their successful dissemination in order to ensure food and nutrition security of the country to build a poverty free smart Bangladesh keeping the agenda 2041 in mind.

**Dr. Debasish Sarker**  
Director General, BARI





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







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# TUBER CROPS

01



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 2022-2023 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

S. Naznin, M.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. Rahman, M.S. Hossain, M. M. Islam, M.M.H. Molla 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 have flowers 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 Debiganj and Gazipur using 154 and 132 clones/ varieties, respectively under 16 hours extended photoperiod to create variability, and to select superior genotypes in the subsequent generations. At Gazipur, 121 out of 371 crosses and at Debiganj, 411 out of 1256 crosses produced berries. In total 365g hybrid seeds were produced of which 215g were at Debiganj and 150g at Gazipur. We found seeds from 130, 54, 40, 45 and 263 crosses for heat and salt tolerant, late blight resistant, processing attributes, biofortified and table purpose, respectively. Those seeds were preserved for next year F1 seedling tuber production for subsequent variety development process.

#### Production of seedling tubers of the potato hybrid (F<sub>1</sub>C<sub>0</sub>) population

M. Rahman, M. S. Hossain, S. Naznin, M.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. M. Islam, M.M.H. Molla and S. Akhter

Hybrid true seeds which were produced in 2021-22 at Gazipur and Debiganj were sown at Breeder Seed Production Centre, BSPC, Debiganj, Panchagarh during this season 2022-23. After harvesting of all plantlets, 233 single plants and 647 single tubers of 720 crosses were selected. In total 400 kg seedling tubers were stored for next year.

#### Selection of potato hybrids in subsequent clonal generations (F<sub>1</sub>C<sub>1</sub>, F<sub>1</sub>C<sub>2</sub> and F<sub>1</sub>C<sub>3</sub>)

M. Rahman, M. S. Hossain, S. Naznin, M.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. M. Islam, M.M.H. Molla and S. Akhter

During the selection process all potato clones are examined critically. Each generation materials are planted separately. In three generations of single plant, plant row and single plot (F<sub>1</sub>C<sub>1</sub>, F<sub>1</sub>C<sub>2</sub> and



F1C3 generations) 113 potato clones weighing 1080 kg were selected and stored at BSPP, Debigonj for further evaluation.

#### **Preliminary yield trial with hybridized potato lines**

T. Jahan, A.T. M. Tanjimul Islam, M. A. Kawochar, S. Naznin, M.M. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

Eight hybridized lines viz. 19.3, 19.34, 19.87, 19.96, 19.99, 19.113, 19.147 and 19.153 along with four checks BARI Alu-7, BARI Alu-13, BARI Alu-25 and BARI Alu-28 were evaluated at two locations named as TCRC, BARI, Gazipur and BSPP, Debigonj during the last 2022-23. Significant variation was observed due to both environmental and genotype factors to the expression of different characters of potato emphasized with the yield and dry matter production. Considering both the locations, the top most producer was the hybrid clone 19.3 (54.43 t/ha). But all the check variety BARI Alu-13 (25.86 t/ha), BARI Alu-7 (25.05 t/ha), BARI Alu-25 (14.75 t/ha) and BARI Alu-13 (13.20 t/ha) at Gazipur showed the lowest yield gradually. On the otherhand, the same static and lowest performance was revealed in the variety BARI Alu-7 (25.03t/ha) and the clone 19.34 (25.41 t/ha) at Debigonj. The top most dry matter (%) was gained from the clonal hybrid 19.34 (23.26%) and 19.113 (23.22%) at Gazipur but at Debigonj, the clone 19.34 (23.17%) and 19.153 (23.18%) performed the best and same. In both the locations, the check variety BARI Alu-13 (17.63%, Gazipur and 17.49%, Debigonj) was the lowest dry matter producer. Considering the overall performance, all the clonal hybrids can be selected for SYT.

#### **Secondary yield trial with hybridized potato lines (F1C6)**

S. Naznin, M.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. Rahman, M.S. Hossain, M.S. Rahman, M.M Kadir, M.K. Alam, M. Salim, B. Anwar, K.U. Ahammad, M. Rahman, M. Sultana, M.T. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

Seven hybridized lines of potato were evaluated along with four check varieties at six different agro-ecological zone of Bangladesh. Combined analysis was done to see the genotype and location interactions. The significant influence was observed for different environmental factors of different

locations on the expression of different characters of potato. The highest average yield (44.19 t/ha) was observed in genotype 18.19 followed by clones 18.46 (40.47 t/ha) and 18.117 (39.46 t/ha). Genotypes 18.19, 18.46 and 18.117 can be selected for AYT due to their higher tuber yield potentialities. In case of dry matter content check variety BARI Alu-28 (Lady Rosetta) gave the highest result (22.06%) followed by clone 18.8 (20.57%) which is suitable for processing purpose. Considering all the characters these five genotypes (18.8, 18.13, 18.19, 18.46 and 18.117) can be selected for next year AYT.

#### **Advanced yield trial with hybridized potato lines (F1C7)**

M.A. Kawochar, S. Naznin, T. Jahan, A.T.M.T. Islam, M. Rahman, M.S. Hossain, M.S. Rahman, M.M Kadir, M.K. Alam, M. Salim, B. Anwar, K.U. Ahammad, M. Rahman, M. Sultana, M.T. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

Five hybridized lines along with four checks of potato were evaluated in six locations during 2022-23. Line 17.19 gave the significantly highest tuber yield at 65 DAP in Debigonj (22.52), Jamalpur (43.02 t/ha) and Jessore (32.73). This line also gave the highest average tuber yield (27.85 t/ha) over the locations. At final harvest, line 17.19 gave the statistically highest marketable tuber yield (50.03 t/ha) at Jamalpur too. Across the environment, the highest average tuber yield was found in the same line (39.13 t/ha) as well. Average dry matter percentages of all the advanced lines were not suitable for processing purpose where check BARI Alu-28 (Lady Rosetta) gave the statistically highest percentage of average dry matter (21.14%). But, the most promising line 17.19 performed not enough well regarding dry matter and it was 18.19%. The line 17.19 need to be study closely, precisely and vigorously with all other parameters and some critical attributes before go to release.

#### **Participatory variety selection of AYT materials (F1C7)**

M.A. Kawochar, A.T.M.T. Islam, S. Naznin, T. Jahan, M. Rahman, M.S. Hossain, M.S. Rahman, M.M Kadir, M.K. Alam, M. Salim, B. Anwar, K.U. Ahammad, M. Rahman, M. Sultana, M.T. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

Five hybridized lines with two check 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 check BARI Alu-25(Asterix) (40.77 t/ha) followed by genotype 17.18 (40.28 t/ha) and lowest average yield was found in genotype 17.159 (29.27 t/ha). Considering tuber yield, tuber size, shape and colour, the most of the farmers showed their keen interest to 17.18, but varied from location to location. Therefore, further evaluation is needed for confirmation.

#### **Regional yield trial of hybridized potato varieties**

A.T.M.T. Islam, M.A. Kawochar, S. Naznin, T. Jahan, M. Rahman, M.S. Hossain, M.S. Rahman, M.M Kadir, M.K. Alam, M. Salim, B. Anwar, K.U. Ahammad, M. Rahman, M. Sultana, M.T. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

Four hybridized germplasm namely 16.9, 16.16, 16.28 and 16.62 along with check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta) were assessed at six different agro-ecological environment/locations during 2022-23 cropping season. The hybridized germplasm 16.9 produced the maximum yield (42.51 t/ha), which was statistically comparable to the yield produced by hybridized germplasm 16.28 (39.87 t/ha). Intriguingly, the yield of the other two hybridized germplasms, 16.16 and 16.62, was the same (35.50 t/ha). All four hybridized germplasm namely 16.9, 16.16, 16.28 and 16.62 performed the best in terms of taste, appearance and texture when boiled. Taking into account tuber yield, disease, insect infestation, and tuber characteristics (shape, size, color, and scoring), these four hybridized germplasm (16.9, 16.16, 16.28, and 16.62) can be chosen for release.

#### **Participatory variety selection of advanced lines of RYT materials**

A.T.M.T. Islam, M.A. Kawochar, S. Naznin, T. Jahan, M. Rahman, M.S. Hossain, M.S. Rahman, M.M Kadir, M.K. Alam, M. Salim, B. Anwar, K.U. Ahammad, M. Rahman, M. Sultana, M.T. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

Four advanced potato lines for table purposes along with checks BARI Alu-7(Diamant) and BARI Alu-25(Asterix) were evaluated in the farmer's field in

four different locations during the cropping season 2022-23. In case of average yield over four locations, line 16.16 produced the highest tuber yield (43.35 t/ha). All the lines performed more yield than 40 t/ha and even more than the checks BARI Alu-7 (Diamant) and BARI Alu-25 (Asterix) excepting line 16.28. All the lines except line 16.28 performed 1.32% to 9.86% more tuber yield over the checks. Considering size, shape and colour, farmers of all locations showed their keen interest about the all the advanced lines.

#### **Preliminary yield trial of exotic potato varieties**

T. Jahan, A.T. M. Tanjumul Islam, M. A. Kawochar, S. Naznin, M.M. Rahman, M. M. Islam, M.M.H. Molla 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. An evaluation study was carried out for three exotic varieties of potato along with four check varieties BARI Alu-7, BARI Alu-13, BARI Alu-25 and BARI Alu-28 at TCRC, BARI, Gazipur and BSPC, Debiganj, Panchagarh during the last 2022-23 fiscal year. Considering mean performance over the location, the top most result was obtained from the Toronto (31.11 t/ha) followed by BARI Alu-25 (31.07 t/ha) at Debiganj. The genotype Sound gave the highest yield (25.41 t/ha) pursued by BARI Alu-28 (13.10 t/ha) at Gazipur but possessed the lowest yield (9.377 t/ha) at Debiganj. Moreover, statistically the same and lowest yield was obtained from the genotype Lady Alicia (12.38 t/ha), Toronto (11.29 t/ha), BARI Alu-7 (10.55 t/ha), BARI Alu-13 (9.593 t/ha), BARI Alu-25 (11.44 t/ha) and BARI Alu-28 (13.10 t/ha) at Gazipur. The variety BARI Alu-28 achieved the highest dry matter (22.10%) pursued by Lady Alicia (21.68%) and Toronto (21.51%) at Gazipur but the check BARI Alu-13 was the lowest dry matter generator in both locations (17.23%, Gazipur) and (17.81%, Debiganj). 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**

S. Naznin, M.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. Rahman, M.S. Hossain, M.S. Rahman, M.M Kadir, M.K. Alam, M. Salim, B. Anwar, K.U. Ahammad, M. Rahman, M. Sultana, M.T. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

Three exotic varieties 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 six different agro-ecological zone of Bangladesh during 2022-23 for second generation trial. A significant influence was observed due to different germplasms on the expression of different characteristics of potato. Exotic variety Chenoa gave the highest yield (37.23 t/ha) followed by Zorba (34.59 t/ha). Dry matter percentage at harvest was the highest with check variety Lady Rosetta (21.9) followed by Zorba (20.52) which is suitable for processing purpose. Chenoa and Zorba are selected for the next year's trial.

#### **Advanced yield trial of exotic potato varieties**

S. Naznin, M.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. Rahman, M.S. Hossain, M.S. Rahman, M.M Kadir, M.K. Alam, M. Salim, B. Anwar, K.U. Ahammad, M. Rahman, M. Sultana, M.T. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

One exotic variety viz. SHC 1010 along with four check 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 locations of Bangladesh named as Bogura, Debiganj, Gazipur, Jamalpur, Jashore and Munshiganj during 2022-23. Significant variation was observed due to environmental factors in different locations to the expression of different characters of potato. The highest yield was obtained from exotic variety SHC 1010 (44.61 t/ha) at Bogura and this variety also gave the highest average yield (35.76 t/ha) over the location. This exotic variety gave 7.97%, 31.91%, 7.52% and 15.28% higher yield than check varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix) and BARI Alu-28 (Lady Rosetta), respectively. This exotic variety also produced higher dry matter content (21.16%) which is

suitable processing purpose. Considering the overall performance, SHC 1010 can be selected for RYT.

#### **Evaluation of exotic varieties and advanced lines for early heat tolerance**

M. Rahman, M. A. Halim, M. S. Hossain, S. Naznin, M.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. M. Islam, M.M.H. Molla 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 of November. Performance of sixteen genotypes of potato along with four check varieties BARI Alu-13 (Granola), BARI Alu-60, BARI Alu-29 (Courage) and BARI Alu-28 (Lady Rosetta) were evaluated at the breeder seed production center, Debiganj during Rabi season 2022-2023 following a randomized complete block design with three replications. The results revealed significant variations due to genotypes for all characters. Emergence, plant height, stem per hill, tuber yield at 60 days were recorded to identify the early bulker varieties. Finally, clone 17.18, 17.19, and exotic variety Twinner can be selected for early heat tolerant variety on the basis of field performance.

#### **Advanced yield trial of CIP biofortified (Fe & Zn rich) potato clones**

A.T.M.T. Islam, M.A. Kawochar, S. Naznin, T. Jahan, M. A. Ali, E. H. M. S. Rahaman, D. Chanda, M. M. Islam, M.M.H. Molla 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<sup>-1</sup> (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. 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. An experiment was conducted at six locations (Jamalpur, Jessore, Debiganj, Bogura, Gazipur & Munshiganj) for searching of biofortified potato genotypes. In this experiment, 39 biofortified germplasm provided by CIP and four BARI-released varieties BARI Alu-7 (Diamant), BARI Alu-13 (Granola), BARI Alu-25 (Asterix), and BARI Blu-28 (Lady Rosetta) as checks were evaluated. The experimental design was row-column with fully randomized and evaluated regarding their phenotypic characters, yield, and yield contributing characters. The yield of these biofortified materials ranged from 44.47 to 18.29 tons/ha. Five genotypes were selected for RYT Considering yield and yield contributing characters viz, CIP-404, CIP-416, CIP-17, CIP-28, and CIP-430, and their yield was 44.47, 38.65, 36.21, 38.24, and 38.68 tons/ha, respectively.

#### **Advanced yield trial of CIP late blight potato germplasm**

A.T.M.T. Islam, M. A. Kawochar, S. Naznin, T. Jahan, M. A. Ali, E. H. M. S. Rahaman, D. Chanda, M. Moniruzzaman, M. Rahman, M.S. Hossain, M. M. Islam, M.M.H. Molla and S. Akhter

The most important disease of potato (*Solanum tuberosum* L.) in Bangladesh is late blight caused by *Phytophthora infestans*. The experiment was conducted under natural inoculum pressure in the isolated field of Panchagarh, Rangpur, Bogura, and Gazipur to evaluate 8 (Eight) CIP potato germplasm along with LB resistant BARI Alu-46, BARI alu-53, BARI Alu-90, BARI alu-91 and susceptible BARI Alu-25 against late blight disease during 2021-22 crop season. 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 gives a higher yield (57.51 t/ha) followed by CIP-449 (48.72 t/ha), BARI Alu-90 (46.55 t/ha), BARI alu-53 (45.82 t/ha), CIP-445 (42.16 t/ha), and CIP-444 (40.77 t/ha). In respect of resistance and tuber yield performance of promising germplasm CIP-449, CIP-445, and CIP-444 can be released as a late blight-resistant variety.

#### **Secondary yield trial of CIP heat tolerant potato germplasm**

M.A. Kawochar, S. Naznin, A.T.M.T. Islam, T. Jahan, M.S. Rahman, N. Akter, M.I.A. Howlader, M.A. Ali, E.H.M.S. Rahaman, D. Chanda, M. M. Islam, M.M.H. Molla and S. Akhter

International Potato Center (CIP), bred potato genotypes produce various yields under heat stress conditions due to being sown late. This study presented results from high temperature screening of 13 genotypes in both the stress and non-stress condition in the field at OFRD, Shampur, Rajshahi and RHRC, Labukhali, Patuakhali, Bangladesh during 2022-23 cropping season. Paired trials were conducted in the field under high temperature (stress) and optimum temperature (non-stress) conditions. Under the heat stress condition, the highest tuber yield (34.76 t/ha and 34.09 t/ha) obtained from CIP-403 at Patuakhali and BARI Alu-72 at Rajshahi while the highest mean tuber yield (32.91 t/ha and 32.30 t/ha) obtained from check BARI Alu-72 and CIP-444. Genotypes CIP-449, CIP-448 and CIP-444 showed relatively higher HTI, lower HSI and lower yield reduction. Moreover, they ranked as second, third and fourth respectively. Heat intensity index (HII) was 0.21. These genotypes need to be selected for father evaluation to get precise information.

#### **Advanced yield trial of colored flesh potato germplasm**

A.T.M.T. Islam, M.A. Kawochar, S. Naznin, T. Jahan, M. Rahman, M.S. Hossain, M.S. Rahman, M.M Kadir, M.K. Alam, M. Salim, B. Anwar, K.U. Ahammad, M. Rahman, M. Sultana, M.T. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

Potatoes with special attributes like colored skin/flesh having more anthocyanins, better taste or



texture, nutritionally superior (zinc and iron rich, anthocyanin/antioxidants rich) or having low glycemic index are also becoming popular. Color is one of the most important quality factors of both fresh and processed food. Since most quality traits like color are genetically controlled, breeding work can successfully meet this requirement. This study was started to develop color flesh potato varieties. During the 2022-23 cropping season, two exotic germplasm, namely 33.32 and 33.33, along with control varieties BARI Alu-7 (Diamond), BARI Alu-13 (Granola), BARI Alu-25 (Asterix), and BARI Alu-28 (Lady Rosetta) were evaluated in six distinct agro-ecological environments/locations. The exotic germplasm 33.33 produced the maximum yield (40.27 t/ha), which was statistically similar to the yield of exotic germplasm 33.32 (38.14 t/ha). Both the exotic germplasm had acceptable average dry matter percent. These two exotic germplasm performed the best regarding taste, appearance and texture of boiled potato. Taking into account tuber yield, disease, insect infestation, and tuber characteristics especially for their flesh color, these two exotic germplasm (33.32 and 33.33) can be chosen for the RYT in the following cropping season.

#### **Participatory variety selection of coloured flesh potato germplasm**

A.T.M.T. Islam, M.A. Kawochar, S. Naznin, T. Jahan, M. Rahman, M.S. Hossain, M.S. Rahman, M.M Kadir, M.K. Alam, M. Salim, B. Anwar, K.U. Ahammad, M. Rahman, M. Sultana, M.T. Rahman, M. M. Islam, M.M.H. Molla and S. Akhter

Two exotic advanced lines with two checks BARI Alu-7(Diamant) and BARI Alu-25(Asterix) were evaluated at farmer's field under participatory variety selection to understand the performance as well as farmers opinion. Colour flesh potato lines produced lower tuber yield than the checks BARI Alu-7(Diamant) and BARI Alu-25(Asterix) in every locations except Munshigang. Considering the average tuber yield over the locations, the advanced coloured flesh potato lines produced around 20 t/ha tuber yield. They were unhappy with the yield performance of the colour fleshed advance lines. However, farmers showed interest on them due to attractive skin colour and flesh colour.

#### **Morphological characterization of advanced breeding lines and exotic potato varieties**

S. Naznin, M.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. M. Islam, M.M.H. Molla and S. Akhter

Morphological characterization is essential for recognizing, distinguishing and describing a variety. The central theme is identification of a variety through the use of some parameters of characterization. Precise information about the extent of genetic divergence and on characters used for discrimination among the population is crucial in any crop improvement program, because selection of plants based on genetic divergence has become successful in several crops. In recent years a number of newly developed advanced breeding lines have been added to the germplasm collection. Therefore, the parents to be used in breeding improved potato cultivars to grow in these contrasting growing conditions ought to be different. 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. Eleven advanced clonal hybrids of potato developed by TCRC and two exotic germplasm were characterized at TCRC, Gazipur during 2022-23 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, 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.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. Rahman, M.S. Hosasin, M. M. Islam, M.M.H. Molla and S. Akhter

The efficiency of breeding new potato cultivars may be enhanced by pre-breeding that is by developing parental lines, which have new traits, not present in the genetic pool available for breeders. That's why, the present study has been undertaken. A study with 132 and 154 genotypes



was carried out in the research field of Gazipur and Debigonj for screening of some parental lines delivering good performance in different angles. The germplasm were planted in different times set for the convenience of crossing. 371 and 1256 crosses were made in Gazipur and Debigonj, and 121 and 411 crosses produced berries. Finally, some genotypes were selected existing good growth, excellent bearing and good male and female parent named as BARI Alu-100 (Ottawa), BARI Alu-32 (Quincy), BARI Alu-72, BARI Alu-73, BARI Alu-52 (Labadia), BARI Alu-38 (Omega), BARI Alu-86, BARI Alu-92, BARI Alu-93 BARI Alu-96, BARI Alu-83 (Cimega), BARI Alu-47, BARI Alu-48, BARI Alu-53 and BARI Alu-77 (Sarp Mira).

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

M. Rahman, M. S. Hossain, S. Naznin, M. A. Kawochar, T. Jahan, A.T.M.T. Islam, M. M. Islam, M.M.H. Molla and S. Akhter

Any variety, line, genotypes and land races considered as germplasm which are very important for breeding point of view. Number of germplasm is also important for genetic base of the population. If the number is high the genetic base is high and contained high genetic pool. Some of the materials contained some valuable genes which are important for future breeding work. In that case Maintenance breeding is very much important for conservation as well as preservation of gene pool in future use. It is also necessary for breeding programme in our country, where the variability of potato is very low because potato is not a crop in this region. 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 conduct the same experiment for this same purpose. A total of 21837 kg seeds of potato were preserved in Breeder Seed Production Center cold storage, Debigonj, Panchagarh collected from 3775 potato variety/germplasm/hybrid clone during 2022-2023. 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.A. Kawochar, T. Jahan, A.T.M.T. Islam, M. Rahman, M.S. Hosasin, M. M. Islam, M.M.H. Molla and S. Akhter

Indigenous potato variety (IPV) contains higher proportion of amylopectin than EPV which make 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 be checked with view to how much progress of yield compared to previous year. These were the objectives for this trial. During 2022-2023 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. There are 299 Kg seeds preserved in cold-storage of BSPC, Debigonj, 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 has been used to generate half-sib sweet potato hybrid seeds with great variability regarding yield potentiality, dry flesh, earliness, carotene content, disease tolerance & good taste. In reality, there is only one breeding objective- a better variety. The experiment was conducted during 2022-23 at Gazipur and a total of 491 F<sub>1</sub> seeds were collected from twelve parents (Table 1). The highest number of F<sub>1</sub> seeds was collected from Moz1.9 (104) followed by Moz1.15

(80) and the lowest number of F<sub>1</sub> seeds from BARI Mistialu-3 (2). These F<sub>1</sub> 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

To create variability of different characters like early bulking, carotene containing, high dry matter, starch containing and weevil tolerance, International Potato Centre (CIP) has taken an initiative to bring all Asian sweet potato growing countries under a network. Orange flesh sweet potato (OFSP) will help in elimination of hunger and malnutrition worldwide. 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.

#### **Preliminary yield trial of 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, M. M. H. Molla and S. Akter

An experiment was conducted at three locations (Bogura, Gazipur & Jamalpur) for searching early and regular bulking genotype harvesting at 90 & 120 days, respectively. In this experiment, 27 OFSP germplasm, for early bulking and 20 OFSP, 31 PFSP, 25 Hybrid clones, and 8 newly imported CIP materials including four BARI-released varieties as checks were evaluated. The experimental design was augmented with fully randomized and evaluated regarding their phenotypic characters, yield, and yield contributing characters. Six genotypes were selected as an early bulker for SYT. In the case of regular bulking, from OFSP, PFSP, Hybrid clones, and newly imported CIP materials 3, 2, 3, and 2 genotypes were selected, respectively.

#### **Regional yield trial of sweet potato clones**

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

BARI has developed ten sweet potato clones, namely Moz.1.15, Moz.1.9, SPM-103, SPO-104, H9.7.12, H9.10.12, H6.52.11, H9.48.11, H5.ej.10, and H16.ej.10. These clones are considered high yielding and nutrient-rich compared to traditional varieties. In order to identify the high yielding varieties, five multi-location trials were conducted, incorporating three check varieties, namely BARI Mistialu 12, BARI Mistialu 16, and BARI Mistialu-17. Among the ten sweet potato clones, H9.7.12 and Moz.1.15 exhibited higher yields in the majority of the trial locations. These superior yielding sweet potato clones will be utilized in future breeding programs to develop desired varieties.

#### **Participatory variety selection trial with sweet potato clones**

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 was carried out in Gazipur, Bogura and Jamalpur with clones namely H9.7/12, H9.10/12, H6.52/11, H5.ej/10, H16.ej/10, H9.48/11, Moz1.9, Moz1.15, SPM103 and SPO104 with three check variety BARI Mistialu-12 and BARI Mistialu-16 during the winter season of 2022-23. Farmers experienced very good mouth feel during testing BARI Mistialu-12, SPO104, Moz1.15 and BARI Mistialu-17. Overall, they choose H16.ej/10, Moz1.15 and SPO104 in respect of their marketable yield and organoleptic test.

#### **Screening of suitable sweet potato variety for northern part of bangladesh**

M. Rahman, Z. Alam, M. A. Ali, M. A. H. Khan, M. S. Alam, M. M. Uddin, M. M. Islam, M. M. H. Molla and S. Akter

The study aimed to select high-yielding sweet potato varieties that are suitable to grow in northern part of Bangladesh. The experiment was conducted following randomized complete block design with three replications. 17 BARI released sweet potato varieties and 2 local genotypes were used in this study. The results showed that there were significant differences in the characters of 19 sweet potato genotypes in terms of their length of vines,

number of branches, marketable root weight and biomass yield and tuber yield. The study showed that local genotype 1 gave the highest yield (33.19 t ha<sup>-1</sup>) followed by BARI Misti Alu-12 (32.65 t ha<sup>-1</sup>), and the lowest was documented in BARI Misti Alu-13 (9.71 t ha<sup>-1</sup>). and no significant variations were found in number of marketable roots, number of non-marketable roots, and non-marketable roots weight.

#### **Observational trial of white skin and white fleshed CIP sweet potato germplasm**

M. Rahman, Z. Alam, M. A. Ali, M. A. H. Khan, M. S. Alam, M. M. Uddin, M. M. Islam, M. M. H. Molla and S. Akhter

The study aimed to select high-yielding sweet potato varieties that are suitable to grow around Bangladesh. The experiment was conducted following randomized complete block design with three replications. 10 CIP sweet potato germplasm and 2 BARI released variety were used in this study. The results showed that there were significant differences in the characters of 12 sweet potato genotypes in terms of their marketable root weight, number of non-marketable roots, non-marketable roots weight and biomass yield. The study showed that CIP.Moz.2020.46 germplasm gave the highest marketable root weight (1110.67 g/plant) followed by CIP.Moz.2020.494 germplasm (753.33 g/plant), and the lowest was recorded in CIP.Moz.2020.13 germplasm (262.07 g/plant). and no significant variations were found in number of marketable roots.

#### **Screening of salt tolerant sweet potato genotypes**

Z. Alam, M.A. Ali, M. A. H. Khan, A. F. M. S. Ahsan (Plant Physiology Division), M.M. Islam, and S. Akhter

The research was carried out at TCRC, Gazipur from January to April 2023. Nine sweet potato advanced clones (CIP TCRC-03, CIP TCRC-04, Moz1.15, Moz1.9, SPM103, H16ej/10, H9.7/12, H9.48/11 and SPO104) and six sweet potato varieties (BARI Mistialu-8, BARI Mistialu-12, BARI Mistialu-14, BARI Mistialu-15, BARI Mistialu-16 and BARI Mistialu-17) were planted under five salinity levels (0, 6, 8, 10 and 12 dSm<sup>-1</sup>). The maximum plant height and leaf number was observed in H16ej/10. Whereas, the highest number of branches was observed in CIP TCRC-03 and

highest leaf area coverage was observed in BARI Mistialu-16. The highest root weight (161.60g) and marketable root weight (156.50g) was found in H9.48/11 clones.

## **Mukhikachu**

### **Collection and maintenance of aroids germplasm**

F. Begum, M.S. Alam, M.Z.H. Prodhan, M.M. Islam, M. M. H. Molla and S. Akhter

Germplasm collection and documentation are necessary for effective conservation and management of plant genetic resources. In 2022-23 ten germplasm of different aroids were collected from different parts of Bangladesh. Nineteen of mukhikachu, fifty of panikachu and one of each of panchamukhikachu, poindalkachu, dudhkachu, and ghatamankachu germplasms collected from home and abroad in recent past years and conserved at TCRC field, Gazipur.

### **Advanced yield trial of mukhikachu lines**

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

Eleven Mukhikachu (*Colocasia esculentavar. Antiquorum*) viz. MK 140, MK 179, MK 182, MK 184, MK 186, MK 187, MK 189, MK 190, MK 191, MK 192 and MK 193 were evaluated under advanced yield trial during April to November 2022 at TCRC research field, Gazipur. The growth parameters, yield components and yield were statistically significant among the lines. The highest yield (16.10 t/ha) was recorded in MK 179 closely followed by MK 140 (15.28 t/ha).

### **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, M.M. Islam, M. M. H. Molla and S. Akhter

Four genotypes of Mukhikachu (*Colocasia esculenta*) viz. Mk 122, MK 129, MK 131, MK 176 along with a BARI released variety Bilasi and BARI Mukhikachu 2 as check were evaluated under regional yield trial during March to November 2022. The yield components and yield were statistically significant among the lines. The Mukhikachu line MK 176 produced the highest



yield (28.08 t/ha) which was statistically similar with Bilasi (26.87 t/ha) at Gazipur.

## **Panikachu**

### **Hybridization of panikachu**

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

To exploit heterozygosity among Panikachu varieties half diallal method has been used to generate hybrid seeds with great variability regarding yield potentiality, dual purpose Panikachu line, earliness, disease tolerance & good taste. In reality, there is only one breeding objective- a better variety. The experiment was conducted during 2021-22 at Gazipur. One thousands of F<sub>1</sub> seeds were collected from seven parents.

### **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, M.M. Islam, M. M. H. Molla and S. Akhter

Three lines of rhizome producing Panikachu (*colocasia esculenta*) viz. PK 180, PK 181, PK 182 along with two released variety BARI Panikachu-4 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 21.61 t/ha at Gazipur. The highest marketable rhizome yield (65.18 t/ha) was obtained in BARI Panikachu-6 at Jamalpur. but PK 182 obtained second in two locations at Jamalpur and Bogura.

### **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, M.M. Islam, M. M. H. Molla and S. Akhter

Three lines of stolon producing Panikachu (*Colocasia Esculenta*) namely PK 134, PK 178, PK 179 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 2022. Most of the vegetative growth parameters, yield contributing characters and yield were statistically significant between interaction effect of the genotypes and locations. Stolon yield was the highest (20.99 t/ha) in Latiraj, PK 179 at Jamalpur. The marketable rhizome yield was the highest (70.22 t/ha) in PK 179 at Jashore.

### **Participatory variety selection trial on rhizome producing Panikachu lines**

M. S. Alam, F. Begum, M. Z. H. Prodhan, M. T. Rahman, M. S. Rahman, M. M. Islam, M. M. H. Mollah and S. Akhter

Experiments were conducted at the farmer's field of Gazipur, Jamalpur and Bogura during the period from January to august, 2022. Three promising lines like PK 180, PK 181 and PK 182 with two check varieties of BARI Panikachu 4 and BARI Panikachu 6 were included in the experiment. Among the lines, PK 182 was the highest producer in both of rhizome (71.26 t/ha) and stolon (10.98 t/ha) but BARI Panikachu 6 gave the highest rhizome as well as stolon yield.

## **Minor aroids**

### **Advanced yield trial of Ghataman kachu in relation to spacing**

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

Three spacings like 60 cm × 60 cm, 75 cm × 60 cm and 75cm × 75 cm on Ghataman kachu (*Alocasia* SP.) Were evaluated during March to December 2022 at the field of tuber crops research centre, Gazipur. The vegetative growth parameter, yield contributing characters and yield were influenced significantly. 60 cm × 60 cm spacing was produced the highest (15.35 t/ha) yield than 70 cm × 60 cm spacing (13.63 t/ha).

### **Advanced yield trial of Panchamukhi kachu in relation to spacing**

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

Three spacings like 60 cm × 60 cm, 75 cm × 60 cm and 75 cm × 75 cm on Panchamukhi kachu



(*colcasia esculenta*) were evaluated during March to December 2022 at the field Of Tuber Crops Research Centre, Gazipur and Jamalpur. The yield was statistically significant in two location. The yield was around 24.04 t/ha at Jamalpur and 21.79 t/ha at Gazipur for 60 cm × 60 cm.

### **Yam, Cassava & 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 four varieties of yam as BARI Mete Alu-1, BARI Mete Alu-2, 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 released 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 different locations of Bangladesh and evaluated those materials for growth habit, yield potentialities, pest vulnerabilities, diseases incidence, organoleptic test, morphological & 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**

M.H. Rashid, K.A.M.M. Rahman, M. Sultana, M.T. Rahman, B. Anwar, F. Yasmin, M.M. Molla, M.M. Islam and S. Akhter

Bog-1, Bog-2, Bog-3, M.Man-2, KHG-1, Lal-1, M.man-1 and HOM 47 eight lines were selected for evaluation as RYT at Joydebpur, Bogura and Jashore during 2022-2023 cropping season. 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 germplasm, Results of the present study clearly indicated among the germplasm, Bog-1 (62.25 t/ha), Bog-3 (57.52 t/ha), M.Man-2 (51.39 t/ha) and HOM-47 (56.88 t/ha) offered highest yielder. So, those could be advanced to release as variety considering the result.

### **Secondary yield trial of yam**

M.H. Rashid, K.A.M.M. Rahman, B. Anwar, F. Yasmin, M.M. Molla, M.M. Islam and S. Akhter

Nine yam germplasm namely Jas-1, Jas-2, Jas-3, Jas-4, Jas-5, Jas-6, Jas-7, Jas-8 and Jas-9 selected and evaluated at research field of TCRC, Gazipur and RARS, Jashore during 2022-2023 cropping season under PYT. 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, Jas-7 (61.42 kg) offered highest yielder followed by Jas-1 (58.58 t/ha), Jas-6 (55.56 t/ha) and Jas-9 (54.39 t/ha). So, those could be advanced to release as variety considering the result.

**Preliminary yield trial of yam**

M.H. Rashid, B. Anwar, F. Yasmin, M.H. Molla, M.M. Islam and S. Akhter

Five yam germplasm namely DAC-1, DAC-2, DAK-1, DAL-1 and DDB-1 were selected and evaluated at research field, TCRC, Gazipur during 2022-2023 cropping season under PYT. Results of the present study clearly indicated among the germplasms, DAL-1 (44.17 t/ha) offered highest yielder followed by DAC-2 (41.27 t/ha) and DAK-1 (37.33 t/ha). So, those could be advanced to release as variety considering the result.

**Regional yield trial of some exotic cassava**

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

Three exotic cassava germplasm namely MEE-01, MEE-02 and MEE-03 were evaluated at research field, TCRC, Gazipur and RARS, Cumilla during 2021-2022 cropping season under RYT. Results of the present study clearly indicated among the germplasms, MEE-1 harvested at 290 DAP gave the highest return (Starch 31% and yield 68 t/ha), MEE-2 harvested at 280 DAP gave the highest return (Starch 22% and yield 62 t/ha) and MEE-3 harvested at 290 DAP gave the highest return (Starch 33% and yield 80 t/ha). From this analysis it had a confirmation that after a certain time of period, with increasing DAP yield of cassava increased but starch content gradually decreased. Results of the present study clearly indicated among the germplasms, Cumilla (44.99 ton/ha) gave more than double yield than Gazipur (21.63 ton/ha). The highest yield were exhibited by MEE-3 (64.09 ton/ha) which was followed by MEE-1 (39.00 ton/ha) at Cumilla. So, those could be advanced to release as variety considering the result.

**Regional yield trial of some local cassava**

M.H. Rashid, K.A.M.M. Rahman, S. Sultana, F. Akhter, F. Yasmin, M.H. Molla, M.M. Islam 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 2022-23 cropping season under RYT. Results of the present study clearly indicated among the germplasms, MEL-1 harvested at 290 DAP gave

the highest return (Starch 29.6% and yield 46 t/ha), MEL-2 harvested at 300 DAP gave the highest return (Starch 22.1% and yield 55 t/ha). This line also gave the satisfactory return (Starch 23.3% and yield 50 t/ha) at 270 DAP, so considering 30 days 270 DAP was recommended for suitable harvest date and MEL-3 harvested at 280 DAP gave the highest return (Starch 26.9% and yield 70 t/ha). On average, Cumilla (72.58 ton/ha) gave three times higher yield than Gazipur (24.38 ton/ha). The highest yields were exhibited by MEL-3 (97.13 ton/ha) which was followed by MEL-1 (80.70 ton/ha) at Cumilla. So, those could be advanced to release as variety considering the result.

**Preliminary yield trial of some local cassava**

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

Six local cassava germplasm namely MEL-4, MEL-5, MEL-6, MEL-7, MEL-8 and MEL-9 were evaluated at research field, TCRC, Gazipur during 2022-23 cropping season under PYT. Results of the present study clearly indicated among the germplasms, MEL-6 offered highest yielder (27.17 ton/ha) which was followed by MEL-5 (22.11 ton/ha). So, those could be advanced to release as variety considering the result.

**Collection and evaluation of cassava germplasm**

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

The experiment was conducted at the experimental field of Tuber Crop Research Centre, Regional Agricultural Research Station, BARI, Jamalpur during the cropping season of 2022-23 to develop new high yielding variety. Four collected cassava germplasm viz. ME Jam-001, ME Jam-002, ME Jam-003 and ME Jam-004 were evaluated. Results of the present study clearly indicated among the germplasms, ME Jam-02 produced the highest yield (156.06 t/ha) which was followed by ME Jam-001 (120.10 t/ha). The lowest yield was obtained from ME Jam 003 (28.90 t/ha).

**Hybridization in jicama**

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

Hybridization was done at Gazipur using 5 clones to create variability, and to select superior genotypes in the subsequent generations. At

Gazipur, 48 out of 266 crosses produced berries. In total 21.27g hybrid seeds were produced.

## Conventional Production Technology

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

M. Salim, M. K. Alam, R. Akter, M. M. Islam and S. Akther

An experiment was conducted at the Tuber Crops Research Sub-Centre (TCRSC), Bangladesh Agricultural Research Institute (BARI), Munshiganj during 2022-23 with seven treatments namely  $T_1$  = Control (No weeding),  $T_2$  = Weeding and hilling up (2 times) at 30 and 60 DAP,  $T_3$  = Herbicide + Weeding and hilling up (2 times) at 30 and 60 DAP,  $T_4$  = Sowing lentil,  $T_5$  = 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 (0.069kg/m<sup>2</sup>) fresh biomass of weed accumulation was recorded from  $T_5$  treatment which was followed by  $T_6$  and  $T_7$  treatment. The maximum potato equivalent yield (40.97 t/ha), gross return (Tk. 573639/ha), net return (Tk.385639/ha) and benefit cost ratio (3.06) were found in  $T_5$  treatment which was followed by  $T_6$  and  $T_7$  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 different types of mulching and plant spacing on weed control and yield of sweet potato at Munshiganj region

M. Salim, M. K. Alam, R. Akter, M. M. Islam and S. Akther

An experiment was conducted at the Tuber Crops Research Sub-Centre (TCRSC), Bangladesh Agricultural Research Institute (BARI), Munshiganj during 2022-23 with five types of mulch materials namely  $M_1$  = Rice Straw,  $M_2$  = Water Hyacinth,  $M_3$  = Rice Straw + Water Hyacinth,  $M_4$  = Newspaper 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 find out the suitable combination of mulching and plant spacing on weed control and yield of sweet potato. The maximum root yield (49.59 t/ha) was obtained from treatment combination  $M_4S_2$  which was statistically similar to  $M_3S_2$  and  $M_2S_2$ . Therefore, mulch materials Newspaper with  $S_2$ =60 cm x 30 cm spacing may be practiced to cultivate sweet potato.

### Effect of spacing on seed size potato tuber production under different varieties

M. Salim, M. K. Alam, R. Akter, M. M. Islam and S. Akther

An experiment was conducted at the Tuber Crops Research Sub-Centre (TCRSC), Bangladesh Agricultural Research Institute (BARI), Munshiganj during 2022-23 with four types of spacing like  $S_1$ =75cm x 30cm,  $S_2$ =60 cm x 25cm,  $S_3$ =50cm x 20cm and  $S_4$ =30cm x 15cm with four varieties namely  $V_1$ =BARI Alu-25,  $V_2$ =BARI Alu-37,  $V_3$ =BARI Alu-62 and  $V_4$ =BARI Alu-77 with a view to find out suitable spacing for seed size potato tuber production in Munshiganj region. Results showed that the maximum seed size potato tuber (28-40mm) (% number) was produced by treatment combination  $V_3S_4$  which was at par with  $V_1S_4$ ,  $V_2S_3$  and  $V_2S_4$ . Closer spacing is more suitable for seed size potato tuber production than wider spacing. In case of yield, the maximum tuber yield (44.46 t/ha) was obtained from treatment combination  $V_3S_4$  which was statistically similar to  $V_4S_4$ . Therefore, considering the seed size potato tuber production, final yield and yield contributing characters sowing of potato BARI Alu-25, BARI Alu-37, BARI Alu-62, BARI Alu-79 with closer spacing (30cm x 15cm) may be practiced to cultivate seed size potato tuber in our country.

### Evaluation of potato varieties in raise bed cultivation for adverse climatic condition at Munshiganj region

M. Salim, M. K. Alam, R. Akter, M. M. Islam and S. Akther

An experiment was conducted at the Tuber Crops Research Sub-Centre (TCRSC), Bangladesh Agricultural Research Institute (BARI), Munshiganj during 2022-23 with six treatments namely  $T_1$  = BARI Alu-13,  $T_2$  = BARI Alu-28,  $T_3$  = BARI Alu-29,  $T_4$  = BARI Alu-72,  $T_5$  = BARI



Alu-73,  $T_6$  = BARI Alu-79 with a view to select suitable potato variety (es) for the adverse climatic condition and make the potato production more profitable. Results showed that the maximum potato yield (28.58 t/ha) was found in  $T_6$  treatment which was statistically similar to  $T_5$  and  $T_1$  treatment whereas the lowest potato yield was produced by  $T_3$  treatment. But  $T_6$  treatment i.e. BARI-73 was found very much common scab disease susceptible where 59.04% potato was infected by common scab disease. Therefore, considering capability to survive in adverse climatic condition at the same time good yield and yield contributing characters BARI Alu-13, BARI Alu-28, BARI Alu-29, BARI Alu-72 and BARI Alu-79 may be cultivated to get good early profit from potato production.

#### **Evaluation of BARI Alu-7 (Diamant) from different sources on common scab disease development at munshiganj region**

M. Salim, M. K. Alam, R. Akter, M. M. Islam and S. Akther

An experiment was conducted at the Tuber Crops Research Sub-Centre (TCRSC), Bangladesh Agricultural Research Institute (BARI), Munshiganj during 2022-23 with five treatments namely  $T_1$  = Diamant (BARI),  $T_2$  = Diamant (Private company),  $T_3$  = Diamant (BADC),  $T_4$  = Farmers' Diamant (2<sup>nd</sup> Year),  $T_5$  = Farmers' Diamant (3<sup>rd</sup> Year) with a view to find out the safe sources of seed tuber of BARI Alu-7 (Diamant) to produce common scab free potato and to grow awareness about the common scab diseases among the farmers. Results showed that the maximum potato common scab incidence (47.29%) was found from  $T_3$  treatment which was statistically at par with  $T_5$  treatment and similar to  $T_4$  treatment. In case of scab severity the highest common scab severity (1.55) was observed in  $T_3$  treatment whereas the lowest scab severity (0.78) was found in  $T_1$  treatment. The maximum potato fresh tuber yield (22.88 t/ha) was found from  $T_2$  treatment which was statistically similar to  $T_1$  treatment whereas the lowest fresh tuber yield (13.10 t/ha) was found from  $T_3$  treatment. Therefore, considering the common scab incidence (%), scab severity and fresh marketable yield  $T_1$  and  $T_2$  treatment performed well than other treatments.

#### **Controlling of potato common scab development by sulphur and irrigation regimes in munshiganj region**

M. Salim, M. K. Alam, R. Akter, M. M. Islam and S. Akther

An experiment was conducted at the Tuber Crops Research Sub-Centre (TCRSC), Bangladesh Agricultural Research Institute (BARI), Munshiganj during 2022-23 with eighteen treatments namely  $T_1$  =  $I_1S_0G_1$ ,  $T_2$  =  $I_1S_0G_2$ ,  $T_3$  =  $I_1S_0G_3$ ,  $T_4$  =  $I_1S_1G_1$ ,  $T_5$  =  $I_1S_1G_2$ ,  $T_6$  =  $I_1S_1G_3$ ,  $T_7$  =  $I_1S_2G_1$ ,  $T_8$  =  $I_1S_2G_2$ ,  $T_9$  =  $I_1S_2G_3$ ,  $T_{10}$  =  $I_2S_0G_1$ ,  $T_{11}$  =  $I_2S_0G_2$ ,  $T_{12}$  =  $I_2S_0G_3$ ,  $T_{13}$  =  $I_2S_1G_1$ ,  $T_{14}$  =  $I_2S_1G_2$ ,  $T_{15}$  =  $I_2S_1G_3$ ,  $T_{16}$  =  $I_2S_2G_1$ ,  $T_{17}$  =  $I_2S_2G_2$ ,  $T_{18}$  =  $I_2S_2G_3$  with a view to find out the cultural management of potato common scab using irrigation regimes and application of sulphur-containing fertilizers. Results showed that at 70 DAP, the best performance in terms of mitigating common scab infection was found from the treatment combination  $T_{18}$  =  $I_2S_2G_3$  (28.23%) and the minimum scab severity (0.68) was observed in  $T_4$  =  $I_1S_1G_1$ . At 85 DAP, the treatment combination  $T_{18}$  =  $I_2S_2G_3$  (19.49%) showed the best performance to minimize common scab infection and only (0.67) scab severity was produced by treatment combination  $T_{15}$  =  $I_2S_1G_3$ . At final harvest (95 DAP) only (6.48%) scab incidence was found from  $T_7$  =  $I_1S_2G_1$  and the treatment combination  $T_{18}$  =  $I_2S_2G_3$  showed the promoting performance (0.58) to minimize scab severity. The maximum marketable fresh yield at 70, 85 and 95 DAP was produced by  $T_8$  =  $I_1S_2G_2$  (19.75 t/ha),  $T_{14}$  =  $I_2S_2G_2$  (28.35) and  $T_7$  =  $I_1S_2G_1$  (35.12 t/ha), respectively. Therefore, considering the common scab incidence (%), scab severity and fresh marketable yield sulphur containing fertilizer may be applied at both planting and tuberization stage with shorter and longer irrigation interval to get good fresh yield in our country.  $I_1$ = Shorter irrigation interval (10 days) 30, 40, 50, 60 and 70 DAP,  $I_2$ = Longer irrigation interval (20 days) 30, 50 and 70 DAP;  $S_0$ = No application of Sulphur fertilizers (control);  $S_1$ = Wettable Sulphur (Silica);  $S_2$ = Ammonium Sulphate (Haysulf 80 wp);  $G_1$ = At planting;  $G_2$ = At tuber initiation;  $G_3$ = At both stages.

#### **Integrating biochar and vermicompost on yield and quality of potato**

R. Akter, M. Salim, M. K. Alam, S. Parvin, M. M. Islam and S. Akther

The experiment was conducted at TCRSC, Munshigonj during 2022-2023 to find out the



suitable combination of inorganic fertilizers and organic fertilizers with proper planting technique in a split plot design. Variety (BARI Alu 62, BARI Alu 63, BARI Alu 79) was in main plot and fertilizer combination ( $T_1$ =Control,  $T_2$ = biochar 12 t/ha+vermicompost 0 t/ha,  $T_3$  = biochar 9 t/ha+vermicompost 3 t/ha,  $T_4$  = biochar 6 t/ha+vermicompost 6 t/ha,  $T_5$ = biochar 3 t/ha+vermicompost 9 t/ha,  $T_6$ = biochar 0 t/ha+vermicompost 12 t/ha) was in sub plot with three replications. The result revealed that when 12 t/ha of biochar is used with 0 t/ha<sup>-1</sup> of vermicompost gave the highest yield (39.21 t/ha) whereas the lowest yield (19.91 t/ha) was found in  $T_1$  treatment combination where no biochar and vermicompost were applied.

### **Relaying of different crops with potato at Munshigonj region**

R. Akter, M. Salim, M. K. Alam, S. Parvin, M. M. Islam and S. Akther

The experiment was conducted during rabi season of 2022-2023 at Tuber Crop Research Sub-Centre, Munshigonj to find out suitable intercrop combination for higher profitability and economic return. Six relay crop combinations ( $T_1$ = Relaying maize with potato,  $T_2$ = Relaying mung bean with potato,  $T_3$ = Relaying jute with potato,  $T_4$ = Relaying okra with potato,  $T_5$ = Relaying pumpkin with potato,  $T_6$ = Relaying brinjal with potato) were evaluated in the present study. As only one variety is used in this study and the experiment was not completed so yield did not vary significantly and we couldn't calculate potato equivalent yield. The highest potato yield (35.23 t/ha) was obtained from  $T_1$  treatment and lowest (33.12 t/ha) from  $T_6$  treatment.

### **Sensory evaluation of sweet potato shoot as leafy vegetables**

S. Parvin, Z. Alam, M. Mollah, K. Alam, S. Sultana, A. 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 BARI

Mistialu 11 (scored 4.8) performed better as leafy vegetables followed by sweet potato lines AnIg<sub>22</sub> (scored 5.2) and BARI Mistialu 17 (scored 4.3). Vit-c and anthocyanin ranged from 13.6 to 76.9 and 0.11 to 1.55 mg/100g, respectively for while carbohydrate varied from 2.35 to 6.35%. These results reveal that leaves provide appreciable amount of nutrients which could be included in diets to base diets for the nutritionally vulnerable in rural and urban communities.

### **Effect of planting time and spacing on the yield BARI Mistialu-17**

S. Parvin, M. H. Khan, Z. Alam and S. Akhter

The experiment was conducted at TCRC, Gazipur during rabi 2022-23 to find out optimum date of planting, and spacing for higher yield of Anthocyanin content BARI Mistialu-17. Four levels of planting dates viz. D1 = 15 October, D2 = 1st November, D3 = 15 November and D4 = 1st Dec, D5 = 15 December along with three spacing viz. S1 = 60x30 cm, S2 = 60x40 cm, S3 = 60x50 cm were included in the study. The results revealed that among all treatment combinations 15 October planting date with 60x30 cm spacing combination performed better in considering yield (34.63 t ha<sup>-1</sup>) yield of BARI Mistialu-17.

### **Effect of different organic manure and chemical fertilizers on the yield of BARI Mistialu-17**

M. T. Rahman, M. M. Islam, M. R. H. Mondol, M. Z. H. Prodhan and S. Akhter

An experiment was conducted with six (6) types of organic manures available in the market and inorganic fertilizers where anthocyanin rich BARI Mistialu-17 was used as test crop. There were seven treatment combinations viz.  $T_1$  (Control, native nutrient),  $T_2$  (RD + Cowdung @ 10 t/ha),  $T_3$  (RD + Compost @ 5 t/ha),  $T_4$  (RD + Poultry manure @ 5 t/ha),  $T_5$  (RD + Polli Joibo Sar @ 5 t/ha),  $T_6$  (RD + Vermicompost @ 5 t/ha) and  $T_7$  (RD + Biochar @ 5 t/ha) were included in the experiment to find out suitable fertilizer recommendations for BARI Mistialu-17. The experiment was implemented at Tuber Crops Research Sub-Station, Seujari, Bogura which is under Level Barind Tract (AEZ-25) region during the rabi season of 2022-2023. Sweet potato vines were sown on 28 November 2022. The yield contributing characters of sweet potato were significantly influenced by the application of

organic manure and inorganic fertilizer. The highest vine length (72.45 cm), root wt. /hill (0.38 kg/hill), fresh weight (3.62 kg) was observed in T<sub>4</sub> treatment (RD + PM @ 5 t/ha). The highest yield (26.5 t/ha) and dry matter (% DM) content (31.1%) was also found in T<sub>4</sub> where poultry manure @ 5 t/ha along with RDCF was applied. According to cost and return analysis, among the treatments the highest gross margin (Tk. 737,400/ha) and BCR (5.14) was estimated from T<sub>4</sub> (RD + Poultry manure @ 5 t/ha) treatment.

#### **Impact of organic and inorganic fertilizers on growth, yield and economics of BARI Alu-90**

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

Ten treatments viz. T<sub>1</sub>=Control, T<sub>2</sub>=Recommended chemical fertilizers + 10 t ha<sup>-1</sup> Cow dung, T<sub>3</sub>=50% Recommended chemical fertilizers+150% of Cow dung, T<sub>4</sub>=Recommended chemical fertilizers+100% Vermicompost, T<sub>5</sub>=50% Recommended chemical fertilizers+150% of vermicompost, T<sub>6</sub>=Recommended chemical fertilizer+100% ACI organic fertilizer bumper, T<sub>7</sub>=50 % Recommended chemical fertilizer+150% ACI organic fertilizer bumper, T<sub>8</sub>=Recommended chemical fertilizer+50% Cow dung+50% Vermicompost, T<sub>9</sub>= Recommended chemical fertilizer+50% Cow dung+50% ACI organic bumper, T<sub>10</sub>=Recommended chemical fertilizer+50% Vermicompost+50% organic fertilizer bumper were evaluated at TCRSC, Bogura during 2022-23 to determine a suitable dose of fertilizers for enhancing the productivity and profitability of BARI Alu 90. The highest gross margin (Tk 549725/ha) and BCR (2.95) was estimated from 50% Recommended chemical fertilizers + 150% of cow dung.

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

M.R.H. Mondol, M. S. Alam, M.T. Rahman, M.A. Akther, M.M. Sultana, S. parvin and M.Z.H. Prodhan and S. Akhter

Two varieties viz. V<sub>1</sub> = BARI Mukhikachu-1 and V<sub>2</sub> = BARI Mukhikachu-2 along with five levels of sowing dates viz. D<sub>1</sub> = 10 February, D<sub>2</sub> = 20 February, D<sub>3</sub> = 2 March, D<sub>4</sub> = 12 March and D<sub>5</sub> = 22 March were evaluated at TCRSC, Bogura during 2021-22 to find out suitable variety and

optimum sowing date for enhancing the productivity of mukhikachu. In considering yield, BARI Mukhikachu-2 on 10 February sowing combination showed better performance (18.00 t ha<sup>-1</sup>) among the all-treatment combination.

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

M. A. Akhter, M.M. Sultana, S. parvin and M.Z.H. Prodhan and S. Akhter

Banana-potato intercropping is the popular cultivation system in Bogura. A field experiment was conducted with six newly developed varieties to find out their performance in banana-potato intercropping system. Among the tested varieties BARI Alu-86, BARI Alu-54 and BARI Alu-84 produced higher yield.

### **Organic Production Technology**

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

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

An experiment was conducted to evaluate the efficacy of seven botanical namely *Lantana camara*, *Eucalyptus globulus*, *Tagetes minuta*, *Pyrethrum* flowers, *Azadirachta indica*, *Nicotiana tabacum* and *Mentha viridis* against potato tuber moth including two checks under storage conditions at Munshiganj. BARI Alu 36 was used as material produced 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 plant extract treated with talcum powder/1 kg tubers. The tubers were kept in the wooden box in ambient condition for natural infestation by Potato Tuber Moth. Data recording yet not completed. Till today, tuber infestation was reduced in botanicals and the best performance against PTM infestation was observed in case of lantana and neem.

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

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

Eight different botanical pesticide namely *Mentha viridis*, *Allium cepa*, *Azadirachta indica*, *Datura stramonium*, *Nicotiana tabacum*, *Lantana camara*,

Citrus limon and Corchorus capsulari were evaluated to investigate their efficacy against Phytophthora infestans both in field and in vitro condition. The experiment was executed at TCRC, BARI, Joydebpur during the year of 2022-23. Plant extract powder (@ 2%) was chosen as the treatment under field condition while different concentrations (0.2 to 0.6%) of promising botanicals were tested in in Vitro condition. In laboratory, neem, lantana and pudina was found to be effective to suppress the mycelium growth. In field condition, lantana showed the best performance to reduce disease severity (2.81%) and the highest tuber yield (24.4 t/ha) which was followed by neem.

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

M. Salim, M. K. Alam, R. Akter, S. Parvin, M. M. Islam and S. Akhter

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 2022-23. Two bio-fertilizers namely Azotobacter and Phosphorus Solubilizing 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 ton/ha and 8 ton/ha were chosen as the treatment. The number treatment was 8 namely T<sub>1</sub> : Control, T<sub>2</sub> : Vermicompost 10 t/ha, T<sub>3</sub> : Trico-compost 10 t/ha, T<sub>4</sub> : ACI Organic Fertilizer 10 t/ha, T<sub>5</sub> : Bio-fertilizer (Azotobacter + PSB), T<sub>6</sub> : Vermicompost 8 t/ha + (Azotobacter + PSB), T<sub>7</sub> : Trico-compost 8 t/ha + (Azotobacter + PSB), T<sub>8</sub> : 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 (27.95 t/ha) tuber yield was obtained from T<sub>6</sub> treatment which was treated with (Vermicompost 8 t/ha + (Azotobacter + PSB) was at par with T<sub>8</sub> and statistically similar to T<sub>7</sub> and T<sub>5</sub> treatment whereas the minimum fresh tuber yield (13.24 t/ha) was produced by treatment T<sub>1</sub> (control). Moreover, the highest gross return (Tk. 1006200/ha), net return (Tk. 477200/ha) and Benefit Cost Ratio (BCR)-1.90 were found from T<sub>6</sub> treatment which was followed by T<sub>8</sub> treatment (Tk.

994680/ha) and net return (Tk. 465680/ha) and Benefit Cost Ratio (BCR)-1.88.

#### **Evaluation of sweet potato varieties under organic production system**

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

Fifteen (15) sweet potato varieties were evaluated to find the superior variety under organic cultivation system. The experiment was executed at 'Organic Block', TCRC research field, Gazipur over the period from November, 2022 to April 2023. 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 (24.72t/ha) was obtained from the variety BARI SP 12 followed by BARI SP16 (21.47 t/ha) and was statistically different from all other varieties including check.

### **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, M.S. Hossain, M.M.H. Molla, M. M. Islam, and S. Akhter

A survey work was conducted to observe the incidence of potato diseases in the northern part of Bangladesh. Late blight disease incidence was medium in Panchagarh, Thakurgaon, and Nilphamary and lower in Rangpur, Kurigram, Dinajpur, Lalmonirhat and Gaibandha districts. Bacterial wilt and Blackleg disease incidence were medium in the early season of potato cultivation whereas lower in season. Common scab, mosaics, stem rot, early blight, stem canker, and black scurf, PVY were less disease incidences of potato in Bangladesh.



## Fungal disease management

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

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

The Detached Leaf Bioassay (DLBs) of *Phytophthora infestans* on twenty three varieties from BARI namely CIP-402, CIP-449, CIP-401, CIP-446, CIP-450, CIP-444, CIP-448, CIP-447, CIP-445, CIP-403, BARI Alu-91, BARI Alu-77, BARI Alu-101, BARI Alu-46, Katahdin, BARI Alu-72, BARI Alu-53, BARI Alu-25, BARI Alu-8, BARI Alu-90, BARI Alu-13, BARI Alu-7 and BARI Alu-102 was conducted to observe their performance in controlling late blight disease causing pathogen under laboratory conditions. The tested varieties were found resistant and susceptible to *P. infestans* with various level ranged from 68-100%. BARI Alu-90 and BARI Alu-91 provided complete resistant to *P. infestans* after 10 days of incubation.

### Screening of potato varieties and germplasms against late blight

M.M. Rahman, M.Z. Masud, A. K. Saha, M.M. Begum, M.S. Hossain, M.M.H. Molla, M. M. Islam, and S. Akhter

Late blight of potato, caused by *Phytophthora infestans* (Mont.) de Bary, is one of the most important diseases of potato (*Solanum tuberosum* L.) in Bangladesh. The experiment was conducted under natural field condition in the isolated field of BSPC, BARI, Debiganj, Panchagarh to evaluate 40 (forty) potato varieties/germplasm/cultivars against late blight disease during 2022-23 crop season. None of the variety/germplasm was found immune. BARI Alu-46, and BARI alu-90 were found highly resistant and BARI alu-91 was found resistant. but BARI Alu- 57 and BARI Alu-77 were moderately resistant. Yield of BARI Alu-46 produced the significantly highest yield (43.80 t ha<sup>-1</sup>) and it was almost similar with BARI Alu-90 (40.30 t ha<sup>-1</sup>), followed by BARI Alu-77 (33.75 t ha<sup>-1</sup>) and BARI Alu-53 (25.92 t ha<sup>-1</sup>).

### Efficacy of different biofungicides against soil borne fungal diseases at seedling stages of potato

M. M. Begum, M. I. Hossain, M. Z. Hoque, M.M.H. Molla, M. M. Islam, and S. Akhter

An experiment was conducted at TCRC, BARI, Gazipur to find out the effective management practices in controlling seedling disease var. Diamant. A total of twelve (12) treatments including farmer practices were selected as different combinations of seed and soil treatments. The treatment T<sub>10</sub> and T<sub>5</sub> found to be more effective to control potato disease the incidence.

## Bacterial Disease Management

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

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

Sixteen potato varieties viz. BARI Alu-7, BARI Alu-8, BARI Alu-13, BARI Alu-25, BARI Alu-29, BARI Alu-36, BARI Alu-37, BARI Alu-40, BARI Alu-41, BARI Alu-47, BARI Alu-48, BARI Alu-49, BARI Alu-56, BARI Alu-62, BARI Alu-72, and BARI Alu-90 were evaluated to screen resistant varieties against scab disease at Tuber Crops Research Centre, BARI, Joydebpur, Gazipur during 2022-23 cropping year under the field condition at Rabi season. Considering scab incidence, BARI Alu-13, BARI Alu-25, BARI Alu-36, BARI Alu-37, BARI Alu-41, BARI Alu-47, BARI Alu-49 and BARI Alu-62 performed better and found completely free from common scab of potato.

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

M.M Rahman, M. M. Begum, M.Z. Masud, M.N. Amin, A. K. Saha, M. M. Islam (Ppd), M.S. Hossain, M.M.H. Molla, M. M. Islam, and S. Akhter

Bacterial wilt (BW) caused by the bacteria *Ralstonia solanacearum* is the most important disease of potato (*Solanum tuberosum* L.) in Bangladesh especially for table-stock purposes in the early season planting. More than 100 early bulking varieties are cultivated in different regions only in Bangladesh as early-season cultivars. Potato growers usually cultivate 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 earlier than the normal growing season



temperature and humidity prevail higher in the environment thus crops affected highly by BW ultimately growers economically suffered. Fourteen BARI-released early bulker Potato varieties along with one local variety seven were evaluated at farmers' fields, Debiganj, Panchagarh under natural inoculum pressure to find out suitable early season varieties against bacterial wilt disease. Among the tested varieties all are affected by bacterial wilt disease. BARI Alu-13 (Granola), BARI Alu-31 (Sagita), BARI Alu-44 (Elgar) BARI Alu-73, BARI Alu-79, and BARI Alu-62 can be cultivated as early-season varieties for table-stock purposes because of their higher yield and other yield contributing characteristics after facing the disease. Farmer cultivated BARI Alu-28 (Lady Rosetta), BARI Alu-29 (Courage) and Local variety seven as early-season varieties due to their higher market value even though they produce lower yields and showed higher disease.

## **Viral Disease Management**

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

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

Twelve potato lines were evaluated against PLRV and PVY to find out the resistant source (s) at Joydebpur, Gazipur during 2022-23. Based on field observation and according to ELISA test, the four lines namely 15.126 and 15.92 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 (third progeny)**

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

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 2022-23 at Joydebpur. The hybrid clones namely 16.16, 16.28, 17.5, 17.24 and 16.7 performed better and found free from any other viruses.

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

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

Fifteen 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 18.43 found free from any other viruses.

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

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

A total of three exotic lines along with check Diamant were evaluated against PLRV and PVY to find out the resistant source (s) at Joydebpur, Gazipur during 2022-23 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, A. H. Khan, S. Alam, Z. Alam, M.M.H. Molla, M. M. Islam, and S. Akhter

An experiment was conducted to screen the sweet potato lines against different virus diseases in 2022-23 cropping season at Tuber Crop Research Centre, Bangladesh Agricultural Research Institute, Gazipur. Fourteen sweet potatoes germplasms were evaluated against virus diseases and only mild mosaic virus was observed in the field. Among 14 tested lines, eight lines SPE-103, H9.48/11, MOZ-1.9, BARI SP-12, H 9.10/12, h 9.7/12, BARI SP-13, H 16.ej/10, and H 5.ej/10 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, M.M.H. Molla, M. M. Islam, and S. Akhter

A total of 760 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). Among the tested samples, virus free found about 80% and 20% found infected with different alone and combine viruses. Mixed virus found the highest about 45% followed by PVX (23%), PVS (20%), PVY (9%), PLRV (2%) and PVM (1%).

### Post-Harvest Management and Storage

#### Monitoring of different released potato varieties against post-harvest diseases

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

Thirteen potato varieties namely BARI Alu-7, BARI Alu-8, BARI Alu-13, 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 post harvest rottage and shelf life at Joydebpur under natural storage conditions during 2022-23. All tested varieties found to be better for 90 days of preservation with lower rottage value, while BARI Alu-62 and BARI Alu-91 found suitable for long shelf life up to 180 days followed by BARI Alu-90.

### Insect pest Management

#### Development of biorational based management approach against Root aphid (*Rhopalosiphum rufiabdominalis*) attacking potato

M.Z.H. Prodhan, F. Yasmin, M.M.H. Molla, M. M. Islam, and S. Akhter

The field trial was conducted at Joypurhat to find out the most effective management option for root aphid on potato with 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,  $T_4$ :  $T_1$  + 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 lowest infestation, highest yield and gross margin was obtained from the treatment  $T_5$  (Thiamethoxam). Biorational based treatments also showed minimum infestation over control.

#### Evaluation of advanced materials of potato against potato cutworm (*Agrotis ipsilon*) in field condition

M.Z.H. Prodhan, F. Yasmin, M.M.H. Molla, M. M. Islam, and S. Akhter

Nineteen germplasms namely 15.11, 15.14, 15.16, 16.16, 16.28, 16.33, 16.62, 16.7, 16.9, 33.28, 33.33, Alcander, Asterise, Deli Red, Hind, Innovator, Katadin, Rslin and Twinner along with nine varieties, BARI Alu-7 (Diamant), BARI Alu-13 (Granola), Al russet (BARI Alu-97), BARI Alu-98 (Arigona), BARI Alu-99 (HZD-061249), BARI Alu-100 (Ottawa), BARI Alu-101 (Blackberry), BARI Alu-102 (Red marker) and Lalpakri were evaluated against cutworm at TCRSC, Bogura. Germplasms, 33.28 (1.07%), Katadin (1.19%), Lalpakri (0%), and BARI Alu-100 (Ottawa) (0.03%) showed comparatively lower infestation.

#### Development of management package against sweet potato weevil in field condition

M.Z.H. Prodhan, F. Yasmin, M.M.H. Molla, M. M. Islam, and S. Akhter

The trial was carried out at TCRSC, Bogura to develop eco-friendly, cost effective and compatible IPM measures for the management of sweet potato weevil with five treatments viz.  $T_1$ : Pheromone trap + Earthing-up three times (30, 60 and 90 DAP),  $T_2$ : Pheromone trap + Soil REcharge @ 3g/L of water at 45 days and 90 days after planting,  $T_3$ : Application of Phytomax (Neem seed extracts 0.1% Azadiractin) @ 2 ml/L of water at 60 and 90 days,  $T_4$ : Application of Chlorantraniliprole (Ferterra 0.4G @ 10 kg/ha at 60 and 90 days after planting with irrigation,  $T_5$ : Untreated control. All

the treatments had lower infestation and higher yield over control. In case of Marginal Benefit Cost Ratio, the highest value was also obtained from T<sub>4</sub> (45.81) followed by T<sub>2</sub> (38.10). Huge number of moth captured in pheromone traps. Average number of captured weevil was 14.85/trap/week (average of 14 weeks).

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

M.Z.H. Prodhan, F. Yasmin, M.M.H. Molla, M. M. Islam, and S. Akhter

The trial was carried out to find out an effective management approach for potato cutworm at TCRSC, Bogura with six treatments viz. T<sub>1</sub>= Poison bait: (Rice husk 5kg + sugar 200g + Cartap + water) (Three times at 15 days interval starting from after emergence of the seedling), T<sub>2</sub>= Chlorantraniliprole (Ferterra 0.4G)@ 10 kg/ha application during land preparation and earthing up, T<sub>3</sub>=Sex pheromone mass trapping, T<sub>4</sub>= T<sub>1</sub>+ T<sub>3</sub>, T<sub>5</sub>= T<sub>2</sub>+ T<sub>3</sub>, T<sub>6</sub>= Untreated Control. Very little infestation observed (0.83-5.85%). All treatments had minimum infestation over control. Yield did not varied significantly due to minimum infestation.

#### **Management of potato tuber moth (PTM) in storage condition**

M.Z.H. Prodhan, F. Yasmin, M.M.H. Molla, M. M. Islam, and S. Akhter

The trial was carried out at TCRSC, Bogura to find out an effective management approach for potato tuber moth (PTM) in storage with seven treatments viz. T<sub>1</sub> = Mass trapping for potato tuber moth with attract and kill method (0.2% Abamectin, 0.16%, Trans-4, cis-7-tridecadienyl acetate and trans-4 cis-1, cis-10 tridecatrienyl acetate) (Applied 2g, 1 feet above the stored tubers, supporting by wooden pole and replaced every 12 weeks), T<sub>2</sub> = Pheromone mass trapping, T<sub>3</sub> = Spraying of Abamectin @ 1.5 ml/L of water (Spray to wet tuber and then dried in shade), T<sub>4</sub> = Potato tubers covered with thin layer of dry sand (0.5cm sand layer), T<sub>5</sub> = Potato tubers covered with dried *Lantana camara* shoot, Chop lantana shoots (stem, leaves, and flowers) in small pieces (3-5 cm) and shade dry them for 4-5 days. Cover the upper surface of tubers with dried lantana (30g/kg seed tuber), T<sub>6</sub> = Application of *Bacillus thuringiensis* subsp. *kurstaki* and T<sub>7</sub> = Control. The lowest infestation was found in T<sub>4</sub>

followed by T<sub>2</sub>. Treatment T<sub>2</sub>, T<sub>5</sub>, T<sub>3</sub> and T<sub>6</sub> had also effective against PTM over control. Average no of trapped moth was 65.54/trap/week (mean of 13 Weeks)

#### **Survey and monitoring of new pest arthropods infesting tuber crops**

M.Z.H. Prodhan, F. Yasmin, M.M.H. Molla, M. M. Islam, and S. Akhter

Survey and monitoring was conducted to identify new insect pests attacking tuber crops at different tuber crops growing areas. The insects was brought out to the laboratory, reared and observed their morphology and nature of infestation. Six new insect pests (one in potato and five on sweet potato) was found to attack tuber crops in Bangladesh.

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

M.Z.H. Prodhan, F. Yasmin, M.M.H. Molla, M. M. Islam, and S. Akhter

Ten advanced materials H<sub>5.ej</sub>/10, H<sub>6.52</sub>/11, H<sub>9.7</sub>/12, H<sub>9.10</sub>/12, H<sub>9.48</sub>/11, H<sub>16.ej</sub>/10c, Moz1.15, Moz1.9, SPM-103, SPO-104 and eight varieties (B.SP-4, B.SP-8, B.SP-10, B.SP-12, B.SP-14, B.SP-16, B.SP-17 and Local) were evaluated against sweet potato weevil at TCRSC, Bogura. Genotypes, SPM-103, Moz1.9, H<sub>9.7</sub>/12 showed comparatively less infestation than other advanced materials/varieties.

#### **Studies on succession of insect-mite pests on jicama**

M.Z.H. Prodhan, F. Yasmin, M.M.H. Molla, M. M. Islam, and S. Akhter

The trial was conducted at TCRSC, Bogura to identify of insect pests attacking jicama under different growth stages. The crop was kept unprotected. Ten insect pests i.e. Whitefly, Leaf roller, Jassid, Thrips, Monolepta beetle, Grass hopper, Leaf weevil, Mealy bug, Common cutworm and Pod borer were found to attack the crop. All pests were appeared at vegetative and fruiting stage and caused minor damage.



## Tuber Crops Biotechnology and Seed Production

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

M.M.H. Molla, F. Akhter, S. Islam, M. M. 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 19305 disease free plantlets of BARI released potato varieties were planted at Breeder Seed Production Centre, Debiganj for G<sub>0</sub> generation development during 2022-2023. 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, M. M. Islam and S. Akhter

A total of sixty-eight meristems were isolated and cultured from three indigenous varieties namely Shilbilatiand, Lalpakhri and sadaguti on basal MS media. DAS ELISA test has been conducted of these meristem derived plantlets and nine virus free plantlets of shilbilati were obtained, ten plantlets of sadaguti had only one virus (PVS), lalpakri showed three viruses.

### Tissue culture of cassava (*manihot esculenta crantz*) germplasm

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

This study was conducted at the tissue culture lab, TCRC in BARI during 2022-2023 with a view to establishing a protocol for *in vitro* multiple shoot production. Nodal explants in liquid MS medium supplemented with 0.05 mg/l (T<sub>3</sub>) TDZ showed better performance for expand explant after 7 days of culture. MS media supplemented with 1.5 mg/l BAP and 0.20 mg/l GA<sub>3</sub> (T<sub>4</sub>) showed highest number of shoots/explant (average 7 shoots/explant) after 7 days of culture.

### *In vitro* propagation of late blight resistant and heat tolerant potato varieties and standardization of nutrient film technique protocol for quality seed production round the year

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

The range of tuber production per plant and tuber weight (g) of the varieties were 52.42 to 58.50 and 288.92 to 330.50 (g), respectively. Among the varieties BARI Alu-46 performed better compared to BARI Alu-53 and 73. Total harvested tubers were 2074 which was 13.87Kg. 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 (28.58) harvested on June 12, 2023, from the variety of BARI Alu-53 followed by the same variety (23.50) on April 26, 2023. Similarly, the highest weight of tubers was found on April 6, 2023, from the variety of BARI Alu-46 (88.75 g) followed by BARI Alu-53 (48.93 g).

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

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

This study was conducted at the tissue culture lab, TCRC in BARI during 2022-2023 with a view to establish a protocol for *in vitro* multiple shoot production from sprout tip of mukhikachu and olkachu. For mukhikachu maximum number of shoots (5-6) per explant was obtained from MS media supplemented with 8 mg/l 6- benzyl amino purine (BAP) and 0.5 mg/l Indole butyric acid (IBA) after 4 weeks days of culture and maximum number of roots (22) was obtained from ½ MS supplemented with 0.5mg/l IBA after 4 weeks of culture. Minimum 4 days recorded for shoot initiation of olkachu when explants were cultured on MS media supplemented with 8 mg/l 6- benzyl amino purine (BAP) and 0.5 mg/l Indole butyric acid (IBA).

### Molecular characterization of BARI released sweet potato varieties using SSR marker

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

The study has been conducted at Molecular Biology Lab, TCRC, BARI, Gazipur during 2022-

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

#### **Fingerprinting of BARI released potato varieties using SSR marker**

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

The study has been conducted at molecular lab, TCRC, Gazipur using a total of 83 BARI released potato varieties. To determine the genetic diversity of these varieties, 25 SSR markers were selected. DNA finger printing has been conducted using 12 SSR markers.

#### **Secondary yield trial (SYT) of late blight resistance potato derived from QTL mapping populations tb8, tb10 and tb17**

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

A total of 38 lines from the population of TB8, 10, and 17 were planted both at BSPC and TCRC. In TCRC there was no late blight infection during this year. Only late blight was found from the BSPC location. Significant variations were found for the trait of rAUDPC\*100, tuber number, tuber weight and yield. Yield and the rAUDPC had been reported here. Some lines had excellent late blight resistance with good agronomic traits. Out of 38 lines 16 lines had less than 10% percent infection where zero percent was 3. Some lines produced more than 40 t/ha tuber yield. 14 lines (TB10-019, TB10-039, TB10-075, TB10-082, TB10-083, TB10-103, TB10-21B, TB10-89A, TB10-89B, TB10-90A, TB17-29A, TB17-29B, TB8-003A and TB8-020) were selected to evaluate next year 2023-24.

#### **Preliminary yield trial (PYT) of heat tolerant potato germplasm derived from MAS**

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

Eighty-five crosses among the late blight and heat tolerant varieties were made in 2019-20. TPS was planted and tuberlets were produced from those crosses at BSPC in 2020-21. From the evaluation of those lines at BSPC in 2019-20 and 2020-21 some genotypes were discarded based on the yield performance, and size and shape of the tuber. A total of 85 lines were finally selected from the field evaluation of 2021-22 of BSPC. Yield was observed from plants during the evaluation. Based on the tuber size, shape, colour and expected yield, TB59-9, M2-34 (2), M3-48 (2), TB70-1 (2), TB63-15(15), TB38-12 (1), TB67-55, TB63-43, M3-15.49, TB62-8, TB64-04 and TB28-37 lines were selected finally. All the selected lines stored at BSPC to set up the experiment next year as a PYT of heat tolerant variety development program.

#### **Molecular diagnosis and study of genetic diversity of potato viruses in Bangladesh**

S Islam, F. Akhter, M. M. H. Molla., M.M. Begum, M.M. Rahman, M. M. Islam 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, 2021-22 and 2022-23. Most of the germplasm produced virus symptoms and found PVY, PLRV after ELISA test. RNAs were isolated from infested tubers and identified the viruses from the samples. RNA samples were sent abroad and sequenced for the genetic diversity analysis. Data are in hands and analyses are being run at TCRC.

#### **Identification and characterization of r-genes for late blight disease of potato germplasm**

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

Resistant varieties along with susceptible varieties were planted in TCRC, Gazipur in greenhouse to identify the r-genes. Resistant varieties along with susceptible varieties were planted in RARS, Rangpur in 2020-21. From that year the highest rAUDPC was found in non-spray plots of BARI Alu-25 (80.4) followed by Katahdin (73.18) Percent yield loss ranges from 2.55-79.12. The lowest yield loss was found in BARI Alu-46

(2.55%) followed by BARI Alu-91 (26.52%). R-genes from those potato germplasms was identified through PCR- based molecular markers. Almost every germplasm had R-genes against late blight, but all were not found effective in late blight control. Only the R-gene had defeated action in the field found effective to tolerate late blight of potato. Defeated R-gene needed to control late blight of potato. PCR analysis was done and found Phu6, apbt, stol, and blb1 R-gene in BARI Alu-46, 53, and 57.

#### **Marker assisted selection (MAS) of disease resistance r-genes in tetraploid bio-fortified potato for late blight and virus**

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

TCRC developed late blight resistant variety BARI Alu-BARI Alu-53 and BARI Alu-77, virus resistant advanced lines, M2-28 and M2-94, anthocyanin rich potato, BARI Alu-101 recently. All the late blight, virus resistance, anthocyanin rich varieties and advanced lines of TCRC potato germplasm were planted in the crossing block November and December of 2022-23 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, 16 crosses were found success. The total number of TPS was 3660 from the weight of 16 family's 2.266g TPS.

#### **Secondary observation trial (50 hills) with late blight resistant clonal potato hybrids (fics)**

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

TCRC developed late blight resistant variety BARI Alu-46, BARI Alu-53, BARI Alu-77, BARI Alu-90 and BARI Alu-91. Several crosses were made among the late blight resistant varieties and with the susceptible varieties, BARI Alu-7 and BARI Alu-25. A total of 33 lines from the population late blight resistance population was planted at BSPC. Late blight infection was found in BSPC location. From the LBR families, significant variations were found for the trait of rAUDPC\*100, tuber number, tuber weight and yield. Yield and the rAUDPC had been reported here. Some lines had excellent late blight resistance with good agronomic traits. Out of

33 lines 6 lines had less than 10% percent infection (TB27-5, TB31-13, TB31-2, TB37-26, TB49-10, TB82-1). Some lines produced more than 40 t/ha tuber yield which was even greater than BARI released late blight resistant varieties.

#### **Preliminary yield trial (PYT) of late blight resistance potato germplasm (tb11) derived mas**

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

TB11 was developed from the cross of BARI Alu-46 and BARI Alu-53. A total of 45 lines from the population of TB11 was planted both at BSPC and TCRC. In TCRC there was no late blight infection during this year. Only late blight was found from the BSPC location. Significant variations were found for the trait of rAUDPC\*100, tuber number, tuber weight and yield. Yield and the rAUDPC had been reported here. Some lines had excellent late blight resistance with good agronomic traits. Out of 45 lines 28 lines had less than 10% percent infection where zero percent was 19. Some lines produced more than 40 t/ha tuber yield.

#### **Regional yield trial of combined pvv and plrv resistance germplasms**

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

The genotypes of M2, and M3 populations had PVY and PLRV R-gene from MSR061-01 and Alca Tarma, respectively and they segregated in the population. Location wise yield performance was 36.60, 35.57 and 31.84 t/ha in Gazipur, Debiganj and Bogura, respectively. Genotypic variations were also found significant for all the traits. The M2-28 produced the highest yield at 65 DAP (23.72 t/ha). Yield from the lines of M2-23, M2-28, and M2-62 was produced highest among these lines. When comparing locations and lines on an average M2-23, M2-28, M2-62, and M3-34 produced higher yield than others. More than 20% dry matter percent found in M2-23, M2-28, M2-62, M3-34, BARI Alu-7 and BARI Alu-28.

#### **Participatory variety selection of combined pvv and plrv resistance germplasms**

S. Islam, M.M. Molla, F. Akhter, M. Rahman, M.M. Rahman, S. Naznin, M.Z.H. Prodhan, M. M. Islam 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 the 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 can be released in Bangladesh to improve nutritional security of the country.

### **Secondary observation trial (50 hills) with heat tolerant clonal potato hybrids (f1c3)**

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

Eighty-five crosses among the late blight and heat tolerant varieties were made in 2019-20. TPS was planted and tuberlets were produced from those crosses at BSPC in 2020-21. From the evaluation of those lines at BSPC in 2019-20 and 2020-21 some genotypes were discarded based on the yield performance, and size and shape of the tuber. A total of 85 lines were finally selected from the field evaluation of 2021-22 of BSPC. Yield was observed from plants during the evaluation. Based on the tuber size, shape, colour and expected yield, TB59-9, M2-34 (2), M3-48 (2), TB70-1 (2), TB63-15(15), TB38-12 (1), TB67-55, TB63-43, M3-15.49, TB62-8, TB64-04 and TB28-37 lines were selected finally. All the selected lines stored at BSPC to set up the experiment next year as a PYT of heat tolerant variety development program.

### **Selfing in diploid potato germplasm**

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

Selected diploid lines were planted at TCRC and BSPC. Total planted genotypes were 10 in both places. Most of them did not flower at all in both locations. Some of them produced flowers but there was no viable pollen to self them. Rest of them produced pollen but did not set berry. When selfing, some genotypes were found self-compatible. Due to self-incompatibility, one genotype did set berry this year at both locations.

### **Preliminary yield trial (pyt) of diploid potato germplasm**

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

Diploid potato germplasms were introduced from Michigan State University in 2017-18 and planted in BSPC to get tubers. High yield tuber producing lines were selected to plant in the crossing block both at BSPC and TCRC. From the evaluation of those lines at BSPC in 2018-19, 2019-20 and 2020-21 some genotypes were discarded based on the virus infection, yield performance, and size and shape of the tuber. In this year of 2022-23, 30 genotypes were planted and genetic variations for tuber number, tuber weight per plant and yield were found to be significant. The distribution was normal in TCRC for tuber number whereas left skewed in BSPC, but for the trait of tuber yield, the distribution was again left skewed at both locations. In BSPC, 11 genotypes and in TCRC only 7 genotypes produced more than 20 t/ha tuber yield.

### **Morpho-molecular characterization of BARI released varieties and developed advanced panikachu line**

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

The study was conducted at Molecular Biology Lab, TCRC, BARI, Gazipur during 2022-23. 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.

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

F. Akhter, M.M.H. Molla, S. Islam, M. M. 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). MS+ 2.0mg/l BAP +0.5mg/l Kn showed the best results in the case of no of nodes and no. of leaves/plantlet for both varieties, BARI Misti Alu-4 and BARI Misti Alu-8.

Internodes, petioles, leaf segments of *in vitro* plantlets were used for callus formation. Explants cultured on 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.

#### **Performance of potato varieties for mini-tuber production in aeroponic technique**

M.H. Rashid, F. Akhter, M.M.H. Molla, M.M. Islam 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. After 120 DAP, BARI Alu-72 gave the highest number (238) mini-tuber which was 1323 gram and BARI Alu-101 gave 119 mini-tuber of 1037. From this structure a total of 357 out of 2360 g mini-tuber was obtained within that time period. It will be continued till 180 DAP and when conclusion will be drawn.

#### **Production and maintainance of minor crops seed**

M.H. Rashid, A.K.M.M Rahman, F. Yasmin, M.M.H. Molla, M.M. Islam 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 337.00 kg yam seed tuber were produced from mentioned varieties and advanced lines and 10,900 stem cuttings were produced from cassava varieties and advanced lines on research field of TCRC, Gazipur.

#### **Production of nucleus seed potato (mini tuber, G<sub>0</sub>) using *in vitro* plantlet**

M. Rahman, M.W. Rahman, M.A. Halim, M.S. Hossain, M.M.H. Molla, M.M. Islam and S. Akhter

This work was carried out to produce high quality Mini tuber from *in vitro* plantlet. A total of 4665 kg mini-tubers were produced from 44875 plantlets

during 2022-23 cropping season at Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh. Mini tubers of all varieties are stored in Breeder seed production centre (BSPC) cold storage and used for next year multiplication for subsequent generation as well as to meet up BADC and other organization requirement. Mini-tuber of different lines was multiplied for next year trial setup. The highest amount was contributed by the variety BARI Alu-29 (Courage) 1181 kg.

#### **Production of breeder and foundation potato seed at BSPC, Debiganj, Panchagarh during 2022-2023**

M.W. Rahman, M. Rahman, M. Z. Masud, M. A. Halim, B.R. Barman, M.K. Kobra, M. O. Haque, A. K. Das, M.S. Hassain, M.M.H. Molla, M.M. Islam and S. Akhter

Breeder and Foundation Seed Production of different potato varieties is the routine works of Breeder Seed Production Centre (BSPC), Debiganj, Panchagarh. A total of 575.602-ton nucleus, breeder, foundation and germplasm seed were produced from 110 acre of land during 2022-23 cropping season. To produce breeder seed, nucleus and G<sub>1</sub> seed were used and in case of foundation seed production breeder seed were used. All varieties Mini tuber were multiplied for next year Breeder seed production to meet up requirement of BADC and other organization. Mini tubers 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.Z.H. Prodhan, M. Sultana, M. S. Rahman. M.M. Kadir, M. M. Islam, M.M.H. Molla and S. Akhter

Seed production is a regular programme of TCRC for varietal maintaining and distribution to farmers or different adaptive or demonstration trials. Four lakhs one thousand seven hundreds of vine cuttings of the seventeen Sweet potato varieties, around two lakhs ninety-three thousands of Panikachu suckers of the seven Panikachu varieties and around One thousand five hundred twenty kilograms of corms (Seed) of the two Mukhikachu varieties were produced at Gazipur, Jamalpur, Bogura and jashore. From that around two lakh seven thousand vine

cuttings of sweetpotato, around two lakhnineteen thousand suckers (seedlings) of Panikachu and around one thousand fifty hundreds twenty-kilogram corms (seed) of Mukhikachu varieties were distributed for farmers and used in the different experiments.

## Post Harvest Technology

### Storage behaviour of hybrid clones of potato under RYT in natural condition

T. Hasan, M.H. Rashid, M.M. Islam and S. Akter

An experiment was conducted at Tuber Crops Research Center, BARI during March to August 2022. Tubers of clonal hybrids of RYT were evaluated for storage behavior under natural condition. Among the three hybrid clones 15.139 and 15.156 were the better performer at RYT. Cumulative weight loss was 34.47% and 37% in 15.139 and 15.156 respectively at 150 days after storage (DAS). On the other hand, minimum soft rot was found in BARI Alu-28 (19.77%) followed by BARI Alu-13 (23.87%) at 150 DAS. Regarding loss due to Fusarium Dry Rot (FDR) only 15.112 was recorded with 1.13% rottage loss at 60 DAS among the hybrid materials. In case of physiological behavior 15.139 was found to have the lowest degree of shrinkage (scored 1) followed by maximum skin color and marketability (scored 4).

### Storage behaviour of exotic potato varieties under RYT in natural condition

T. Hasan, M.H. Rashid, M.M. Islam and S. Akter

An experiment was conducted at Tuber Crops Research Center, BARI during March to August 2022. Tubers of exotic potato varieties of RYT were evaluated for storage behavior under natural condition. Among the three exotic varieties Rslin performed better regarding cumulative weight loss%, rottage loss % at 90 DAS and physiological behavior. Minimum weight loss was found in BARI Alu-13 (7.37%) while Rslin was recorded with 23.7% at 90 DAS. Maximum weight loss was found in Hind (54.67%) with 40.87% rottage loss at 150 DAS followed by Alcander. Regarding physiological behavior Rslin was found with minimum degree of shrinkage (scored 1) with maximum marketability (scored 4). No Fusarium

Dry Rot (FDR) was recorded in the tested exotic varieties.

### Storage behaviour of late blight resistant potato varieties under RYT in natural condition

T. Hasan, M.H. Rashid, M.M. Islam and S. Akter

An experiment was conducted at Tuber Crops Research Center, BARI during March to August 2022. Tubers of late blight resistant potato varieties of RYT were evaluated for storage behavior under natural condition. Among the three varieties Twister performed better regarding cumulative weight loss%, rottage loss % at 90 DAS and 150 DAS and physiological behavior. Minimum weight loss was found in BARI Alu-13 (7.37%) while Twister was recorded with 13.40% at 90 DAS. At 150 DAS Twister was found with 26.67% weight loss while the maximum was found in Twinner (60.53%). For loss due to Bacterial Soft Rot (BSR) Twister was recorded with the minimum (7.63%) while twinner was the maximum (27.27%). Regarding physiological behavior Twister was found with minimum degree of shrinkage (scored 1) with maximum marketability (scored 4).

### Storage behaviour of hybrid clones of potato under AYT in natural condition

T. Hasan, M.H. Rashid, M.M. Islam and S. Akter

An experiment was conducted at Tuber Crops Research Center, BARI during March to August 2022. Tubers of six hybrid clones of AYT were evaluated for storage behavior under natural condition. Among the hybrid clones 16.16, 16.28, 16.33 and 16.62 showed better performance in terms of cumulative weight loss% and rottage loss % at 90 Days After Storing (DAS). Minimum weight loss was found in BARI Alu-13 (7.37%) which was statistically similar with 16.28 (17.47%) and maximum was recorded in 16.9 (43%) at 90 DAS. The hybrid clones of 16.28, 16.33 and 16.62 were found to medium weight loss (30.40%, 33% and 36.67% respectively) which was statistically similar with BARI Alu-7 (32.97%) at 120 DAS. Rottage loss due to Bacterial Soft Rot (BSR) was maximum in 16.9 (54.33%) and rest of the hybrid clones showed medium loss at 90 DAS while Twister was recorded with 13.40% at 90 DAS.



**Storage behaviour of hybrid clones of potato under SYT in natural condition**

T. Hasan, M.H. Rashid, M.M. Islam and S. Akter

An experiment was conducted at Tuber Crops Research Center, BARI during March to August 2022. Tubers of hybrid clones of SYT were evaluated for storage behavior under natural condition. In case of cumulative weight loss at 90 DAS all the tested hybrid clones were found with moderate weight loss ranged from 26-41.20% where 17.578 (26%) was the minimum and statistically significant with BARI Alu-8 (25%) and BARI Alu 77 (25.23%) and 17.19 (41.20%) was the maximum. For 120 DAS 17.578 (35.82%) was again recorded with the minimum weight loss among the hybrid clones. Maximum rottage loss due to BSR was found in 17.167 (70.53%), 17.19 (65.33%) and 17.5 (60.53%) and minimum in 17.66 (22.13%) and 17.24 (23.53%) at 90 DAS. A rapid and significantly higher rottage loss due to BSR than the check varieties was observed in the hybrid clones ranging from 62.93%-86.40%.

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

T. Hasan, M.H. Rashid, M.M. Molla, M.H.H. Khan, M.M. Islam and S. Akter

Hybrid clones, exotic varieties, colored varieties and late blight resistant materials under SYT, AYT and RYT were studied for their processing quality in the form of Chips and French Fries. Processing quality of hybrid clones 18.8 and 18.102 showed good performance for both chips and French fries where 18.19 was good for producing chips under SYT. Among the four exotic materials under SYT Chonia and Zorba were good for both chips and French fries where all the varieties produce excellent chips. The colored fleshed hybrid clone 33.32 under SYT performed good regarding both chips and French fries. 17.19 produced excellent quality chips while 17.12a, 17.159 and 17.167 produced good quality chips among hybrid clones at AYT level. None of the materials were good for French fries. Among eight late blight resistant materials under AYT CIP-445 and CIP-447 produce excellent chips but none are suitable for French fries. All the hybrid clones under RYT were better at producing chips but not French fries.

**Technology Transfer****Potato****Adaptive Trial with Newly Released Potato Varieties in Different Locations**

A.T.M.T. Islam, M.A. Kawochar, S. Naznin, T. Jahan, A.A. Mahmud, M.J. Alam, M.S. Rana, M.J. Uddin, S. Ahmed, M. R. Amin, M. Asaduzaman, J.A. Mahmud, M.Z. Ferdous, A.H. Talukder, M.S. Rahman, G.N. Hasan, M.S.I. Khan, M.M. Islam, M.M. Hawlader, M.T. Islam, M. Moniruzzaman, N. Sultana, M. Mohiuddin, M.H. Rashid, M.K. Shahadat, M. S. Islam, M.A. Rahman, M.M. Rahman, M.A. Rahman, M.M.H. Molla and S. Akhter

Under the direction of the On-Farm Research Division (OFRD), BARI, a series of trials were carried out at farmers' fields in twenty different locations during the rabi season of 2022–2023 to assess the performance of the 10 (Ten) high-yielding potato varieties and learn about farmers' preferences regarding the varieties. The highest average tuber yield of the studied potato types was produced by BARI Alu-79 (35.12 t ha<sup>-1</sup>), followed by BARI Alu-41 (33.60 t ha<sup>-1</sup>) and BARI Alu-62 (33.32 t ha<sup>-1</sup>), while BARI Alu-7 had the lowest yield (27.11 t ha<sup>-1</sup>). Location-wise, Mymensingh had the highest average tuber yield (39.93 t ha<sup>-1</sup>), followed by Kishoregonj and Gopalganj (38.25 t ha<sup>-1</sup> and 37.95 t ha<sup>-1</sup>, respectively), while Khulna had the lowest (22.65 t ha<sup>-1</sup>). Among the crop varieties, BARI Alu-41 produced the average highest gross return (533371 Tk. ha<sup>-1</sup>) and gross margin (339558Tk. ha<sup>-1</sup>) whereas the average lowest gross return (390003 Tk. ha<sup>-1</sup>) and gross margin (195308 Tk. ha<sup>-1</sup>) were found in BARI Alu-7.

**Promotion and Dissemination of Late Blight-Resistant Potato Varieties in Different Locations**

S. Naznin, A.T.M.T. Islam, M.A. Kawochar, T. Jahan, A.A. Mahmud, M.J. Alam, M.S. Rana, A.K. Saha, M.Z. Ferdous, A.H. Talukder, M.S. Huda, M.M. Ahmed, M.S. Rahman, M.Sultana, M.M. Islam, M.M.H. Molla and S. Akhter

During the Rabi season of 2022–2023, a total of 36 trials were carried out at farmers' fields in nine locations in the districts of Gaibandha, Lalmonirhat, Kurigram, Rangpur, Nilphamari, Rajshahi, Bogura, Dinajpur and Joypurhat to assess

the performance of the two late blight-resistant potato varieties BARI Alu-53 and BARI Alu-77 (Sarpomir) as well as find out about farmers' perceptions of these varieties. BARI Alu-53 and BARI Alu-77 (Sarpomir), two of the studied potato varieties, outperformed the control variety BARI Alu-8 (Cardinal) in all areas and produced 10.67% and 15.56% more tuber yield, respectively. These two varieties had a late blight infection rate in the leaves reaching less than 5%. The late blight disease of the potato was thought to be very resistant to BARI Alu-53 and BARI Alu-77 (Sarpomir), which also reduced the cultivation costs without compromising tuber yield.

### **Promotion and Dissemination of Newly Released Climate-Smart (Heat and Salt Tolerant) Potato Varieties**

M.A. Kawochar, A.T.M.T. Islam, S. Naznin, T. Jahan, M. H. Rashid, G.N. Hasan, M.S.I. Khan, M. Islam, M.S. Islam, M. S. Bhuiyun, M. Ahmed A.A. Mahmud, M.J. Alam, M.S. Rana M.M. Islam, M.M.H. Molla and S. Akhter

BARI Alu-72, BARI Alu-73, and BARI Alu-78, three climate-smart (heat and salt tolerant) potato varieties, underwent evaluation for yield performance at the farmer's field in six locations. The Khulna region's Batiaghata, Bagerhat, Koyra, and Dumuria recorded soil salinity while the remaining locations (Bhola, Noakhali, Patuakhali, Cox's Bazar and Borguna) were found to be non-saline. The average soil salinity in the Khulna region fluctuated from 1.13 to 5.21 dSm<sup>-1</sup>. The variety BARI Alu-72 (28.95 t ha<sup>-1</sup>) had the highest average tuber yield among all the varieties, next to BARI Alu-73 (27.32 t ha<sup>-1</sup>) and BARI Alu-78 (25.04 t ha<sup>-1</sup>). A larger average gross return and gross margin were calculated from BARI Alu-72 for its higher yield.

### **Participatory Adaptive Trial of Early Bulking Potato Varieties**

T.M.T. Islam, M.A. Kawochar, M. A. Ali, S. Naznin, T. Jahan, E. H. M. S. Rahaman, D. Chanda, M. M. Molla, M. Moniruzzaman M.M. Islam, M.M.H. Molla and S. Akhter

A participatory adaptive trial was conducted at two locations situated in Nilphamari and Panchagarh districts for searching for early bulking potato genotypes in 2022-23. This experiment was designed for two years, and this is the 1st year trial.

In this experiment, seven (7) BARI-released potato varieties were used selected from CIP germplasm, and three (3) BARI-released varieties BARI Alu-13 (Granola), BARI Alu-28 (Lady Rosetta), and BARI Alu-29 (Caurage) used as checks were evaluated. The experimental design was RCBD with fully randomized and evaluated regarding their phenotypic characters, yield, and yield contributing characters. The marketable root weight of these materials ranged from 120g to 446g. All varieties showed a positive trend like to increase the number of tubers per kg to increase tuber yield loss.

### **Adaptive trial with anthocyanin rich potato varieties (BARI Alu-101 and BARI Alu-102)**

S. Islam, M. Rahman, F. Akhter, M.M.H. Molla, S. Akhter, M. A. Rahaman, M. S. Rahman, Md. Zannatul Ferdous, Eakramul Haque, M. M. I. Chowdhury, M.S. Huda, M.S. Hossain, David Douches, M. M. Islam, and S. Akhter

Adaptive trials with new potato varieties were conducted at seven districts to promote as well as to know the farmers acceptance about the new potato varieties, BARI Alu-101 and BARI Alu-102. All the tested varieties varied among the districts. The average highest yield over the location 37.08 t/ha was recorded in BARI Alu-101 followed BARI Alu-102 (31.49 t/ha) and BARI Alu-7 (30.08 t/ha). BARI Alu-8 was the lowest yielder (26.24 t/ha). Farmers' reaction varied among the locations. BARI Alu-101 and BARI Alu-102 varieties were accepted by farmers of different locations. Their demand is timely supply of quality seed of the tested new varieties.

## **Sweet Potato**

### **Adaptive Trials with Sweet Potato Varieties**

M. I. Nazrul, M. J. Alam, M. S. Rana, A. A. Mahmud, M. M. Rahman, A.K.M.Z.U. Noor and M.A. Rahman

The demonstration trials were conducted during 2022-23 in winter season at Sylhet, Sherpur, Gaibandha and Gazipur to evaluate the performance of color flesh newly developed sweet potato varieties in Sylhet. Five different varieties of sweet potato viz. V<sub>1</sub>: BARI Mishti Alu-12, V<sub>2</sub>: BARI Mishti Alu-14, V<sub>3</sub>: BARI Mishti Alu-15, V<sub>4</sub>: BARI Mishti Alu-16, V<sub>5</sub>: BARI Mishti Alu-17 were used in this trial. The experiment was setup in

randomized complete block design with three replications. The average root yield of five varieties at four locations ranges from 24.49 to 30.39 t ha<sup>-1</sup>. The highest root yield obtained from BARI Mistialu-12 and the lowest yield was found in BARI Mistialu-17.

## **Aroids**

### **Adaptive trials with panikachu varieties at different AEZ of Bangladesh**

M.S. Alam, F. Begum, Z. H. Prodhan, M.S. Rahman, A. A. Mahmud, M.I. Nazrul, M. M. Islam, M.M. H. Mollah and S. Akhter

Adaptive trials with Panikachu varieties were conducted at five districts to disseminate as well as to know the farmers' acceptance about the varieties during 2022 crop season. On an average both the stolon producing Panikachu varieties viz. BARI Panikachu 1 (Latiraj) and BARI Panikachu 2 gave similar stolon yield. The highest stolon yield (20.56 t/ha) was recorded in Bogura from BARI Panikachu 2. The highest rhizome yield (51.34 t/ha) was recorded in Jamalpur followed by Bogura (48.67 t/ha) from BARI Panikachu 6.

## **RARS Jashore**

### **Seed multiplication of BARI released potato variety**

MB Anwar and K U Ahammad

Potato seed multiplication programme was undertaken at RARS, Jashore during 2022-23. Total one thousand one hundred and fifty five kg seeds of BARI Alu-7, BARI Alu-13, BARI Alu-25, BARI Alu-28, BARI Alu-35, BARI Alu-41, BARI Alu-62, BARI Alu-72 and BARI Alu-79 were produced.

### **Vine multiplication of BARI released sweet potato variety**

MB Anwar and K U Ahammad

Sweet potato vine multiplication programme was undertaken at RARS, Jashore during 2022-23.

Total sixty thousand vines of BARI Mistialu-4, BARI Mistialu-8, BARI Mistialu-12, BARI Mistialu-16 and BARI Mistialu-17 were produced.

### **Seed multiplication of BARI released olkachu variety**

MB Anwar and K U Ahammad

OI-kachu seed multiplication programme was undertaken at RARS, Jashore during 2022-23. Total five hundred kg of BARI Olkachu-1 and BARI Olkachu-2 seeds were produced.

### **Sapling production of BARI released panikachu variety**

MB Anwar and K U Ahammad

Panikachu sapling production programme was undertaken at RARS, Jashore during 2022-23. Total three thousand and five hundred saplings of BARI Panikachu-1, BARI Panikachu-2, BARI Panikachu-3, BARI Panikachu-4, BARI Panikachu-5, BARI Panikachu-6 and BARI Panikachu-7 were produced.

### **Block demonstration on BARI Mistialu-17**

MB Anwar and K U Ahammad

A block demonstration program of BARI Mistialu-17 conducted at Barbakpur, Jhikargacha, and Jashore during Rabi 2022-23. The vines of BARI Mistialu-17 were planted on 12 December, 2022. The tuber yield was found 20 t/ha. Farmers are interested to cultivate these newly release anthocyanin rich sweet potato variety. They demanded timely supply of vine.

### **Block demonstration on BARI Alu-35**

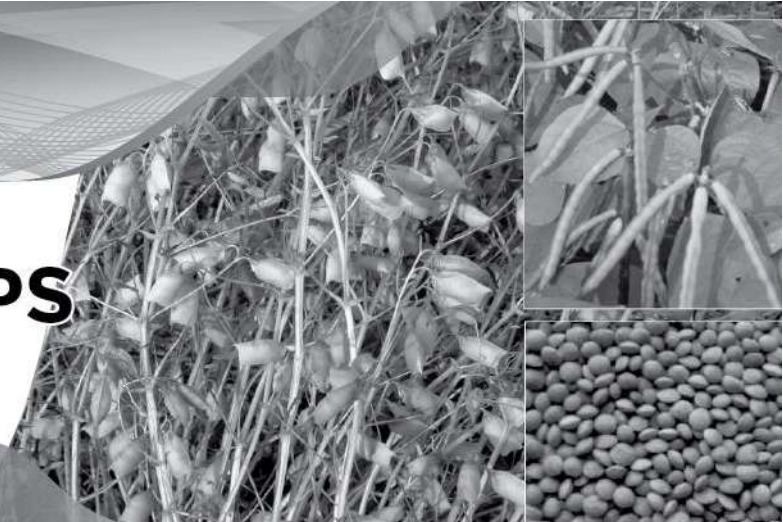
MB Anwar and K U Ahammad

BARI Alu-35 was demonstrated as block approach at Mohinikati, Jhikargacha, Jashore during Rabi 2022-23. The tubers of BARI Alu-35 were planted on 6 December, 2022. The yield was found 32 t/ha. Farmers are interested to cultivate this potato variety. They demanded timely supply of seed.



# PULSE CROPS

02



## **Blackgram**

### **Varietal Improvement**

#### **Hybridization of blackgram**

M. M. Hossain, M. J. Alam, 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, 2022 at Pulses Research Centre, Ishwardi, Pabna. Five parents with desired characters were used and a total of 90 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. M. Hossain, M. J. Alam, AKMM Alam and M. M. Uddin

To ensure fertile crosses between the parents, confirmation is very much essential. 147 seeds from Nine  $F_1$ s obtained from Kharif II, 2021 were grown along with their parents at Pulses Research Centre, Ishwardi, Pabna during Kharif II, 2022. 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. M. Hossain, M. J. Alam, AKMM Alam and M. M. Uddin

Nine  $F_2$  segregates were grown along with one check BARI Mash-3 to advance the generation at Pulses Research Centre, Ishwardi, Pabna during

Kharif II, 2022. 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. M. Hossain, M. J. Alam, AKMM Alam and M. M. Uddin

Fourteen  $F_3$ s were grown along with check to advance the generation at Pulses Research Centre, Ishwardi, Pabna during Kharif II, 2022. 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 $F_4$ generation of blackgram**

M. M. Hossain, M. J. Alam, M. S. U. Zaman, AKMM Alam and M. M. Uddin

Fifteen  $F_4$ S progenies were evaluated and their seeds were bulked during Kharif-II, 2022 and each of the individual single plants will be grown in an individual line as  $F_5$ s generation in the next season where family selection will be done.

#### **Growing and evaluation of blackgram $F_5$ generation**

M. M. Hossain, M. J. Alam, 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  $F_5$ s were grown along with check varieties at Pulses Research Centre, Ishwardi, Pabna. Finally, sixty single plants were selected which will be grown in the next year at  $F_6$  generation.

### Growing and evaluation of F<sub>6</sub> generation of blackgram

M. M. Hossain, M. J. Alam, AKMM Alam and M. M. Uddin

Genetic combination turns to more homozygous condition in F<sub>6</sub> and for this reason selection of family is done in this generation. To select appropriate and desired combinations nine F<sub>6</sub>s and one interspecific cross material were grown along with check varieties at Pulses Research Centre, Ishwardi, Pabna. Finally, sixty single plants were selected which will be grown in the next year at F<sub>7</sub> generation/OT trial.

### Preliminary yield trial of blackgram

M M Hossain, M J Alam, S Mahmud, J Rahman, MS Kobir and M. M. Uddin

The trial was carried out to determine the performance of five blackgram genotypes for yield and yield contributing characters and reaction against disease at Pulses Research Centre, Ishurdi, Pabna, PRSS Gazipur, RPRS, Madaripur, RARS, Jamalpur and RARS, Jashore. Significant differences were observed for days to flowering, days to maturity, plant height, pod/plant and 100 seed weight. Among the tested entries short plant stature (42.60cm) over location were found in BBLxK2-016003-3 and BBLxK2-016015-14. BARI Mash-3 showed the highest number of pods/plant (27.90) over location. A part from these highest seed weight (4.68g) was observed in BARI mash-4 followed by BARI Mash-3 and BBLxK2-016015-6. In case of yield/ha all location sowed statistically non-significant except Gazipur location. From the table 1.4 it was found that BARI Mash-3 was the highest mean yield (1416 kg/ha) performer over the five locations. But all genotypes showed higher mean yield than BARI Mash-4.

### Participatory variety selection of blackgram

M M Hossain, M J Alam, AKM M Alam, S Mahmud, J Rahman, MEA Pramanik, MS Kobir and M. M. Uddin

The experiment was conducted at Ishurdi, Madaripur, Jamalpur, Barind and Jashore during Kharif-II season of 2022. Four Blackgram genotypes viz. BBLXK2-08008-2-1, BBLXK2-12005-5, BBLXK2-12002-4 and BBLXK2-12005- 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-3 (58.4 cm) followed by BBLXK2-12002-4 and the lowest in BBLXK2-12005-6 (50.7cm) followed by BBLXK2-12005-5. The highest pods/plant was observed in BARI Mash-4 and BBLXK2-12005-6 followed by BBLXK2-12005-5 and BBLXK2-12002-4. BARI Mash-4 gave the highest 4.73g 100 seed weight and the lowest 100 seed weight was found in BBLXK2-12005-6 (3.86 g). The highest seed yield was found in BBLXK2-08008-2-1 (1388 kg/ha) followed by BARI Mash-3 (1386kg/ha) and the lowest yield was found in BBLXK2-12005-5 (1152 kg/ha) followed by BBLXK2-12005-6 (1186 kg/ha) over location.

### Crop and Soil Management

#### Effect of bio-fertilizer and phosphorus levels on growth and yield of black gram

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

Bio-fertilizers competitively colonize plant root systems, which, in turn, enhance nutrient uptake, increase productivity and crop yield, improve plants' tolerance to stress and their resistance to pathogens, and improve plant growth through mechanisms such as the mobilization of essential elements, nutrients, and plant growth hormones (Denial *et. al.*, 2022). Bio-fertilizers are cost-effective and ecofriendly in nature and their continuous usage enhances soil fertility (Denial *et. al.*, 2022). They also increase crop yield by up to about 10–40% by increasing protein contents, essential amino acids, and vitamins, and by nitrogen fixation (Denial *et. al.*, 2022). Both phosphorus and sulphur can improve the quality and quantity of black gram (Mir *et al.*, 2017). As so, a field experiment was conducted at PRC, BARI, Ishurdi, Pabna during Kharif-2 season of 2022 to find out the response of black gram to different levels of phosphorus, and bio-fertilizer on growth and yield. The experiment was laid out in a Randomized Complete Block Design with assigned 7 different treatments. The treatments were T<sub>1</sub> = Native fertility, T<sub>2</sub>= P<sub>18</sub> kg ha<sup>-1</sup> (Recommended dose), T<sub>3</sub>= *Rhizobium*, T<sub>4</sub>= *Rhizobium* + P<sub>6</sub> kg ha<sup>-1</sup>, T<sub>5</sub>= *Rhizobium* + P<sub>18</sub> kg ha<sup>-1</sup> (RD), T<sub>6</sub>= *Rhizobium* + P<sub>12</sub> kg ha<sup>-1</sup> and T<sub>7</sub>= *Rhizobium* + P<sub>27</sub> kg ha<sup>-1</sup>, K<sub>20</sub>S<sub>10</sub>B<sub>2</sub> kg ha<sup>-1</sup> are at blanket dose or flat rate for all treatment. The results revealed that *Rhizobium* + recommended dose of phosphorus (T<sub>6</sub>) showed significant effect on nodulation and yield of

blackgram. The highest seed yield ( $1.76 \text{ t ha}^{-1}$ ) was obtained from ( $T_6$ ) and the lowest seed yield ( $1.02 \text{ t ha}^{-1}$ ) was recorded in the control ( $T_1$ ). The maximum nodule number  $\text{plant}^{-1}$  (29) was found in  $T_6$  while the minimum nodule number  $\text{plant}^{-1}$  (16) was in control. Yield increased 27-42% over control. The higher gross margin (Tk 66480  $\text{ha}^{-1}$ ) was found in Rhizobium +  $P_{18} \text{ kg ha}^{-1}$ . Rhizobium treated seed +  $P_{18} \text{ kg ha}^{-1}$  ( $N_{20}P_{18}K_{20}S_{10}B_2$ ) recommended dose of fertilizer performed better in blackgram production.

## Disease Management

### Screening of blackgram lines resistant to yellow mosaic virus

D. Sarkar, M. Z. Rahman, M. R. Humayan, B. Akhter, S. Hossain and M. M. Uddin

The screening trial was conducted with 50 blackgram germplasm based on previous year's evaluation for Yellow Mosaic Virus (YMV) resistance at Pulses Research Centre (PRC), Ishwardi, Pabna. These accessions were screened in natural field environment and showed varying level of resistance. Blackgram variety BARI Mash-1 (Susceptible) was used as check throughout the experiment. Among the evaluated lines nineteen germplasm were identified with higher resistance than resistance check BARI Mash 3 that could be used in blackgram breeding for YMV disease resistance.

## Lentil

### Varietal Improvement

#### Hybridization of lentil

M.S.U. Zaman, M.A. Zaman, A.K.M.M Alam, M. Saleh Uddin 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 2022-23. Four parents were used in crosses and a total of 378 successful cross seeds were harvested from six cross combinations. The cross seeds will be sown next season for the confirmation of lentil  $F_1$  plants.

#### Confirmation of $F_1$ plants in lentil

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

To confirm crosses between the parents is essential to advance the generation for variety development. Five  $F_1$ s obtained from Rabi 2021-22 along with their parents were grown at Pulses Research Centre, Ishwardi, Pabna during Rabi 2022-23. On the basis of phenotypic markers such as leaf color, stem pigmentation, flower color, leaf shape, presence/absence of tendrils, 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.A. Zaman, A.K.M.M Alam, M. Saleh Uddin and M. M. Uddin

Five  $F_2$  populations along with check variety BARI Masur-8 were grown at Pulses Research Centre, Ishwardi, Pabna during rabi, 2022-23 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 $F_3$ generation

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

Twelve  $F_3$  populations were evaluated during rabi 2022-23 at Pulses Research Centre, Ishwardi, Pabna to advance the generations. At maturity, one to two pods of each plants were collected and bulked crosswise/population wise. The bulked seeds from each population will be sown next year as  $F_4$  generations.

#### Growing and evaluation of lentil $F_5$ generation

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

Eleven  $F_5$  populations were sown on 16 November 2022 at Pulses Research Centre, Ishwardi, Pabna to advance the generation. A total of 170 individual plants based on the disease reaction, number of branches, number of pods, days to maturity, plant height and plant type from 11 crosses were selected and harvested separately for growing  $F_6$  generation next year.



**Observation trial of lentil**

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

Fifteen F<sub>5</sub> families selected from last season's were grown with check variety BARI Masur-8 during rabi season of 2022-23 at Pulses research center, Ishwardi, Pabna following RCB design with two replications. Among the entries tested, BLX-16001-1 flowered and matured earlier followed by BLX-16001-2. The highest plant height (48 cm) was recorded in BLX-16005-8 while the lowest (40 cm) in BLX-16009-17. The genotype BLX-16006-7 and BARI Masur-8 showed the highest number (104-107) of pods/plant followed by BLX-16009-3. The highest yield (2470 kg/ha) was found in BARI Masur-8 followed by BLX-16009-5. Based on the performance of yield and yield contributing traits five genotypes out-BLX-16001-1, BLX-16009-5, BLX-16009-15, BLX-16009-17 and BLX-16006-7 were selected for next year PYT.

**Regional yield trial of lentil**

S. Zaman, M. A. Zaman, J. Rahman, S. Kobir, R. Uddin, AKMM Alam, M. Saleh Uddin and M. M. Uddin

The experiment was carried out with three promising lentil genotypes to assess the performance of yield and yield contributing traits in six different locations- Ishwardi, Jamalpur, Gazipur, Madaripur, Barishal, Jashore and Jamalpur during rabi, 2022-23. Significant variations was observed in respects to days to flower, days to maturity, seed weight and seed yield among the tested genotypes in most of locations, but the plant height and Pods plant<sup>-1</sup> showed non-significant. Among the genotypes, BLX-14004-5 flowered (57 days) and matured (100 days) earlier than the other genotypes followed by BLX-13005-26. The genotype BLX-13005-26 showed the lowest plant height in compared to others, while the genotype BLX-14004-3 was the tallest. The highest pods per plant (68) were found in BLX-13005-26 but it was severely infested by stemphylium blight disease. The check variety BARI Masur-8 exhibited the highest 100 seed weight (2.2 g) followed by BLX-14004-3. None of the entries were out yielded over BARI Masur-8. Therefore, the genotypes will be stored as germplasm.

**Screening of Lentil Germplasm for resistance to stemphylium blight disease**

M.S.U. Shahin Uz Zaman, S Kabir and M. A. Y. Akhond

Stemphylium blight (SB) is one of the major constraint to lentil production in Bangladesh. Two-hundred and forty lentil germplasm were tested for response to stemphylium blight disease under field conditions in two locations- Pulses Research Centre (PRC), Ishwardi, Pabna and Regional Agricultural Research Station, Jashore. The combined analysis of variance revealed significant effects of genotype, location and genotype × location interactions on disease severity. The mean disease severity varied across environments and this was reflected in the frequency distributions of disease reaction at each location. The frequency distribution of mean disease was a continuous distribution, suggesting several genes with minor effects in SB resistance. Ten accessions/germplasm at Ishwardi and 12 at Jashore showed moderately resistant to SB with a percent disease index of 21-30. Three of them- ILL 6309, LRIL-12-67 and FLIP-2010-106L exhibited moderately resistance at both locations.

**Screening of Lentil Germplasm for Tolerance to Terminal Heat Stress**

M.S.U. Shahin Uz Zaman and M. A. Y. Akhond

Late-sown lentils are exposed to terminal heat stress during reproductive stage. Two hundred and forty lentil germplasm were tested in response to high temperature under field conditions. Significant differences were found in the germplasm under both the optimum and late sowing. Heat stress significantly reduced all the traits. The traits- DF, DM, number of branch, plant height, pods/plant, %filled pods, stemphylium blight, 100 seed weight and seed yield of heat stressed plants in late-sown were decreased by 13, 21, 54, 9, 35, 19, 0.0, 25 and 84%, respectively, compared with the control plants in optimum sowing (Table 1.21). The %Reduction of all the traits were used in principal component analysis. Based on PCA, the genotypes of 39, 45, 21, 189, 190, 166, 34, 61, 40, 106, 12, 198, 63, 161 and 185 were found relatively tolerant to terminal heat stress.

## Crop and Soil Management

### Efficacy of *Rhizobium* on nitrogen compensation and yield of lentil

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

The root nodules are formed by specific group of soil-borne *Rhizobia* bacteria that attach themselves to the roots of these plants. In the symbiotic relationship that forms between the Lentil and *Rhizobia*, the plant provides nutrients and energy to the bacteria, and the bacteria in turn produce nitrogen that helps growth of the plant. While most of the nitrogen is used for plant growth, a tiny part of it is released into the soil when the bacteria die and some more when plant residue decomposes. Therefore, lentil mostly produces sufficient nitrogen to meet its own requirement upon harboring optimum population of *Rhizobia*. Hence, a field experiment was conducted at PRC, BARI, Ishurdi, Pabna during *Rabi* season of 2022-2023 to evaluate the response of *Rhizobium* on nitrogen compensation and yield of lentil. The experiment was laid out in a Randomized Complete Block Design with assigned 8 different treatments. The treatments were as follows T<sub>1</sub>= Native fertility, T<sub>2</sub>= *Rhizobium* inoculant, T<sub>3</sub>= Recommend dose of fertilizer (N<sub>18</sub>P<sub>18</sub>K<sub>27</sub>S<sub>15</sub>Zn<sub>0.7</sub>B<sub>1.2</sub> kg ha<sup>-1</sup> B), T<sub>4</sub>=*Rhizobium* + RD, T<sub>5</sub>= *Rhizobium* + 75% RDN (recommended dose of Nitrogen), T<sub>6</sub>= *Rhizobium* + 50% RDN, T<sub>7</sub>= *Rhizobium* + 25% RDN and T<sub>8</sub>= *Rhizobium* + 0% RDN and other fertilizer used as blanked doses. Lentil was significant effect on number of nodule plant<sup>-1</sup>, branch plant<sup>-1</sup>, pod plant<sup>-1</sup>, seed yield, additional income and gross margin. The results revealed that *Rhizobium* + 75% RDN (T<sub>5</sub>) showed significant effect on nodulation and yield of lentil. The higher seed yield (1.53 t ha<sup>-1</sup>) was obtained from *Rhizobium* + 75% RDN and the lowest seed yield (0.92 t ha<sup>-1</sup>) was recorded in the native fertility. The maximum nodule number 16 plant<sup>-1</sup> was found in *Rhizobium* + 25% RDN while the minimum nodule number 8 plant<sup>-1</sup> was in control. Yield increased over control was 16-40%. The maximum additional income Tk. 49360 ha<sup>-1</sup> and gross margin Tk. 42170 ha<sup>-1</sup> recorded from T<sub>5</sub> and MBCR (10.50) were found in *Rhizobium* T<sub>2</sub> due to minimum price of *Rhizobium*. The 75% recommended dose of N fertilizer and seed treated with *Rhizobium* performed better in lentil (BARI Masur-9) production.

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

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

Growth and yield of lentil depends on plant density and proper fertilizer management. High plant density lesser branch, few number pod formation, ultimately low yield (Islam *et al.*, 2015). Proper plant density gave more yields. The fertility of soil in Bangladesh is deteriorating rapidly due to intensive cultivation of improved modern crop varieties, imbalanced use of chemical fertilizer and improper crop and soil management (Hossain *et al.*, 2005). Moreover, farmers generally use high seed rate and imbalance fertilizer based on their own experience. Furthermore, optimum plant density and fertilizer dose are responsible for higher yield of lentil. hence, a field experiment was conducted at PRC, BARI, Ishurdi, Pabna during *Rabi* season of 2022-2023 to evaluate the optimum plant density and fertilizer management for higher yield of BARI Masur-8. The three seed rates were as follows: S<sub>1</sub>= 20 kg seed ha<sup>-1</sup>, S<sub>2</sub>= 40 kg seed ha<sup>-1</sup> and S<sub>3</sub>= 60 kg seed ha<sup>-1</sup> and three fertilizer treatments were as follows: F<sub>1</sub>=100% recommended dose of fertilizer (45-90-40-55-10 kg ha<sup>-1</sup> urea, TSP, MOP, gypsum and boric acid), F<sub>2</sub>= 110% of RD, and F<sub>3</sub>= 120% of RD. The results revealed that 40 kg ha<sup>-1</sup> seed with 120% recommended dose of fertilizer (S<sub>2</sub>F<sub>3</sub>) showed significant effect on nodulation and yield of lentil. The experiment was laid out in a split-plot design with three replications. The higher seed yield (2.52 t ha<sup>-1</sup>) was obtained from (S<sub>2</sub>F<sub>3</sub>) and the lower seed yield (1.73 t ha<sup>-1</sup>) was recorded in 20 kg seed rate with 100% recommended dose of fertilizer (S<sub>1</sub>F<sub>1</sub>). The higher nodule number plant<sup>-1</sup> (28) and root TDM plant<sup>-1</sup> (0.58 g) were found in S<sub>2</sub>F<sub>3</sub> combination while the lower number of nodule plant<sup>-1</sup> (20) was in S<sub>3</sub>F<sub>1</sub> and root TDM plant<sup>-1</sup> (29g) were in S<sub>1</sub>F<sub>1</sub> combination. Yield increased 5.44-10.32% over recommended dose of fertilizer. The S<sub>2</sub>F<sub>3</sub> combination gave higher gross margin (Tk. 14696 ha<sup>-1</sup>) and MBCR (3.03). The 40 kg seed ha<sup>-1</sup>+120% of recommended dose of fertilizer was profitable for BARI Masur-8 lentil production.

### Performance of different pulse based cropping pattern in the high Ganges river floodplain (AEZ-11)

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

Pulse crop provide the sustainability to crop production system by enriching the soil health through biological nitrogen fixation and their varied uses as feed and fodder (Singh *et. al.*, 2017). On the other hand, efforts are needed to promote intensification of rice-based cropping system in the country with legumes/pulse crops to meet the demand of this crop and for the sustaining crop productivity. Moreover, crop diversification with pulses shows a lot of promises in alleviating poverty, employment generation, ensuring balanced food supply. As so, a field experiment was initiated at Pulses Research Centre, BARI, Ishurdi, Pabna during 2022-23 to find out the more profitable cropping pattern in High Ganges river floodplain (AEZ-11). The experiment was laid out in a Randomized Complete Block Design with three dispersed replications. The four different cropping patterns were as follows i) CP<sub>1</sub> = *T.aman* rice–Fallow –*Boro* rice ii) CP<sub>2</sub> = *T.aman* rice– Lentil –*Boro* rice, iii) CP<sub>3</sub> = *T.aman* rice– Grass pea –*Boro* rice, iv) CP<sub>4</sub> = *T.aman* rice– Field pea –*Boro* rice. Field duration, system productivity (REY), production efficiency (PE) and land use efficiency (LUE) of different cropping pattern in High Ganges river floodplain (AEZ-11) significantly varied among the cropping pattern. The results revealed that *T.aman* rice– Lentil –*Boro* rice cropping pattern (CP<sub>2</sub>) showed significant effect on field duration, system productivity, production efficiency and land use efficiency. The maximum REY (14.46 t ha<sup>-1</sup>), PE (56.48 kg ha<sup>-1</sup> day<sup>-1</sup>) and LUE (96.16%) were obtained from CP<sub>2</sub> and the minimum REY (10.34 t ha<sup>-1</sup>), PE (40.39 kg ha<sup>-1</sup> day<sup>-1</sup>) and LUE (70.14%) were recorded in existing cropping pattern CP<sub>1</sub>. REY increased over existing cropping pattern was 15-28%. The maximum additional income Tk. 103000 ha<sup>-1</sup> and gross margin Tk. 87880 ha<sup>-1</sup> and MBCR (6.81) recorded from CP<sub>2</sub> due to addition lentil in fallow period.

### Response of rhizobium and trichoderma on growth and productivity of lentil at Madaripur

S. Mahmud, P. Chakraborti, M.M. Rashid and M. S. Uddin

A field experiment was conducted at RPRS, Madaripur during Rabi season of 2022-23 to

evaluate the performance of Lentil var. BARI Masur-8 treated with Rhizobium and Trichoderma. Six treatments viz. Lycomax (Trichoderma) @ 3gm/litre, Bioderma (Trichoderma) @ 75kg/ha, Rhizobium, Rhizobium + Lycomax @ 3gm/litre, Rhizobium + Bioderma @ 75kg/ha and control were tested in this experiment. Highest yield was obtained from combined application of rhizobium and bioderma (1658.33kg/ha) and lowest from control (1025kg/ha). The result therefore suggested that combined application of Trichoderma and Rhizobium can increase the growth of lentil which play an important role in organic agriculture.

### Development of integrated weed management practices of lentil in Jashore region

MS Kobir; MS Alam; J Hossain; M Mohi Uddin and KU Ahammad

The experiment was conducted considering different weed management practices viz. T<sub>1</sub> = No weeding, T<sub>2</sub> = Weed free up to 60 DAS, T<sub>3</sub>=pre-emergence herbicide, T<sub>4</sub> = Two times Hand weeding (4-5 weeks after sowing and 6-7 weeks after sowing), T<sub>5</sub> = Pre-emergence herbicide+ Hand weeding at 4-5 weeks after sowing, T<sub>6</sub> = post-emergence herbicide+ Hand weeding at 6-7 weeks after sowing in RCB design with 3 replications. The highest no. of weeds (493 m<sup>-2</sup>, 264 m<sup>-2</sup>) was observed in T<sub>6</sub> treatment in the 40 days after sowing and 60 days after sowing, respectively. The highest weed biomass (136.83 m<sup>-2</sup>, 89.08 g m<sup>-2</sup>) was found in T<sub>1</sub> and T<sub>6</sub> treatment, respectively in the 40 days after sowing and 60 days after sowing, respectively. Application of pre emergence herbicide and one hand weeding at 4-5 weeks after sowing gave highest BCR.

### Effect of foliar spray of boron on yield of relay lentil

R. Uddin and B.C. Kundu

Lentil cultivation is declining over time in south central coastal region of Bangladesh due to responses of 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 of 0.05%, 0.1%, 0.15%, 0.2% and 0.25 % was



compared with No spray (Control). Results revealed that, the maximum seed yield (1457 Kg/ha) and BCR (4.7) can be observed from spraying of 0.15% of boron solution during flowering stage. Among other treatments, spraying of 0.2% and 0.25% of boron also contributed to the statistically identical seed yield with 0.15% of boron solution.

#### **Effects of different levels of Zn on the growth, yield, yield attributes and nutrient uptake by lentil**

Shamima Aktar

The experiment was conducted at Bangladesh Agricultural Research Institute (BARI) Gazipur during Rabi season of 2022-2023 to evaluate the effects of different levels of Zn on the growth, yield, yield attributer and nutrient uptake by of lentil. Six levels of Zinc viz.  $Zn_0$ =Control,  $Zn_3$ = application of Zn @ 3 kg ha<sup>-1</sup>,  $Zn_4$  = application of Zn @ 4 kg ha<sup>-1</sup>,  $Zn_5$  = application of Zn @ 5 kg ha<sup>-1</sup>,  $Zn_6$  = application of Zn @ 6 kg ha<sup>-1</sup> and  $Zn_7$  = application of Zn @ 7 kg ha<sup>-1</sup> were applied in lentil varietal plots. Two varieties of lentil viz. BARI Masur 8 and BARI Masur 3 were used for the experiment. Zinc application showed significant variations among the yield parameters and seed yield of lentil. Among different level of Zn application BARI Masur 8 produced the highest seed yield (1542 kg ha<sup>-1</sup>) compared to BARI Masur 3 (1387 kg ha<sup>-1</sup>). The rate of increment ranged from 7 to 38% over Zn-control treatment ( $Zn_0$ ) and the maximum increment (38%) was application of Zn at a rate of 5 kg ha<sup>-1</sup>. The relationships of P content of lentil seed with Zn levels were antagonistic but synergistic with K and other nutrients. The maximum Zn uptake (92.97 g ha<sup>-1</sup>).

#### **Effects of different application strategies of Zn on the growth, yield, seed Zn, protein content and Zn uptake by lentil**

Shamima Aktar

The experiment was conducted at Bangladesh Agricultural Research Institute (BARI) Gazipur during Rabi season of 2022-2023 to evaluate the effects of different application strategies of Zn on the growth, yield, seed Zn, protein content and Zn uptake by lentil. Five levels of Zn application strategies viz. Soil application, Foliar spray, 50% Soil application + 50% Foliar spray, Seed priming (25%) + Soil application (75%) and Seed priming

(25%) + Foliar spray (75%). Two varieties of lentil viz. BARI Masur 8 and BARI Masur 5 were used for the experiment. BARI Masur-8 gave higher seed yield (1562 kg ha<sup>-1</sup>) compared to BARI Masur-5 (1438 kg ha<sup>-1</sup>). Among the strategies, Zn application as 50% soil and 50% foliar spray showed significantly highest yield (1467 kg ha<sup>-1</sup>), seed Zn content (69 mg kg<sup>-1</sup>), protein content (34%) and Zn uptake (102.14 g ha<sup>-1</sup>).

### **Disease Management**

#### **Efficacy of fungicide for control of stemphylium blight disease of lentil in natural condition**

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

Stemphylium blight disease is a serious constraint to lentil production in Bangladesh. However, research into the management of this fungal disease is limited and foliar application of trifloxystrobin, tebuconazole, and ipridion fungicides are recommended for effective control of the disease. Results showed that significant variation was observed between variety and fungicide spray schedules but not significant among fungicides. However, three time's application of Nativo (trifloxystrobin,) was most effective in reducing disease severity (75.17 %) and (73.17 %) as well as increasing seed yield (39.4%) and (65.75 %) in BARI Masur-8 and BARI Masur-1 respectively. In the Marginal Benefit Cost Ratio most economical (1:8.8) combination was observed at BARI Masur-1 which was applied by three times with Folicur (tebuconazole) and the lowest (1:6.0) in 3 times application of Nativo. Therefore, two times applications of Nativo @ 0.5 g/L in BARI Masur-8 and Folicur @ 1ml/L in BARI Masur-1 can be recommended for preventive control against stemphylium blight disease on lentil.

#### **Screening of lentil germplasm against stemphylium blight**

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

The screening trial was conducted with 72 germplasm based on previous year's evaluation for Stemphylium Blight (SB) resistance at Pulses Research Centre (PRC), Ishurdi, Pabna. These accessions were screened in natural field environment and showed varying level of resistance. Lentil variety BARI Masur-1

(susceptible) was used as check throughout the experiment. Among the evaluated lines three germplasm were identified with higher resistance than resistance check BARI Masur 8 that could be used in lentil breeding program for stemphylium disease resistance.

#### **Prevalence of pathogens associated with root rot disease of lentil**

D. Sarkar, M. Z. Rahman, M. R. Humayan, B. Akhter, S. Hossain 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 severity, a survey was conducted from November, 2022 to March 2023 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 89 isolates obtained Oomycetia (40.6%) was recovered at the highest severity and *Fusarium Rhizoctonia* and *Sclerotium* spp exhibited a consistent presence, ranging from 28%, 18% and 13% respectively. This survey provided baseline information on the prevalence of critical soil borne pathogens of lentil in Ishurdi region.

#### **Effect of biological agents and chemical fungicides for controlling foot and root rot of lentil**

M. Z. rahman, D. Sarkar, M. G. Kibria, M. M. R. Talukder and Raziuddin

The experiment was conducted at RARS, Rahmatpur, Barishal during 2022-23 to find out an effective management practice for the management of foot and root rot disease of lentil. Six management practices, one check, and one control were used as treatment. The lowest foot and root rot (7.17 %) was obtained from the check and a statistically similar result (9.33%) was obtained from a seed treatment with Provax 200 wp (Carboxin + Thiram) @ 3 g/kg and the highest incidence (22.00%) was obtained from untreated control. The highest yield (1736 Kg/ha) was recorded in check variety i.e., BARI Mosur -8 and a statistically similar result (1597 Kg/ha) was yielded seed treatment with Provax 200 wp @ 3

g/kg, and the lowest yield was obtained from untreated control plot (894 Kg/ha).

## **Grasspea**

### **Varietal Improvement**

#### **Hybridization and advancement of fillial generations in grasspea**

M M Rahman, M. J. Alam, M. S. U. Zaman, AKMM. Alam and M. M. Uddin

Hybridization and advancement of  $F_1$  to  $F_6$  generations were conducted during Rabi 2022-23 at PRC, BARI, Ishurdi, Pabna. Different parents were used and successful crossed seeds were collected from selected cross combinations. From  $F_1$ ,  $F_2$ ,  $F_3$ ,  $F_4$ ,  $F_5$  and  $F_6$  generation and four progenies were selected respectively considering higher yield and other desirable traits with low ODAP content.

Hybridization of grasspea was conducted for creating genetic variability with desired gene combinations within the existing germplasm during Rabi season, 2022-23 at Pulses Research Sub-centre, BARI, Gazipur. Seven parents with desired characters were used and a total of 204 successful crossed seeds were collected from ten cross combinations that will be sown during the next season for confirmation of grasspea  $F_1$  generations.

#### **Confirmation of $F_1$ of Grasspea**

M M Rahman, M. J. Alam, M. S. U. Zaman, AKMM. Alam and M. M. Uddin

In Rabi 2021-22 we could not successful in our designed cross combination. For that we cannot confirmation trial of  $F_1$  along with their parents at Pulses Research Center, Ishurdi, Pabna during rabi, 2022-23.

#### **Growing and evaluation of $F_2$ generation of grasspea**

M. J. Alam, M.M. Rahman, M. S. U. Zaman, AKMM. Alam and M. M. Uddin

Ten  $F_2$ s segregates were grown along with check variety BARI Khesari-5 to advance the generation at Pulses Research Centre, Ishwardi, Pabna during rabi, 2022-23. 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 F<sub>3</sub> generation of grasspea**

M. J. Alam, M.M. Rahman, M. S. U. Zaman, AKMM. Alam and M. M. Uddin

Twelve F<sub>2</sub>s segregates were grown along with check variety BARI Khesari-5 to advance the generation at Pulses Research Centre, Ishwardi, Pabna during rabi, 2022-23. The total population was bulked and harvested for retention of more variability which will be grown in the next Rabi season as F<sub>4</sub>s segregation generation in the next season.

### **Growing and evaluation of grasspea F<sub>4</sub> generation**

M. J. Alam, M.M. Rahman, M. S. U. Zaman, AKMM. Alam and M. M. Uddin

Nine F<sub>3</sub>s progenies were evaluated and their seeds were bulked during Rabi 2022-23 and these bulked populations will be grown and evaluated as F<sub>4</sub>s generation in the next season for advancement of grasspea segregating populations.

### **Growing and evaluation of grasspea F<sub>5</sub> generation**

M. J. Alam, M.M. Rahman, M. S. U. Zaman, AKMM. Alam and M. M. Uddin

Six F<sub>4</sub>S progenies were evaluated and their seeds were bulked during Rabi, 2022-23 and each of the individual single plants will be grown in an individual line as F<sub>5</sub>s generation in the next season where family selection will be done.

### **Preliminary yield trial of grasspea (set-2)**

M. M. Rahman, M. J. Alam, S. Mahmud, M. S. Zaman, AKMM. Alam, M. M. Hossen and M. M. Uddin

The experiment was carried out to evaluate the performance of nine grasspea genotypes with check BARI Khesari-3 for yield and yield related traits in two locations viz. RPRS, Madaripur and PRSS, Gazipur during Rabi 2022-23 but RPRS, Madaripur data was not found. Significant variations were found among the genotypes across the single environments. The genotype IFLA 2298(E) and IFLA 1419 (Low ODAP) flowered and matured earlier considering the mean values of gazipur locations followed by BARI Khesari-3. IFLA 2750 (L) (71.4 cm) and IFLA 1522 (E) (72 cm) showed the highest average plant height

followed BARI Khesari-3 (73.6 cm), while the lowest in IFLA 159 (E) (59 cm). The highest number of pods showed IFLA 2298 (E) (44), IFLA 1419 (Low ODAP) (43), IFLA 2750 (L) (39) and IFLA 1522 (E) (40) followed by BARI Khesari-3 (38). The genotypes IFLA 2298 (E) (1425 kg/ha), IFLA 2750 (L) (1340 kg/ha), IFLA 1419 (Low ODAP) (1400 kg/ha) and IFLA 1522 (E) (1375 kg/ha) produced the highest average seed yield followed by BARI Khesari-3 (1500 kg/ha), while the lowest yield in IFLA 2158 (E) (1100 kg/ha) at Gazipur.

### **Preliminary yield trial of grasspea**

M. M. Rahman, M. J. Alam, S. Mahmud, S. Kobir, J. Rahman, AKMM. Alam and M. M. Uddin

The experiment was carried out to evaluate the performance of Six grasspea genotypes with two check BARI Khesari-3 and BARI Khesari-5 for yield and yield related traits in five locations viz. PRC, Ishwardi, Pabna; PRSS, Gazipur; RPRS, Madaripur; RARS, Jessore and RARS, Jamalpur during Rabi 2022-23. Significant variations were found among the genotypes across the environments. The genotypes 66054, IGYT-124 and 114585 flowered and matured earlier considering the mean values of four locations followed by BARI khesari-3 and BARI Khesari-5. BARI Khesari-3 also showed the highest average plant height (82 cm), while the lowest in 116690 (66 cm). The number of pods varied across locations. Highest mean pods per plant (36) found in 66054 followed by IGYT-124 (32) and 114585 (30). The highest average 100 seed weight (7.10 g) recorded in 114585 followed by 116690 (6.25g), 116755 (6.18 g). The genotype IGYT-124 produced the highest average seed yield (1231 kg/ha) followed by 114585 (1219 kg/ha), and 66054 (1181 kg/ha) while the lowest yield (964 kg/ha) performed by 116690.

### **Regional yield trial of grasspea**

M M Rahman, M. J. Alam, M. S. Zaman, S. Mahmud, J. Rahman, S. Kobir, AKMM. Alam and M. M. Uddin

The experiment was carried out to evaluate the performance of seven grasspea genotypes with one check BARI Khesari-5 for yield and yield related traits in five locations viz. PRC, Ishwardi, Pabna; PRSS, Gazipur; RPRS, Madaripur; RARS, Jashore and RARS Jamalpur during Rabi 2022-23.



Significant variations were found among the genotypes across the environments. The genotype IGYT-122, IGYT-123 and IGYT-125 flowered and matured earlier considering the mean values of five locations followed by BARI Khesari-5. The genotype BGP-13010 showed the highest average plant height (77 cm) followed by BGP-13009 (75 cm), IGYT-122 (72 cm) and BARI Khesari-5 (71 cm) while the lowest in IGYT-110 (60 cm). The number of pods varied across locations. Highest pods per plant (39) found in IGYT-122 followed by IGYT-125 (38), IGYT-123 (36) and BGP-13010 while the lowest pods per plant in IGYT-110 (25). The highest average 100 seed weight (6.3 g) recorded in IGYT-125 followed by IGYT-123 (6.2 g) and BGP13009 (6.2 gm) while lowest 100 seed weight in IGYT-110 (5.4 g). The genotype BARI IGYT-125 produced the highest average seed yield (1273 kg/ha) followed by IGYT-122 (1258 kg/ha) and IGYT-123 (1048 kg/ha) while the lowest yield (907 kg/ha) performed in BGP-13009.

#### **Evaluation of some exotic grasspea genotypes**

M. M. Rahman, M. J. Alam, M. S. U. Zaman, AKMM. Alam and M. M. Uddin

Twenty four genotypes selected last year from germplasm of ICARDA were grown along with check variety BARI Khesari-3 during Rabi season of 2022-23 at Pulses research sub-center, BARI, Gazipur following two rows with four meter. After evaluating the yield contributing traits and performance of yield, eleven genotypes; IFLA-118 (L), IFLA 119 (Low ODAP), IFLA 2158 (E), IFLA 2924 (E), IFLA 1419 (Low ODAP), IFLA 2998 (E), IFLA 1707 (Low ODAP), IFLA 2781 (Low ODAP), IFLA 1826 (L), IFLA 2750 (Low ODAP) and IFLA 2974 (E) were selected for next year PYT.

#### **International grass pea yield trial (ICARDA)-1st year**

M. M. Rahman, M. J. Alam, M. S. Zaman, AKMM. Alam, M. M. Hossen and M. M. Uddin

One Hundred grass pea genotypes were collected from the ICARDA previous year 2022 through International grass pea Trial-1<sup>st</sup> year and including one local check BARI Khesari-3 were evaluated at Pulses Research Sub-Center, BARI, Gazipur during rabi 2022-23. The local checks BARI Khesari-3 were earlier than the all exotic entries considering days to 50% flowering and 80% maturity. IF-1842, IF-2084, IF-2085, IF-2145, IF-2166, IF-2170, IF-

2174, IF-2175, IF-2177, IF-2178, IF-2184, IF-2188, IF-2191, IF-2194, IF-2196, IF-2214, IF-2261, IF-2264, IF-2298, IF-2301, IF-2302 and IF-2312 were the earliest and pods per plant among the 100 exotic lines followed by BARI Khesari-3. No exotic lines could exceed the local check in case of yield. So among the the imported lines 22 exotic lines such as IF-1842, IF-2084, IF-2085, IF-2145, IF-2166, IF-2170, IF-2174, IF-2175, IF-2177, IF-2178, IF-2184, IF-2188, IF-2191, IF-2194, IF-2196, IF-2214, IF-2261, IF-2264, IF-2298, IF-2301, IF-2302 and IF-2312 were the considering as a high yielding for further evaluation in next year.

#### **Collection and evaluation of local and exotic grass pea germplasm for genetic perspective in Bangladesh**

M. M. Rahman, M. J. Alam, M. S. Zaman, AKMM. Alam, M. M. Hossen and M. M. Uddin

Three Hundred sixteen local and exotic grass pea germplasms were collected from the Plant Genetic Resources Center (PGRC), BARI, Bangladesh previous year 2022 including one local check BARI Khesari-3 were evaluated at Pulses Research Sub-Center, BARI, Gazipur during Rabi 2022-23. The local checks BARI Khesari-3 and some entries were earlier and comparatively good yield than the all evaluated germplasm considering 80% maturity and yield potentiality in both location. According to clustering the 88 important germplasm were the earliest among the 316 lines followed by BARI Khesari-3. No exotic lines could exceed the local check in case of yield. The 54 imported germplasm were the good yield among the 316 lines followed by BARI Khesari-3. So we can consider 19 germplasm such as BD-3367, BD-3371, BD-3384, BD-3397, BD-3398, BD-3399, BD-3406, BD-3409, BD-3426, BD-3434, BD-3437, BD-3438, BD-3451, BD-3456, BD-3458, BD-3462, BD-3503, BD-4790 and BD-5000 as an earliness and high yielding from the selected germplasm for further evaluation in next year.

#### **Evaluation of grasspea germplasm under waterlogging stress at seedling stage**

M.S.U. Zaman and M.M. Rahman

Grass pea (*Lathyrus sativus* L.) are exposed to waterlogging at different growth stages when grown as relay in rice-based cropping. A total of 8 germplasm were exposed to waterlogging stress for 21 days at seedling stage in the pot soil to identify

waterlogging tolerance at seedling. Significant variation of %Reduction the value of traits in WL soil in compared to drained control was found during WL and recovery. During WL, the genotype 66054 showed the lowest percent of reduction for shoot length (5%), number of nodules (7%), shoot dry mass (16%) and root dry mass (8%) indicating the higher ability to grow under waterlogged soil than the other germplasm. Similarly at recovery, the germplasm 66054 again showed the lowest %Reduction for shoot length (3%), root dry mass (17%), pods/plant (6%) and seed yield (15%) showing the higher ability to recovery than the other germplasm. Based on the response in WL and recovery, the germplasm 66054 regarded as tolerant relative to other germplasm.

## Crop and Soil Mamangement

### Growth and yield of grass pea as influenced by foliar spray of potassium nitrate

M.M. Rashid, P. Chakraborti, S. Mahmud and M. S. Uddin

A field experiment was carried out during 2022-23 in the research field of Regional Pulse Research Station, Madaripur to find out the effect of foliar spray of potassium nitrate on grasspea grown in rainfed lowland rice fallows. The treatments consisted of foliar spray of potassium nitrate (0.25%, 0.50%, 0.75% and 1.00%), water spray and control during 50% flowering. Of them foliar spray with 0.50% of potassium nitrate provide maximum yield than that of all other treatments and over control.

## Chickpea

### Varietal improvement

#### Hybridization of chickpea

M. J. Alam, M. M. Hossain, M. S. U. Zaman, M. G. Azam, AKMM Alam and M. M. Uddin

Hybridization of chickpea was undertaken for creation of genetic variability with desired gene combinations at PRC, Ishurdi, Pabna during rabi 2022-23. Six parents were used followed by half-diallel fashion and a total of 325 successful crossed derived seeds were harvested separately from fifteen cross combinations.

#### Confirmation of chickpea F<sub>1</sub> generation

M. J. Alam, M. M. Hossain, M. S. U. Zaman, M. G. Azam, AKMM Alam and M. M. Uddin

Ten cross combinations were grown along with their male and female parents in both sides during rabi season 2022-23 at PRC, Ishurdi, Pabna. A total of 29 individual F<sub>1</sub>s plants have been confirmed and harvested separately from 10 combinations and these single plants will be grown as F<sub>2</sub> generation in next season.

#### Growing and evaluation of F<sub>2</sub> generation of chickpea

M. J. Alam, M. M. Hossain, M. S. U. Zaman, M. G. Azam, AKMM Alam and M. M. Uddin

Nine F<sub>2</sub> segregates were grown along with two checks, BARI Chola-5 and BARI Chola-10 to advance the generation at Pulses Research Centre, Ishurdi, Pabna during rabi, 2022-23. The total population was bulked and harvested for retention of more variability which will be grown as F<sub>3</sub> segregation generation in the next season.

#### Growing and evaluation of chickpea F<sub>3</sub> generation

M. J. Alam, M. M. Hossain, M. S. U. Zaman, M. G. Azam, AKMM Alam and M. M. Uddin

Bulked population of ten F<sub>3</sub>s accessions were grown along with two checks BARI Chola-5 and BARI Chola-10 to advance the generation at Pulses Research Centre, Ishurdi, Pabna during rabi, 2022-23. Again the population was bulked and harvested for retention of more variability which will be grown as F<sub>4</sub> segregation generation in the next season.

#### Growing and evaluation of chickpea F<sub>5</sub> generation

M. J. Alam, M. M. Hossain, M. S. U. Zaman, M. G. Azam, AKMM Alam and M. M. Uddin

Genetic combination turns to more homozygosity in F<sub>5</sub> and for this reason selection of family is done in this generation. To select appropriate and desired combinations seven F<sub>5</sub>s were grown along with check varieties at Pulses Research Centre, Ishurdi, Pabna. Finally, seventy nine single plants were selected which will be grown in the next year under generation of F<sub>6</sub>.

**Observation trial of chickpea**

M. J. Alam, M. M. Hossain, M. S. U. Zaman, M. G. Azam, AKMM Alam and M. M. Uddin

Eighteen entries selected from last season's  $F_5$  families were grown with check varieties viz. BARI Chola-5 and BARI Chola-10 during rabi season of 2022-23 at Pulses research center, Ishurdi, Pabna following RCB design with two replications. Significant variation was found in yield and yield contributing traits. Among the tested entries, BCX-17007-9 flowered earlier and BCX-17006-3 matured earlier than the other entries. The highest plant height was recorded in BCX-17005-8, while the lowest in BARI Chola-5. The entry BCX-17007-6 followed by BCX-17005-8 showed the highest number of pods/plant followed by BCX-17005-8 while the lowest in BCX-17003-6. The highest yield was found in BCX-17005-8 followed by BCX-17006-6 and BCX-17007-6. Finally, the out yielded entries over the check varieties, viz. BCX-17002-3, BCX-17005-8, BCX-17006-6, BCX-17007-2, BCX-17007-6, BCX-17008-10, BCX-17009-1 and BCX-17009-3 selected for PYT.

**Preliminary yield trial of chickpea**

M. J. Alam, M. M. Hossain, M.S. Kobir, R. Uddin, S. Mahmud, AKMM Alam and M. M. Uddin

The trial was conducted at five locations to evaluate the performance of ten chickpea genotypes including check varieties, BARI Chola-5 and BARI Chola-10. The trial was laid out in a RCB design with three replications. Significant variation was observed in most of the yield contributing characters and seed yield across the locations. The highest average yield (1738 kg/ha) across the locations was found in genotype BCX-16006-4 followed by BCX-16010-2. 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 Jashore and poor at Barishal and Madaripur compared to others. Considering yield and yield contributing traits, four entries BCX-16006-4, BCX-16010-2, BCX-16006-1 and BCX-16006-2 were selected to evaluate next year under RYT.

**Regional yield trial of chickpea**

M. J. Alam, M.S. Kobir, M. E. Pramanik, M. M. Hossain, S. Mahmud, R. Uddin, AKMM Alam and M. M. Uddin

The trial was conducted at six locations to evaluate the performance of six chickpea genotypes along with check BARI Chola-5 and BARI Chola-10. The experiment was laid out in a RCB design with three replications. Significant variation was observed in most of the yield contributing characters except days to flower and pods per plant. The highest average yield across the locations was found in genotype ICCV-181634 and lowest in ICCV-181633. Moreover, the entry ICCV-181634 showed the better yield performance in most of the locations- Ishurdi, 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 ICCV-181634 and ICCV-181627 were selected to evaluate next year under PVS trial.

**On-farm yield trial of promising chickpea genotypes**

M. J. Alam, M.S. Kobir, M. E. Pramanik, M. R. Amin, S. Mahmud, AKMM Alam and M. M. Uddin

The trial was conducted at three locations to evaluate the performance of four chickpea genotypes including check varieties BARI Chola-5 and BARI Chola-10. The experiment was laid out in a RCB design with three replications. Significant variation was observed in most of the yield contributing characters except days to flower and plant height. The highest average yield across the locations was found in genotype BCX-13002-3. In respect to Botrytis Gray Mold disease, there was no appearance of disease symptom this year. Considering yield and yield contributing traits, the entry BCX-13002-3 were selected to evaluate under PVS trial in the next rabi season.

**Crop and Soil Management****Effect of bio-fertilizer and phosphorus on yield of chickpea (BARI chola-10)**

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

Chickpea maintains soil fertility through biological nitrogen fixation and contributes to the sustainability of the cropping system in cereal legume rotation. Similar to other legumes chickpea inherently develops root nodules that absorb inert nitrogen from soil air and convert it into



biologically useful ammonia, a process referred to as biological nitrogen fixation. The root nodules are formed by a specific group of soil-borne Rhizobia bacteria that attach themselves to the roots of these plants. In the symbiotic relationship that forms between the Chickpea and Rhizobia, the plant provides nutrients and energy to the bacteria, and the bacteria in turn produce nitrogen that helps the growth of the plant. So, a field experiment was conducted at PRC, BARI, Ishurdi, Pabna during Rabi season of 2022-2023 to evaluate the effect of bio-fertilizer and phosphorus on yield of chickpea. The treatments were as follows-  $T_1$ = (Native fertility),  $T_2$ = Recommended dose of fertilizer ( $P_{18}K_{20}S_{10}B_2$  kg ha<sup>-1</sup>)  $T_3$  = *Rhizobium*,  $T_4$ = *Rhizobium* + 110% P (19.8 kg ha<sup>-1</sup> P),  $T_5$ = *Rhizobium* + 120% P (23.4 kg ha<sup>-1</sup> P) and  $T_6$ = *Rhizobium* + 140% P (25.2 kg ha<sup>-1</sup> P) and other fertilizers were used as blanket dose. The experiment was laid out in a Randomized Complete Block Design with three replications. Chickpea was significantly higher value of nodule number plant<sup>-1</sup>, plant height, branch plant<sup>-1</sup>, pod plant<sup>-1</sup>, grain and stover yield (t ha<sup>-1</sup>), additional income and gross margin. The results revealed that *Rhizobium* + 110% P ( $T_4$ ) showed significant effect on nodulation and yield of chickpea. The higher seed yield (2.54 t ha<sup>-1</sup>) was found in  $T_4$  and the lower seed yield (1.15 t ha<sup>-1</sup>) was obtained from  $T_1$  (native fertility). The maximum nodule number plant<sup>-1</sup> (58) was recorded from  $T_4$  while the minimum nodule number plant<sup>-1</sup> (17) was in  $T_1$ . Yield increased 41-55% over control. The higher additional income and gross margin was obtained from  $T_4$ . The maximum MBCR (33.86) was found in  $T_3$  due to low price of *Rhizobium*. + The 110% phosphate fertilizer and seed treated with *Rhizobium* performed better in chickpea production.

#### **Efficacy of different source of bio and chemical fertilizer on growth and yield of chickpea**

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

Chickpea maintains soil fertility through biological nitrogen fixation and contributes to the sustainability of the cropping system in cereal legume rotation. Similar to other legumes Chickpea inherently develops root nodules that absorb inert nitrogen from soil air and convert it into

biologically useful ammonia, a process referred to as biological nitrogen fixation. Different research institute have been invented bio-fertilizer for experimental use. To compares between different bio-fertilizer which one is the best? That is why; a field experiment was conducted at PRC, BARI, Ishurdi, Pabna during Rabi season of 2022-2023 to find out the response of chickpea to different bio and chemical fertilizer on growth and yield. The treatments were  $T_1$ = Native fertility,  $T_2$ =Recommend dose of fertilizer ( $P_{18}K_{20}S_{10}B_2$  kg ha<sup>-1</sup>) BARI,  $T_3$ = Easy Rhiz Chickpea + RD,  $T_4$ =Plant mate Rhizobium + RD,  $T_5$ =  $N_{22}P_{18}K_{20}S_{10}B_2$  kg ha<sup>-1</sup> FRG,  $T_6$ = BARI RCA-203 bio-fertilizer +RD. The experiment was laid out in a Randomized Complete Block Design with three replications and assigned 8 different treatments. The results revealed that all the treatment except control showed statistically identical effect on plant height, nodule number plant<sup>-1</sup>, pod plant<sup>-1</sup>, and thousand seed weight of chickpea. The higher seed yield (2.31 t ha<sup>-1</sup>) was found in ( $T_4$ ) and the lower seed yield (1.16 t ha<sup>-1</sup>) was obtained from the control ( $T_1$ ). Yield increased over control was 40-50%. The maximum gross margin and MBCR were found in *Rhizobium* +RD.

#### **Response of rhizobium and trichoderma on growth and productivity of chickpea at madaripur**

S. Mahmud, P. Chakraborti, M.M. Rashid and M. S. Uddin

A field experiment was conducted at RPRS, Madaripur during Rabi season of 2022-23 to evaluate the performance of Chickpea var. BARI Chola-10 treated with Rhizobium and Trichoderma. Six treatments viz. Lycomax (Trichoderma) @ 3gm/litre, Bioderma (Trichoderma) @ 75kg/ha, Rhizobium, Rhizobium + Lycomax @ 3gm/litre, Rhizobium + Bioderma @ 75kg/ha and control were tested in this experiment. The highest yield was obtained from combined application of rhizobium and bioderma (766.66kg/ha) and the lowest from control (383.34kg/ha). The result therefore suggested that combined application of Trichoderma and Rhizobium can increase the growth of lentil which play an important role in organic agriculture.

## Disease Management

### Effect of biological agents and chemical fungicides on fusarium wilt disease in chickpea

M. Z. Rahman, D. Sarkar, M. G. Kibria, M. M. R. Talukder and Raziuddin

The experiment was conducted at RARS, Rahmatpur, Barishal during 2022-23 to find out an effective management practice for the management of Fusarium wilt disease of Chickpea. Five management practices, and one control were used as treatment. The lowest disease incidence (8.92 %) was obtained from the seed treatment with Provax 200 wp (Carboxin + Thiram) @ 3 g/kg seed and the highest incidence (34.34.00%) was obtained from untreated control. The highest seed yield (1650 Kg/ha) was recorded in seed treatment with Provax 200 wp @ 3 g/kg, and the lowest yield was obtained from untreated control plot (1093 Kg/ha).

## Fieldpea

### Varietal improvement

#### Hybridization of fieldpea

M. G. Azam, N. Naher, AKM M. Alam and M. M. Uddin

Hybridization of fieldpea was conducted to obtain genotypes having desired gene combinations during rabi, 2022-23 at Pulses Research Centre, Ishurdi, Pabna. Six parents were used as half diallel fashion and a total of 438 successful crossed seeds were collected from fifteen cross combinations.

#### Growing and evaluation of F<sub>2</sub> generation of fieldpea

M. G. Azam, N. Naher, AKM M. Alam and M. M. Uddin

The maximum segregation is attained in F<sub>2</sub> generation and with a view to select appropriate and desired combinations. Three F<sub>2</sub> segregates were grown along with two checks BARI Motor-2 and BARI Motor-3 to advance the generation at Pulses Research Centre, Ishurdi, Pabna during rabi, 2022. The total population was bulked and harvested for retention of more variability which will be grown as F<sub>3</sub> segregation generation in the next season.

#### Growing and evaluation of fieldpea F<sub>4</sub> generation

M. G. Azam, N. Naher, AKM M. Alam and M. M. Uddin

Seven F<sub>4</sub>s progenies were evaluated and their seeds were bulked during rabi, 2022-23 and each of the individual single plants will be grown in an individual line as F<sub>5</sub>s generation in the next season where family selection will be done.

#### Growing and evaluation of fieldpea F<sub>6</sub> generation

M. G. Azam, N. Naher, AKM M. Alam and M. M. Uddin

Genetic combination turns to more homozygosity in F<sub>5</sub> and for this reason selection of family is done in this generation. To select appropriate and desired combinations nine F<sub>5</sub>s were grown along with check varieties at Pulses Research Centre, Ishurdi, Pabna. Finally, eighteen lines/families were selected which will be grown in the next year at observation trial.

#### Preliminary yield trial of fieldpea

M. G. Azam, N. Naher, M. S. Kobir, R. Uddin and M. M. Uddin

The experiment was carried out to evaluate the performance of five fieldpea genotypes along with check BARI Motor-1 and BARI Motor-3 for yield and yield related traits at Pulses Research Centre, Ishurdi, Pabna (Isd), Pulses Research Sub-station, Gazipur (Gaz) and Regional Agricultural Research Station, Jashore (Jas) and Barishal (Bar) during Rabi 2022-23. 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, BFPX-16003 flowered and matured earlier than the other genotypes. The highest plant height was recorded in BARI Motor-3 followed by BFPX-16008 and BFPX-16005 in all locations. The highest plant height was recorded in BARI Motor-3 followed by BFPX-16008 and BFPX-16005 in all locations. The genotypes BFPX-16003 exhibited the highest number of pods per plant among the tested genotypes. In the current study, as depicted by (Table 1.51) the mean grain yield of 5 genotypes ranged 1212 kg/ha (BARI Motor-1) to 1579 kg/ha (BFPX-16003). As revealed by AMMI and GGE bi plots and average seed yield across locations, the

genotype BFPX-16003 and BFPX-16005 identified as most adapted line and stable performer with negligible GXE interaction and high yield could be used directly as variety.

### Regional yield trial of fieldpea

M. G. Azam, N. Naher, M. S. Kobir, R. Uddin and M. M. Uddin

The experiment was carried out to evaluate the performance of five fieldpea genotypes along with check BARI Motor-1 and BARI Motor-3 for yield and yield related traits at Pulses Research Centre, Ishurdi, Pabna (Isd), Pulses Research Sub-station, Gazipur (Gaz) and Regional Agricultural Research Station, Jashore (Jas) and Barishal (Bar) during Rabi 2022-23. 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, The genotype BFP 15004-8 flowered and matured earlier than others in all the locations. The highest plant height was recorded in BFP 15004-8 followed by BFP 15002-2 and BFP 15004-5 in all locations. The genotypes BARI Motor-3 exhibited the highest number of pods per plant among the tested genotypes. The highest mean HSW was found BFP 15004-8 followed by BFP 15004-5 and the lowest BARI Motor-1. In the current study, as depicted by (Table 2) the mean grain yield of 5 genotypes ranged 1368 kg/ha (BFP 15004-8) to 1032 kg/ha (BARI Motor-1). As revealed by AMMI and GGE bi plots and average seed yield across locations, the genotype BFP 15004-5 identified as most adapted line and stable performer with negligible  $G \times E$  interaction and high yield could be used directly as variety.

### Screening of fieldpea (*Pisum sativum* L.) genotypes based on qualitative and quantitative morphological traits analysis related to yield

M. G. Azam, N. Naher, AKM M. Alam and M. M. Uddin

Fieldpea (*Pisum sativum* L.) is a multipurpose crop and the crop needs further improvement to increase production and yield due to its high value and demand. This study aimed to assess the diversity of qualitative and quantitative morphological characteristics concerning yield among the fieldpea genotypes. Shannon and Weaver diversity index ( $H'$ ) analysis revealed significant intra genotypes diversity for both quantitative and qualitative traits.

Multivariate analysis using principal component analysis (PCA) indicated that first four principle components with Eigen value  $>1$  accounted for 66.3% of the entire variability for quantitative traits. Principal Component Analysis (PCA) detected four components that contributed 81.3% quantitative traits to total variations. Hierarchical cluster analysis separated 85 genotypes into five clusters, where Clusters 1 to 5 assembled with 32, 18, 26, 1 and 8 genotypes, respectively. Considering yield and yield attributes, Cluster 5 genotypes showed promising while, cluster 2 genotypes were dominant on plant growth traits. Pearson correlation analysis among eight quantitative traits showed highly significant positive correlation between all the traits. This variation indicated that there is a way to identify promising genotypes for pea breeding. Considering the above traits, our research found that the BFP78, BFP77, BFP74, BFP 45, BFP79 and BFP80 fieldpea genotypes produced higher yield with corresponding higher pod length seeds per pod and pods per plant suggesting to use them as high yielding genotypes for food and fodder purposes.

### Crop and Soil Management

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

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

A field experiment was conducted at Pulses Research Centre, Ishurdi, Pabna during 2022-23 to find out the suitable herbicide to control *parthenium* weed in field pea. Ten treatments were viz. T<sub>1</sub>: Panida-33EC (Pendimethaline @ 3.0 L ha<sup>-1</sup>), T<sub>2</sub>: Fielder (2,4-D Amine @ 2.50 L ha<sup>-1</sup>), T<sub>3</sub>: Pull (Quizalofop-p-ethyle @ 750 ml ha<sup>-1</sup>), T<sub>4</sub>: Mesotin 50wp (Atrazine + Mecitrone @ 1.8 kg ha<sup>-1</sup>), T<sub>5</sub>: Activar (Oxadiazon @ 1 L ha<sup>-1</sup>), T<sub>6</sub>: Extrapower (Bispiriback Sodium @ 150 g ha<sup>-1</sup>), T<sub>7</sub>: Sunrice (Ethoxisulphuran @ 200 g ha<sup>-1</sup>), T<sub>8</sub>: Oxyflour (@ 200 ml ha<sup>-1</sup>), T<sub>9</sub>: Hand weeding and T<sub>10</sub>: Control (No Weeding). Herbicides were applied at moist condition of soil after irrigation for proper seed germination that means pre-emergence condition. Mesotin control the highest number of *parthenium* weeds but it affected the germination, which decreased the yield of field pea followed by Fielder. Hand weeding gave higher pods plant<sup>-1</sup>, and consequently gave higher yield and the maximum gross return. On the other hand, Fielder gave higher gross margin, and BCR was higher



from Oxyflour due to lower variable cost. Therefore, Fielder was better herbicide to control Parthenium weed in field pea.

### **Competition dynamics of parthenium weed infestation in field pea**

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

The experiment was conducted at the Pulses Research Centre, Ishurdi, Pabna during 2022-2023 to estimate the effect of Parthenium weed on the performance of field pea at different competition durations. Six treatments viz., T<sub>1</sub>: season-long weed-free, T<sub>2</sub>: weed-free after 2 weeks of crop emergence, T<sub>3</sub>: weed-free after 4 weeks of crop emergence, T<sub>4</sub>: weed-free after 6 weeks of crop emergence, T<sub>5</sub>: weed-free after 8 weeks of crop emergence, T<sub>6</sub>: season-long weedy (Control) were included in this experiment. 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 (1.92 t ha<sup>-1</sup>) followed by 2 weeks after emergence (1.69 t ha<sup>-1</sup>) and the lowest seed yield (1.10 t ha<sup>-1</sup>) in weedy plot. The season-long competition caused the highest reductions in plant height, pods plant and grain yield (42%) of field pea.

### **Performance of field pea under different sowing conditions**

MS Kobir; MS Alam; J Hossain; M Mohiuddin and KU Ahammad

The highest gross margin (BDT 167414 ha<sup>-1</sup>) was observed in raised bed with furrow and only green pod treatment combination which is followed by ridge with furrow and only green pod harvesting treatment combination. The highest benefit cost ratio (4.49) was observed in flat bed and only mature pod harvesting treatment and the lowest gross return was found in ridge with furrow and only green pod harvesting treatment combination

## **Cowpea**

### **Performance of cowpea as influenced by sowing dates in Barishal**

R. Uddin and B.C. Kundu

Cowpea sowing at south central coastal region of Bangladesh is varies from region to region

depending upon soil moisture condition and T. Aman rice harvesting. Optimum date of sowing for cowpea in different regimes of southern belt still not investigated. A field study was carried out at RARS, Rahmatpur, Barishal during Rabi season of 2022-23 to observe the effect of different sowing dates on cowpea cultivation. The experiment was carried out with five sowing dates i) November 25 (ii) December 15 (iii) January 04 and iv) January 24 and (v) February 13 under randomized complete block design with three replications BARI Felon-1 was used as the variety. The results revealed that, cowpea at different date of sowing responded with the environmental factors. Cowpea sown at November 25 and December 15 has demonstrated better distribution of developmental stages. November 25- December 15 sown crop has accumulated higher sink dry matter at maturity stages. Considering yield and yield contributing characters, the maximum number of pods/plant (44-47), the maximum number of seeds/pod (14) and seed yield (1327-1461 kg/ha) was demonstrated by November 25-December 15 cowpea sowing.

## **Mungbean**

### **Varietal Improvement**

#### **Hybridization of mungbean**

AKMM. Alam, M. G. Azam, and M. Uddin

Hybridization program was conducted during Kharif-I, 2023 at PRC, Ishurdi, Pabna for creating the genetic variability among the existing germplasm for desired gene pool. Five parents were used having desired genetic combinations and hybridization is going on to fifteen one cross combinations.

#### **Confirmation of mungbean F<sub>1</sub> genetration**

AKMM. Alam, M. G. Azam, and M. Uddin

Six F<sub>1</sub>s obtained from Kharif-I, 2022 were grown along with their parents on both sides at Pulses Research Centre, Ishurdi, Pabna during Kharif-I, 2023. On the basis of desired characters 24 single plants were confirmed from six cross combination and that were marked with new accession number. The confirmed F<sub>1</sub>s will be grown on the next season as F<sub>2</sub>s generations.

**Growing and evaluation of mungbean F<sub>2</sub> generation**

AKMM. Alam, M. G. Azam, and M. Uddin

With a view to select appropriate and desired combinations, twelve F<sub>2</sub>s were grown along with BARI Mung-6 as a check at Pulses Research Centre, Ishurdi, Pabna during Kharif 1, 2021. The total population was bulked and harvested for retention of more variability which will be grown as F<sub>3</sub> segregation generation in the next season.

**Growing and evaluation of mungbean F<sub>3</sub> generation**

AKMM. Alam, M. G. Azam, and M. Uddin

Six F<sub>3</sub>s progenies were evaluated and their seeds were bulked during Kharif- I, 2023 and these plants will be grown and evaluated as F<sub>4</sub>s generation in the next season for advancement of mungbean segregating populations.

**Growing and evaluation of mungbean F<sub>4</sub> generation**

AKMM. Alam, M. G. Azam, and M. Uddin

For advancement of the segregation generations of mungbean from F<sub>4</sub> to F<sub>5</sub> based on phenotypic view with desired genes combinations nine F<sub>4</sub>s generations were grown along with check BARI Mung-6 at Pulses Research Centre, Ishurdi, Pabna during Kharif-I, 2023. Two pods were collected from each of the plant of each progeny and bulked and stored in cool room separately for growing and evaluation in the next season trial as F<sub>5</sub>s generations.

**Growing and evaluation of mungbean F<sub>5</sub> generation**

AKMM. Alam, M. G. Azam, and M. Uddin

Genetic combination turns to more homozygous condition in F<sub>5</sub> and for this reason selection of family is done in this generation. For advancement and attaining more homozygosity in fillial generations of mungbean, Ten progenies of F<sub>4</sub>s seed were grown as F<sub>5</sub>S generation along with check BARI Mung-6 at Pulses Research Centre, Ishurdi, Pabna during Kharif-I, 2023. Two pods were collected from each of the plant of each progeny and bulked and stored in cool room separately for growing and evaluation in the next season trial as F<sub>6</sub>s generations.

**Growing and evaluation of mungbean f<sub>6</sub> generation**

AKMM. Alam, M. G. Azam, and M. Uddin

Genetic combination turns to more homozygosity in F<sub>5</sub> and for this reason selection of family is done in this generation. To select appropriate and desired combinations nine F<sub>5</sub>s were grown along with check varieties at Pulses Research Centre, Ishurdi, Pabna. Finally, eighteen lines/families were selected which will be grown in the next year at observation trial.

**Regional yield trial of mungbean**

AKMM. Alam, M. G. Azam, R Uddin, S kobir, S Mahmud and M. Uddin

This study aims to identify robust genotypes with high yields across different environments and suitable environments. Six mungbean advanced lines were evaluated at five environments using randomized complete block design with three replications. Genotypes responded differently to different environments and at different times of the year. There was a range between BMXK1-16010-3 (1483 Kg/ha) and BARI Mung-7 (1380 Kg/ha) for the highest and the lowest mean grain yields. According to the mean and stability view of the AMMI and GGE biplot, BARI Mung-8 and BMXK1-16010-3 was the most productive genotype in all environments except BMXK1-16008-5 and BMXK1-16006-8 were the least productive. Based on the polygon view of GGE, five sectors were formed genotypes BMXK1-16010-1, BMXK1-16010-3, and BMXK1-16006-8 selected for PVS in the next year. In most environments, BMXK1-16010-3 is a more adaptable genotype than any other genotype, making it a more suitable genotype for commercial production.

**Participatory varietal selection of mungbean**

AKMM. Alam, A Rahman, M Rashid, R Uddin and M Uddin

Four entries including two check varieties BARI Mung-7 and BARI Mung-8 were evaluated were evaluated at OFRD, Tangail, RARS, Barishal and RPRS, Madaripur in a RCB design with 3 replications to select the lines of mungbeanl for releasing as mungbean variety with the direct involvement of farmers. Four lines BMX-010025, BMX-010015, BMX K1-112004 and two check

varieties (BARI Mung-7 and BARI Mung-8) were evaluated in the trial. Among these promising BMX-010015, was the best performer in view of yield and farmer's preferences.

#### **Interspecific hybridization involving *vigna radiata* with *vigna mungo***

AKMM. Alam, M. G. Azam, and M. Uddin

Hybridization program between *Vigna radiata* with *Vigna mungo* was conducted during Kharif-I, 2023 at PRC, Ishurdi, Pabna for creating the genetic variability among the existing germplasm for desired gene pool. Four parents were used having desired genetic combinations and hybridization was going on to seven cross combinations. A total of 5 successful crossed seeds were harvested from five cross combinations and preserved these seed for confirmation of F<sub>1</sub>s in the next season.

#### **Identification and quantification of volatiles compounds through bio-chemicals analysis in aromatic mungbean**

M. G. Azam, AKMM. Alam, AKM Khorsheduzzaman, M. H. Bari, M. S. Uddin, and M. M. Uddin

Mungbean having high food value and easily digestible proteins is one of the socioeconomically important crop of Bangladesh. Among the varied cultivars, aromatic mungbean is having aroma and hence popularly cultivated in the pockets of Ganga river basin at Chapainawbganj, Thakurgaon and Chuadanga districts. In the present study, aroma volatiles with special reference to 2-acetyl-1-pyrroline (2AP) were analyzed using HS-SPME-GCMS from aromatic mungbean and compared with non-scented mungbean (BARI Mung-6). The highest concentration of 2AP was found in dried seeds 0.38 ppm in E8 followed by E33, E55, E4, E32, E25, E27, E8, E31, E22 and the lowest found in E50 (0.07ppm).

#### **Screening of mungbean genotypes on germination stage using peg-induced drought stress levels**

AKMM. Alam, M. G. Azam, and M. Uddin

Genetic variation is the main basis of improvement in crops and plant breeding programs. So, in order to study genetic variation and terminal drought stress on yield related traits in mungbean, an experiment was conducted on 45 mungbean genotypes in a CRD with three replicates under

different stress conditions in PRC, BARI, during 2022-2023 cropping season. The experiment was undertaken to find out the better cultivar against drought stress condition. The experiment results revealed that germination, seedling production and water-related behavior of mungbean genotypes differed significantly under different PEG (drought inducer) concentrations. The results of analysis of variance indicated significant differences among genotypes for all studied traits in both normal and drought stress conditions. From the current study we found, G21 followed by G28, G29, G18, G43, G40 and G37 gave consistently better output under drought stress condition and gradual linear decreases were observed as PEG concentrations increased from 0 percent to 20 percent. These mungbean genotypes should be demonstrated in the field condition to find out desired tolerant mungbean genotypes against drought stress condition.

### **Crop and Soil Management**

#### **Effect of *rhizobium* inoculant on nitrogen compensation and yield of mungbean**

M.S. Alam, M.M. Kamal and M.M. Uddin

Bio fertilizers are gaining importance as they are eco-friendly, non-hazardous and non-toxic. The increasing demand for production of crops and food for such a vast population has led to an interest and necessity for the use of biofertilizers for the betterment of the crops and even for the health of soil (Anita *et al.*, 2017 and, Bagadi and George, 2021). Rhizobium inoculation is essential for all the pulse crops to increase the yield of pulses. Rhizosphere, seed inoculation of legumes with an efficient rhizobial strain is necessary. It is a bio-fertilizer which increases symbiotic nitrogen fixation and ultimately it increases the yield (Okbi *et al.*, 2018 Pramanik and Bera, 2012). As so, a field experiment was conducted at PRC, BARI, Ishurdi, Pabna during 2023 to evaluate the nitrogen compensation potentiality of *Rhizobium* inoculant through nodulation and yield of mungbean. The experiment was laid out in a Randomized Complete Block Design with three replications and assigned 7 different treatments. The treatments were as follows, T<sub>1</sub>= Native fertility, T<sub>2</sub>=Recommend dose of fertilizer (N<sub>20</sub>P<sub>18</sub>K<sub>20</sub>S<sub>10</sub>B<sub>1.7</sub> kg ha<sup>-1</sup>), T<sub>3</sub>= *Rhizobium* inoculant, T<sub>4</sub>= *Rhizobium*+75% RDN (Recommended dose of nitrogen), T<sub>5</sub>=



*Rhizobium*+50% RDN, T<sub>6</sub>= *Rhizobium*+25% RDN, and T<sub>7</sub>= *Rhizobium*+ 0% RDN and other fertilizer used as blanket dose. *Rhizobium* inoculant was significantly effect on nodule number, root dry weight, branch plant<sup>-1</sup>, pod plant<sup>-1</sup>, thousand seed weight, seed yield and stover yield. The results revealed that *Rhizobium* + 75% recommended dose of nitrogen (T<sub>4</sub>) showed significant effect on nodulation and yield of mungbean. The higher seed yield (0.95 t ha<sup>-1</sup>) was found in (T<sub>4</sub>) and the lower seed yield (0.56 t ha<sup>-1</sup>) was obtained from the native fertility (T<sub>1</sub>). The maximum nodule number plant<sup>-1</sup> before and after flowering (57 and 82, respectively) was recorded from T<sub>4</sub> while the minimum nodule number plant<sup>-1</sup> before and after flowering (11 and 15, respectively) was in native fertility. Yield increased over control was 25-41%. The higher additional income (Tk. 31200 ha<sup>-1</sup>) and MBCR (5.31) were found in *Rhizobium* + 75% recommended dose of nitrogen and to reduce the use of 25% N fertilizers.

#### Development of weed management package for summer mungbean

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

A field experiment was conducted at Pulses Research Centre, Ishurdi, Pabna during 2022-23 to find out the suitable weed management package for mungbean. Eight treatments were viz. T<sub>1</sub>: Panida-33EC (Pendimethaline @ 5ml L<sup>-1</sup> water), T<sub>2</sub>: Panida-33EC with one hand weeding at 30 DAE (Days After Emergence), T<sub>3</sub>: Weednil (Quizalofop-p-ethyle@ 1.5 ml L<sup>-1</sup> water), T<sub>4</sub>: Panida-33EC + Weednil, T<sub>5</sub>: Oxiflour (Quizalofop-p-ethyle@ 2.0 ml L<sup>-1</sup> water), T<sub>6</sub>: one hand weeding at 20 DAE, T<sub>7</sub>: Two hand weeding at 20 DAE and 40 DAE, T<sub>8</sub>: Control (No Weeding). Weed control efficiency in Panida+1H was as similar as 2 HW and Panida+weednil. The highest seed yield was recorded from two hand weeding (1241 kg ha<sup>-1</sup>) followed by Panida+1H (1231 kg ha<sup>-1</sup>), but the gross margin was the highest in Panida+1H (Tk. 45710 ha<sup>-1</sup>). Therefore, Panida-33EC with one hand weeding at 30 DAE was better weed management strategy to control weed in mungbean.

#### Determination of optimum dose of panida for weed control in mungbean

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

The experiment was conducted at the Pulses Research Centre, Ishurdi, Pabna during 2022-2023

to find out the appropriate dose of Panida for weed control in mung bean. Six treatments viz., T<sub>1</sub>: 3 ml Panida-33EC L<sup>-1</sup> of water, T<sub>2</sub>: 5 ml Panida-33EC L<sup>-1</sup> of water, T<sub>3</sub>: 7 ml Panida-33EC L<sup>-1</sup> of water, T<sub>4</sub>: 9 ml Panida-33EC L<sup>-1</sup> of water, T<sub>5</sub>: Control (No weedicide) were included in this experiment. This was laid out in Randomized Complete Block Design with three replications. Parthenium, anguli and digera weeds were more controlled in higher dose than no weedicide. The highest seed yield was recorded from 9 ml Panida (842 kg ha<sup>-1</sup>) followed by 7 ml Panida (831 kg ha<sup>-1</sup>) and the lowest seed yield (345 kg ha<sup>-1</sup>) in weedy plot. The gross margin was the highest in 7 ml Panida (Tk. 38916 ha<sup>-1</sup>). Therefore, 7 ml Panida was better dose to control weeds in mugbean based on weed control efficiency, yield and gross margin.

#### Effect of plant growth regulators on mungbean

R. Uddin and B.C. Kundu

Mungbean has an indeterminate form of flowering pattern. Maximum flowering and pod formation generally occurred in first flush. To maximize first flush flowering and reduce flower abortion, farmers generally use different types of commercial plant flowering hormones. Therefore, a field experiment was conducted to evaluate three widely used flowering hormones e.g. protozim, flora and Barti and to find out their role in flowering and seed yield. Results revealed that, use of flora was highly effective for flowering and reducing flower abortion. Use of flora had demonstrated the maximum number of sustained flower count/plant (120), maximum number of pods (39 pods/plant) and hence the highest seed yield (1278.3 kg/ha).

#### Pigeon pea

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

J. Hossain, M.S.Uz. Zaman, D. Sarkar, M.J. Alam, M.S. Alam, M.A. Hossain, M.S. Kabir, J. Rahaman, M.B. Sarker, S. Mahmud and M.M. Uddin

The experiment was carried out at PRC, Ishurdi, RARS, Rongpur, Jamalpur, Jashore and RPRS, Madaripur during 2022-2023 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 BPP-16001 were studied. BPP-16001 showed minimum duration to 50 per cent flowering (154 days) and was relatively short duration physiological maturity (246 days), which was about 32 days earlier maturity than others. BD-3124 gave the highest seed yield (2.40 t ha<sup>-1</sup>) followed by BPP-16001 (1.94 t ha<sup>-1</sup>). Therefore, considering the duration of flower initiation, pod initiation, physiological maturity, maturity type, yield and yield contribution characters, BPP-16001 could be suitable germplasm for varietal improvement of pigeon pea.

### Pulse-based cropping pattern

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

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

A field experiment was carried out at Pulses Research Centre, BARI, Ishurdi, Pabna during 2021-22 to increase cropping intensity and soil health through pulse crops. The experiment was carried out with seven different cropping patterns e.g i) CP<sub>1</sub> = Lentil (BARI Masur-8)– Mungbean (BARI Mung-6) – T.aman (BRRI dhan-71); CP<sub>2</sub> = Lentil (BARI Masur-9)– Boro rice (BINAdhan-14) – T.aman (BRRI dhan-71); CP<sub>3</sub> = Chickpea (BARI Chola-10) –Mungbean (BARI Mung-6)– T.aman (BRRI dhan-71) ; CP<sub>4</sub> = Fieldpea (BARI Motor-2)– Boro rice (BINAdhan-14) – Blackgram (BARI Mash-3); CP<sub>5</sub> = Grasspea (BARI Khesari-5) – Mungbean (BARI Mung-6) – T.aman; CP<sub>6</sub> = Lentil (BARI Masur-8)– Mungbean (BARI Mung-6)– Blackgram (BARI Mash-3); CP<sub>7</sub> = Boro rice (BINA dhan-14) – Fallow – T.aman (BRRI dhan-71). This was laid out in Randomized Complete Block Design with three replications. BARI Masur-8 (CP<sub>1</sub>) gave the highest seed yield (2.71 t ha<sup>-1</sup>) and the lowest (1.46 t ha<sup>-1</sup>) in BARI Chola-10 (CP<sub>3</sub>) among winter pulse crops. CP<sub>1</sub>(Lentil– Mungbean – T.Aman) gave highest gross return (571500 Tk. ha<sup>-1</sup>), but the highest gross margin (429620 t ha<sup>-1</sup>), and BCR (5.90) were obtained from CP<sub>6</sub> (Lentil– Mungbean – Blackgram) due to low cost of production.

### Profitability analysis of pulse based cropping patterns against rice based cropping systems in madaripur

M.M. Rashid, P. Chakraborti, S. Mahmud and M. S. Uddin

A field experiment was conducted at Regional Pulses Research Station, BARI, Madaripur during rabi season 2022-23 to find out the suitable pulse based cropping pattern for Madaripur district. The experiment was conducted in a RCBD design with three replications. There were six cropping patterns viz. CP<sub>1</sub> = T. Aman (cv. BRRI dhan-75) - Mustard (cv. BARI Shorisha-14) – Mungbean (BARI Mung-8) – Jute (Bongobir); CP<sub>2</sub> = T. Aman (cv. BRRI dhan-75) - Lentil (cv. BARI Masur-8) – Mungbean (cv. BARI Mung-8) – Jute (cv. Bongobir); CP<sub>3</sub> = T. Aman (cv. BRRI dhan-75) - Fieldpea (cv. BARI Motor-3) – Mungbean (cv. BARI Mung-8) – Jute (cv. Bongobir); and CP<sub>4</sub> = T. Aman (cv. BRRI dhan-75) - Potato (cv. BARI Alu-75) – Mungbean (cv. BARI Mung-8) – Jute (cv. Bongobir); CP<sub>5</sub> = T. Aman (cv. BRRI dhan-75) - Chickpea (cv. BARI Chola-11) –Jute (cv. Bongobir); CP<sub>6</sub> = T. Aman (cv. BRRI dhan-75) - Grasspea (cv. BARI Khesari-6) –Jute (cv. Bongobir); The highest rice equivalent yield was obtained from the cropping pattern CP<sub>4</sub> and the lowest rice equivalent yield was obtained from the cropping pattern CP<sub>4</sub>. Based on the above results it can be suggested that, T. Aman (cv. BRRI dhan-75) - Potato (cv. BARI Alu-75) – Mungbean (BARI Mung-8) – Jute (Bongobir) may be a best choice for the farmers of Madaripur region for the maximum utilization of their land and gaining more profit compared to the other studied cropping patterns.

### RARS Jashore

#### Performance of field pea under different sowing conditions

MS Kobir and KU Ahammad

An experiment was conducted at RARS, Jashore during 2022-23 consisting with the treatments: Main-plot factor: land configuration (03), L<sub>1</sub>= flat bed (conventional), L<sub>2</sub>= raised bed with furrow, L<sub>3</sub>= ridge with furrow, Sub-plot factor: Product (03) P<sub>1</sub>= green pod, P<sub>2</sub>= grain, P<sub>3</sub>= both green pod and grain in split-plot design with three replications. The highest gross margin (Tk. 167414 ha<sup>-1</sup>) was observed in raised bed with furrow and only green pod

treatment combination which is followed by ridge with furrow and only green pod harvesting treatment combination. The highest benefit cost ratio (4.49) was observed in flat bed and only mature pod harvesting treatment and the lowest gross return was found in ridge with furrow and only green pod harvesting treatment combination.

#### **Development of integrated weed management practices of lentil in Jashore region**

MS Kobir and KU Ahammad

An experiment was conducted at RARS, Jashore during 2022-23 consisting with the treatment considering 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. The highest no. of weeds was observed in  $T_6$  treatment. The highest weed biomass was found in  $T_1$  and  $T_6$  treatment in the 40 and 60 DAS, respectively. Application of pre emergence herbicide and one hand weeding at 4-5 weeks after sowing gave highest BCR.

#### **System productivity profitability and competition indices of fieldpea mixed cropping with mustard in different combinations in Jashore region**

MS Kobir and KU Ahammad

An experiment was conducted at RARS, Jashore during 2022-23 considering different legume–

oilcrop intercropping system viz.  $T_1$ : 100% fieldpea + 10% mustard,  $T_2$ : 100% fieldpea+20% mustard,  $T_3$ : 100% fieldpea + 30% mustard,  $T_4$ : 90% fieldpea+10% mustard,  $T_5$ : 80% fieldpea+20% mustard,  $T_6$ : 70% fieldpea + 30% mustard and sole cultivation of the both crops. The experiment was laid out in RCB design with 3 replications. Mixed cropping practices of field pea and mustard in the combination of 100% field pea+ 30% mustard is the best combination for maximizing the yield.

#### **Performance of lentil and field pea intercropping with chickpea**

MS Kobir and KU Ahammad

An experiment was conducted at RARS, Jashore during 2022-23 consisting with the two sets of experiments of different legume–legume intercropping system viz. In set-1:  $T_1$ =1:1 (lentil: chickpea),  $T_2$ =2:1 (lentil: chickpea),  $T_3$ =3:1 (lentil: chickpea),  $T_4$ = (100% lentil+ 20% chickpea) mixed intercropping and sole cultivation of both the crops. In set-2:  $T_1$ =1:1 (field pea: chickpea),  $T_2$ =2:1 (field pea: chickpea),  $T_3$ =3:1 (field pea: chickpea) and sole cultivation of both the crops in RCB design with 03 replications. The results revealed that intercropping cultivation system is more beneficial than monoculture. Moreover, this production system is also increase the biodiversity. According to the results intercropping combinations of 1:1 (lentil: chickpea) and 2:1 (fieldpea: chickpea) gave the maximum benefit in respect of equivalent yield, gross return and BCR.



# OILSEED CROPS

03

Oilseed Research Centre (ORC) is one of the important Centre of Bangladesh Agricultural Research Institute. It has been conducting research work on nine oilseed crops like rapeseed-mustard, groundnut, sesame, soybean, sunflower, linseed, niger, safflower and perilla of which the first five are considered as major. ORC of BARI has given major thrust to develop high yielding oilseed varieties with special emphasis on short duration to fit in rice based cropping system, dwarf type, waterlogged tolerant and diseases and insects resistant. Also maintenance of germplasm, development of inbred lines, creation of variations and recombination through hybridization and mutation and select of climate resilient varieties. ORC has already developed 52 varieties of different oilseed crops having higher yield, short duration, dwarf type and stress tolerance and their production technologies. The research achievements during 2022-2023 on varietal improvement, Crop and soil management, disease and insect management, and technology transfer have been given below:

## A. Rapeseed-Mustard (*Brassica* spp.)

### Variety Development

#### Sub-Project I: Collection, evaluation and maintenance of oilseed crops germplasm

##### Maintenance of rapeseed mustard germplasm

D. R. Datta, M. S. Uddin, M. A. Latif Akanda and M.T. Islam

The experiment was conducted at Gazipur during *rabi* 2022-23 to maintain the genetic stock with 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 a non-replicated trial at Joydebpur location. The sowing date was 15 November 2022. Unit plot size was 3 rows 3 m long and row to row distance 30 cm and plant to plant distance 5 cm after thinning. Fertilizers were applied @ 120: 80: 60: 40: 4: 1 kg/ha of N: P: K: S: Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Twenty plants were selected randomly from middle row of the plot. The seeds collected from harvesting will be grown in next year and stored for using in future breeding programme.

#### Sub-Project II: Development of high yielding short duration variety in *Brassica rapa* L. and *Brassica napus* L.

##### Hybridization in *Brassica rapa* L.

D. R. Datta, M. S. Uddin and M. A. Latif Akanda

The experiment was conducted at Gazipur during *rabi* 2022-23 to obtain new recombinant for developing early, disease tolerance, abiotic stress tolerance and high yielding *Brassica rapa* L. Nine selected lines of *Brassica rapa* (BC-14016y, BC-14031y, BC-17033y, BC-15022y, BC-15020y, BC-15015y, BC-18315y, BC-1822y, BC-22079) which were used as females and 3 varieties ((BS-20, BS-14 and Tori-7) were used as male. Crossing was done followed by Line  $\times$  Tester method. The sowing date was 15 November 2022. Unit plot size was 3 rows 3 m long and row to row distance 30 cm and plant to plant distance 5 cm after thinning. A total of 2244 seeds were harvested from the obtained cross combinations and preserved for next year confirmation trial.

**Hybridization in *Brassica rapa* L. (Set-I)**

M. K. Alam, M. I. Riad, M. M. Kadir, and M.S.Uddin

A hybridization program was conducted at RARS, BARI, Jamalpur during 2022-23 to obtain new recombinant for developing early, disease tolerance, abiotic stress tolerance and high yielding *Brassica rapa* L. The mating design was 7×7 half diallel fashion. Among the 21 cross combinations, 21 crosses produced seeds successfully. A total of 1396 seeds were harvested from the obtained cross combinations and preserved for next year confirmation trial.

**Confirmation of F<sub>1</sub> generation of *Brassica rapa* L.**

M. K. Alam, M. I. Riad, M. M. Kadir and M.S.Uddin

The experiment was conducted at RARS, Jamalpur during rabi 2022-23 to confirmation of F<sub>1</sub> progenies. The F<sub>1</sub>'s were produced from six parents crossed in 6×6 half diallel mating design during 2021-22. As a result, 15 crosses were made. All six parents and their 15 F<sub>1</sub> progenies were grown in single row 2M long plot. Five competitive plants were randomly selected from each F<sub>1</sub> plots and parents for data collection. The F<sub>1</sub> progenies were harvested, bulked and seeds were preserved to grow F<sub>2</sub> population in next generation.

**Line×Tester analysis of *Brassica rapa* L. (Set-I)**

M. S. Uddin, D. R. Datta, and M. A. Latif Akanda

The experiment was conducted at Gazipur during rabi 2022-23 to study combining ability of parents and find out high yielding genotypes. Parent materials of the experiment consisted of three lines and nine testers. Here, BS-14, BS-15 and BS-17 were used as lines. Besides, BS-4093, BS-12, BS-9, Din-2, SBC-2193, SBC-6823, SBC-8693, Tori-7 and wild were used as testers were used for hybridization following Line × Tester mating design. All of the F<sub>1</sub> progenies were sown on 17 November 2022. Plot size was 4 rows 3 m long per cross. Row to row distance was 30 cm and plant to plant distance was 5 cm. Fertilizers were applied @ 120: 80: 60: 40: 4: 1 kg/ha of N: P: K: S: Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Data were taken on days to flowering, days to maturity, plant height, number of branches per plant, number of silique per plant and yield per plant. Analysis of variance showed that mean squares due to replications, genotypes, lines, tester and interaction of line and tester were significant for all the studied traits except days to maturity and days to flowering in case of lines. It indicated that a large amount of variation present among the studied materials for these traits. Specific combining ability is considered an important criterion for evaluation of hybrid. From the result, the cross BS-14 × BC-4093 has shown the highest value of SCA in case of yield per plant. On the other hand, the parent BS-14 has the highest GCA effect for yield per plant.

**Evaluation of segregating generations of *Brassica rapa* L.**

M.S. Uddin, D.R. Datta, M.A.L. Akanda and M.T. Islam

The experiment was conducted to evaluate the different segregation generations. The F<sub>1</sub> to F<sub>4</sub> progenies seeds were sown cross to row method along with parents and checks. Families of F<sub>5</sub> and F<sub>6</sub> generation were evaluated during rabi 2022-23 at Gazipur. Families were sown following family to row method along with BARI Sarisha-14 as check in 4-rows 3m long plot with spacing 30 cm and 5 cm between rows and plants, respectively. Seeding was done on 21 November 2022. The seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Single plant selection among families was done based on short duration (maturity duration upto 85 days), erect and compact type having desirable agronomic characters, disease and insect tolerance. Considering earliness, seed yield, yield attributing characters 50, 42, 25 and 10 desirable plants were selected in F<sub>2</sub>, F<sub>3</sub>, F<sub>4</sub>, F<sub>5</sub> and F<sub>6</sub>, respectively. From F<sub>6</sub>,

generation 4 progenies were selected for seed yield evaluation in observational trial next year.

### **Selection in segregating generation (F<sub>2</sub>-F<sub>6</sub>) of *Brassica spp.***

M. K. Alam, M. I. Riad, M. M. Kadir and M.S.Uddin

The experiment was conducted to evaluate the different segregation generations at RARS, BARI, Jamalpur. The F<sub>1</sub> to F<sub>4</sub> progenies seeds were sown cross to row method along with parents and checks. Families of F<sub>5</sub> and F<sub>6</sub> generation were evaluated during *rabi* 2022-23. Families were sown following family to row method along with BARI Sarisha-14 as check in 4-rows 3m long plot with spacing 30 cm and 5 cm between rows and plants, respectively. Seeding was done on 14 November 2022. The seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Single plant selection among families was done based on short duration (maturity duration upto 85 days), erect and compact type having desirable agronomic characters, disease and insect tolerance. Considering earliness, seed yield, yield attributing characters 150, 120, 150 and 21 desirable plants were selected in F<sub>2</sub>, F<sub>3</sub> and F<sub>4</sub>, respectively for generation advanced.

### **Observation trial of *Brassica rapa* L. (Set-I)**

M.S. Uddin, D.R. Datta, M.A.L. Akanda and M.T. Islam

Twelve lines of *Brassica rapa* having yellow flower and yellow seed coat colour were selected last year from F<sub>7</sub> generation of different cross combinations. These lines along with two checks as BARI Sarisha-14 and BARI Sarisha-20 were evaluated with two replications under observation trial of *Brassica rapa* (Set-I) at Gazipur during 2022-23. The lines were sown on 17 November 2022 in 3 rows of 3m long with spacing of 30 cm and 5cm between rows and plants, respectively. The seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron

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. All intercultural operations were done timely to raise a good crop. Data were taken on days to flowering, days to maturity, plant height (cm), no. of siliquae per plant, no. of seeds per silique, 1000-seed weight (g) and seed yield/plot. The plot yield was converted into kg/ha to measure the yield of the line. Considering earliness, seed yield and other yield contributing characters, two lines BC2014-y011 and BC2014-y01 were selected for the next trial.

### **Observation trial of *Brassica rapa* L. (Set-II)**

M.S. Uddin, D.R. Datta, M.A.L. Akanda and M.T. Islam

Eleven lines of *Brassica rapa* having yellow flower and brown seed coat colour were selected last year from F<sub>7</sub> generation of different cross combinations. These lines 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 during 2022-23. The lines were sown on 17 November 2022 in 3 rows of 3m long with spacing of 30 cm and 5 cm between rows and plants, respectively. The seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Data were taken on days to flowering, days to maturity, plant height (cm), no. of siliquae per plant, no. of seeds per silique, 1000-seed weight (g) and seed yield/plot. The plot yield was converted into kg/ha. Considering earliness, seed yield and other yield contributing characters, three lines BS-14 X SAU-1-1, BS-15 X SAU-1-1 and BS-14XBS-15-6 were selected for the next trial.

### **Observation trial of *Brassica rapa* L. (Set-III)**

U. Kulsum and M.S. Uddin

Twenty-two lines of *Brassica rapa* having yellow and brown seed coat colour were selected in 2022 from F<sub>7</sub> generation of 16 parents cross



combinations. These lines with three check varieties viz. BARI Sarisha-14, BARI Sarisha-17 and BARI Sarisha-20 were evaluated in an RCB design with three replications for seed yield and yield related characters at Joydebpur during rabi 2022-2023. Seeds were sown on 17 November 2022 in 3 rows of 3 m long with a spacing of 30 cm between row to row. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P: K:S: Zn and Boron from Urea, TSP, MOP, Gypsum, Zinc Sulphate and Boric acid, respectively. Half of the urea and all other fertilizers were applied during the final land preparation. The rest of the urea was applied at the flower initiation stage. All intercultural operations were done timely to facilitate optimal plant growth. Data were taken on days to flowering, days to maturity, plant height (cm), siliques per plant, seeds per silique, thousand-seed weight (g) and seed yield/plot. The plot yield was converted into kg/ha to measure the yield of the line. The data were analyzed statistically with R tools and Microsoft Excel. Considering seed yield and other yield contributing characters, four lines RIL-16, RIL-11, RIL-121 and RIL-118 can be selected for the next yield trial and future breeding program.

#### **Observation trial of *Brassica rapa* L. (Set-IV)**

U. Kulsum and M.S. Uddin

Twenty-eight lines of *Brassica rapa* having yellow and brown seed coat colour were selected in 2022 from F<sub>7</sub> generation of 16 parents' cross combinations. These lines with two check varieties viz. BARI Sarisha-17 and BARI Sarisha-20 were evaluated in an RCB design with three replications for seed yield and yield related characters at Joydebpur during rabi 2022-2023. Seeds were sown on 17 November 2022 in 3 rows of 3 m long with a spacing of 30 cm between row to row. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P: K:S: Zn and Boron from Urea, TSP, MOP, Gypsum, Zinc Sulphate and Boric acid, respectively. Half of the urea and all other fertilizers were applied during the final land preparation. The rest of the urea was applied at the flower initiation stage. All intercultural operations were done timely to facilitate optimal plant growth. Data were taken on days to flowering, days to maturity, plant height (cm), siliques per plant, seeds per silique, thousand-seed weight (g) and seed yield/plot. The plot yield was converted into kg/ha to measure the yield of the line. The data were

analyzed statistically with R tools and Microsoft Excel. Considering seed yield, three lines RIL-25, RIL-26, and RIL-27 can be selected as breeding materials and used in the next yield trial.

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

M.S. Uddin, D.R. Datta, M.M.H. Khan, M.R. Humayan, M.I. Riad, M.K. Alam, M.H. Rahman, M.A. Monim, S. Ghosh, T.A. Mujahidi, M.M. Kader, M.A.L. Akanda and M.T. Islam

The experiment was conducted at Gazipur, Ishurdi, Barishal, Jeshore and Rangpur during rabi 2022-23 with 11 genotypes of *Brassica rapa* having yellow seed coat colour along with one check as BARI Sarisha-14. The experiment was laid out in randomized complete block design with three replications. The plot size was 3m x 0.9m. Seeding was done on 14 November 2022 at Gazipur, 11 November 2022 at Ishurdi, 01 November 2022 at Jashore, 18 November 2022 at Rahmatpur, Barishal and 23 November 2022 at Rangpur as continuous sowing in rows of 30 cm apart. The seedlings were thinned after few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Data were taken on days to 50% flowering (DFF), days to maturity (DM), plant height (PH), no. of primary branches per plant (NBPP), number of siliques per plant (NSPP), number of seeds per silique (NSPS), 1000 seed weight (g) (TSW) and seed yield per plot. The plot yield was converted into seed yield per hectare. The data were analyzed statistically with STAR and R software. Considering stability parameter, earliness, seed yield and other yield attributing characters, four lines like BC-100614(4)-5, BC-100614(4)-2, BC-100614(4)-11 and BC-100614(8)-2 were selected for RYT in the next year.

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

M I Riad, M K Alam, M Kadir and M.S. Uddin

The experiment was conducted at Regional Agricultural Research Station, Jamalpur during Rabi 2022-2023 with 12 promising genotypes of

*Brassica rapa*. It was laid out in randomized complete block design with three replications. BARI Sarisha-14 and Tori-7 were used as check. The plot size was 3 m x 2 m. Seeds were sown on the 10 November, 2022 in continuous and row was 30 cm apart from each. The seedlings were thinned after 7-11 days of germination 5 cm apart. Fertilizer were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn: and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Boric acid. Half of the urea and all other fertilizers were applied during final land preparation. The rest of the urea was applied at the initial stage of flowering. All intercultural operations were done timely to raise the crop uniformly. Data were taken on days to maturity, plant height, number of primary branches/plant, silique length, number of siliquae/plant, seeds/silique and yield per plot and yield (kg/ha). The plot yield was converted into hectare. The data were analyzed statistically. From the above results it can be concluded that BC-18008, BC-15044 and BC-18009 can be selected for regional yield trial on the basis of short duration and seed yield per hectare in the next season.

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

M I Riad, M K Alam, M. M. Kadir, and M.S.Uddin

The experiment was conducted at Regional Agricultural Research Station, Jamalpur during Rabi 2022-2023 with 12 promising genotypes of *Brassica rapa*. It was laid out in randomized complete block design with three replications. BARI Sarisha-9 and Tori-7 were used as check. The plot size was 3 m x 2 m. Seeds were sown on the 11 November, 2022 in continuous and row was 30 cm apart from each. The seedlings were thinned after 7-11 days of germination 5 cm apart. Fertilizer were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn: and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Boric acid. Half of the urea and all other fertilizers were applied during final land preparation. The rest of the urea was applied at the initial stage of flowering. All intercultural operations were done timely to raise the crop uniformly. Data were taken on days to maturity, plant height, number of primary branches/plant, silique length, number of siliquae/plant, seeds/silique and yield per plot and yield (kg/ha). The plot yield was converted into hectare. The data were analyzed statistically. From

the above results it can be concluded that BC-22035, BC-122072, BC-14021 and BC-15003 can be selected for regional yield trial on the basis of short duration and seed yield.

#### **Regional yield trial of *Brassica rapa* L.**

M.S. Uddin, D.R. Datta, M.M.H. Khan, M.R. Humauan, M.K. Alam, M.H. Rahman, M.A. Monim, S. Ghosh, T.A. Mujahidi, M.M. Kader, M.A.L. Akanda, and M.T. Islam

The experiment was conducted at Barishal, Gazipur, Ishurdi Jamalpur, Jashore and Rangpur during *rabi* season 2022-23. It consisted of seven advanced lines of *Brassica rapa* along with two checks *viz.* BARI Sarisha-14 and BARI Sarisha-20. The experiment was laid out in randomized complete block design with three replications. The plot size was 3m×1.8m. The seeds were sown on 18 November 2022 at Barishal, 15 November 2022 at Gazipur, 14 November 2022 at Jamalpur, 10 November 2022 at Ishurdi, 1<sup>st</sup> November 2022 at Jashore, 08 November 2022 at Rangpur. The seeds were sown continuous and row to row distance was 30 cm apart from each. The seedlings were thinned after few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg ha<sup>-1</sup> of N:P:K:S:Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Data were taken on days to 50% flowering (DFF), days to 80% maturity (DM), plant height (PH), number of branches per plant (NBPP), number of siliquae per plant (NSPP), number of seeds per silique (NSPS), 1000 seed weight (TSW), seed yield (kg ha<sup>-1</sup>). The data were analyzed statistically with STAR and R software. Considering earliness, seed yield, yield attributing traits and all stability statistics together identify two lines like BC-100614 (4)-7 (1715 kg ha<sup>-1</sup>) and BS-15-YF-01 (1488 kg ha<sup>-1</sup>) were selected for adaptive trials in the next year.

#### **Hybridization in *Brassica napus* L. (Set-I)**

M. K. Alam, M. I. Riad, M. M. Kadir and M.S.Uddin

A hybridization program was conducted at RARS, BARI, Jamalpur during 2022-23 to obtain new recombinant for developing early, disease

tolerance, abiotic stress tolerance and high yielding *B. napus* L. The mating design was 8×8 half diallel fashion. Among the 28 cross combinations were produced seeds successfully. A total of 1203 seeds were harvested from the obtained cross combinations and preserved for next year confirmation trial.

#### **Hybridization in *Brassica napus* L. (Set-II)**

M. S. Uddin, D.R. Datta, and M. A. Latif Akanda

The experiment was conducted during rabi 2022-23 at Gazipur to obtain new recombinant for developing early, disease tolerance, abiotic stress tolerance and high yielding *Brassica napus* L. with ten selected lines of *Brassica napus* (Nap-50021, Nap-16021, Nap-19021, Nap-32021, Nap-37021, Nap-38021, Nap-44021, Nap-47021, Nap-49021, Nap-51021) which were used as females and 3 varieties (BS-8, BS-13 and BS-18) were used as male or tester. Crossing was done followed by Line × Tester method. The sowing date was 15 November 2022. Unit plot size was 3 rows 3 m long and row to row distance 30 cm and plant to plant distance 5 cm after thinning. A total of 3653 seeds were harvested from the obtained cross combinations and preserved for next year confirmation trial.

#### **Confirmation of F<sub>1</sub> generation of *Brassica napus* L.**

M. K. Alam, M. I. Riad M. M. Kadir and M.S.Uddin

F<sub>1</sub> seeds were obtained from 21 cross combinations from *Brassica napus*. It was made during 2020-21 and was included in this trial. The seeds were sown on the 14 November, 2022. Each entry was grown in a single row of 2 m long plot with spacing 40 cm and 10 cm between row and plant respectively along with their parents as check. Five competitive plants were randomly selected from each F<sub>1</sub> plots and parents for data collection.

#### **Observation yield trial of *Brassica napus***

M. K. Alam, M. I. Riad, M. M. Kadir and M.S.Uddin

The experiment was conducted at Regional Agricultural Research Station, Jamalpur during rabi 2022-2023 with 30 promising genotypes of *Brassica napus* including two checks BARI Sarisha-8 and BARI Sarisha-13. It was laid out in RCBD design with two replications. The plot size

was 3.0 m x 2.0 m. Seeds were sown on the 13<sup>th</sup> November, 2022 in continuous and row was 30 cm apart from each. The seedlings were thinned after 11 days of germination 5 cm apart. Fertilizer were applied @ 120:80:60:40:4:1 kg/ha of N: P: K: S: Zn: and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Boric acid. Half of the urea and all other fertilizers were applied during final land preparation. The rest of the urea was applied at the initial stage of flowering. All intercultural operations were done timely to raise the crop uniformly. Data were taken on days to flowering, plant height, pod/plant, seeds/pod, pod length, days to mature and yield per plot. The plot yield was converted into hectare. Nap-22015, Nap-22014 and Nap-22044 these three lines took just 78-79 days to mature and produced almost 2000 kg/ha yield and may be used in preliminary yield trial in next season.

#### **Adaptive yield trial of *Brassica napus***

M. K. Alam, M. I. Riad, M.S. Uddin and M. M. Kadir

The experiment was conducted farmer's field at Melanda Upazila, in Jamalpur District during rabi 2022-2023 season with 9 promising genotypes of *Brassica napus*. It was laid out in randomized complete block design with three replications. BARI Sarisha-8 released variety of *Brassica napus* used as check. The plot size was 3.0 m x 2.0 m. Seeds were sown on the 9<sup>th</sup> November, 2022 in continuous and row was 30 cm apart from each. The seedlings were thinned after few days of germination 5 cm apart. Fertilizer were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn: and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Boric acid. Half of the urea and all other fertilizers were applied during final land preparation. The rest of the urea was applied at the initial stage of flowering. All intercultural operations were done timely to raise the crop uniformly. Data were taken on days to mature, inflorescence length, plant height, primary branches/plant, secondary branches/ plant, pods/plant, length of pod, seed/pod, and yield per hectare. The data were analyzed statistically. Three genotypes Nap-15037, Nap-15029 and Nap-16064 may be selected for further evaluation in the farmers' field on the basis of early mature, pods/plant and yield performances in the next season.



**Observation yield trial of *Brassica napus* (canola)**

M. K. Alam, M. I. Riad, M. M. Kadir and Ms.Uddin

An observation yield trial was conducted at RARS Jamalpur during rabi 2022-2023 with 27 promising genotypes of *Brassica napus* with RCBD design and two replications. BARI Sarisha-18 the released variety of *Brassica napus* used as check. The plot size was 3.0 m x 2.0 m. Seeds were sown on the 14<sup>th</sup> November, 2022 in continuous and row was 30 cm apart from each. The seedlings were thinned after few days of germination 5 cm apart. Fertilizers were applied based on recommended dose. All intercultural operations were done timely to raise the crop uniformly. Data were taken on yield contributing parameters. The data were analyzed statistically. From the above results, it can be concluded that, considering canola quality, seed yield and other yield attributing characters these three lines NAP-02 X NAP-0865, NAP-02 X BEN-21, and NAP-02 X NAP-15029 may be selected for preliminary yield trials in the next year.

**Regional yield trial of *Brassica rapa***

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

The experiment was conducted at RARS Jamalpur during rabi 2022-2023 with 10 promising genotypes of *Brassica rapa*. It was laid out in RCBD design with three replications. BARI Sarisha-9 and BARI Sarisha-12 were used as check. The plot size was 3.0 m x 2.0 m. Seeds were sown on the 12<sup>th</sup> November, 2022 in continuous and row was 30 cm apart from each. The seedlings were thinned after few days of germination 5 cm apart. Fertilizers were applied based on recommended dose. All intercultural operations were done timely to raise the crop uniformly. Data were taken on yield contributing parameters. The data were analyzed statistically. Four genotypes BCC-22004, BCC-22002, BCC-22003 and BCC-22001 may be selected for adaptive trial in the farmers' on the basis of early mature, pods/plant and yield performances in the next season.

**Observation yield trial of *Brassica napus* I. (Set-II)**

U. Kulsum and M. S Uddin

The experiment was conducted with fifteen lines of *Brassica napus* with one check variety BARI

Sarisha-18 at Joydebpur in 2023. The experiment was laid out in RCB design having three replications. Each entry was grown in 3m long 3 rows with row-to-row spacing of 30 cm. The sowing date was 17 November 2022. Fertilizers were applied @ 260:170:90:160:5 and 10 kg/ha as urea, TSP, MOP, Gypsum, Zn oxide and Boric acid. All fertilizers and half urea will be applied as basal and the remaining half at flower initiation. Other cultural operations were done as and when necessary. Data were collected from 5 randomly selected plants. Data were taken on days to flowering, days to maturity, plant height (cm), branches per plant, siliques per plant, no. of seeds per silique, thousand-seed weight (gm), seed yield per plot (gm), seed yield (kg/ha), disease and insect reaction. The data were analyzed statistically with R tools and Microsoft Excel. The lines, SDNapus-15, SDNapus-2 and SDNapus-8 produced the highest yield than the existing check variety BARI Sarisha-18. Thus, these can be used in preliminary yield trial in the next season.

**Preliminary yield trial of *Brassica napus***

M. K .Alam, D. Datta, A. Monim, M. I. Riad M. M. Kadir and M. S Uddin

The experiment was conducted at Regional Agricultural Research Station, Jamalpur, Jessore and Joydevpur during rabi 2022-2023 with 14 promising genotypes of *Brassica napus*. It was laid out in randomized compete block design with three replications. BARI Sarisha-8 and BARI Sarisha-13 released variety of *Brassica napus* were used as check. The plot size was 3.0 m x 2.0 m. Seeds were sown on the 13<sup>th</sup> November, 2022 in continuous and row was 30 cm apart from each. The seedlings were thinned after 11 days of germination 5 cm apart. Fertilizers were applied based on FRG-2018. The rest of the urea was applied at the initial stage of flowering. All intercultural operations were done timely to raise the crop uniformly. Data were taken on yield and yield contributing traits. The plot yield data was converted into hectare. The data were analyzed statistically. From the above results it can be concluded that Nap-47021, Nap-32021 and Nap-33021 genotypes can be selected for regional yield trial on the basis of their seed yield per hectare and other traits.

**Regional yield trial of *Brassica napus* (canola)**

M. K. Alam, M. I. Riad, M. R. Humayun, M. S. Huda, K.C. Saha and M. M. Kadir

The experiment was conducted at RARS Jamalpur during rabi 2022-2023 with 16 promising genotypes of *Brassica napus*. It was laid out in randomized complete block design with three replications. BARI Sarisha-18 released variety of *Brassica napus* used as check. The plot size was 3.0 m x 2.0 m. Seeds were sown on the 12<sup>th</sup> November, 2022 in continuous and row was 30 cm apart from each. The seedlings were thinned after few days of germination 5 cm apart. Fertilizers were applied based on recommended dose. All intercultural operations were done timely to raise the crop uniformly. Data were taken on yield contributing parameters. The data were analyzed statistically. Genotypes BNC-22019, BNC-22023, BNC-22018 and BNC-22020 may be selected for adaptive trial in the farmers' on the basis of canola quality, early mature, pods/plant and yield performances in the next season.

**Regional yield trial of *Brassica napus* L.**

M. K. Alam, D. R. Datta, A. Monim, R. Humayun, M. H. Khan, M. I. Riad, M. M. Kadir and M. S. Uddin

The experiment was conducted at RARS Jamalpur, Rahmatpur, Borirhat, Ishurdi, Jessore and Joydevpur during rabi 2022-2023. The experiment consisted of 12 promising genotypes including BARI Sarisha-8 and BINA Sarisha-9 used as check with RCBD design and 3 replications of *Brassica napus*. The plot size was 3.0 m x 2.0 m. Seeds were sown on the 12<sup>th</sup> November, 2022 in continuous and row was 30 cm apart from each. The seedlings were thinned after few days of germination 5 cm apart. Fertilizers were applied based on FRG-2018. The rest of the urea was applied at the initial stage of flowering. All intercultural operations were done timely to raise the crop uniformly. Data were taken on yield and yield contributing traits. The data were analyzed statistically. Considering seed yield and other yield contributing characters, four lines like Nap-20002, Nap-16021 Nap-16004 and Nap-20008 may be selected for adaptive trial in the farmers' on the basis of early mature, pods/plant and yield performances in the next season.

**Sub-Project III: Development of high yielding variety in *Brassica juncea* L. and *Brassica carinata* L.****Regional yield trial of *Brassica juncea* l.**

M.S. Uddin, D.R. Datta, M.M.H. Khan, M.R. Humayun, M.K. Alam, M.H. Rahman, M.A. Monim, S. Ghosh, T.A. Mujahidi, M.M. Kader, M.A.L. Akanda, and M.T. Islam

The experiment was conducted at Barishal, Gazipur, Ishurdi, Jamalpur, Jashore and Rangpur during rabi 2022-23. It consisted of 8 advanced lines of *Brassica juncea* along with two checks viz., BARI Sarisha-11 and BARI Sarisha-19. The experiment was laid out in randomized complete block design with three replications. The plot size was maintained 3m x 1.8m. Seeding was done on 18 November 2022 at Barishal, 21 November 2022 at Gazipur, 14 November, 2022 Ishurdi, 17 November 2022 at Jamalpur, 1<sup>st</sup> November 2022 at Jashore and 23 November 2022 at Rangpur in continuous sowing and row was 30 cm apart from each. The seedlings were thinned after a few days of germination 5 cm apart from plant-to-plant distance was maintained. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron from Urea, TSP, MP, 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. All intercultural operations were done timely to raise a good crop. Data were taken on days to 50% flowering (DFF), days to maturity (DM), plant height (PH), no. of primary branches per plant (NBPP), number of siliques per plant (NSPP), number of seeds per silique (NSPS), 1000 seed weight (g) (TSW) and seed yield per plot. The plot yield was converted into seed yield per hectare. The data were analyzed statistically with STAR and R software. Considering seed yield and other yield contributing characters, two lines BJ 11536 (12)-1 (1898 kg ha<sup>-1</sup>) and BJ DH -05 (1849 kg ha<sup>-1</sup>) were selected for adaptive trial in the next year.

**Interspecific hybridization in *B. Napus* L.; *B. Rapa* L. and *B. Carinata* L.**

M.S. Uddin, D.R. Datta, and M.A.L. Akanda

One variety of *Brassica napus* (BARI Sarisha -18) which was used as female parent and 6 testers

((BS-14, BS-16, Carinata, *Rorippa indica*, White mustard and Black Mustard) were used as male. The seeds were sown continuous and row to row distance was 30 cm apart from each. The seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg ha<sup>-1</sup> of N:P:K:S:Zn and Boron 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. All intercultural operations were done timely to raise a good crop. The sowing date was 15 November 2022. Unit plot size was 2 rows 3 m long and row to row distance 30 cm and plant to plant distance 5 cm after thinning. Crossing was done followed by Line × Tester method. Emasculation and pollination were followed by bagging with thin brown paper bags and labelled with tags. To overcome the interspecific pre-fertilization barrier, 0.1% gibberellic acid was sprayed after emasculation by using a hand sprayer. Achieving the proper maturation of silique F<sub>1</sub> hybrids were harvested and after proper drying the seeds were stored in the refrigerator for the use of next winter season. At flowering time single crosses were made. Matured siliques of all the crosses were harvested, dried and after threshing seeds were preserved properly for next use. Twenty-four interspecific cross buds were successful, from which a total of 47 seeds were found. The collected seeds were properly stored for evaluation in the next season.

#### **Evaluation of segregating generation of interspecific crosses**

M.S. Uddin, D.R. Datta, M.A.L. Akanda and M.T. Islam

F<sub>1</sub> and F<sub>2</sub> seeds were sown cross to row method along with parents and checks. Families of six F<sub>6</sub> generation were evaluated during *rabi* 2022-23 at Gazipur. Families were sown following family to row method along with BARI Sarisha-18 as check in 2-rows 3m long plot with spacing 30 cm and 5 cm between rows and plants, respectively. Seeding was done on 21 November 2022. The seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Single plant selection among families was done based on short duration), erect and compact type having desirable agronomic characters, disease and insect tolerance. Considering earliness, seed yield, yield attributing characters 43 desirable plants were selected in F<sub>2</sub>. From F<sub>6</sub>, generation 2 progenies were selected for seed yield evaluation in observational trial next year.

#### **Preliminary yield trial of entries developed from interspecific hybridization among *B. Carinata* and *B. Napus***

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

The experiment was conducted with five accessions including one check variety BARI Sarisha-18 at Joydebpur, Burirhat and Jashore in 2022-23. The entries were developed crossing between the BARI Sarisha-13 with *B. carinata*. The seed was sown on 16 November 2022. The experiment was laid out in RCB design having three replications. Each entry was grown in 3m long 3 rows with row to row spacing of 30 cm. Fertilizers were applied @ 260:170:90:160:5 and 10 kg/ha as urea, TSP, MOP, Gypsum, Zn oxide and Boric acid. All fertilizers and half urea will be applied as basal and the remaining half at flower initiation. Other cultural operations were done when necessary. Data were collected from 5 randomly selected plants. Data were taken on days to flowering, days to maturity, plant height (cm), no. of branches per plant, no. of silique per plant, no. of seeds per silique, thousand-seed weight (gm), seed yield per plot, seed yield (kg/ha), disease and insect reaction. The data were analyzed statistically with R tools and Microsoft Excel. After considering yield along with most of the yield related traits, 13CA12014-1 and 13CA52014-3 were out-yielded compared to check varieties in multi-location. As it was the first year, the trial will be repeated next year with the same entries. Additionally, these highest-performing entries will be used for the Regional Yield Trial program.



## **Sub-Project IV: Development of hybrid variety in *Brassica rapa* L. and *Brassica napus* L.**

### **Maintenances of CMS, maintainer and restorer lines of *B. Napus***

M.S. Uddin, D.R. Datta, M.A.L. Akanda, and M.T. Islam

The experiment consisted of two CMS lines like CMSZ<sub>1</sub> (248) and CMSZ<sub>2</sub> (279), two maintainer lines like Nap-248M and Nap-279M and one restorer line like Nap-14-01R. It was conducted at Gazipur during rabi 2022-23. Unit plot size was four rows three meter long. Seeding was done on 17 November 2022. The seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron 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. CMS lines were crossed with maintainer lines. Maintainer lines and restorer lines were selfed. Bagging was done to protect out crossing. Crossing and selfing were done by hand pollination. Two CMS lines like CMSZ<sub>1</sub> (248) and CMSZ<sub>2</sub> (279), was crossed with two maintainer lines like Nap-248M and Nap-279M, respectively to maintained CMS lines. A total of 8398 CMS lines seed, 4995 maintainer lines seed and 3403 restorer line seeds were found. The CMS lines, maintainer lines and restorer line seeds were stored for a future breeding programme.

### **Development of hybrid variety in rapeseed**

M.S. Uddin, D.R. Datta, M.A. L. Akanda and M.T. Islam

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

Two CMS lines [CMSZ<sub>1</sub> (248) and CMSZ<sub>2</sub> (279)], one Restorer line (Nap-14-01R), three short duration (87-88 days) of *Brassica napus* lines (Nap-0876, Nap-0869 and Nap-205), two varieties (BARI Sarisha-8 and BARI Sarisha-13) and one *Brassica napus* line (Nap-14-015) were used as experimental materials. The experiment was conducted during rabi 2022-23 *rabi* at Gazipur. Seeds were sown on 22 November 2022 as continuous sowing in rows of 30 cm apart. The

seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron 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. CMS lines were crossed with three short duration *Brassica napus* lines and BARI Sarisha-8 and BARI Sarisha-13. Bagging was done to protect out crossing. Crossing was done by hand pollination.

#### **II. Development of test cross hybrid in *Brassica napus* l.**

CMS line [CMSZ<sub>1</sub> (248) was crossed with Restorer line (Nap-2014-01R-P<sub>6</sub>) and CMS line [CMSZ<sub>2</sub> (279) was crossed with Restorer line (Nap-2014-01R-P<sub>10</sub>) to develop test cross hybrid seed. Seeds of female and male parent were sown on 15 November 2022 following 4:2 ratio. Unit plot size was twenty rows of 3m long. Netting was done to protect out crossing. Hand pollination was done for proper seed setting. The experiment was conducted at Gazipur.

#### **III. Evaluation of test cross hybrids in *Brassica napus* l.**

Two CMS lines, CMSZ<sub>1</sub>(248) and CMSZ<sub>2</sub> (279) were crossed with Restorer lines, Nap-2014-01R-P<sub>6</sub> and Nap-2014-01R-P<sub>10</sub> during last rabi 2021-22 to develop test cross hybrids. Developed two hybrids were evaluated during rabi 2022-23. Hybrid seeds were sown on 21 November 2023. Unit plot size was 20 rows of 3m long with 3 replications. The experiment was conducted at Gazipur.

#### **Heterosis study of hybrids developed through selected restorers**

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

Twenty-four restorer lines have been developed through backcrossing by incorporating early genes in the supplied restorer. Using advanced restorers twenty-four test cross hybrids were developed and twenty restorer lines with good heterosis were selected in 2019. In 2020, by considering the fertility status of the restorer and seed yield, fifteen hybrid lines were selected. The performance of these fifteen hybrid lines was evaluated with check variety BARI Sarisha-13 in 2021 and 2022 and finally, ten restorers were selected. This year's

experiment was conducted with ten hybrid lines developed with those selected restorers along with BARI Sarisha-18 and a commercial hybrid of Avanta (*Brassica juncea*) as checks. The experiment was laid out in RCBD design having three replications. Unite plot size was 3 m long 6 lines with 30 cm line to line spacing. The seed of hybrids was sown on 28 November 2022 at Joydebpur. Recommended doses of fertilizer and other cultural operations were done when necessary. The selected seeds of each CMS and restorer line were kept for future use. Data have been taken from randomly selected 5 plants from each accession. Standard heterosis was calculated using the formula:  $(F_1 - \text{Check}) / \text{Check} \times 100$ . By considering all the parameters, Hybrid 4 and Hybrid 3 will be selected for next year's adaptive trial. Further, seed production of selected hybrid lines will be done in isolated conditions for future use.

#### Evaluation of hybrid rapeseed-mustard

M.S. Uddin, U. Kulsum, D.R. Datta, S. Ghosh, M.A.L. Akanda and M.T. Islam

The experiment was conducted at Gazipue, RARS, Burirhat, Rangpur and OFRD, Khukna during rabi 2022-23 using promising hybrid mustard BHS-01 and BHS-02 along with check variety Advanta (AHS-01). The unit plot size was 3. m x 2.0 m. Seeds were sown on 09 November, 2022 in line sowing. Line to line spacing was 30 cm. Fertilizers were applied at the rate of 115-33-43-27-2-1 N-P-K-S-Zn-B kg/ha. Half N and all other fertilizer were applied as basal and remaining N was top dressed at vegetative stage (22 Days after Emergence). All the intercultural operations were done as and when necessary. Salinity data was recorded at 15 days interval during the crop growing period with harvested date. The salinity of experiment field was 2.3-5.31 dS/m. The crop was harvested at 29 January 2023 to 13 February, 2023. BHS-01 (3497 kg/ha) produced a higher seed yield compared to the check variety (Advanta). BHS-01 produced about 11% higher seed yield than check variety. BHS-01 also took less time to mature than Advanta hybrid mustard. Considering seed yield and other yield attributing characters, BHS-01 performed better than the check variety. This experiment will be repeated next year for confirmation of the result.

### Sub-Project V: Development of double low (canola) variety in rapeseed

#### Hybridization in double low *B. Napus* L.

M.S. Uddin, D.R. Datta, and M.A.L. Akanda

15 double low lines of *Brassica napus* which were used as female parent one testers (BS-18) were used as male. Parent materials of the experiment consisted of two species (*Brassica rapa* and *Brassica napus*). BARI Sarisha-17 of *Brassica rapa*, Nap-0876 and Nap-0569 of *Brassica napus* [high erucic acid (30-45%) but short duration (80-85 days)]. Nap-14-001, Nap-14-004, Nap-14-007, Nap-14-010 and Nap-14-011 of *Brassica napus* [low erucic acid (less than 2%), high yielding (2.0-2.5 t/ha) but long duration (100-105 days)]. BARI Sarisha-17, Nap-0876 and Nap-0569 were crossed with Nap-14-001, Nap-14-004, Nap-14-007, Nap-14-010 and Nap-14-011 during last rabi 2015-16. Developed 15F<sub>1</sub>s were selfed during 2016-2021 to develop F<sub>6</sub> generation. Developed 15F<sub>6</sub>s (Nap-RIL-01 to 15) with two tester BA-9 and BS-18 were sown on 20 November 2022. The seeds were sown continuous and row to row distance was 30 cm apart from each. The seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg ha<sup>-1</sup> of N:P:K:S:Zn and Boron 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. All intercultural operations were done timely to raise a good crop. The crossing was done followed by Line × Tester method. Emasculation and pollination were followed by bagging with thin brown paper bags and labelled with tags. Six hundred ninety-seven cross buds were successful, and 11,623 seeds were found. The collected seeds were properly stored for evaluation in the next season.

#### Evaluation of segregating generation of *Brassica napus* L.

M.S. Uddin, D.R. Datta, M.A.L. Akanda and M.T. Islam

Families of F<sub>5</sub> and F<sub>6</sub> generation were evaluated during rabi 2022-23 at Gazipur. Families were sown following family to row method along with BARI Sarisha-18 as check in 4-rows 3m long plot with spacing 30 cm and 5 cm between rows and plants, respectively. Seeding was done on 21

November 2022. The seedlings were thinned after a few days of germination 5 cm apart. Fertilizers were applied @ 120:80:60:40:4:1 kg/ha of N:P:K:S:Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Single plant selection among families was done based on short duration, erect and compact type having desirable agronomic characters, disease and insect tolerance. Considering earliness, seed yield, yield attributing characters 6 desirable plants were selected in F<sub>5</sub> respectively. From F<sub>6</sub>, generation 5 progenies were selected for seed yield evaluation in observational trial next year.

### **Sub-Project VII: Development of climate smart variety of Rapeseed-mustard through Speed Breeding**

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

M.S. Uddin, D.R. Datta, M.A.L. Akanda and M.T. Islam

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. Eight 4-way crosses, five 6-way crosses and two 8-way crosses were made successfully. The crosses will be grown in the next rabi season along with their parents for confirmation.

#### **Development of hexaploidy *Brassica spp.***

M.S. Uddin, D.R. Datta, M.A.L. Akanda and M.T. Islam

Crosses were done in the fashion between two of the three allotetraploids, following which will be produce hybrid crossed to the third species (e.g. AACC × BBCC → CCAB × AABB → AABBCC). The allohexaploids produce by crosses between the allotetraploid species, referring to the names of the species in the cross combination (*B. napus*, *B. carinata* and *B. juncea*; NCJ model). Crosses between allotetraploids rely on production of unreduced gametes (gametes with the somatic

chromosome number, or all chromosomes present in the somatic tissue of the interspecific hybrid) in the cross to restore balanced ploidy level, while crosses between diploids rely on colchicine treatment to double the chromosome number. Both of these two methods have only ever been successfully carried out using one order of crossing. Crosses will be grown in one row 1 m long plot in greenhouse. First generation found 25 seed (2021-22) and second generation produced 35 (2021-22) allohexaploid. The seeds of allohexaploid were successfully grown during 2022-23. Among the allohexaploids, 5 plants were selected to grow in the next season along with their parents for the subsequent generations. There was either immune or resistance line or variety of mustard against the diseases in current study. Therefore, further study was needed to search resistance or moderately resistance sources to combat against *Alternaria* blight and white mold disease of mustard in the field condition.

#### **Development of nested association mapping (NAM) populations**

M.S. Uddin, D.R. Datta, M.A.L. Akanda and M.T. Islam

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.S. Uddin, D.R. Datta, M.A.L. Akanda and M.T. Islam

The experiment was conducted at breeding field of ORC, Bangladesh Agricultural Research Institute, Gazipur to introgression of heat and aphid tolerance gene and to broadening of genetic diversity. From 120 F<sub>3</sub> plants 17 desirable plants were selected for advancing F<sub>4</sub> generation in next season.



### Sub-Project VIII: Maintenance breeding of rapeseed-mustard

#### Maintenance of BARI released rapeseed-mustard varieties (Set-I)

D. R. Datta, M. S. Uddin and M. A. Latif Akanda

A total 13 BARI released rapeseed-mustard varieties were grown in Rabi season 2022-23. Unit plot size was 15 rows 3 m long and row to row distance 30 cm and plant to plant distance 5 cm after thinning. Fertilizers were applied @ 120: 80: 60: 40: 4: 1 kg/ha of N: P: K: S: Zn and Boron from Urea, TSP, MOP, Gypsum, Zinc sulphate and Boric acid, respectively. Netting was done in whole plot to maintain proper genetic purity. Collected seeds from each variety were properly stored for using in the next year breeding programme.

#### Maintenance of short duration inbred lines in *Brassica rapa* L. (Set-II)

D. R. Datta, M. S. Uddin and M. A. Latif Akanda

Eleven short duration inbred lines in *B. rapa* L. were sown in rabi season 2022-23. Selfed seeds from individual plant of source populations obtained (i.e. 386 selfed plants) from previous year were sown following plant to row method. Seeds were sown on 16 November 2022. Fertilizers were applied @ 120: 80: 60: 40: 4: 1 kg/ha of N: P: K: S: Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Unit plot size was 1 row 3 m long. Selfing of plants were done through bud pollination. Besides, proper bagging was done to protect out crossing. Total 7766 selfed seeds were stored separately for sowing in the next year

#### Maintenance of convergent cross lines of *Brassica rapa* (Set-III)

D. R. Datta, M. S. Uddin and M. A. Latif Akanda

BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-17 and BARI Sarisha-6 were used as female parents and S<sub>6</sub> generation of BARI Sarisha-9 and Tori-7 were used as male parents to develop single crosses during rabi 2014-15. F<sub>1</sub>s were grown during rabi 2015-16 and crossed with BARI Sarisha-6 and BARI Sarisha-17 to develop three-way crosses. The convergent lines developed from these crosses are maintained through bud pollination of selfed plant.

Two thousand and three hundred one seeds were obtained from all cross combinations were stored for evaluation in the next season.

#### Maintenance of 15 double low genotypes of *Brassica napus* L. (Set-IVa)

D. R. Datta, M. S. Uddin and M. A. Latif Akanda

Parent materials of the experiment consisted of two species (*Brassica rapa* and *Brassica napus*). BARI Sarisha-17 of *Brassica rapa*, Nap-0876 and Nap-0569 of *Brassica napus* [high erucic acid (30-45%) but short duration (80-85 days)]. Nap-14-001, Nap-14-004, Nap-14-007, Nap-14-010 and Nap-14-011 of *Brassica napus* [low erucic acid (less than 2%), high yielding (2.0-2.5 t/ha) but long duration (100-105 days)]. BARI Sarisha-17, Nap-0876 and Nap-0569 were crossed with Nap-14-001, Nap-14-004, Nap-14-007, Nap-14-010 and Nap-14-011 during last rabi 2015-16. Developed 15F<sub>1</sub>s were selfed during 2016-2021 to develop F<sub>6</sub> generation. Developed 15F<sub>6</sub>s were sown on 17 November 2022. Selfing was done through bud pollination for evaluation in the next season. Selfed seeds were stored for evaluation in the next season.

#### Maintenance of double low genotypes of *Brassica napus* (Set-IVb)

D. R. Datta, M. S. Uddin, and M. A. Latif Akanda

Five double low lines of *Brassica napus* were grown at Joydebpur location during Rabi season 2022-23. Unit plot size was 5 rows 3 m long in which row to row distance was 30 cm and plant to plant distance was 5 cm after thinning. Fertilizers were applied @ 120: 80: 60: 40: 4: 1 kg/ha of N: P: K: S: Zn and Boron 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. All intercultural operations were done timely to raise a good crop. Whole plot was netted to maintain genetic purity of these advance lines. Collected seeds were stored to maintain the genotypes of *Brassica napus* and to use in future breeding programme.

#### Maintenance of inbred lines of *Brassica juncea* (Set-V)

D. R. Datta, M. S. Uddin, and M. A. Latif Akanda

Thirteen lines of *Brassica juncea* were grown at Gazipur location during 2022-23. The seeds were

sown on 17 November 2022 in 3 rows of 3 m long with spacing of 30 cm and 5 cm between rows and plants respectively. The seedlings were thinned after few days of germination 5 cm apart. Fertilizers were applied @ 120: 80: 60: 40: 4: 1 kg/ha of N: P: K: S: Zn and Boron from Urea, TSP, MOP, Gypsum, inc 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. All intercultural operations were done timely to raise a healthy crop. Data were taken on days to flowering, days to maturity, plant height (cm), no. of primary branches/plant, no. of siliquae per plant, no. of seeds per siliqua, 1000-seed weight (g) and seed yield/plot. The plot yield was converted into kg/ha. Total seeds collected from different lines were properly stored for maintaining and using in the next breeding programme.

#### **Maintenance of inbred lines of *Brassica juncea* (Set-VI)**

D. R. Datta, M S Uddin, and M. A. Latif Akanda

The experiment was conducted at Gazipur, during Rabi season 2022-23. The experiment consisted of 11 lines of *Brassica juncea* having yellow seed coat colour. Seeding was done on 17 November 2022 at Gazipur, in continuous sowing and row was 30 cm apart from each. The seedlings were thinned after few days of germination 5 cm apart. Fertilizers were applied @ 120: 80: 60: 40: 4: 1 kg/ha of N: P: K: S: Zn and Boron 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 the initial stage of flowering. All intercultural operations were done timely to raise a good crop. Data were taken on days to flowering, days to maturity, plant height in cm, no. of primary branches/plant, no. of siliquae per plant, no. of seeds per siliqua, 1000 seed weight (g) and seed yield/plot. The plot yield was converted into seed yield kg/hectare. The total amounts of seeds collected from different genotypes were properly stored for maintaining and using in future breeding programme.

## **Crop and soil management**

### **Effect of relaying maize with mustard**

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

The experiment was conducted at the research field of Oilseed Research Centre (ORC), BARI, Gazipur during rabi season of 2022-2023 to determine the optimum relaying time of maize for better growth and yield of mustard. There were five treatments viz. Sowing mustard and maize together, Sowing maize after 30 days of mustard sowing, Sowing maize after 40 days of mustard sowing, Sowing maize after 50 days of mustard sowing and Sowing maize after 60 days of mustard sowing. The crop varieties were BARI Sarisha-14 and Khoibutta. Mustard seed were sown in 27 December 2021 and maize seeds were sown in treatment wise at Gazipur. Fertilizers were applied 138-87-60-32-3-2 kg/ha in the form of N,P,K,S,Z,B respectively and cow dung 8t/ha. Data on yield and yield contributing characters were recorded and analyzed statistically using SPSS program. The maximum (1.4 t/ha) mustard yield was produced in the treatment of Sowing maize after 50 days of mustard sowing, where sowing maize after 50 days of mustard sowing it may be the causes of height no of seed/pod and 1000seed weight and it was followed by Sowing maize after 40 days of mustard sowing treatment where sowing maize after 40 days of mustard sowing. The effect of relaying maize with mustard was significantly influenced on the parametres of maize like plant height, cob length and seeds/cob. In case of yield of maize the maximum (2.5 t/h) yield was obtained from Sowing maize after 40 days of mustard sowing treatment. It may be the causes of height number of seeds/cob. and the lower (1.5t/h) was got from Sowing mustard and maize together treatment. Among the treatment the height mustard equivalent yield was obtained from Sowing maize after 40 days of mustard sowing treatment and it was statically identical with the Sowing maize after 50 days of mustard sowing treatment. The maximum gross margin and BCR was found in the treatment Sowing maize after 40 days of mustard sowing and minimum was found in the Sowing mustard and maize together treatment. Result revealed that maize can be sown as a relay crop after 40 days of mustard sown would be the agronomically and economically profitable.

### Growth and maturity pattern of different mustard species

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

The experiment was conducted at the research field of Oilseed Research Centre (ORC), BARI, Gazipur during the rabi season of 2022-2023. There were nine treatments which were nine genotypes from three species of mustard viz. BARI Sarisha-14, BARI Sarisha-15, Advance line (*B. campestris*), BARI Sarisha-11, BARI Sarisha-16, Advance line (*B. juncea*), BARI Sarisha-13, BARI Sarisha-18 and Advance line (*B. napus*). The experiment was design in RCB with three replications. Seeds were sown on 4 November 2022 at Gazipur with a plot size of 3m x 4m. Fertilizers were applied at the rate of N88P34K80S28Zn3B2 kg/ha-1 in the form of urea, TSP, MOP, gypsum, zinc oxide and boric acid, respectively. Full amount of all fertilizers and half of urea were broadcasted in the experimental plot at the time of final land preparation. The rest half of urea was applied in equal amounts at 30 & 55 days after sowing (DAS). Irrigation was applied as per requirement. Number of flower, total siliquae, and matured siliquae was counted at every three days interval from its first flowering. Data on yield and yield contributing characters were recorded and analyzed statistically using R program. Seed yield was recorded maximum in Advance line of (*B. juncea*) followed by BARI Sarisha-16 which might be due to higher number of branch, siliquae and seed weight. Similar findings was observed by Flagella et al., 2002. Minimum seed yield was in treatment (BARI Sarisha-14) which might be due to lower number of branch, siliquae per plant, lower seed number and lower seed weight. Similar result also observed by Monira et al., 2015. All the genotypes started flowering around one month after sowing. In case of species *B. campestris* maximum number of flower blooming was at 46 days after sowing. Similar flowering also observed in case of *B. juncea* except the advance line i.e. Advance line (*B. juncea*). On the other hand, all the genotypes of *B. napus* took around 50 days for maximum flowering. However, time required for siliquae formation was varied among all three species of mustard. The highest time was taken by BARI Sarisha-16 followed by BARI Sarisha-11 while the lowest in BARI Sarisha-14. Besides this, genotypes of *B. juncea* group took more time to mature than other species whereas it was lower in *B. campestris*

group. In conclusion, maximum flowering was observed at 40 to 45 days, 46 to 50 days and 50 to 52 days for the species of *B. campestris*, *B. napus* and *B. juncea* respectively. In case of siliquae formation genotypes of *B. campestris* took around 52 days whereas *B. juncea* and *B. napus* took around 70 days. Maturity observed at around 80 DAS, 100 DAS and 108 DAS for *B. campestris*, *B. juncea* and *B. napus* respectively.

### Effect of insecticides on foraging behavior of honeybee (*Apis mellifera* L.) on mustard (*Brassica rapa*)

R. Islam, E. A. Pramanik, M. A. Islam and A. Samiha

The present study was conducted to observe the effect of insecticides on foraging behaviour of honey bees (*Apis mellifera* L.) on mustard (*Brassica rapa*) at ORC, BARI, Gazipur and OFRD, Barind, Rajshahi. Four insecticides imidacloprid, thiamethoxam, spinosad, nimbecidine were sprayed on the mustard field during peak flowering period. The design was RCBD with 3 replications. The percent reduction over control of honeybee population was found higher with imidacloprid (100%, 100%, 82.72%, 76.69%) treated plots followed by thiamethoxam (100%, 100%, 78.93%, and 67.67%) treated plots and lowest was found in nimbecidine (87.21%, 84.25%, 8.672%, 0.75%) treated plots to the entire spray schedules. Similar trend was observed at OFRD, Barind, Rajshahi.

### Development of a management approach against flea beetle (*Phyllotreta striolata*) attacking mustard

M. A. Islam, A. Samiha and R. Islam

The present study was conducted to observe the incidence and damage severity of flea beetle in mustard during *robi* season 2022-23 at ORC research field, BARI, Gazipur which was laid out in RCBD design with three dispersed replications. The treatments were: T<sub>1</sub>= White sticky trap +Bt+abamectin (Antario) @ 1.0 g/L of water, T<sub>2</sub>= White sticky trap + *Celastrus angulatus* 1% EW (Bio-chamak) @ 2.5 ml/L of water, T<sub>3</sub>= White sticky trap+ Spraying of 0.5% Matrine (Biotrin) @ 1.5ml/L of water, T<sub>4</sub>= White sticky trap+ Spraying of Spinosad (Success2.5 SC) @ 1.2 ml/ L of water, T<sub>5</sub>= Spraying of Emamectin benzoate (Proclaim 5 SG) @ 0.5 g/L of water, T<sub>6</sub>= Untreated control.



Treatment applications were started as soon as the infestation was noticed. Management package comprising of installation of White sticky trap + *Celastrus angulatus* 1% EW (Bio-chamak) @ 2.5 ml/litre of water was effective against flea beetle followed by Emamectin benzoate (Proclaim 5 SG) @ 0.5 g/L of water.

### **Screening of rapeseed and mustard genotypes against aphid (*Lipaphis erysimi*, Kalt.) Under natural field condition**

R. Islam, M. A. Islam and A. Samiha

Eighteen entries of rapeseed and mustard were evaluated against mustard aphid (*Lipaphis erysimi* Kalt.) during Rabi 2022-23 cropping season at ORC, BARI, Gazipur. The design was RCBD with 3 replications. There was no aphid infestation observed during the cropping season because the weather condition was not favorable for aphid multiplication.

## **B. Sesame**

### **Maintenance of germplasm of sesame**

M H Rashid, M Munim and M R Humayun

The experiment was conducted at Oilseed Research Centre, Gazipur RARS Ishurdi and Jashore during Kharif-1 season of 2022 to rejuvenate of all existing germplasm collection. Sixty six entries including two check varieties of BARI Til-3 and BARI Til-4 were shown without replication. The seeds were sown on 11<sup>th</sup> March, Gazipur, 2<sup>th</sup> March in Jashore and 8<sup>th</sup> March in Ishurdi during 2022. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of N P K S Zn, respectively. Intercultural operations were done as and when necessary. Seeds of all entries were collected and kept in cold storage for further evaluation and to use in different breeding purpose.

### **Hybridization of sesame**

M H Rashid and M. S UDDIN

Six released varieties and one advanced line were sown on 23 August 2022 at Gazipur in net house. Seeds of individual parents were planted in 2 rows of 2m long plot with the spacing 50 cm and 10 cm between rows and plants respectively. Crosses were done in 1<sup>st</sup> week of October 2022. A total of 350 capsule produced out of 540 pollinated buds in 24 cross combinations which produced 11000 F<sub>1</sub>

seeds. The seeds will be sown next year as F<sub>1</sub> population to obtain F<sub>2</sub> seed.

### **Evaluation of F<sub>3</sub>, F<sub>5</sub> AND F<sub>6</sub> generation of sesame**

M H Rashid and M. S Uddin

F<sub>3</sub> generation of seven cross combinations, F<sub>5</sub> generation eleven families and F<sub>6</sub> generation twelve families were evaluated at Gazipur during kharif-1, 2022. Seeds of F<sub>3</sub>, F<sub>5</sub> and F<sub>6</sub> generations were sown on March 11, 2022. Spacing was 30cm between rows and 8cm between plants. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively. Intercultural operations were done as and when necessary. Data on days to flowering, days to maturity and seed yield/plant were taken. Desired plants from each cross combination were selected. Considering plant growth, maturity, size and number, seed color, disease and insect reactions, 25 plants from F<sub>3</sub>, 65 plants from F<sub>5</sub> and 47 plant from F<sub>6</sub> were selected. Seed of selected plant were kept separately in cool house to use in next breeding activity.

### **Observation trial of sesame**

M H Rashid and M. S Uddin

Ten entries of sesame along with BARI Til-4 as check were evaluated at Gazipur during Kharif-1, 2022. The seeds were sown on March 10, 2022. The lines were laid out in a randomized complete block design with 3 replications. Unit plot size was 3rows 4m long with the spacing of 40cm between rows and 8cm between plants. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively. Intercultural operations were done as and when necessary. Data on days to flowering days to maturity and seed yield per plot were taken on plot basis. The other yield contributing characters were recorded from 5 randomly selected plants of each plot. Recorded data were analyzed statistically. Considering seed yield and other yield contributing characters, the entries BT-2 X BT-3-2 (Black), BT-2 X Ses-207 (White) and BT-2 X BT-3-8(Black) were selected for the next yield trial.

### **Preliminary yield trial of sesame**

M H Rashid, M Munim, M R Humayun, M. S Uddin and M S Huda

Seven lines of sesame were evaluated at Gazipur and RARS, Ishurdi, Jashore and ARS Dinajpur,

during kharif, 2022. The seeds were sown on 12<sup>th</sup> March 2022 in Gazipur, 27 March in Dinajpur, 20 March in Ishurdi and Jashore. Released varieties BARI Til 4 were used as checks. The lines were laid out in a randomized complete block design with 3 replications. Unit plot size was 6 rows 4 m long with the spacing of 30cm between rows and 8cm between plants. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively (FRG, 2018). Intercultural operations were done as and when necessary. Data on days to flowering and maturity, and seed yield were taken on plot basis. The other yield contributing characters were recorded from 10 randomly selected plants of each plot. Recorded data were analyzed statistically. Two entries Ses-JP-25 and Ses-115 showed promising in over locations.

#### **Regional yield trial of sesame**

M H Rashid, M Munim, M R Humayun, M. S Uddin, J A Mahmud and M S Huda

Seven lines including one check were evaluated at five locations during kharif, 2022. One release varieties BARI Til-4 was used as checks. The experiment was sown on 13 March, 2022 at HQ, Gazipur, 20 March, RARS, Ishurdi, Jashore, 25 March, OFRD Kushtia and Agricultural Research Centre, Dinajpur. The lines were laid out in a randomized complete block design with 3 replications. Unit plot size was 6 rows 4 m long with the spacing of 40cm between rows and continue sowing. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively (FRG, 2018). Data on days to flowering and maturity, plant height (cm), no. of branches/plant, no. of capsules/plant, no. of seeds/capsule and seed yield/plot (kg) were recorded. Data on days to flowering and maturity, and seed yield were taken on plot basis. The other yield contributing characters were recorded from 10 randomly selected plants of each plot. Recorded data were analyzed statistically. Considering seed yield and other yield contributing characters, the entries Ses-79, Ses-65 and Ses-05115 and Ses-05178 were selected for adaptive trial

#### **Screening of sesame genotypes under water logged condition**

M H Rashid and M. S Uddin

Fifty one genotypes of sesame including T-6, BARI Til 3, BARI Til 4 and BARI Til-5 were evaluated at Gazipur during kharif, 2022 in net house. Fifty one entries were grown in plastic container. Soil of plastic pot were prepare with 50% organic manure and 40% cow dung and 10% garden soil. Intercultural operations were done as and when necessary. Water logged condition was created by applying excess water during flowering stages. Depth of applying water was about 4 cm above soil level. Standing water remained a set for 24 hour and another set for 48 hour. No. of initial plants/plot and no. of survived plants/plot were recorded for both set. Most of the genotypes could not survive in water logged condition. Only six Ses-FR-20, Ses-0570, Ses-9571, Ses-5, Ses-0178 and Ses-37 genotypes could survive. These survival genotype will be test next year under water logged condition.

#### **Maintenance of released varieties and advanced line of sesame**

M H Rashid and M. S Uddin

Twenty accession of which six release varieties and 14 advanced lines were grown in Kharif-1, 2022. The seed were sown on 12 March 2022 in Gazipur. Unit plot size was 8 rows 4 m long and row to row distance 40 cm and plant to plant distance 5 cm after thinning. Twenty plants were selected randomly from middle row of the plot. Recommended doses of fertilizers were applied @ 80:65:60:20:4 kg/ha of NPKSZn, respectively. Intercultural operations were done as and when necessary. Genetically pure seed of 20 line/varieties were collected. Total 8.04 kg seed of different line/varieties were stored in cool house to use different breeding programme.

#### **Crop and soil management**

#### **Development of Mustard - Sesame - T. Aman cropping pattern for increasing cropping intensity and productivity**

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

The field experiment was conducted at the ORC of BARI Joydebpur (AEZ 28) during 2022-23. Soil analysis report is presented in Table 1 & 2. The cropping pattern was T.Aman (var. BRRI dhan75) – Mustard (var. BARI Sarisha-18) - Sesame (var. BARI Til-5). The experiment was laid out in a Randomized Complete Block (RCB) design with 4 replications. The unit plot size was 6m x 4m.

Mustard was grown during rabi season and it was the first crop of the sequence. BARI Sarisha-18 was sown with 30 cm x 5 cm spacing on 25 October 2022 and harvested on 10 January 2023. Seed yield and straw yield were taken from whole plot. BARI Til-5 was sown on 15 February 2023. Sesame was harvested on 30 May 2023. Seeds of BRRIdhan 75 are now in seed bed and it is the third crop of the sequence. Twenty to twenty five days old days old seedling of BRRIdhan 75 will be transplanted with 20cm x 15cm spacing on July. Seed yield of mustard (BARI Sarisha-18) was 2.00 t/ha and stover yield was 3.0 t/ha. In case of sesame seed yield was 1.2 t/ha. Crop duration for mustard and sesame were 110 and 95 days, respectively. This experiment is continuing still in the field level. So final conclusion will be done after the harvest of final crop.

#### **Performance of sesame varieties at charland areas in Bangladesh (Faridpur)**

S. Ahmed, Md. Z. H. Sohel, F. Begum and P. Roy

The trials were conducted at the FSRD site, Faridpur and MLT site, Rajbari during Kharif I, 2023 to evaluate the performance of BARI released sesame varieties in the farmer's field. Four BARI varieties viz. BARI Til-3, BARI Til-4, BARI Til-5, BARI Til-6 along with one check variety viz. local were evaluated in this study. The experiment was laid out in RCB design with six replications having plot size 4 m x 3 m. Seeds were sown by line sowing method. One irrigation was applied at immediately after sowing. Weeding and thinning was done at 27 DAS. Fungicide (Autostin) and insecticide (Gilder, Carate) were applied according to the pest attack. All fertilizers were applied as basal during final land preparation. Harvesting was done upon crop maturity. Data on different yield and yield contributing characters were recorded and were analyzed statistically with the "R" software. The statistically highest seed yield (1.74 t ha<sup>-1</sup>) was obtained from BARI Til-4 due to might be highest number of seeds siliqua-1 (71.72). The lowest seed yield (1.49 t ha<sup>-1</sup>) was calculated from BARI Til-3 due to might be lowest number of seed siliqua-1 (58.06). From economic perspective, BARI Til-6 was the most viable variety for farmers with the highest BCR (2.42) and gross margin (Tk. 95380 ha<sup>-1</sup>). Local sesame variety performed better than BARI Til-3 considering yield and economy. Although BARI Til-4 had more yield than BARI

Til-5 and 6, the profit is higher in BARI Til-5,6 due to higher market price. BARI Til-4 had the highest yield but market price is less than the black coated varieties. Among the varieties, BARI Til-6 was the most desired variety as it had black coating and satisfying yield.

#### **Development of IPM package against the major insect pests of sesame**

M. A. Islam, A. Samiha and R. Islam

The present study was conducted to observe the incidence and damage severity with the most effective management package(s) against insect pests of sesame during kharif season 2023 at ORC research field, BARI, Gazipur which was laid out in RCBD design with three dispersed replications. The treatments were : T<sub>1</sub>(IPM Package 1) = Hand Picking of larvae + Perching + spraying Spinosad (Success 2.5 SC) @ 1.2 ml/L of water, T<sub>2</sub>(IPM Package 2) = Hand Picking of larvae + Perching + spraying Spinetoram 11.7% SC (Delegate) @ 1ml/L of water, T<sub>3</sub>(IPM Package 3) = Hand picking of larvae + Perching + spraying *Celastrangulatas* 1% EW ( Bio-chamak) @ 2.5 ml/L of water, T<sub>4</sub> = Farmers practice (Spraying of Chlorpyrifos+Cypermethrin (Nitro 505 EC) @ 1.0 ml/L of water), T<sub>5</sub> = Untreated control. Among the treatments Chlorpyrifos+Cypermethrin (Nitro 505 EC) 1.0 ml/L of water followed by installation of white sticky trap + Perching+ *Celastrangulatas* 1% EW (Bio-chamak) @ 2.5 ml/L of water were more effective against major insect pest of sesame with higher yield (1.47 t/ha) and marginal benefit cost ratio (6.22).

### **C. Groundnut (*Arachis hypogaea* L.)**

#### **Collection of groundnut germplasm**

M M Kadir, K C Saha and M S Uddin

Seeds of ten groundnut germplasm were collected from International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India during 2022-23. Collected germplasm will be used in the future breeding program.

#### **Maintenance and evaluation of groundnut germplasm**

K C Saha and M S Uddin

A total of 246 genotypes were grown in a non replicated trial at Gazipur to evaluate the collected



materials for future use in the breeding program. The sowing date was 22 December, 2022. 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 1<sup>st</sup> flowering, days to maturity, plant height, mature pods/plant, 100 kernel weight (g), shelling % and plot yield were 46-63 days, 135-150 days, 24-58 cm, 13-47, 46-67 g, 60-80 and 1560-3600 kg/ha respectively. The highest coefficient of variation (CV%) was recorded for the character plot yield (20.11%). 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.

### Hybridization in groundnut

K C Saha and M S Uddin

Two batches of six parental lines were sown on ten days interval in 26 December, 2022 and 04 January, 2023 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 were made. 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.). A total of 173 pods were harvested from 519 pollinated buds out of fifteen crosses. On an average 33% crosses were successful. The pollinated pods will be grown in the next Rabi season for F<sub>1</sub> confirmation

### Evaluation of segregating generations of groundnut

K C Saha and M S Uddin

Seeds of seventeen cross combinations from F<sub>2</sub>, 05 entries from F<sub>3</sub>, 08 entries from F<sub>4</sub>, 20 entries from F<sub>5</sub> and 12 entries from F<sub>6</sub> respectively were sown on December 21, 2022 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 80, 25, 37, 89 and 55 single plants were selected from F<sub>2</sub>, F<sub>3</sub>, F<sub>4</sub>, F<sub>5</sub> and F<sub>6</sub> generations respectively. The seeds from selected single plants of F<sub>2</sub> were collected and stored for advancing the generation as F<sub>3</sub> in the next season. On the other hand, the seeds from selected plants of F<sub>3</sub> were collected and stored according to the cross and generation will be advanced as F<sub>4</sub> generation. From the F<sub>4</sub> generation 37 plants were selected from 08 accessions and will be tested their performance as F<sub>5</sub> generation in the next season. From the F<sub>5</sub> generation 89 plants were selected from 20 accessions and will be tested their performance as F<sub>6</sub> generation in the next season. From the F<sub>6</sub> generation 55 plants were selected from 12 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, 2022-23. Seeds were sown on 20 December, 2022 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 (73%), ICGV 92229 (73%) and ICGV 01105 (73%). Highest pod yield (2713 kg/ha) was obtained from the genotype TG51Bom115 followed by the genotype BDGN 14 (2610 kg/ha), ICGV 3479 (2550 kg/ha), ICGV 9118 (2493 kg/ha), ICGV 92229 (2466 kg/ha), JL-24 (2370 kg/ha) and TG 37115 (2336 kg/ha) which were 16%, 12%, 9%, 7%, 6%, 2% and 1% higher than the check variety BARI Chinabadam-8 respectively. Maximum number of mature pods per plant was observed from the entry TG 51Bom115 (30). Highest 100 kernel weight (55 g) was obtained from the entry ICGV 00351. Considering the pod yield seven genotypes TG51Bom115, BDGN 14, ICGV 3479, ICGV 9118, ICGV 92229, JL-24 and TG 37115 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, 2022-23. Seeds were sown on 20 December, 2022 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 (2770 kg/ha) was obtained from the genotype ICGV 4514 followed by the genotype ICGV 864017 (2713 kg/ha), Mahshwa (2693 kg/ha), Beijing-3 (2606 kg/ha), BDGV 9112-2-1-1 (2553 kg/ha), BDGV 9112-5-1-1 (2513 kg/ha), ICGV 1352 (2393 kg/ha), BDGV 7112-2-2-1 (2310 kg/ha), TMV-2 (2263 kg/ha), ICGV 92269 (2196 kg/ha) and ICGV 07406 (2153 kg/ha) which were 30%, 27%, 26%, 22%, 20%, 18%, 12%, 8%, 6%, 3% and 1% higher than the check variety BARI Chinabadam-8 respectively. Highest hundred kernel weight were found in ICGV 93471 (62 g) followed by ICGV 1352 (61 g), SM-14 (61g) and ICGV 07406 (61g). Maximum number of mature pods per plant was observed from the entry ICGV 4514 (33). Considering the bold seeded, pod yield and duration eleven genotypes ICGV 4514, ICGV 864017, Mahshwa, Beijing-3, BDGV 9112-2-1-1, BDGV 9112-5-1-1, ICGV 1352, BDGV 7112-2-2-1, TMV-2, ICGV 92269 and ICGV 07406 have been selected for PYT.

#### **Observation trial of groundnut (Set-III)**

M K Alam, M I Riad and M M Kadir

The experiment was conducted at RARS, Jamalpur during Rabi 2022-2023 with 24 lines of groundnut including BARI Chinabadam-8 and BARI Chinabadam-9 as checks. The plot size was 4 rows 3.5m long. Seeds were sown on the 24<sup>th</sup> November, 2022 in 15 cm seed to seed and row was 30 cm apart from each. Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively. It was observed from the table that the groundnut line L-27 produced the highest nut yield of 3189 kg/ha which was 36 % and 44 % 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 149 days to mature. The line G-3 produced the 2nd highest yield of 3120 kg/ha which was 33 % and 41 % higher than the check variety, BARI Chinabadam-8 and BARI

Chinabadam-9, respectively. It took 151 days to mature. The third highest yield was recorded from L-25. It produced 3017 kg/ha which was 28% and 36% higher than check variety, BARI Chinabadam-8 and BARI Chinabadam-9, respectively. This groundnut line took 149 days to mature. Three genotypes L-27, G-3 and L-25 may be selected for preliminary yield trial on the basis of early mature, pods/plant and yield performances in the next season.

#### **Observation trial of groundnut (Set-IV)**

M K Alam, M I Riad and M M Kadir

The experiment was conducted at RARS, Jamalpur during Rabi, 2022-2023 with 20 lines of groundnut including Dhaka-1 and BARI Chinabadam-10 as checks. The plot size was 4 rows 3.5 m long. Seeds were sown on the 24<sup>th</sup> November, 2022 in 15 cm seed to seed and row was 30 cm apart from each. Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively. It was observed that the groundnut line NMUS-15 produced the highest nut yield (1976 kg/ha) which was 38 % and 19 % higher than the check variety, Dhaka-1 and BARI Chinabadam-10, respectively. It produced significantly higher yield among the lines included in this trial. It took 139 days to mature. The line NMUS-14 produced the 2nd highest yield. It produced 1836 kg/ha nut yield which was 28 % and 11 % higher than the check variety, Dhaka-1 and BARI Chinabadam-10, respectively. It took 138 days to mature. The third highest yield was recorded from NMUS-16. It produced 1791 kg/ha which was 25% and 8% higher than check variety, Dhaka-1 and BARI Chinabadam-10, respectively. This groundnut line took 138 days to mature. Three genotypes NMUS-15, NMUS-14 and NMUS-16 may be selected for preliminary yield trial on the basis of early mature, pods/plant and yield performances in the next season.

#### **Preliminary yield trial of groundnut (Set-I)**

M K Alam, M I Riad and M M Kadir

The experiment was conducted at RARS, Jamalpur during Rabi 2022-2023 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 8<sup>th</sup> November, 2022 in 15 cm seed to seed and row was 30 cm apart from each.

Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively. It was observed from the table that the groundnut line ICGV-171011 produced the highest nut yield of 2647 kg/ha which was 46% higher than the check variety BARI Chinabadam-8. It produced significantly higher yield among the lines included in this trial. It took 153 days to mature. The line ICGV-171012 produced the 2nd highest yield. It produced 2609 kg/ha nut yield which was 44% higher than BARI Chinabadam-8. It took 154 days to mature. The third highest yield was recorded from ICGV-171051. It produced 2311 kg/ha which was 28% higher than check variety, BARI Chinabadam-8. This groundnut line took 153-158 days to mature. These three lines may easily be grown and harvested before flash flood at char area. Three genotypes ICGV-171011, ICGV-171012 and ICGV-171051 could be selected for regional yield trial on the basis of early mature, pods/plant and yield performances in the next season.

#### **Preliminary yield trial of groundnut (Set-II)**

M K Alam, M I Riad and M M Kadir

The experiment was conducted at RARS, Jamalpur during rabi, 2022-23 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, 2022 in 15 cm seed to seed and row was 30 cm apart from each. Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively. It was observed that the groundnut line PN-02 produced the highest nut yield of 2556 kg/ha yield which was 34 % and 25 % higher yield than the check varieties BARI Chinabadam-6 and BARI Chinabadam-7, respectively. It took 153 days to mature. BARI Chinabadam-7 produced the 2<sup>nd</sup> highest yield 2051 kg/ha. It produced 7 % higher yield than the check variety BARI Chinabadam-6. It took 148 days to mature. The 3<sup>rd</sup> highest yield was recorded in PN-15. These three lines may easily be grown and harvested before flash flood at char area. Three genotypes PN-2, PN-15 and PN-10 may be selected for regional yield trial on the basis of early mature, pods/plant and yield performances in the next season.

#### **Regional yield trial of groundnut (Set-I)**

K C Saha and M S Uddin

The experiment was conducted with 17 groundnut genotypes including 2 checks as Dhaka-1 and BARI Chinabadam-8 at Joydebpur in a randomized complete block design with 3 replications. 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 @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively. Significant differences were observed among the genotypes for all the characters except shelling percentage studied at Joydebpur. Maturity duration ranged from 140-147 days. Highest number of mature pods/plant (33) was obtained from the entry ICGV SL-1. The range of hundred kernel weight was 44-63 g. Highest shelling percentage was recorded from the genotype Golachipa (70%). The genotype ICGV SL-1 produced maximum pod yield (2730 kg/ha) followed by ICGV 38-3 (2656 kg/ha), Jhaldhaka (2646 kg/ha), 6112-6-1 (2566 kg/ha), 14-403 (2556 kg/ha), PK-1 (2426 kg/ha), 14-103 (2246 kg/ha), ISD 0414 (2093 kg/ha), 702-6-2-1 (2030 kg/ha) and Golachipa (2020 kg/ha) which were 37%, 33%, 33%, 29%, 28%, 22%, 13%, 5%, 2% and 1% higher than the check variety BARI Chinabadam-8 respectively. Five genotypes ICGV SL-1, ICGV 38-3, Jhaldhaka, 6112-6-1, 14-403 were selected for adaptive trial.

#### **Regional yield trial of groundnut (Set-II)**

K C Saha and M S Uddin

The experiment was conducted at Joydebpur during Rabi 2022-23 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 plot size was 4m x 2.4m. Spacing was 15 cm seed to seed and 40 cm row to row. Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively. Significant differences were observed among the genotypes for all the characters except shelling percentage studied at Joydebpur. Maturity duration ranged from 140-147 days. Highest number of mature pods/plant (32) was obtained from the entries ICGV 35-1, ICGV 93420 and ICGV 0704. The range of hundred kernel weight was 44-61g. Highest shelling percentage (71) was recorded in the genotype 14-203 and ISD 4114. The genotype ICGV 35-1



produced the maximum pod yield (2780 kg/ha) followed by ICGV 93420 (2703 kg/ha), ICGV 0704 (2657 kg/ha), ICGV 0207 (2567 kg/ha), 14-203 (2557 kg/ha), ICGV 09516 (2550 kg/ha), ISD 3814 (2513 kg/ha), ICGV 0107 (2467 kg/ha) and ICGV 95090 (2427 kg/ha) which were 16%, 13%, 11%, 7%, 7%, 6%, 5%, 3% and 1% higher than the check variety BARI Chinabadam-8. Five genotypes ICGV 35-1, ICGV 93420, ICGV 0704, ICGV 0207, 14-203 have been selected for Adaptive Trial.

### Regional yield trial of groundnut (Set-III)

M K Alam, M I Riad and M M Kadir

The experiment was conducted at RARS, Jamalpur during Rabi 2022-23 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 20<sup>th</sup> November, 2022 in 15 cm seed to seed and row was 30 cm apart from each. Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively. Most of the lines produced higher nut yield than Dhaka-1. It was observed from the table that the groundnut line BAG-19005 produced the highest nut yield. It produced 2135 kg/ha yield which was 17 % higher than the traditional variety Dhaka-1. It produced significantly higher yield among the lines included in this trial. It took 144 days to mature. The line ICGV-07245 produced the 2<sup>nd</sup> highest yield. It produced 2079 kg/ha nut yield, which was 13 % higher than Dhaka-1. It took 147 days to mature. The third highest yield was recorded from BINA Chinabadam-4. It produced 2050 kg/ha which was 11 % higher than check variety, Dhaka-1. These groundnut lines took 144-147 days to mature. Three genotypes BAG-19005, ICGV-07245 and BINA Chinabadam-4 may be selected for may be selected for adaptive trial in the farmers' on the basis of early mature, pods/plant and yield performances in the next season.

### Maintenance of released varieties of groundnut

K C Saha and M S Uddin

For seed increase twelve groundnut varieties namely Dhaka-1, Bashontibadam, Tridanabadam, Jhingabadam, BARI Chinabadam-5, BARI Chinabadam-6, BARI Chinabadam-7, BARI Chinabadam-8, BARI Chinabadam-9, BARI

Chinabadam-10, BARI Chinabadam-11 and BARI Chinabadam-12 were grown separately at ORC research field, BARI, Gazipur during rabi season 2022-23. Seeds were sown on 5<sup>th</sup> December, 2022. Spacing was 30 cm between the rows and 15 cm between the plants. Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively. A total of 61 kg seeds were produced from twelve groundnut varieties. These seeds will be used to maintain the varietal purity.

### Adaptive Trial of groundnut (Set-I)

M M Bashir and M S Islam

The adaptive trial was carried out in the farmer's field of Nuru Patwarihat, Sadar upazilla of Noakhali district during the Rabi season of 2022-23 with a view to test the yield performance of groundnut advanced lines (ICGV-36-1, ICGV-07219 & ICGV-06285) with BARI Chinabadam-8 and local variety Dhaka-1 as check in the farmers' field. The trial was laid out in a RCB design with six dispersed replications. The soil of the experimental plot was sandy loam with medium fertility level and 5-6 ds m<sup>-1</sup> salinity level at maturity stage. The unit plot size was 25m×10m. The seeds were sown on 19 January, 2023 with a spacing of 25cm×15cm. All the yield contributing characters were differed significantly; but there was no significant difference in yield. The highest plant height, branch plant-1, and seeds pod-1 were recorded from ICGV-36-1 line; but the highest groundnut plant-1 (26.2 No.s) was observed in ICGV-07219 line and 100 seed weight was the highest (64.5 g) in BARI Chinabadam-8. Plant height and seeds pod-1 were the lowest (32.9cm and 1.8g, respectively) in ICGV-07219. Maximum 100 groundnut weight was recorded in BARI Chinabadam-8 (64.5g) and the lowest 100 seed weight was observed in Dhaka-1 (55.02g), which was statistically similar to ICGV-06285 (56.15g). Though, there was no significant difference in groundnut yield of all the lines/varieties, but numerically the highest groundnut yield (1.83t ha-1) was recorded in BARI Chinabadam-8 and the lowest in ICGV-36-1 (1.65t ha-1). In general, lower yield of groundnut is related to premature harvest of the crop before Tornado "Mokha" attack. As all production practices were same the gross return and gross margin were also the highest from BARI Chinabadam-8 (Tk. 228750 ha-1 and 163550 ha-1,

respectively). This year, the experiment was harvested before full maturity, so the experiment may be repeated in the next year for more confirmation.

### **Adaptive Trial of groundnut (Set-II)**

M K Alam, M I Riad and M M Kadir

The experiment was conducted at Regional Agricultural Research Station, Jamalpur during Rabi 2021-22 with 8 lines of groundnut including BARI China badam-8 as checks. The plot size was 4 rows 3.5 m long. Seeds were sown on the 24<sup>th</sup> November, 2022 in 15 cm seed to seed and row was 30 cm apart from each. Recommended doses of fertilizers were applied @ 10:70:50:30:4:2 kg/ha of N P K S Zn B respectively. It was observed from the table that the groundnut line ICGV-07219 produced the highest nut yield. It produced 2018 kg/ha yield which was 30 % higher check variety BARI Chinabadam-8. It took 142 days to mature. The line ICGV-07245 produced the 2<sup>nd</sup> highest yield. It produced 1979 kg/ha nut yield which was 28 % higher than BARI Chinabadam-8. It took 145 days to mature. The third highest yield was recorded from BAG-19005. It produced 1937 kg/ha which was 25 % higher than check variety, BARI Chinabadam-8. This groundnut line took 145 days to mature. These three lines may easily be grown and harvested before flash flood at char area. ICGV-07219 produced the highest seed yield and tolerates the drought stress. Three genotypes ICGV-07219, ICGV-07245 and BAG-19005 may be selected for may be selected for adaptive trial in the farmers' on the basis of early mature, pods/plant and yield performances in the next season.

## **Crop and soil management**

### **Intercropping bunching onion with groundnut**

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

The field experiment was conducted at the research field of ORC, BARI, Gazipur during rabi season of 2022-2023 with six treatments viz. Sole groundnut, One row of bunching onion (15cmX10cm) in between two normal rows of g.nut (40cmX15cm), Two rows of bunching onion in between two normal rows of g.nut, Two g.nut rows alternate with two rows of bunching onion, Bunching onion broadcast in between two normal rows of g.nut (40cmX15cm) and sole bunching onion. The

experiment was laid out in Randomized Complete Block Design with three replications and unit plot size was 4m x 5m. BARI Chinabadam-8 were sown on 12 November, 2022 and BARI Patapeaz-1 were transplanted (40 days seedling) in the main field at same date. Fertilizers at the rate of N12P31K43S55B1.5 kg/ha in the form of urea, TSP, MOP, gypsum and boric acid, respectively were applied for both sole groundnut and intercrop. 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 R software. 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. Maximum no. of nut per plant (35) and highest nut yield (2.42 t/ha) were obtained from sole crop Sole groundnut treatment. Lowest yield (1.21 t/ha) was obtained from two g.nut rows alternate with two rows of bunching onion treatment which might be due to lowest number of mature nut per plant (18) and lower 100 seed weight (42 g). The highest GEY (3.22 t/ha) was obtained from One row of bunching onion (15cmX10cm) in between two normal rows of g.nut (40cmX15cm) treatment and the lowest (1.40 t/ha) in sole bunching onion. Maximum gross return (Tk. 322000/ha) and highest gross margin (Tk. 216250/ha) were recorded in one row of bunching onion (15cmX10cm) in between two normal rows of g.nut (40cmX15cm) treatment while lowest in sole bunching onion treatment due to lower GEY. However, the highest benefit cost ratio (BCR) (3.04) was obtained from one row of bunching onion (15cmX10cm) in between two normal rows of g.nut (40cmX15cm) treatment which might be due to higher GEY and gross return. All the intercrop treatments showed much higher benefit over sole groundnut but highest in one row of bunching onion in between two normal rows of groundnut. Therefore, 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.

### **Performance of intercropping garlic, onion, fenugreek, black cumin with groundnut in charland areas (Tangail)**

S. Roy, M. A. Rahaman, T. Tasmima, G. Paul, K. Roy, F.Begum and P.Roy

The experiment was conducted at the MLT site Bhuapur, Tangail under AEZ # 8 during *Rabi* season 2021-22 and 2022-23. 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.*, Sole groundnut (100%), Two rows of black cumin in between two rows of groundnut, One row of fenugreek in between two rows of groundnut, One row of garlic in between two rows of groundnut, One row of onion in between two rows of groundnut. Spacing of groundnut was maintained at 40 cm x 15 cm. The plot was fertilized with 45-36-75-30-2-1 kg N-P-K-S-Zn-B ha<sup>-1</sup> for sole and intercropping treatments. The variety of groundnut were BARI Chinabadam-9, BARI Kalozira-1, BARI Methi-1, BARI Rashun-2 and onion (Taherpuri). Seeds of groundnut, black cumin, fenugreek, bulb of onion and cloves of garlic were planted on 15 November, 2022. The onion was harvested on 16 March, 2023, black cumin on 22 March, 2023, garlic on 16 April, 2023, fenugreek on 22 March, 2023 and the groundnut on 7 May, 2023. 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. The maximum number of effective pods plant<sup>-1</sup> was observed in Sole groundnut treatment (19.73) followed by one row of onion in between two rows of groundnut. Spacing of groundnut was maintained at 40 cm x 15 cm treatment (19.00), and One row of garlic in between two rows of groundnut treatment (18.43). The highest hundred pod weight (72.06 g) and pod yield (1.79 t ha<sup>-1</sup>) was found when groundnut is grown solely (Sole groundnut treatment) followed by one row of onion in between two rows of groundnut. Spacing of groundnut was maintained at 40 cm x 15 cm treatment (1.70 t ha<sup>-1</sup>) treatment. The maximum groundnut equivalent yield was observed in one row of onion in between two rows of groundnut. Spacing of groundnut was maintained at 40 cm x 15 cm treatment (5.80 t ha<sup>-1</sup>) whereas the lowest in Sole groundnut treatment (2.14 t ha<sup>-1</sup>). In cost and return analysis, the maximum gross return (Tk. 493000 ha<sup>-1</sup>) and gross margin (Tk. 388270 ha<sup>-1</sup>) was observed in one row of onion in between two rows of groundnut. Spacing of groundnut was maintained at 40 cm x 15 cm treatment. On the other hand, the lowest gross return (Tk. 147900 ha<sup>-1</sup>) and gross margin (Tk. 67795 ha<sup>-1</sup>) were found in Sole groundnut

treatment. From the results of the present study, it can be concluded that groundnut can be successfully intercropped with 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 in between two rows of groundnut.

### Effect of seed priming on yield and seed quality of groundnut

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

The seeds of groundnut variety BARI Chinabadam-8 was subjected to three treatments namely Control (No priming), seeds soaked in water for 6 hours followed by shade drying and seeds soaked in water for the period of 12 hours followed by shade drying. The experiment was conducted at the experimental field of Oilseed Research Centre of BARI in Randomized Complete Block Design with four replications. Prior to the experimentation, seeds were soaked in tap water at 1:5 ratios for 6 or 12 hours. Further they were decanted and surface dried for their original weight. The soaked seed and dried seed were utilized for this experiment. The experiment was started at November 15, 2022. Data on yield and yield contributing characters were recorded after harvest and analyzed statistically using R program. Among the treatments, T<sub>6</sub> treatment recorded highest number of mature pods per plant (25) followed by treatment (24). The crop raised from unprimed seed gave lowest number of mature pods per plant (21). Priming treatments did not have any significant effect on the number of immature pods per plant or aerial pegs per plant. Among the priming treatments, seeds soaked in water for the period of 12 hours followed by shade drying treatment produced highest pod yield per hectare (1720 kg). The crop raised from unprimed seed recorded lowest pod yield per hectare (1560 kg). The treatment T<sub>3</sub> gave higher yield of 41.4% over the unprimed Control. Among the treatments, seeds soaked in water for the period of 12 hours followed by shade drying treatment gave slightly higher 100-kernel weight (46.10 g) and minimum was in unprimed seed (41.20 g). Shelling (%) showed insignificant differences among the treatments where highest was in Control (No priming) treatment and lowest was in seeds soaked in water for the period of 12 hours followed by shade drying treatment. From the present investigation, it was observed that seed priming has



a positive effect on the sowing quality of groundnut seeds, as well as its performance, leading to higher yield. Hydro priming for 6 hours followed by shade drying to the original moisture content, proved to be the best treatments in enhancing field emergence and subsequent performance leading to higher yield.

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

M. A. Islam, A. Samiha and R. Islam

The present study was conducted to identify the resistant groundnut variety(ies) to sucking pest, hairy caterpillar and leaf roller during *rabi* season 2022-23 at ORC research field of BARI, Gazipur which was laid out in randomized complete block design with three replications. Eleven varieties of groundnut were evaluated which were: V<sub>1</sub>=Dhaka-1, V<sub>2</sub>=Basonti Badam, V<sub>3</sub>=Tridana Badam, V<sub>4</sub>=Jhinga Badam, V<sub>5</sub>=BARI Chinabadam-5, V<sub>6</sub>=BARI Chinabadam-6, V<sub>7</sub>=BARI Chinabadam-7, V<sub>8</sub>=BARI Chinabadam-8, V<sub>9</sub>=BARI Chinabadam-9, V<sub>10</sub>=BARI Chinabadam-10, V<sub>11</sub>=BARI Chinabadam-11. Among the varieties Basonti Badam, BARI Chinabadam-5, BARI Chinabadam-6, BARI Chinabadam-7, BARI Chinabadam-10 were less susceptible, Dhaka-1, Tridana Badam and BARI Chinabadam-11 are more susceptible.

### **D. Soybean (*Glycine max* L )**

#### **Maintenance and evaluation of soybean germplasm**

U. Kulsum and M S Uddin

A total of one hundred twenty germplasm were planted in an augmented design at Joydebpur, together with three check varieties, BARI Soybean-5, BARI Soybean-6, and BARI Soybean-7. Seeds had been sown in three rows, each 4 meters long, with a line-to-line spacing of 40 cm. The date for planting was January 12, 2023. Fertilizers were applied @ Urea 55kg, TSP 165 kg, MP 110 kg, Gypsum 100 kg and Boric acid 9 kg per ha. Two/three times roughing was done to maintain genetic purity of the germplasms. Other intercultural operations were done properly to obtain optimum plant growth. The range of germplasm for days to flowering, days to maturity, plant height (cm), root length (cm), pod length

(cm), pods per plant, hundred seed weight (gm) and seed yield kg/ha were 51 to 74 days, 95 to 136 days, 21.0 to 80.6 cm, 7.2 to 16.9 cm, 2.2 to 10.4 cm, 15 to 88, 5 to 18 gm and 523.8 to 2738.1 kg/ha respectively. The highest value CV% was observed for seed yield (30 %) followed by pods per plant (27%) and hundred seed weight (21%). The highest value (44.4) of standard error was recorded for seed yield kg/ha and moderate was recorded for pods per plant and hundred seed weight (gm). Thus, the germplasm showed the highest variation for seed yield kg/ha, pod per plant and hundred seed weight (gm). Seeds of five healthy, disease-free, vigorous, nearly identical plants of each germplasm were collected and stored to maintain the purity of the germplasm and used in future breeding programs. Based on descriptive statistics, genotypes selected through seed yield (kg/ha), pods per plant and hundred seed weight (gm) could significantly improve the grain yield of soybean.

#### **Hybridization in soybean**

S. Ghosh and A. K. Saha

USDA-53 and USDA-72 were used as female parents and MTD-453 and Richmond were used as male parents. The hybridization between them was done at RARS, Burirhat, Rangpur during kharif 2022-23. Since anthesis occurred between 7.00 and 8.00 a.m., the optimum time for hybridization of soybeans in Bangladesh, is in the morning. Flowers were successfully emasculated about 24 hours before anthesis, and freshly-shed pollen should be used immediately. Unit plot size was 6 rows 4m long. Other intercultural operations were done as and when necessary. Soybeans are cleistogamous and the small bud size at anthesis causes difficulty in normal hybridization. A total of 24 buds were crossed from which only 8 pods were developed and 20 seeds were produced. About 34% crosses were succeeded to produce pod and seed. Failure of hybridized flowers to set pods due to inadequate pollen grain germination and low relative humidity. All F<sub>1</sub> seeds have been stored for next year evaluation. F<sub>1</sub> seeds were stored carefully for evaluation in the next season.

#### **Development of recombinant inbred lines (Ril) of soybean**

U. Kulsum and M S Uddin

Two varieties BARI Soybean-7 and BARI Soybean-6 were used as parents to create the RIL

population. The female parent BARI Soybean-7 is a short, bold-seeded, disease and pest resistance and drought-tolerant variety. and the male parent BARI Soybean-6 is a semi-tall and well adapted variety. The crossing between BARI Soybean-7 and BARI Soybean-6 was done in Kharif, 2019-2020 at ORC field, BARI. F<sub>1</sub> and F<sub>2</sub> generations were grown at Robi, 2020-21 and 2021-2022. The F<sub>3</sub> seeds of nine single plants along with the parents had sown on 12 January 2023 in a plant to row method. Each row was 4 meters long, with the line to line spacing of 40 cm and plant to plant 10 cm. Twenty plants from F<sub>3</sub> segregating generation were selected and harvested based on bearing habits and pest and disease tolerance. The progeny of the F<sub>3</sub> population exhibited higher pod per plant (57) and seed yield (150.6 gm/m<sup>2</sup>) compared to both parents, BARI Soybean-6 and BARI Soybean-7. However, the variations introduced by crossing were much lower, indicating a potential genetic relationship between the parents. The seeds of selected plants with desirable characters were stored separately for next year's sowing as the F<sub>4</sub> generation.

#### **Observation trial of soybean**

U. Kulsum and M S Uddin

Eleven entries including two check varieties namely BARI Soybean-6 and BARI Soybean-7 were evaluated in an RCB design with three replications for seed yield and yield related characters at Joydebpur during rabi 2023. The unit plot size was 3 rows of 4 m and the spacing was maintained 40 cm row to row and 10 cm plant to plant. The sowing date was 10 January 2023. Statistically, highly significant ( $p < 0.01$ ) genotypic differences were observed for all the characters under study. The study showed that days to flowering and days to maturity for the eleven entries ranged from 53 to 67 days and 103 to 112 days, respectively. The minimum days to maturity were observed for BARI Soybean-7 (103 days). The maximum number of pods per plant (78) and the second highest hundred seed weight (14 gm) was found in the entry Australia-1. Hundred seed weight was maximal in Richmond (18 gm). The seed yield ranged from 1244 kg/ha to 2781 kg/ha. The highest seed yield was recorded in Australia-1. Out of 11 entries, Australia-1, LG-92P-1825 and USDA 50 were over yielded 38%, 19% and 9% respectively compared to the check variety BARI

Soybean-6. After considering yield along with most of the yield related traits, Australia-1, LG-92P-1825 and USDA 50 were out-yielded and these will be used for the next year's yield trial program.

#### **Preliminary yield trial of soybean**

U. Kulsum and M S Uddin

Ten entries, including two check varieties, BARI Soybean-6 and BARI Soybean-7, were evaluated for seed yield and its components in an RCBD design with three replications at Joydebpur and Noakhali in 2023. The unit plot size was 4 rows of 4 m and the spacing was maintained 40cm x 10cm apart. The sowing date was 10 January 2021 at Joydebpur, BARI. All the parameters revealed highly significant variation among excluding root length(cm). The parameter days to flowering and day to maturity ranged from 53-68 days and 102-112 days respectively. The highest number (84) of pods per plant was produced by USDA 107 and the lowest by USDA 40 (38). The parameter hundred seed weight was maximal (13.0 gm) in USDA 3 and USDA 4. Out of 10 entries, only USDA 3 (2552.4 kg/ha) and USDA-107 (2062 kg/ha) were produced 29%, and 4% over yield compared to the check variety BARI Soybean-6. In the multi-location trial, on average BARI Soybean 7 took the lowest days to mature along with USDA 4 and USDA 40. The entries USDA 3 (2291.2 kg/ha) and USDA 107 (2036.3 kg/ha) also showed the highest average seed yield over location which were 13% and 1% higher than the mean yield of check variety BARI Soyben-7. In combined analysis, significant variation was observed for both maturity (days) and seed yield (kg/ha). After considering yield along with most of the yield-related traits, USDA 3 and USDA 107 were out-yielded than both check varieties. As a result, these highest-performing entries will be selected for the Regional Yield Trial program next year.

#### **Regional yield trial of soybean**

U. Kulsum and M S Uddin

Eight entries, including two check varieties, BARI Soybean-6 and BARI Soybean-7, were evaluated for seed yield and others yield contributing characters in an RCBD design with three replications at Joydebpur, Burirhat and Cumilla (Chandpur) in 2022-2023. The unit plot size was 4 rows of 4 m and the spacing was maintained 40cm x 10cm apart. The sowing date was 10, January

2023 at Joydebpur. A significant difference was observed for yield and yield contributing characters in BARI, Joydebpur. The parameter days to maturity for the eight entries ranged from 101 to 119 days. Maximum pods per plant (73) were found in the entry USDA 72 while minimum in BARI Soybean-7 (36). The range of hundred seed weight was 7.3 to 17.7 (gm). The seed yield data of two entries MTD-453 (2312.5 kg/ha) and ST-1 (2194.4 kg/ha) were 19% and 13% out-yielded than the check variety, BARI Soybean-7. Over the location, the mean days to maturity ranged from 101 to 117 days. The average seed yield ranged from 1603.2-2082.1 kg/ha. The entry USDA-72 produced the highest yield (2082.1 kg/ha) followed by Richmond (2034.9 kg/ha) and MTD-453 (2012.7 kg/ha) which were 9%, 6% and 5% higher than the check variety BARI Soybean-7. A statistically significant difference was observed among the entries for seed yield and maturity in combined analysis. Furthermore, these highest-performing entries will be used for the Adaptive Yield Trial program next season. Also as it was the first year, the trial will be repeated next year with the same entries.

#### **Maintenance of released variety and advanced lines of soybean**

U Kulsum and M S Uddin

For the maintenance, BARI released soybean varieties namely Shohag, Bangladesh soybean-4, BARI Soybean-5, BARI Soybean-6 and BARI Soybean-7 and advanced lines viz. Richmond, ST-1, MTD-453 were grown separately at Joydebpur during rabi, 2023. Total 11 kg, 19 kg, 27 kg, 90 kg and 60 kg seeds of Shohag, Bangladesh Soybean-4, BARI Soybean-5, BARI Soybean-6 and BARI Soybean-7 were produced. Moreover, a total of 14 kg, 5 kg, and 2 kg of seeds, respectively were harvested from three advanced lines of soybean, namely ST-1, MTD-453, and Richmond for future breeding purpose. Around 200 plants were selected from each variety/line based on genetic purity, uniformity, and distinctness. Seeds of selected plants were threshed, dried, cleaned, and stored in bulk for sowing the next year. The breeder seeds will be used to maintain the varietal purity of BARI-released soybean varieties. The seeds of advanced lines will be used in the breeding program.

## **Crop and soil management**

### **Effects of different tillage conditions on the growth and yield of soybean varieties in southern region of Bangladesh**

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

The field experiment was conducted at RARS, BARI, Rahmatpur, Barishal during the Rabi seasons of 2021-22 and 2022-23. Treatments were: Factor A. Three tillage conditions (Conventional tillage, Minimum tillage and Zero tillage i.e. relay cropping with T.aman rice); Factor B. Three soybean varieties (Bangladesh Soybean-4, BARI Soybean-5 and BARI Soybean-6). The experiment was laid out in randomized complete block design with three replications. In case of zero tillage (Zero tillage i.e. relay cropping with T.aman rice), seeds were sown through broadcasting at the rate of 30 kg/ha as relay cropping with existing T.aman rice before 10 days earlier of rice harvest). However, soybean seeds were sown after 15 and 25 days of relay cropping for minimum tillage (Minimum tillage) and conventional tillage (Conventional tillage), respectively. The experimental plots were fertilized with 60-175-120-115-10 kg/ha urea, triple super phosphate (TSP), muriate of potash (MP), gypsum and boric acid, respectively along with 5 t/ha cowdung. Data were collected on different relevant parameters. Data were analyzed statistically using windows based computer software of Statistix 10 version and then the mean differences were adjudged with DMRT. In 2021-22, interaction of Conventional tillage with BARI Soybean-6 gave the highest yield of seed (2233 kg/ha) that was statistically identical with Conventional tillage with Bangladesh Soybean-4 (2122 kg/ha) and Conventional tillage with BARI Soybean-5 (1869 kg/ha). The lowest yield was achieved from Zero tillage i.e. relay cropping with T.aman rice with BARI Soybean-5 (1119 kg/ha). In 2022-23, Conventional tillage with BARI Soybean-6 gave the highest yield of seed (1970 kg/ha) that was statistically identical to that of Conventional tillage with Bangladesh Soybean-4 (1842 kg/ha), Minimum tillage with BARI Soybean-6 (1656 kg/ha) and Minimum tillage with Bangladesh Soybean-4 (1623 kg/ha). The lowest yield was achieved from Zero tillage i.e. relay cropping with T.aman rice with BARI Soybean-5 (551 kg/ha). Among the treatment interactions, the highest gross



return of Tk. 169595/ha was obtained from Conventional tillage with BARI Soybean-6. Somewhat similar gross return was also obtained from the interactions of Conventional tillage with Bangladesh Soybean-4 (Tk. 159789) and Conventional tillage with BARI Soybean-5 (Tk. 140765/ha). The lowest gross return was computed in Zero tillage i.e. relay cropping with T.aman rice with BARI Soybean-5 (Tk. 67413/ha). The highest gross margin (Tk. 98523/ha) was obtained from the interaction of Conventional tillage with BARI Soybean-6 that was to some extent similar to that of Conventional tillage with Bangladesh Soybean-4 (Tk. 89879/ha) and Conventional tillage with BARI Soybean-5 (Tk. 70274/ha), but the lowest return (Tk. 3760/ha) was observed in Zero tillage i.e. relay cropping with T.aman rice with BARI Soybean-5. Gross margins obtained from interactions of Minimum tillage with Bangladesh Soybean-4 and Minimum tillage with BARI Soybean-6 were Tk. 57829 and 57293/ha, respectively. BARI Soybean-6 and Bangladesh Soybean-4 could be cultivated under conventional tillage condition for getting higher yield and economic returns under rice based cropping systems in southern region of Bangladesh.

#### **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. There were four treatments viz. 40cm x 10cm, 35cm x 10cm, 30cm x 10cm and 40 cm x 5cm, 45cm x 10cm (recommended spacing). The crop variety was BARI Soybean-7. The experiment was design in RCB with three replications. Seed were sown on 27 December, 2022 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. Ten plants were selected for collecting data on various parameters. Data on yield and yield contributing characters were recorded and analyzed statistically using SPSS program. The highest (34) no of pod/plant was found in 30cm x 10cm treatment and it was statically similar with the treatment of (35cm

x 10cm). The lowest no of pod/plant was recorded in the treatment of 40cm x 5cm. Number of seeds/pod was varied from 2-3 in all the treatments. The 100 seed weight was recorded maximum (11.59gm) in the treatment of 45cm x 10cm and it was followed by 40cm x 5cm treatment. The seed yield was obtained highest (1.55 t/ha) in the treatment of where 30cm x 10cm spacing was maintained and lowest (0.81 t/ha) in the 40 cm x 5cm treatment. 30cm x 10cm treatment gave highest (1.55t/h) yield, it may be due to higher no. of pod/plant in the same treatment. From the above results and discussions, it may be concluded that, 30cm x 10cm is the suitable spacing for BARI Soybean-7 cultivation to get higher yield.

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

M. A. Islam, A. Samiha and R. Islam

The present study was conducted to identify the resistant soybean variety(ies) to sucking pest, hairy caterpillar and leaf roller during *rabi* season 2022-23 at ORC research field of BARI, Gazipur which was laid out in randomized complete block design with three replications. Five varieties of soybean were evaluated which were: V<sub>1</sub> =Shohag, V<sub>2</sub> =Bangladesh soybean-4, V<sub>3</sub> =BARI Soybean-5, V<sub>4</sub> =BARI Soybean-6, V<sub>5</sub> =BARI Soybean-7. Among the varieties BARI Soybean-7 are less susceptible, variety shohag is moderately susceptible and variety BARI Soybean-5 BARI Soybean-6 are more susceptible.

#### **E. Sunflower (*Helianthus annus* L.)**

##### **Maintenance of sunflower germplasm**

S H Habib

Forty-three sunflower accessions including two released variety BARI Surjamukhi-2 and BARI Surjamukhi-3 were grown at the research field of ORC, BARI Gazipur on 30<sup>th</sup> November 2022. Seeds were sown in 2 rows x 4 m long plot, where row to row distance was 50 cm and plant to plant distance was 25 cm. Fertilizers were applied @ 25:35:55:18 kg/ha of NPKS, respectively from Urea, TSP, MP and Gypsum. Half of the Urea and other fertilizers were applied at the time of final land preparation. The remaining half of the Urea was applied as top dress during flower primordial stage. Pollen of each entry within a plot was collected in bulk. Then crossing was done within

the genotypes of that plot. After crossing, bagging was done properly. Other intercultural operations were done when necessary to obtain optimum plant growth. Five healthy, disease free, vigorous plants were harvested and seeds were collected in bulk from each entry. This seed will be used to maintain and grown to rejuvenate in the next season as well as to utilize in future breeding program.

### **Regional yield trial of sunflower**

S. H. Habib, M A L Akanda, F. Begum, Md. M. Ali, U. Kulsum, M. A. Monim, M. M. H. Bhuiyan & M. R. Humauan

Thirteen sunflower lines along with three check varieties BARI Surjamukhi-2, BARI Surjamukhi-3 and Hysun-33 were evaluated for yield and yield contributing characters at Joydebpur, Ishurdi, Jessor and Cumilla region during the Rabi season of 2022-23. Seeds were sown at these locations on 28, 16, 16 November and 01 December 2022, respectively. Experiments were laid out in RCB design with 3 replications. Unit plot size was 10 m<sup>2</sup>. Each plot consisted of 6 rows which were 4 m long with 50 cm row to row and 25 cm plant to plant distance. Fertilizers were applied @ 90:35:80:30:3.6 and 1.8 kg/ha of NPKSZn and B, respectively, from urea, TSP, MP, Gypsum, Zinc sulphate and Boric acid (FRG, 2018). Half of the Urea and the other fertilizers were applied at the time of final land preparation. The remaining half of the urea was applied as top dress during flower primordial stage. Other intercultural operations were done properly to obtain optimum plant growth. Data on days to flowering, days to maturity and seed yield were taken on plot basis. The other yield contributing characters were recorded from 10 randomly selected plants of each plot. Seed yield was converted into yield/ha. Significant differences among the genotypes were observed for most of the characters studied at different locations. The genotype Compoosite-5 was found to be the dwarf (82 cm) and produced more or less similar yield (2.32 t/h) compared to check varieties at Gazipur location. This genotype also contained higher oil % compared to check varieties. Over location, except at Isurdi, the hybrid variety Hysun-33 took highest days to mature compared to at other locations while some genotypes took around 94 to 100 days to mature. As shown in Table 3, with some exception, the hybrid variety Hysun-33 produced tallest plant (174-239 cm) whilst many

other genotypes performed as dwarf to medium dwarf in stature. For yield attributes though none of the genotypes was performed better than the hybrid variety Hysun-33, however, some of the genotypes performed better than the local checks. Among the entries, composite-5, S7GP01002, S7GP01015, S7GP04026, S7GP04016 (P16) and S7GP04016 (SP) performed better for plant height as well as yield. These genotypes could be selected for varietal development program.

### **Development of synthetic sunflower variety**

S H Habib

To develop synthetic sunflower variety, four sunflower inbred lines (P1: P-S-2-OP1, P2: P-S-2-OP3, P6: P-S-2-OP2, and P8: P-S-2-OPb) were selected as good general combiner in the rabi season 2018-19. All possible crosses (both cross and reciprocal cross)) were made between the inbreeds in rabi season 2019-20. In the subsequent season the generations were advanced from Syn-1 to Syn-3 selecting better plants of good agronomic traits. Seeds were sown on 24 November, 2022, in a 40m X 36m plot, maintaining row to row distance 50 cm and plant to plant distance 25 cm. Fertilizers were applied @ 25:35:55:18 kg/ha of NPKS, respectively from Urea, TSP, MP and Gypsum (FRG, 2018). From sowing to harvesting all cultural practices were followed as recommended for sunflower cultivation. In Syn-3 generation desirable heads were harvested in bulk and kept for tested in the yield competing trials with check variety in the next rabi season. The desired heads from Syn-2 generation were grown as Syn-3 generation and evaluated in 2022-23. A number of desired heads with good agronomic traits were selected and evaluated in Syn-3 generation. At maturity after discarding the unwanted plants, desirable heads were harvested in bulked. Seeds from selected plants will be mixed and grown as Syn-3 generation in the next *Rabi* season and will be evaluated for yield and yield contributing traits comparing with check variety.

### **Creating new genetic variability in sunflower using induced mutation: Evaluation of M6 mutant's family created by Gamma Radiation**

S H Habib

Gamma radiation treated M5 seeds of sunflower variety BARI Surjamukhi-2 were used in this study. All the M5 seeds along with a total of 150

non-irradiated seeds were sown at the research field of ORC, BARI Gazipur on 03 December, 2022 to generate M6 population. The seed were grown as head to row method in 4 m long plot maintaining 50 cm×25 cm row to row and plant to plant distance, respectively. Fertilizers were applied @ 25:35:55:18 kg/ha of NPKS, respectively from Urea, TSP, MP and Gypsum. Half of the Urea and other fertilizers were applied at the time of final land preparation. The remaining half of the Urea was applied as top-dressing during flower primordial stage. Other intercultural operations were done properly to obtain optimum plant growth. Plot of each treatment was covered with nylon net to prevent outcrossing and selfing was done within the treatment. The entire M5 populations were grouped into very dwarf (plant height <65 cm), dwarf (plant height 65-100 cm), medium dwarf (plant height 100-120 cm), and tall (plant height 120-150 cm). The note on plant architecture such as big-headed mutant (head diameter greater than 17 cm) and robust stem girth (stem diameter thicker than 1.5 cm) also were taken in this study as important criteria. Mature heads of each group were harvested separately and kept for growing as M7 family mutants in the next rabi season. A total of 291 single mutants from five different groups (very dwarf: 28, dwarf: 203, medium dwarf: 28, and tall: 6 & new phenotype: 26) were harvested and kept for further evaluation. In this generation the mutants of each group show nearly homogenous, therefore, the single head of each genotype will be bulk and grown as family in the next rabi season.

#### **Creation of sunflower mutant through ems: evaluation of M4 mutants**

S H Habib

EMS treated (0.5% EMS treated) M4 seeds of sunflower variety BARI Surjamukhi-2 (obtained from *Rabi* season 2021-22) were sown in head to row method at the research field of ORC, BARI Gazipur on 04 December, 2022 to generate M5 population. Along with a total of 150 non-treated seeds of BARI Surjamukhi-2 were also sown. The seed were grown in 4 m long plot in required number of rows maintaining 50 cm×25 cm row to row and plant to plant distance, respectively. Fertilizers @ 25:35:55:18 kg/ha of NPKS, respectively from Urea, TSP, MP and Gypsum (FRG, 2018) were applied as recommended time.

Intercultural operations were done properly to obtain optimum plant growth. Plot of each group was covered with nylon net to prevent outcrossing and individual head was self-fertilized using hand pollination by rubbing the head. The desirable mutants from different group [very dwarf (plant height <65 cm), dwarf (plant height 65-100 cm), medium dwarf (plant height 105-120 cm), tall (plant height 120-150 cm), and very tall (plant height >150 cm)] was evaluated and screened. The mutants with big-headed (head diameter greater than 17 cm), and robust stem girth (stem diameter thicker than 1.5 cm) also were selected in this study as an important criterion. A total of 648 single head from different groups (very dwarf: 153, dwarf: 446, medium dwarf: 36, and tall: 10 & very tall: 3) were harvested. As most of the mutants shows homogeneity in plant height in each group, the selected heads from each group was bulked and will be evaluated in the next *Rabi* season.

#### **Molecular characterization of sunflower dwarf mutants by the expression analysis of genes regulating Gibberalic Acid (GA) pathway**

S H Habib, Pryanka Roy, Ummy Kulsum and Md Motiar Rahman

A total of 42 gamma radiation treated sunflower mutants (dwarf, medium dwarf and tall in height) were selected for this study. The genomic DNA was extracted from 3<sup>rd</sup> and 4<sup>th</sup> leaf by ORC lab optimized DNA extraction protocol. Then a total of 25ng of genomic DNA was used for PCR amplification for the dwarfing gene *GA2ox1*. From the Semi-quantitative RT-PCR analysis in this experiment revealed that GA-deactivation enzymes, *GA2oxs* gene was expressed in 29 gamma radiation treated mutant sunflower leaf. Expression levels of *GA2oxs* gene in mutant plants thus suggesting that these genes might play an important regulating role in transcription level in GA biosynthesis of the dwarfing phenotype in sunflower.

#### **Molecular characterization of sunflower mutants by the expression analysis of *FAD*, *SAD* and *oleic* gene sequences**

S H Habib, Pryanka Roy, Ummy Kulsum and Md Motiar Rahman

Gamma radiation treated 42 mutants of BARI Sunflower-2 were taken for this study. Genomic DNA was extracted from 3<sup>rd</sup> and 4<sup>th</sup> leaf of mutant's plants using ORC Molecular biology Lab



optimized protocol. A chosen target was amplified from extracted DNA using PCR primers for *FAD*, *SAD* and *oleic* genes. From the Semi-quantitative RT-PCR analysis in this experiment, among the 42 mutants, *SAD* gene was found to be expressed in 22, *FAD* gene was found to be expressed in 16 and *oleic* gene was found to be expressed in 28 sample. Expression levels of both *SAD* and *FAD* genes increases the total high unsaturated amount of fatty acid levels which is healthier for human consumption and helps regulating blood cholesterol. The expression of *oleic* gene in the mutant plant further confirms that the population is well mutagenized. The mutants that expressed for *SAD* and *FAD* gene expression are valuable mutants for producing high total unsaturated fatty acid congaing sunflower variety.

### 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 U Kulsum

Fifty-two genotypes including two varieties (BARI Sarisha-17 and 20) belonging to *Brassica rapa* was used in this study. Genomic-DNA from fresh and young leaves was isolated and purified following ORC Molecular Biology Lab standardized protocol. Highly polymorphic SSR markers were obtained from journal article search. Then the genomic DNA was amplified using appropriate PCR protocol. Data from the primers were analyzed to obtain the information on genetic diversity of the *B. rapa* accessions. The summary statistics including the number of alleles per locus, major allele frequency, gene diversity, Polymorphism Information Content (PIC) and genetic distance-based clustering was performed with Unweighted Pair Group Method for Arithmetic. Average (UPGMA) tree using Power Marker v 3.25 (Liu and Muse, 2005) and the dendrogram was constructed using MEGA 5.0 software. A total 284 alleles were amplified across 14 markers among all the 52 genotypes. Genetic diversity varied from minimum 0.311 for marker SALSrk to maximum 0.95 for marker Q1 with an average value of 0.85. Polymorphism information content (PIC) value of the markers varied from minimum of 0.30 with the marker SALSrk and maximum of 0.95 with primer Q1 with a mean

value of 0.84. Genetic similarity analysis using UPGMA showed that three clusters were obtained i.e., C-I, C-II and C-III and majority of the genotypes were found to be fall in cluster III which were further divided in several sub clusters, which indicated that dissimilar accessions are grouped into distantly related clusters. This dissimilar grouping or distant clusters is so important because it helps the breeders to select the accession(s) with important dissimilar traits from the studied accessions for hybridization to get the higher heterotic responses. Among the 52, 4 low glucosinolate and 2 low erucic acid containing genotype was determined by gene specific marker.

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

S H Habib

For nucleus seed production around 1000 heads were selected from the breeders' seed production field of BARI Surjamukhi-3. Seeds were threshed, dried, cleaned, and stored in bulk as nucleus stock. For seed increase of advance lines, seeds from four advance lines of sunflower namely P1 (Synthetic), P2 (Synthetic), P6 (Synthetic) and P8 (Synthetic), respectively were grown separately at ORC research field, BARI, Gazipur during *Rabi* season 2022-23. Seeds of each genotype were sown on 30 November 2022 in a 8 X 4 m long plot where the spacing was 50 cm between the rows and 25 cm between the plants. Fertilizers were applied @ 90:35:80:30:3.6 and 1.8 kg/ha of NPKSZn and B, respectively, from urea, TSP, MP, Gypsum, Zinc sulphate and Boric acid (FRG, 2018). Half of the Urea and all other fertilizers were applied at the time of final land preparation. The remaining half of the Urea was applied as top dress during flower primordial stage. To obtain optimum plant growth other intercultural operations were done properly when necessary. Each plot was covered with nylon net to protect out crossing. The plants in each genotype were allowed to intermate by rubbing the pollen collecting within the same genotype. A total of 19 kg nucleus seed of released dwarf sunflower variety BARI Surjamukhi-3 was produced. A total of 1.7, 1.2, 1.1 and 1.6 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

#### Evaluation of different sunflower varieties under saline soil

Mm Islam, Kn Islam, Msi Khan and S. H. Habib

The experiment was conducted at Amtoli, Borguna during the Rabi season, 2022-23 to evaluate the performance of advanced lines and varieties of sunflower in coastal saline environment under farmers field condition. Three sunflower varieties i.e. BARI Surjamukhi-2, BARI Surjamukhi-3, Hysun-33 with three lines spgp04017, spgp04026 and comp5 were evaluated in the trial. BARI Surjamukhi-2, Hysun-33 was tall variety but BARI Surjamukhi-3 and others three line was dwarf and short duration variety. Hysun-33 is a popular and highly farmers demanded hybrid variety marketed by BRAC. The materials were evaluated in RCB design with 3 replications. The experimental land was ploughed with 4 passes 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 of the Urea was applied in two equal splits at 25 days after sowing (DAS) and 45 DAS. Unit plot size was 8m x 5m. Seeds were sown on 29 December 2022 maintain 60cm x 25cm spacing. The field was irrigated twice at 25 DAS and 45 DAS in the growing season. To control catterpillar, 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 from 01 April to 22 April 2023. Yield and yield attributes were recorded properly and analyzed over the location.

#### Performance of sunflower varieties in southern region of Bangladesh (Barisal)

Md. M. H.Khan, B.C Kundu, M.S Uddin, S.H. Habib and F. Begum

The experiment was conducted at RARS, Rahmatpur during the Rabi season, 2022-23 to evaluate the performance of sunflower varieties in the environment under Barishal region. Three sunflower varieties BARI Surjamukhi-2, BARI Surjamukhi-3 and Hysun-33 were evaluated in the trial. The materials were evaluated in RCB design with 3 replications. Normal cultural management

and recommended doses of fertilizers were applied @ of 90, 80, 30, 25, 3.6, 1 kg/ha of NPKSZn and Boron from Urea, TSP, MP, Gypsum, Zink Sulphate and Boric acid respectively. Seeds were sown on 25 December 2022 maintaining the spacing of 60 cm x 25cm for composite varieties and 75cm x 40cm for hybrid Hysun variety. The crops were harvested 15 March to 25 March 2023. All intercultural operations were done timely to raise good crop. Data were taken on days to 50% flowering, days to maturity, plant height (cm), head diameter (cm), grain per head, thousand seed weight (g) and yield/plot. The plot yield was converted into yield per hectare. The data were analyzed statistically using Statistical Analysis System (SAS) version 9.4 for all of the morphological traits described. Among the varieties flowering started earlier in BARI Surjamukhi-3 and also matured 8-15 days earlier than BARI Surjomukhi-2. Hysun 33 took the highest times (114 days) to be matured. The tallest plants were found in Hysun-33 (160.33cm) that was statistically similar with BARI Surjomukhi-2. The variety BARI Surjamukhi-3 produced the biggest size head (66.76 cm) with the highest number of seeds (547(. The thousand seed weight (66.19g) was recorded higher for BARI Surjamukhi-3 than another varieties BARI Surjamukhi-2 and Hysun-33. The highest yield was observed in BARI Surjamukhi-3 (2.14 t/ha) followed by Hysun-33 (1.83 t/ha) while the lowest yield was found in BARI Surjomukhi-2 (1.79 t/ha). Among the three varieties BARI Surjomukhi-3 are performed better. Plants of BARI Surjomukhi-3 are very short and remain standing condition during adverse conditions basically heavy wind and rainfall.

#### Insect pollinators and their role to yield of sunflower (*Helianthus annuus* L.)

R. Islam, M. A. Islam and A. Samiha

The study was conducted to observe the diversity and abundance of different insect visitors and their role on yield on sunflower at ORC, BARI, Gazipur. There were three treatments (i) Open pollination, (ii) bagged pollination and (iii) hand cross pollination, design was RCBD with 3 replications. Here a total of 623 insect visitors were found from 4 orders belonging hymenoptera, diptera, lepidoptera and coleoptera order. Among them hymenopteran insect visitors were the most dominant. On the other hand, seed set per plant,

100 seed weight, seed yield per plant was found higher 72.66%, 76.20%, and 68.83% respectively in open pollination than bagged pollination. The oil percent was also observed higher (4.89%) in open pollination than the bagged pollination in this experiment.

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

M. A. Islam, A. Samiha and R. Islam

The research work was conducted to record the insect pests with their natural enemies and the extent of damage by the major insect pests of sunflower during Rabi 2022-23 season at ORC research field and laboratory of BARI, Gazipur. The survey was conducted at early and late robi season from three dispersed sunflower fields each of which was about 33 decimals in size. Sunflower seeds were sown on last week of November 2022 and first week of January 2023. The nature of damage and feeding behavior of the insect pests with their population per plant was recorded from seedling to mature stage of the crops. The succession of appearances of the insect pests on sunflower showed that the population of different pest species occurred in an overlapping manner and the crop was under the continuous attack of one or more pests. Most of the major and minor pests appeared in the crop during vegetative to flowering stages (30-70 Days after sowing) and the maximum infestation occurred during vegetative and flowering stages of the crop.

## **F. Linseed**

### **Maintenance and evaluation of linseed (*Linum usitatissimum* L.) Germplasm**

Hosna Kohinoor, Debi Rani Datta, T.A. Mujahidi and M S Uddin

The experiment was carried at the research field of ORC, BARI, Joydebpur during rabi 2022-23 with forty genotypes of linseed including the released variety Neela. Seeds were sown on December 06, 2022. The unit plot size of each genotype/line was 4m long with 2 rows with 40cm x 10cm spacing between rows and plants respectively. Fertilizers were applied @ 120: 80: 60: 40: 4:1 kg/ha of N: P: K: S: Zinc and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Borax. All the fertilizers were applied during the final land

preparation except urea. The urea was applied at vegetative (20 days after germination) and reproductive (40 days after germination) stages in two splits. Other intercultural management was done properly and when it was necessary. The highest CV was recorded for the parameter number of pods per plant (27%) followed by plot yield (25.03%) and number of branches plant (22.25%) respectively. The highest yield was obtained from Lin-S-19 followed by Lin-1308 and BD-10703. Considering yield related traits Lin-S-19, Lin-1308, BD-10703, Lin-1903, Lin-H-18, Lin-1403, Lin-C-16 and Neela were selected for observation trial in the next Rabi season 2023-24. Collected seeds were preserved separately for further research work.

### **Regional yield trial of linseed (*Linum usitatissimum* L.)**

Hosna Kohinoor, Debi Rani Datta, T .A. Mujahidi and M S Uddin

The experiment was carried at the research field of ORC, BARI, Joydebpur during rabi 2022-23 with four genotypes of Linseed including the released variety Neela. Seeds were sown on December 06, 2022. The unit plot size of each genotype/line was 4m long with 6 rows with 40cm x 10cm spacing between rows and plants respectively. Fertilizers were applied @ 120: 80: 60: 40: 4:1 kg/ha of N: P: K: S: Zinc and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Borax. All the fertilizers were applied during the final land preparation except urea. The urea was applied at vegetative (20 days after germination) and reproductive (40 days after germination) stages in two splits. Other intercultural management was done properly and when it was necessary. Among the genotypes the most dwarf and tallest genotypes were Lin-H-18 (64.5 cm) and Neela (69.6cm) respectively. Highest plot yield (g) was obtained from Lin-W-17 (450g) followed by Neela (443g). Maximum number of pods (62.8) and maximum number (8.6) of seeds were obtained from Lin-1503/2 and Lin-H-18. Collected seeds of Lin-W-17, Lin-1503/2, Lin-H-18 and Neela would be preserved properly to evaluate in different locations next year.



## G. Niger

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

Hosna Kohinoor, Debi Rani Datta, T.A.Mujahidi and M S Uddin

The experiment was carried at research field of ORC, Joydebpur during Rabi 2022-23 with twenty one genotypes of Niger. Seeds were sown on December 06, 2022. The unit plot size of each genotype/ was 2 rows x 4 meter long maintaining 40cm and 10cm spacing between rows and plants respectively. Fertilizers were applied @ 120: 80: 60: 40: 4:1 kg/ha of N: P: K: S: Zinc and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Borax. All the fertilizers were applied during the final land preparation except urea. The urea was applied at vegetative (20 days after germination) and reproductive (40 days after germination) stages in two splits. Other intercultural management was done properly. The highest CV (22.27%) was observed for the trait number of pods per plant followed by five plants yield and number of branches per plant. Considering yield related traits Nig-1306, Nig-140/6, Nig-7506, Nig-3006 and Nig-1606 were selected for Observational trial for next Rabi season 2023-24.

### Observation trial of niger (*Guizotia abyssinica*)

Hosna Kohinoor, Debi Rani Datta, T.A.Mujahidi and M S Uddin

Six Niger lines including released variety Shova were evaluated at the research field of ORC, BARI, Gazipur during Rabi 2022-23. Seeds were sown on December 06, 2022. Each genotype was grown in a 6 rows x 4m long unit plot maintaining 40cm and 10cm spacing between rows and plants respectively. Fertilizers were applied @ 120: 80: 60: 40: 4:1 kg/ha of N: P: K: S: Zinc and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Borax. All the fertilizers were applied during the final land preparation except urea. The urea was applied at vegetative (30 days after germination) and reproductive (70 days after germination) stages in two splits. Other intercultural management was done properly. Among the genotypes the most

dwarf and tall genotype were Nig-3706 and Nig-140/6 respectively. Highest plot yield (g) was obtained from Nig-8506 followed by Nig-3706. Maximum number of pods per plant and seeds per pod were obtained from Nig -5806 and Nig-140/6. The highest yield over check (26.92%) was observed in Nig-3606 followed by Nig-140/6. This experiment would be studied at different location of Bangladesh in next rabi season 2023-24.

## H. Safflower

### Observation trial of safflower (*Carthamus tinctorius*)

Hosna Kohinoor, Debi Rani Datta, T. A. Mujahidi and M S Uddin

Five safflower genotypes including one check variety BARI Saff-1 were evaluated for yield and yield contributing characters at the research field of ORC, BARI, Gazipur during rabi 2022-23. Seeds were sown on December 06, 2022. Each genotype/line was grown in a 4 rows x 4 m long unit plot maintaining 40 cm and 10cm spacing between rows and plants respectively. Fertilizers were applied @ 120: 80: 60: 40: 4:1 kg/ha of N: P: K: S: Zinc and Boron from Urea, TSP, MP, Gypsum, Zinc sulphate and Borax (FRG, 2018). All the fertilizers were applied during the final land preparation except urea. The urea was applied at vegetative (30 days after germination) and reproductive (70 days after germination) stages in two splits. Other intercultural management was done properly. Among all yield contributing parameters seeds per pod showed highest CV (10.8 %) followed by branches/plant (6.7%), pods per plant (9.0) and yield (6%). In case of plant height the most dwarf and tallest entries were SAF-503 (108.3) and SAF-502 (119.3 cm) followed by SAF-504 and BARI Saff-1 respectively. Maximum numbers of pods/plant were observed in SAF-T-2017. Maximum yield (1980 kg/ha) were obtained from SAF-503 (1980 kg/ha) followed by BARI SAFF-1 and SAF-504. These study would be repeated in next rabi season 2023-24.

# SPICES CROPS

## 04



## Onion

### Varietal development

#### Characterization and evaluation of onion germplasm for winter season

M.N.A. Chowdhury, S. N. Mozumder H. Mohonta and M. Z. H. Prodhan

The experiment was conducted at Spices Research Centre, Shibganj, Bogura during November 2022 to April 2023 with a view to characterization and evaluation of onion germplasm for winter season and to select promising onion germplasm. The experiment was laid out in randomized complete block design with three replications. Nineteen germplasm of onion viz., Ac Bog 434, Ac Bog 435, Ac Bog 436, Ac Bog 437, Ac Bog 438, Ac Bog 439, Ac Bog 440, Ac Bog 440-1, Ac Bog 440-2, Ac Bog 441, Ac Bog 442, Ac Bog 443, Ac Bog 444, Ac Bog 445, Ac Bog 446, Ac Bog 447, Ac Bog 448, Ac Bog 449, Ac Bog 450 with BARI Piaz-4 and BARI Piaz-6 were used as check in the study. It was reported the lowest neck diameter (0.79 cm) was found from Ac Bog 440-2 and the highest (1.31 cm) was recorded from Ac Bog 450. It was found that Ac Bog 436 gave the higher bulb diameter and single bulb weight (4.60 cm & 42.00 g, respectively). The lowest bulb diameter and single bulb weight (2.80 cm and 20.59 g, respectively) was recorded from Ac Bog 444. The highest bulb yield (25.22 t/ha) was found from Ac Bog 436 and the lowest (11.05 t/ha) was recorded from Ac Bog 444. The germplasm, Ac Bog 442 gave the highest TSS (14.60%) and the lowest (9.98%) was found from Ac Bog 438. The germplasm Ac Bog 435, Ac Bog 436, Ac Bog 437, Ac Bog 438, Ac Bog 440, Ac Bog 440-1, Ac Bog 440-2, Ac Bog 441, Ac Bog 442, Ac Bog 443, Ac Bog 448, Ac Bog 449, Ac Bog 450 and BARI Piaz-4 & BARI Piaz-6 showed moderately resistant to purple leaf blotch disease and rest of them resulted

moderately susceptible. The germplasm Ac Bog 436, Ac Bog 437, Ac Bog 440-2 and Ac Bog 450 were performed better.

#### Evaluation of onion advanced lines for winter season

M.n.a. chowdhury, s. N. Mozumder h. Mohonta and m. Z. H. Prodhan

The experiment was conducted at Spices Research Centre, Shibganj, Bogura during November 2022 to April 2023 with a view to evaluate the onion advanced lines for winter season and to select promising winter onion line(s). The experiment was laid out in randomized complete block design with three replications. Seven advance lines of onion (ON0333-1, ON0333-2, ON0353, ON0353-1, ON0353-2, ON0374-1 and ON0376) with BARI Piaz-4 and BARI Piaz-6 were used as check in the study. The higher bulb diameter and single bulb weight (4.81 cm & 33.73 g, respectively) was recorded from ON0333-2 and the lowest (2.92 cm & 26.00 g, respectively) was observed from ON0353-1. The highest bulb yield (20.67 t/ha) was found from ON0333-2 and the lowest (14.17 t/ha) was recorded from ON0353-1. The line, ON0333-2 gave the highest TSS (13.60%) and the lowest (9.10%) was found from ON0333-1. The line ON0333-1, ON0333-2, ON0353, ON0353-2, ON0374-1, India-1, BARI Piaz-4 and BARI Piaz-6 showed moderately resistant to purple leaf blotch disease and rest of them resulted moderately susceptible. Considering all the characters, ON0333-2, ON0353-2, ON0374-1 and India-1 were performed promising.

#### Collection and evaluation of summer onion germplasm (set-i)

M.N.A. Chowdhury, S. N. Mozumder H. Mohonta and M. Z. H. Prodhan

The study was conducted at Spices Research Centre, Shibganj, Bogura, during July 2022 to

November 2022 with a view to find out the superior summer onion line (s) and to develop new summer onion variety with good keeping quality. Six summer onion lines (Ac Bog 435, Ac Bog 437, Ac Bog 439, Ac Bog 440-1, Ac Bog 440-2 and Ac Bog 442) with BARI Piaz-5 were used as check in the study. The experiment was laid out in randomized complete block design with three replications. It was noted that Ac Bog 440-2 gave the higher bulb diameter and single bulb weight (4.28 cm & 38.22 g, respectively). The lowest bulb diameter and single bulb weight (2.68 cm & 22.13 g, respectively) was recorded from Ac Bog 442. Significantly the highest bulb yield (18.03 t/ha) was found from Ac Bog 440-2 and the lowest (6.68 t/ha) was recorded from Ac Bog 442. The germplasm, Ac Bog 440-2 performed the lowest mortality (5.20%) and the highest (10.79%) was recorded from Ac Bog 442. The germplasm, Ac Bog 437 gave the highest TSS (13.26%) and the lowest (11.26%) was found from Ac Bog 440-1.

#### **Collection and evaluation of summer onion germplasm (set-ii)**

M.N.A. Chowdhury, S. N. Mozumder H. Mohonta and M. Z. H. Prodhan

The study was conducted at Spices Research Centre, Shibganj, Bogura, during July 2022 to November 2022 with a view to find out the superior summer onion line (s) and to develop new summer onion variety with good keeping quality. Twelve summer onion lines (Ac Bog 434, Ac Bog 436, Ac Bog 440, Ac Bog 441, Ac Bog 443, Ac Bog 444, Ac Bog 445, Ac Bog 446, Ac Bog 447, Ac Bog 448, Ac Bog 449 and Ac Bog 450) with BARI Piaz-5 were used as check. The experiment was laid out in randomized complete block design with three replications. It was noted that Ac Bog 449 gave the higher bulb diameter and single bulb weight (4.21 cm & 30.20 g, respectively). The lowest bulb diameter and single bulb weight (2.98 cm & 18.20 g, respectively) was recorded from Ac Bog 443. The highest bulb yield (16.46 t/ha) was found from Ac Bog 449 followed by Ac Bog 434 (16.33 t/ha) and Ac Bog 445 (15.67 t/ha) and the lowest (7.33 t/ha) was recorded from Ac Bog 443. The germplasm, Ac Bog 449 showed the lowest mortality (5.16%) and the highest (10.20%) was found from Ac Bog 447. The highest TSS (14.10%) was recorded from Ac Bog 448 and the lowest (9.80%) was found from Ac Bog 440.

#### **Development of diverse onion germplasm through hybridization (Advancing of generation F<sub>2</sub> bulbs to F<sub>3</sub> seeds)**

M. A. Alam, M. A. Khan, A. H. F. Fahim, S. N. Mazumder and H. C. Mohanto

An experiment was conducted to produce F<sub>2</sub> seeds from F<sub>1</sub> bulbs with the main goal to develop diverse onion germplasm through hybridization at Spices Research Centre, Shibganj, Bogura during 2022-2023. Three released varieties i.e., BARI Piaz-1, BARI Piaz-4 and BARI Piaz-6 were used in this study. Diallel mating design was followed for crossing during the season 2018-2019. An amount of approximately 9-78 g seeds were harvested from the F<sub>2</sub> bulbs of six segregating population.

#### **Searching of male sterile and maintainer lines of onion**

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

An experiment was conducted to search male sterile and maintainer lines of onion at Spices Research Centre, Shibganj, Bogura during 2022-2023. Ac Gaz 379 were used in this study to make cross with two released variety BARI Piaz-4 and BARI Piaz-6 along with eighteen other onion lines. Approximately 2-150 g of seed was harvested from each cross which will be tested in the next season.

#### **Development of inbred lines of onion through hybridization**

##### **(Set-2: Advancing of generation F<sub>1</sub> seed to F<sub>1</sub> bulb)**

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

An experiment was conducted to inbred lines of onion at Spices Research Centre, Shibganj, Bogura during 2022-2023. A total of five experimental test cross F<sub>1</sub> were used in this study. Hybridization was done during the season 2021-2022. Approximately 1.23 to 2.84 Kg of F<sub>1</sub> bulbs were harvested from different cross combinations which will be used to produce F<sub>2</sub> seeds in the next season. Performances of some F<sub>1</sub>'s were promising and could be utilized in future breeding program to develop superior inbred lines or base population.



**Mass selection for onion population development**

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

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 2022-2023. Twenty-four onion genotypes were grown in family rows for random mating and seed production. The experiment was randomized in complete block design with three replications. A total of 2097 g seeds from different onion genotypes were collected separately and preserved for Mass population development. Maximum

**Development of S<sub>1</sub> bulb generation in onion**

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

The field experiment was carried on at Regional Spices Research Centre, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during rabi 2022-23. Nine S<sub>1</sub> onion population were evaluated for bulb production. Variations among onion populations were observed in respect to bulb size and bulb yield. The highest individual bulb weight was recorded from Ac Gaz384 (35.73 g) and the lowest from Mass 2 (23.73 g). The highest plot yield was recorded from the entry Mass3 (3.51 kg) and the lowest from Mass 2 (2.25 Kg). Total 80.48 kg bulb was harvested from different individual genotypes.

**Development of S<sub>2</sub> bulb generation in onion**

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

An experiment was conducted to Advance S<sub>2</sub> seed to S<sub>2</sub> bulb generation of onion for Inbred line development at Regional Spices Research Centre, BARI, Gazipur during 2022-23. Thirteen collected onion lines were grown for advancing seed to bulb generation. The highest plot yield was recorded from the entry G13=Polypop31B123 (5.4 kg) and the lowest from G1=AcB403/B2/2023 (1.9 Kg). A Total 111.08 kg Bulb were collected from different onion lines and preserved for advancing generation in the next year.

**Cultural management****Effect of intercropping bulb set and seedling transplanting onion with brinjal for proper utilization of interspace**

M.M. Rahman & M.A. Khan

A field study was carried out at Spices Research Sub-Centre (SRSC), BARI, Faridpur during the season of 2022-2023 to find out the combinations of brinjal and onion which can be profitable than monocropping. Seven treatments combination viz., brinjal 100% + onion 70%, brinjal 100% + onion 60%, brinjal 100% + onion 50%, brinjal 100% + onion 40%, brinjal 100% + onion 30% and sole crop of brinjal and sole crop of onion were evaluated in RCBD design with three replications. BARI Begun-12 and BARI Piaz-4 were used as planting material. Onion was planting in two times, first set to bulb method and after harvesting onion seedlings were transplanted in same field with same design. Both brinjal and onion gave highest yield in sole planting but by the economic performance highest gross return (Tk. 2204300 tk ha<sup>-1</sup>), gross margin (Tk. 1844199 tk ha<sup>-1</sup>), net return (1818699 tk ha<sup>-1</sup>) and BCR (5.72), LER (1.55) and MAI (Tk. 552650 ha<sup>-1</sup>) were found in brinjal 100% + onion 50% intercropping system against the minimum for brinjal 100% + onion 30% system. Among the intercropping treatment highest RVI (1.77) was showed by 70% onion intercropped in between two brinjal rows (100%). On the basis maximum economic parameter, the brinjal 100% + onion 50% intercropping system was found as the best intercrop combination among other treatments.

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

Md. Mostaque Ahmed, Md, Eakramul Haque and Md. Nasirul Farid

A field trail was carried out during growing season Rabi 2022-23 at the Spices Research Sub-Centre, BARI, Lalmonirhat to study the effects of maturity indices under different onion variety on the quality true seed production of onion. Three onion varieties viz. (BARI Piaz-1, BARI Piaz-4 & BARI Piaz-6) and 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 randomized complete block design with three replications. In respect of varieties, the highest result was recorded in germination

percentage (86.22%), root length (1.60 cm) with BARI Piaz-4, but shoot length (5.48 cm) seedling length (6.97 cm) and vigor index (585.20 %) were responded in highest with BARI Piaz-1. However, in respect of maturity indices, all parameters i.e., germination (91.33 %), root length (1.61 cm), shoot length (5.54 cm), seedling length (7.16 cm) and vigor index (653.83 %) showed in highest with BARI Piaz-6. all parameters responded highest performance with 30% exposed of onion seed but statistically similar trend was found in 20% exposed of onion seed regarding with seedling length and vigor index. However, the treatment combination of BARI Piaz-1 with 30% exposed of onion seed performed highest in respect of shoot length (6.60 cm), seedling length (8.06 cm) and vigor index (720.53 %) and BARI Piaz-4 with 30% exposed of onion seed showed in highest with germination percentage (92.67 %), root length (1.73 cm) and vigor index (720.53 %). In case of vigor index, BARI Piaz-1 and BARI Piaz-4 with 20% exposed of onion seed statistically similar to BARI Piaz-1 and BARI Piaz-4 with 30% exposed of onion seed.

## Nutrient and water management

### Nutrient management on growth and bulb yield of onion

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

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 2022-2023. The experiment was designed in Factorial Randomized Complete Block Design having three replications. The treatment composed of three onion varieties [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 NPKSZnB  $ha^{-1}$ ) + Cow dung 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, yield contributing parameters and N, P, K & S uptake of onion. The highest bulb yield (32.06  $t ha^{-1}$ ), marketable bulb yield (31.03  $t ha^{-1}$ ) and N, P, K & S uptake (126.58, 17.09, 115.18 & 29.3  $kg ha^{-1}$ ) were recorded when onion

variety BARI Piaz-4 cultivated under 100% RDF + Vermicompost 3  $t ha^{-1}$  ( $N_2$ ) in the study area. Total PLW was higher (11%) with onion variety BARI Piaz-6 and application of 100% RDF + Poultry manure 3  $t ha^{-1}$   $kg$  during 60 days of storage.

### 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, A. H. F. Fahim and Z. H. Prodhan

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 were studied in a randomized complete block design with four replications. The highest yield (20.75  $t/ha$ ) was found in  $T_5$ . The highest level of gross margin (tk. 397593), BCR (1.50) and MBCR (1.57) were obtained from  $T_4$ . Highest level of gross margin (tk. 563731), BCR (1.83) and MBCR (6.72) were obtained from  $T_5$ .

### Effect of different organic fertilizers on yield and quality of onion

M. A. Rahman, M. N. A. Chaudury and Z. H. Prodhan

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the rabi season of 2022 - 2023 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 a randomized complete block design with five replications. Positive effects of different treatments were recorded on yield and yield contributing characters of onion. The highest yield (16.85  $t/ha$ ) was found in  $T_3$ . The highest level of gross margin (tk. 247959), BCR (1.46) and MBCR (3.19) were obtained from  $T_4$ .

## Insect pest and disease management

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

Md. Nasirul Farid and Md. Mostaque Ahmed

The experiment was conducted at Spices Research Sub-Center, BARI, Lamonirhat, during October 2022 to April 2023 to find out the effective fungicidal package for quality onion seed production. The experiment was laid out in Randomized Complete Block (RCB) design having four treatments, viz. T<sub>1</sub>=Seed treatment and foliar spraying with Rovral 50 WP (Iprodion) @ 2glitre<sup>-1</sup> water, T<sub>2</sub>=Seed treatment and foliar spraying with Luna Sensation (Fluopyram +Tryfloxystrobin) @ 1ml litre<sup>-1</sup> water, T<sub>3</sub>=Seed treatment and foliar spraying with Amistar Top (Azoxystrobin +Difenoconazole) @ 1mlitre<sup>-1</sup> water and T<sub>4</sub>=Untreated control. Seed bulb onion treated with Luna Sensation (Fluopyram +Tryfloxystrobin) @ 1ml litre<sup>-1</sup> 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<sup>-1</sup> water could also be another option for controlling those diseases.

## Agril. Engg. and post-harvest technology

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

MA Mottalib, MA Alam and ZH Prodhan

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. 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 seven 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. Besides, only NDVI image was used to carry out regression analyses with the yield data collected from onion field in this reporting year. The other VIs images will be used to identify the most suitable VI for predicting yield in the next reporting year at which VIs will be highly correlated to the yield.

### Effect of curing method on the storability and quality of onion bulbs

M. A. Khan and M. M. Rahman

A storage trial was conducted at the ambient storage of SRSC, BARI, Faridpur in 2023 to find out optimum curing method of onion bulbs with the variety BARI Piaz-4. Four curing methods were included in this trial as storing bulbs without curing (control-T<sub>1</sub>), curing bulbs with tops for 3 days (T<sub>2</sub>), curing bulbs with tops for 5 days (T<sub>3</sub>) and curing bulbs with tops for 7 days (T<sub>4</sub>). The experiment was laid out under completely randomized design with three replications. The storage data were recorded periodically at 20 days interval on sprouting loss (%), rotting loss (%), physiological loss in weight (PLW, %) and total loss (%) of bulbs. So far data were taken for 2 months 20 days. The results revealed that significant difference was observed on rotting, PLW and total loss of bulbs except sprouting. However, no sprouting was recorded from the treatments. The highest rotting (7.14%), PLW (9.60%) and total loss (15.90%) were registered from T<sub>2</sub>, T<sub>1</sub> and T<sub>1</sub>, respectively. The lowest rotting loss (5.40%), PLW (7.27%) and total loss (13.09%) were recorded from T<sub>3</sub>, T<sub>4</sub> and T<sub>4</sub>, respectively. The average rotting, PLW and total losses were 6.16%, 8.19% and 14.35%, respectively for 2 months 20 days storage of onion



under the study. The study will be continued up to October, 2023.

#### **Effect of stacking height on the storability and quality of onion bulbs**

M. A. Khan and M. M. Rahman

A shelf life study was conducted at the ambient storage of SRSC, BARI, Faridpur in 2023 to see the effect of stacking thickness on storability of onion bulbs (var. BARI Piaz-4). Five stacking heights were considered in this trial as 6" (15.24cm), 9" (22.86cm), 30.48cm, 18" (45.72cm) and 21" (53.34cm). The experiment was laid out under completely randomized design with four replications. The storage data were recorded periodically at 20 days interval on sprouting loss (%), rotting loss (%), physiological loss in weight (PLW, %) and total loss (%) of bulbs. So far data were taken for 2 months 20 days. The results revealed that significant difference was observed on sprouting, rotting, PLW and total loss. The total loss was increased with the increase in stacking height of onion bulbs. The highest sprouting (0.03) was recorded with 18 inches stacking height. The maximum rotting (5.82%), PLW (11.80%) and total loss (16.32%) were noted from 18", 21" and 21", respectively. Six inches stacking height showed the lowest rotting loss (3.97%), PLW (8.00%) and total loss (11.97%). The average sprouting, rotting, PLW and total losses were 0.006%, 4.63%, 9.62% and 14.26%, respectively for 2 months 20 days storage of onion under the study. The study will be continued up to October, 2023.

#### **Effect of different preservatives, packaging material and temperature on onion paste**

Md. Masud Alam, M. G. F. Chowdhury and Md. Zulfikar Haider Prodhan

This experiment was undertaken to study the paste behavior of treated and untreated onion of BARI piaz-4 under room temperature and refrigerated temperature. The fresh, peel and sliced onion were crushed in blender. The onion paste was prepared using 250 ml water per kg sliced onion. The onion paste treated with citric acid (CA) + Sodium benzoate ( $\text{Na}_2\text{S}_2\text{O}_5$ ), CA + KMS, sodium chloride (NaCl) + CA +  $\text{Na}_2\text{S}_2\text{O}_5$ , NaCl + CA + KMS and CA alone and another was non treated onion paste (control). All the samples of prepared onion paste were stored in glass container and kept in room and refrigerated temperature. The colour, flavor, texture and overall

acceptability of all the samples (treated and untreated) of onion paste were observed at 15 days interval up to 270 days storage. The colour, flavour, texture and overall acceptability of the onion pastes, treated with NaCl + CA + KMS was more acceptable at room temperature compared to other treatments. On the other hand, all the treated samples, stored in glass container at refrigerated temperature (RFT) were acceptable up to 270 days of storage.

#### **Nutritional and microbiological study of src developed spices powder compared to fresh sample**

Md. Masud Alam and Md. Zulfikar Haider Prodhan

Processing and preservation of onion by suitable means is a major thrust area since a long time. These techniques are mainly used for preservation and value addition of onion. It is used in number of food items like soup, fast food, pizza, vegetables, dry sauces etc. This study was concerned with the development of export-oriented quality onion powder using dehydration technology with attractive organoleptic and nutritional properties. The onion powder obtained from fresh onion through processing process in which remains all active ingredients of the onion can be added into other food for improving the mouth feeling of the food as the spice during eating. Now a day people do not have enough time to prepare onion paste at home, so they depend on the ready to eat spice for curry making. The chemical compositions of the fresh and dehydrated onion products were determined and it was observed that the qualities of the products were satisfactory. Organoleptic taste testing showed that the developed product was accepted by the panelists. The study thus shows that high quality shelf-stable onion powder can be developed utilizing available low-cost dehydration processes and thereby, post-harvest losses of onion can be reduced to an acceptable level.

## **Garlic**

### **Cultural management**

#### **Weed management practices in garlic (*Allium sativum* L.)**

M.M. Rahman and M.A. Khan

An integrated weed management program is essential for garlic production because of the unique challenges posed by their planting densities

and susceptibility to weed competition. Garlic is slow-growing and shallow-rooted, planted at high densities, and susceptible to severe yield loss from weed competition and high amount of labors are needed for controlling weed. For acknowledging this a field study was done at Spices research sub-centre, BARI, Faridpur during rabi season of 2022-23 to identify the best profitable weed management practices for garlic production. Four types of herbicides (Pendimethalin 30% EC, oxadiazon 25% EC, oxyflufen and quizalofop) and there combination along with manual hand weeding were practiced as treatments. Total twelve treatments combination were used with three replications in RCB design. Among all treatments highest yield (8.17 t/ha), individual bulb weight (21.44 g) were found in weed free treatment followed by T<sub>12</sub> (post-emergence (POE) spray of oxyflufen @ 0.150kg a.i./ha + post-emergence (POE) spray of Quizalofop @ 0.050kg a.i./ha).

#### **Effect of mulching and different weed management practices on weed control and yield of garlic**

Md. Nasirul Farid, Md. Akhtaruzzaman Sarker and Md. Eakramul Haque

A field experiment was carried out at Spices Research Sub-Centre, Bangladesh Agricultural Research Institute, Lalmonirhat during November 2022 to April 2023 to assess the effect of mulching and different weed management of garlic. The treatments comprised of T<sub>1</sub>: Rice straw 1 t/ha + Pendimethalin (30% EC) @ 5ml/L, T<sub>2</sub>: Rice straw 2 t/ha + Pendimethalin (30% EC) @ 5 ml/L, T<sub>3</sub>: Rice straw 3 t/ha + Pendimethalin (30% EC) @ 5 ml/L, T<sub>4</sub>: Rice straw 4 t/ha + Pendimethalin (30% EC) @ 5 ml/L, T<sub>5</sub>: Manual weeding (25, 50 and 75 DAP) and T<sub>6</sub>: (Control). The experiment was laid out in RCB design with three replications using BARI Rashun-3 as test material. Mulching and spraying of herbicide affected all the parameters studied. The lowest dry weed biomass (g/m<sup>2</sup>) 5.26g was found at T<sub>3</sub> and the highest (38.85 g) was found at T<sub>6</sub> after 60 DAP. At 60 DAP the highest WCE (%) 86.46 was found at T<sub>3</sub> followed by T<sub>1</sub> and it was 85.81%. The lowest WCE (%) 79.07 was found at T<sub>4</sub>. Among the treatments, the highest yield of 9.47 tha<sup>-1</sup> was obtained from treatment T<sub>3</sub>: Rice straw 4 t/ha + Pendimethalin (30% EC) @ 5 ml/L and the lowest yield was 1.36 tha<sup>-1</sup> from treatment T<sub>6</sub>: (Control). The highest gross return

(Tk. 520850 ha<sup>-1</sup>), gross margin (Tk. 356350 ha<sup>-1</sup>) and BCR (3.17) were obtained from treatment T<sub>3</sub> (Rice straw 3 t/ha + Pendimethalin (30% EC) @ 5 ml/L). The lowest gross return (Tk. 74800 ha<sup>-1</sup>), gross margin (Tk. 52200 ha<sup>-1</sup>) and BCR (0.59) were recorded from T<sub>6</sub> (Control). Therefore, on the basis of weed control efficiency, yield and economic return Rice straw 3 t/ha + Pendimethalin (30% EC) @ 5 ml/L was suitable herbicide for controlling weed.

## **Nutrient and water management**

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

Md. Nasirul Farid and Md. Akhtaruzzaman Sarker

A field experiment was carried out at Spices Research Sub-Centre, Bangladesh Agricultural Research Institute, Lalmonirhat during November 2022 to April 2023 to assess the effect of organic manures on yield and storage quality of garlic. The treatments comprised of T<sub>1</sub>: Recommended Dose of Chemical Fertilizer (RDCF) + 5 tha<sup>-1</sup> Cowdung T<sub>2</sub>: RDCF + 3 tha<sup>-1</sup> Vermi compost, T<sub>3</sub>: RDCF + 5 tha<sup>-1</sup> Mustard Oil Cake (MOC), T<sub>4</sub>: RDCF + 2 tha<sup>-1</sup> Bone meal and T<sub>5</sub>: 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) found highest at T<sub>3</sub>: RDCF + 5 tha<sup>-1</sup> Mustard Oil Cake (MOC) and minimum (20.64g) was recorded at treatment T<sub>1</sub>: Recommended Dose of Chemical Fertilizer (RDCF) + 5 tha<sup>-1</sup> Cowdung. Among the treatments, the highest bulb yield of 10.83 tha<sup>-1</sup> was obtained from treatment T<sub>3</sub>: RDCF + 5 tha<sup>-1</sup> Mustard Oil Cake (MOC) and the lowest yield was 7.17 tha<sup>-1</sup> from treatment T<sub>1</sub>: Recommended Dose of Chemical Fertilizer (RDCF) + 5 tha<sup>-1</sup> (Cowdung). Total soluble solids (TSS) ranges from (39.67 % to 42 %). The marketable yield will be estimated after collect storage.

### **Study on nitrogen and variety for secondary sprouting of garlic**

M. R. Islam, M. M. Haque and M. M. Zaman

A field experiment was carried out at Regional Spices Research Centre, Bangladesh Agricultural Research Institute, Magura during 2021-22 and 2022-23 to find out the reason of secondary

sprouting of garlic. The two-factor experiment was designed in Randomized Complete Block Design (RCB) with three replications. The treatments comprised of three varieties of garlic (BARI Rashun-1, BARI Rashun- 3 and Local line) and four dose of nitrogen. The highest yield per hectare (13.30 t/ha in 2021-22 and 13.48 t/ha in 2022-23) observed in T<sub>4</sub>V<sub>3</sub> (local garlic variety with nitrogen @ 115 kg/ha) and the lowest yield per hectare (8.31 t/ha in 2021-22 and 9.06 t/ha in 2022-23) T<sub>1</sub>V<sub>2</sub> (BARI Rashun-3 with nitrogen @ 70 kg/ha). Maximum number of secondary sprouting (22.88 % in 2021-22 and 18.23% in 2022-23) were observed in T<sub>4</sub>V<sub>3</sub> (local garlic variety with nitrogen @ 115 kg/ha) where the minimum percent of secondary sprouting (4.54% in 2021-22 and 0.45% in 2022-23) were observed in T<sub>1</sub>V<sub>2</sub> (BARI Rashun-3 with nitrogen @ 70 kg/ha).

#### **Study on irrigation and variety for secondary sprouting of garlic**

A. J. M. Obaidullah, M. M. Haque and M. M. Zaman

A field experiment was carried out at Regional Spices Research Centre, Bangladesh Agricultural Research Institute, Magura during 2021-2022 and 2022-2023 to find out the reason of secondary sprouting of garlic. The two-factor experiment was designed in Randomized Complete Block Design (RCB) with three replications. The treatments comprised of three varieties of garlic (BARI Rashun-1, BARI Rashun-3 and Local line) and four schedule of irrigation (T<sub>1</sub>: Irrigation at 30 days interval, T<sub>2</sub>: Irrigation at 25 days interval, T<sub>3</sub>: Irrigation at 20 days interval and T<sub>4</sub>: Irrigation at 15 days interval). The highest yield (10.65 t/ha in 2021-22 and 11.18 t/ha 2022-23) was observed from T<sub>4</sub>V<sub>3</sub> (local garlic variety with irrigation at 15-day interval) whereas the lowest yield (6.26 t/ha in 2021-22 and 7.26 t/ha 2022-23) and minimum secondary sprouting infected plant (3.33% in 2021-22 and 4.81 in 2022-23) was observed from T<sub>1</sub>V<sub>2</sub> (BARI Rashun-3 with irrigation at 30 days interval).

#### **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 and Z. H. Prodhan

There were thirteen treatment combinations viz. T<sub>1</sub> = ZnSO<sub>4</sub> 0.2% (2 g/L), T<sub>2</sub> = ZnSO<sub>4</sub> 0.35% (3.5 g/L), T<sub>3</sub> = ZnSO<sub>4</sub> 0.55% (5.5 g/L), T<sub>4</sub> = H<sub>3</sub>BO<sub>3</sub>

0.1% (1 g/L), T<sub>5</sub> = H<sub>3</sub>BO<sub>3</sub> 0.2% (2 g/L), T<sub>6</sub> = H<sub>3</sub>BO<sub>3</sub> 0.3% (3 g/L), T<sub>7</sub> = CuSO<sub>4</sub>. 5 H<sub>2</sub>O 0.1 % (1 g/L), T<sub>8</sub> = CuSO<sub>4</sub>. 5 H<sub>2</sub>O 0.25 % (2.5 g/L), T<sub>9</sub> = CuSO<sub>4</sub>. 5 H<sub>2</sub>O 0.5 % (5 g/L), T<sub>10</sub> = ZnSO<sub>4</sub> 0.1% + H<sub>3</sub>BO<sub>3</sub> 0.1% + CuSO<sub>4</sub>. 5 H<sub>2</sub>O 0.1 %, T<sub>11</sub> = ZnSO<sub>4</sub> 0.25% + H<sub>3</sub>BO<sub>3</sub> 0.2% + CuSO<sub>4</sub>. 5 H<sub>2</sub>O 0.25 %, T<sub>12</sub> = ZnSO<sub>4</sub> 0.5% + H<sub>3</sub>BO<sub>3</sub> 0.3% + CuSO<sub>4</sub>. 5 H<sub>2</sub>O 0.5 % and T<sub>13</sub> = control (recommended dose of urea, TSP, MoP, gypsum and zinc sulfate) studied in a randomized complete block design with three replications. The highest ratio of green portion of leaf to burned portion was recorded in T<sub>11</sub> (4.11), ratio of number of green leaves to the number of burned leaf/plant was recorded highest in T<sub>11</sub> (3.49), per plant tip burn was recorded highest in T<sub>13</sub> (8.35%) and per plot tip burn was recorded lowest in T<sub>11</sub> (6.52%). The highest yield was recorded in T<sub>11</sub> (10.98 t/ha) with highest dry matter (%) on weight basis (31.84) including highest level of BCR (3.35). On the other hand, chlorophyll a (mg/g), chlorophyll b (mg/g), total chlorophyll and carotenoids content (mg/kg) were recorded highest in T<sub>11</sub>.

#### **Agri. Engg. and post-harvest technology**

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

MA Mottalib

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 hectareage that to be needed for crop



cultivation during a cropping season in the study areas. Besides, only NDVI image was used to carry out regression analyses with the yield data collected from garlic field in this reporting year. In the next reporting year, other VIs images will be assessed to find out the most suitable VI for garlic yield prediction at which VIs will be highly correlated to the yield.

### **Land suitability assessment for spices crop production through remote sensing and gis in southern saline region of Bangladesh**

MA Mottalib, MA Rahman AND ZH Prodhan

In order to optimize the production of the spices crop, this research aims to promote climate-smart agriculture by optimizing the identification of the appropriate land using special scientific tools like Remote Sensing and GIS technology, so that proper measurements could be taken for the sustainable agriculture. The objective of this research is to investigate, estimate, and identify the suitable land areas for spices crop production based on the topography, climate, and soil characteristics in the coastal region of Bangladesh. The methodology of the study included a Geographic Information System (GIS) and the Multicriteria Decision-Making approach: the Analytical Hierarchy Process (AHP). Datasets were collected and prepared using Sentinel-2 imagery, the Center for Hydrometeorology and Remote Sensing (CHRS) data portal, the Bangladesh Agricultural Research Council (BARC) and Soil Resource Development Institute (SRDI). The primary data use for the study was the satellite images. This study employed an index-based approach of using Geographic Information System with field data. This study was first year trial so it will be continued to next year for interpretation of result. In this reporting year, Sentinel-2 satellite imagery with 10-meter spatial resolution was analyzed through supervised classification algorithm facilitated to classify LULC thematic map the study area with overall accuracy 81%. In the next reporting year, all the datasets will be processed into raster images and then reclassified into four classes: Highly Suitable (S1), Moderately Suitable (S2), Marginally Suitable (S3), and Not Suitable. Then, the AHP results will be applied to produce a final specific spices crop suitability map with four classes of suitability.

### **Field performance evaluation of bari power tiller operated multi-crop seeder in spices crop production**

MA Mottalib and ZH Prodhan

This study 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). In case 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, fenugreek, coriander and black cumin. Significantly the highest yields were found from T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> planted plots than those of other plots. Significantly the lowest yield was obtained from T<sub>4</sub>. The highest marginal benefit cost ratio (MBCR) was obtained from T<sub>2</sub> (2.76) and T<sub>1</sub> (2.66) followed by T<sub>4</sub> (2.23). The lowest BCR was found from T<sub>3</sub> (2.15). In this reporting year, the economic analysis of black cumin was worked out. The economic analysis of other crop will be calculated and reported next year. This experiment was second year trial so experiment will be continued to next year for better result.

## **Chilli**

### **Varietal development**

#### **Development of inbred lines of chilli**

##### **(Set-2: Advancing of generation S<sub>0</sub> to S<sub>1</sub>)**

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

The present experiment was conducted to produce S<sub>1</sub> generation from S<sub>0</sub> with the goal to develop superior homozygous inbred lines of chilli at Spices Research Centre, Shibganj, Bogura during 2022-2023. The S<sub>0</sub> progeny from hybridization of four

experimental combination e.g., (OC-18 x OC22; TOZP-11 x OC-22; BGCMA-4 x OC-22 and OC-22 x BARI Morich-2) were used in this study. Promising population will be further advanced in next season with the goal of developing superior inbred lines.

#### **Evaluation of test cross hybrids of chilli**

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

The present experiment was conducted to select superior chilli germplasm for higher yield at Spices Research Centre, Shibganj, Bogura during 2022-2023. Ten chilli genotypes including BARI Morich-4 along with two others as check were used in this study. The experiment was laid out in alpha lattice design with three replications. The genotype BGCMA-1 performed well which was closely followed by INDCH-39 x BARI Morich-2 and might be evaluated further in next season.

#### **Advancing F<sub>2</sub> generation of chilli**

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

This study was undertaken to advance F<sub>2</sub> progenies of Chillies obtained from a 5x5 half diallel at RSRC, BARI, Gazipur. F<sub>2</sub> progenies were grown in replicated trail during rabi 2022-2023. Variation was observed in different traits among the F<sub>2</sub> progenies. Based on yield (t/ha) the progeny P3x P1F2, P3xP2 F2, P4 xP1F2 and P4 xP3F2 showed significantly better performance.

#### **Maintenance of chilli germplasm (set-i)**

M. A. Alam, m. I. Haque, m. M. Hasan, a. H. F. Fahim, s. N. Mojumdar and h. C. Mohanto

The present experiment was conducted to maintain the existing chilli germplasm with the aim to preserve the existing variability for future breeding program at Spices Research Centre, Shibganj, Bogura during 2022-2023. Observations were recorded for limited numbers of traits to capture the variability.

#### **Maintenance of chilli germplasm (set-ii)**

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

The present study was conducted on 35 Chilli genotypes during 2022-23 to enhance, increase and conserve chilli germplasm to utilize in the crop

improvement of chilli. A total ten agronomic traits of chilli genotypes were recorded and higher standard deviation was observed in fruit weight per plant and 50% flowering and 50% fruiting. A Total 153.6 gm seeds of different chilli genotype were harvested and stored as nucleus seeds for future research purpose

### **Cultural management**

#### **Effect of different polythene mulch on weed control efficiency and yield of chilli**

S. Brahma, M.N. Yousuf, M.S. Rahman, M.I. Haque and R. Ara

A field experiment was conducted during *kharif* seasons of 2022-2023 in the research field of Regional Spices Research Centre, BARI, Gazipur, to study the effect of polythene mulch on growth, yield and weed infestation of chilli cv. BARI Morich-2. The experiment was set up in Randomized Complete Block Design (RCBD) with five treatment combinations were T<sub>1</sub> = Black polythene mulch (30μ thickness), T<sub>2</sub> = Transparent polythene mulch (30μ thickness), T<sub>3</sub> = Silver on black polythene mulch (30μ thickness), T<sub>4</sub> = Pre-emergence herbicide (Pendimethalin) and T<sub>5</sub> = Control (no weeding), having three replications. Almost all the yield and yield contributing characters were significantly influenced due to application of polythene mulches to produce fruit yield of chilli. Significantly higher green and dry fruit yield (18.1 and 7.40 t ha<sup>-1</sup>) was obtained from treatment Silver on black polythene mulch (30μ thickness) and the minimum green and dry fruit yield (7.2 and 2.3t ha<sup>-1</sup>) in control treatment. Hence, the application of Silver on black polythene mulch (30μ thickness) could be regarded as the best mulching package for achieving higher fruit production and weed infestation in Grey Terrace Soil of Madhupur Tract (AEZ-28).

### **Insect pest and disease management**

#### **Development of bio-rational based management approach against major insect and mite pests complex of chilli**

M. M. Hossain, M. Z. H. Prodhan, K. M. Khalequzzaman, M. A. Sarker and N. K. Dutta

The field experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura,

Bangladesh during Rabi season of November 2022-May 2023 for development of a bio-rational based management approach against major insect and mite pests complex of chilli. Five different treatments were applied on the plant to manage major insect and mite pests complex of chilli. The efficacy of bio-rational based management packages and synthetic pesticides was compared to control treatment (untreated). Treatments were assigned in a randomized complete block design with three replications. BARI Morich-2 was used as test crop for this trial. Pheromone mass trapping with spraying of Spinosad (Spinomax 1SC) at 1ml/L and Biotrine (Abamectin 5% w) at 0.5ml/L as well as soil application of recharge (*M. anisopliae* + *Trichoderma sp.*) at 3g/L resulted in the lowest number of aphids (0.85 aphids/leaf), thrips (0.67 thrips/leaf), mite (0.95 mite/leaf) and fruit borer i.e. *H. armigera* (0.24 larvae/plant) and *S. litura* (0.51 larvae/plant) with the 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 aphids (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+ Biotrine + Soil recharge. So, Pheromone mass trapping with the spraying of Spinosad (Spinomax 1SC) and Biotrine (Abamectin 5% w) as well as soil application of recharge (*M. anisopliae* + *Trichoderma sp.*) may be recommended for effective management of major insect and mite pests complex of chilli field.

#### Control of foot and root rot disease of chilli

K. M. Khalequzzaman, M. A. Wadud, M. N. A. Chowdhury and M. Z. H. Prodhan

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during Rabi season of 2022-23 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 9.75 to 23.55%, while Poultry refuse @5 t/ha + T<sub>1</sub> (Autostin 50 WDG @0.2%) treated plots resulted the lowest disease incidence which was followed by Companion 75 WP @0.2% with 10.45% and

Cabriotop @0.3% with 11.88%, where untreated control plot showed the highest incidence. The highest plant height (91.81 cm), single fruit weight (3.23 g), fruit length (7.23 cm), number of fruits/plant (357.56) and weight of fruits/plant (941.71 g) were recorded in Poultry refuse @5 t/ha + T<sub>1</sub> (Autostin 50 WDG @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<sub>1</sub> (Autostin 50 WDG @0.2%) showed the highest fresh yield (23.48 t/ha) which was statistically similar to Companion 75 WP @0.2%, but untreated control showed the lowest fresh yield (10.73 t/ha) of chilli. The highest gross return (Tk. 11,74,000/- ha<sup>-1</sup>), gross margin (Tk 7,63,938/- ha<sup>-1</sup>) and BCR (2.86) were obtained from poultry refuse (5 t/ha) + Autostin 50 WDG (0.2%) treated plots, which was followed by Companion 75 WP @0.2% and Cabriotop @0.3% treated plots. But lowest of these parameter were calculated from control treatment. This comparative study indicated that poultry refuse (5 t/ha) + Autostin 50 WDG (0.2%) treated plots ensured higher profit compare to other treatments.

## Ginger

### Varietal development

#### Evaluation of ginger germplasm

M. A. Islam, Rumman Ara, M. M. Hasan and Z. H. Prodhan

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura during April 2022 to February 2023 to select the promising ginger germplasm for releasing a variety. Twenty different ginger germplasm (G0042, G0023, G0010, G0020, G0047, G0025, G0021, G0045, G0022, G0036, G0032, G001, G0043, G004, G0033, G0040, G0034, G0024 and G0044) with BARI Ada-1 as check were evaluated based on their yield and other characters. The experiment was laid out in randomized complete block design with three replications. Significantly the highest plant height, number of tillers/plant, number of leaves/plant, weight of primary and secondary rhizome was observed in the line G0042. The highest yield (37.9 t/ha) was also obtained from G0042 and the lowest yield (21.66 t/ha) was found from G0040 line.



## Cultural management

### Effect of different rhizome size for ginger seedling production under pro-tray technique

A. H. F. Fahim and M. Z. H. Prodhan

The study was conducted at Spices Research Centre, BARI, Shibganj, Bogura during Kharif season of 2023 to identify suitable rhizome size for producing ginger seedlings under the pro-tray technique and to ensure sustainable ginger production. BARI Ada-1 was used as the test crop. The experiment was laid out in a Completely Randomized Design (CRD) for raising ginger seedlings in pro-tray and Randomized Complete Block Design (RCBD) to establish produced seedlings in the main field. Nine different rhizome sizes (viz. 2g, 3g, 4g, 5g, 6g, 7g, 8g, 9g and 10g) were considered as the treatment for this trial. It was found that the different parameters for quality seedlings were statistically significant due to different rhizome size. 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.

## Nutrient and water management

### Effect of different organic fertilizers on yield and quality of ginger

M. A. Rahman and Z H Prodhan

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the rabi season of 2022 - 2023 to know the effect of different organic fertilizers on yield and quality of ginger. There were four treatment combinations viz. T<sub>1</sub>: 100% recommended dose of chemical fertilizer (RDCF) + 5 t/ha compost (control), T<sub>2</sub>: 75% RCF + 25% from vermicompost, T<sub>3</sub>: 75% RCF + 25% from tricho-vermicompost and T<sub>4</sub>: 75% RCF + 25% from tricho-compost studied in a randomized complete block design 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<sub>3</sub> (27.91 t/ha) but highest level of

BCR (3.87) and MBCR (10.02) were obtained from T<sub>4</sub> treatment.

## Insect, pest and disease management

### First record of fall armyworm, *spodoptera frugiperda* (j.e. smith) (lepidoptera: noctuidae) on ginger in Bogura, Bangladesh

MZH Prodhan, Nk Dutta and Ma Sarker

Fall Armyworm (FAW), *Spodoptera frugiperda*, (J.E. Smith) has been recorded in Bangladesh on maize during November 2018. It is a destructive and invasive pest, about 79% maize plants and 26% cob were damaged by the pest in Bangladesh during 2019-20. Subsequently the pest was reported to attack on cabbage and tobacco from Rangpur, Bangladesh. Recently, the pest was found to attack on ginger (*Zingiber officinale*) fields on June 2023, about 25.25% infestation observed on Ginger. This is the first record of the FAW on ginger in Bangladesh. It is suspected that the infestation spread gradually to the ginger growing areas in Bangladesh.

### Management of leaf spot disease of ginger

K. M. Khalequzzaman, M. A. Wadud, M. A. Islam and M. Z. H. Prodhan

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during 2022-23 to find out the effective fungicides to control leaf spot of ginger. BARI Ada 1 was used in this experiment. Eight different fungicides were used as treatment. The lowest leaf spot (8.71%) was recorded in T<sub>1</sub> (Rhizome treatment and foliar spraying with Ridomil gold @0.2%) which was followed by T<sub>5</sub> (Rhizome treatment and foliar spraying with Companion 75 @0.2%) and T<sub>2</sub> (Rhizome treatment and foliar spraying with Autostin 50 WDG @0.15%), and the highest leaf spot (23.49%) was recorded in untreated control. The highest number of primary rhizomes (6.40) per clump and the highest weight of primary rhizomes (82.14 g) per clump was obtained from T<sub>1</sub> which was followed by T<sub>5</sub> and T<sub>2</sub>, and the lowest number (3.99) and weight (58.64 g) of primary rhizomes per clump was recorded in untreated control. T<sub>1</sub> also showed the highest number (22.79) and weight (345.39 g) of secondary rhizomes per clump which was followed by T<sub>5</sub> and T<sub>2</sub>, and control treatment showed the lowest number (13.17) and weight

(239.55 g) of secondary rhizomes per clump. T<sub>1</sub> gave the highest weight of rhizome per plant (767.00 g) which was followed by T<sub>5</sub> and T<sub>2</sub>, and control treatment resulted the lowest weight of rhizome per clump (555.44 g). Yield varied from 17.37 to 27.13 t/ha, while T<sub>1</sub> showed the highest yield which was followed by T<sub>5</sub> and T<sub>2</sub>, and control treatment showed the lowest yield which was statistically dissimilar to other treatments. The highest gross return (Tk. 27,13,000 ha<sup>-1</sup>), gross margin (Tk. 22,31,214 ha<sup>-1</sup>) and BCR (5.63) were obtained from Rhizome treatment and foliar spraying with Ridomil gold @0.2% which was followed by T<sub>5</sub> and T<sub>2</sub>. But lowest of these parameter were calculated from control treatment. This result indicates among the treatments, Rhizome treatment and foliar spraying with Ridomil gold @0.2% was found economically profitable.

## **Turmeric**

### **Varietal development**

#### **Maintenance of turmeric germplasm**

M. A. Alam, M. M. Zaman, M. M. Hasan, A. H. F. Fahim, S. N. Mojumdar and H. C. Mohanto

The present experiment was conducted to maintain the existing turmeric germplasm with the aim to preserve the existing variability for future breeding program at Spices Research Centre, Shibganj, Bogura during 2022-2023. Observations were recorded for limited numbers of traits to capture the variability.

### **Cultural management**

#### **Integrated weed management in turmeric**

M. R. Islam, M. M. Zaman, M. M. Haque, K. M. Khalequzzaman and A. J. M. Obaidullah

The experiment was conducted at Regional Spices Research Centre, BARI, Magura during 2021-22 and 2022-23 to find out the best management practices for controlling weed of Turmeric. The experiment was laid out in randomized complete block design with three replications. Nine different treatments and a control plot were studied. Significant differences regarding yield and yield attributes were observed among different treatments. The highest fresh yield (64.63 t/ha in

2021-22 and 58.28 t/ha in 2022-23) was found from treatment T<sub>5</sub> (Glyphosate @ 10 ml/L+ 1 HW at 70 DAP + Straw mulch @ 5 t/ha) and the lowest yield (20.16 kg/ha in 2021-22 and 20.07 in 2022-23) was found from control plot T<sub>10</sub>. Maximum weed control efficiency (91.97%) was found from treatment T<sub>5</sub> (Glyphosate @ 10 ml/L+ 1 HW at 70 DAP + Straw mulch @ 5 t/ha).

## **Nutrient and water management**

### **Nutrient management on growth and rhizome yield of turmeric**

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

A Field experiment was conducted at Regional Spices Research Centre, BARI, Gazipur to find out the varietal efficacy under different nutrient management package of turmeric during 2022-2023. The experiment was designed in Factorial Randomized Complete Block Design having three replications. The treatment composed of three turmeric varieties [BARI Holud-3 (V<sub>1</sub>), BARI Holud-4 (V<sub>2</sub>) and BARI Holud-5 (V<sub>3</sub>)] with three nutrient management packages i.e., 100% RDF (180-60-160-30-4-2 kg NPKSZnB ha<sup>-1</sup>) + Cowdung 5 tha<sup>-1</sup> (N<sub>1</sub>), 100% RDF + Vermicompost 3tha<sup>-1</sup> and 100% RDF + Mustard cake 2tha<sup>-1</sup> (N<sub>3</sub>) kg ha<sup>-1</sup>. The individual as well as interaction effect of turmeric varieties and nutrient management packages showed significant effect on yield, yield contributing parameters of turmeric. The highest rhizome yield (45.81 t ha<sup>-1</sup>) was recorded when turmeric variety BARI Holud-4 cultivated under 100% RDF (180-60-160-30-4-2 kg NPKSZnB ha<sup>-1</sup>) + Vermicompost 3 t ha<sup>-1</sup> (N<sub>2</sub>) in Grey Terrace Soil of Madhupur Tract (AEZ-28).

## **Coriander**

### **Varietal development**

#### **Evaluation of coriander germplasm**

M. M. Hasan, M. A. Alam, S. N. Mazumdar, Hc Mohanta and Z H Prodhan

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 2022-2023.

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 the traits varied significantly among the genotypes. The highest plant height (145.73cm) and number of branches/plant (7.93) was found in COR34. The highest seed yield was found in COR10 (2.65 t/ha) and the lowest (1.61 t/ha) was COR20.

## Cultural management

### Effect of leaf cuttings on seed yield of coriander

M. M. Hasan, M. A. Alam and Z H Prodhan

The experiment was conducted to the effect of leaf cutting on seed yield of coriander and to study the effect of leaf cutting on seed yield at Spices Research Centre, BARI, Shibganj, Bogura during rabi 2022-2023. Two genotype namely COR11 and COR20 and three cutting treatment was also applied i.e. C0 = without cutting, C1 = one cut at the 45 days after sowing and C2 (two cutting) first cutting at 45 days after sowing and second cutting at 60 days after sowing. The experiment was laid out in RCB design with three replications. The height leaf yield (4.45 t/ha) was found COR11 and (7.70 t/ha) was observed in C2 cutting. The genotype COR11 was found best seed and leaf producing genotype.

## Nutrient and water management

### Effect of integrated nutrient management on seed yield of coriander

M.N. Yousuf, S. Brahma, M.A.A. Khan and R. Ara

A field experiment was conducted during rabi seasons of 2022-2023 in the research field of BARI, Gazipur, to study the effect of integrated nutrient management on seed yield and yield contributing characters of coriander cv. BARI Dhania-2. The experiment was set up in Randomized Complete Block Design (RCBD) with five treatment combinations were  $T_1 = 100\%$  RDCF (80-35-60-15-2.5-1.5 kgNPKSZnBha<sup>-1</sup>),  $T_2 = 75\%$  RDCF + 25% N from Cowdung,  $T_3 = 75\%$  RDCF + 25% N from Vermicompost,  $T_4 = 75\%$  RDCF + 25% N from Poultry manure and  $T_5 =$  Control (native fertility), having three replications. Almost all the yield and yield contributing

characters were significantly influenced due to application of organic manures with combinations chemical fertilizers on the IPNS basis to produce coriander seed production. Significantly higher seed yield (2.14 tha<sup>-1</sup>) was obtained from treatment 75% RDCF + 25% N from vermicompost and the minimum seed yield (0.66 t ha<sup>-1</sup>) in control (native fertility) treatment. Hence, the application of 60-35-60-15-2.5-1.5 kgNPKSZnBha<sup>-1</sup> with combination of vermicompost @1850 kg ha<sup>-1</sup> could be regarded as the best nutrient management package for achieving higher coriander seed production in Grey Terrace Soil of Madhupur Tract (AEZ-28).

## Cumin

### Varietal development

#### Evaluation of cumin germplasm

M. M. Hasan, M. A. Alam, S. N. Mazumdar, Hc Mohanta and Z H Prodhan

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during rabi season of 2022-2023 to evaluate the germplasm which collected from different sources and to identify the best germplasm with higher yield and other desirable characters. The experiment was laid out in RCB design with three replications. Eighteen different cumin genotypes were evaluated for yield and yield contributing characters. Seed yield and yield contributing characters were significantly different among the germplasm except plant height (cm), number of primary branches, number of umbellets/umbel, number of seeds/umbellet and 1000 seeds weight (g). The highest seed yield was obtained from CN03 (600.00 kg/ha) and the lowest seed yield was recorded from CN48 (323.70 kg/ha).

## Cultural management

### Effect of planting and irrigation method for cumin

M. M. Hasan and Z H Prodhan

The experiment was conducted to determine optimum planting and irrigation method on yield and yield components of cumin (*Cuminum cyminum* L.) at Spices Research Centre, BARI, Shibganj, Bogura during rabi 2022-2023. A factorial arrangement of a split plot design with



three replications was conducted. Three irrigation methods (surface irrigation, micro sprinkler and shower) in main plot and four land configurations (flat bed, raised bed 50 cm, raised bed 75 cm (normal bed) and wider raised bed 100 cm) in sub plots were applied. According to result, seed yield was influenced by irrigation methods and land configuration. Surface irrigation gave higher seed yield (271.94 kg/ha) followed by shower irrigation (226.48 kg/ha) and lowest yield (138.33 kg/ha) with sprinkler irrigation. Among the land configuration, raised beds 75 cm gave highest yield (221.97 kg/ha).

## **Black cumin**

### **Cultural management**

#### **Effect of sowing time on the yield and yield components of black cumin in cumilla region**

M Rahman, M. A. Siddiky, M M H Bhuiyan and M O Kaisar

The experiment was conducted at the Regional Agricultural Research Station, BARI, Cumilla during Rabi season of 2022-23 to find out the optimum sowing time for black cumin in Cumilla region. The experimental treatments include (i) 4 dates of sowing viz.,  $S_1=16$  October,  $S_2=1$  November,  $S_3=16$  November,  $S_4=1$  December. Results revealed that sowing time had significant influences on various crop characters and seed yield. The experiment was laid out in randomized complete block design with three replications. Among the planting time treatments,  $S_3$ , (Sowing on 16 November) was superior in relation to plant height, number of primary branches plant<sup>-1</sup>, number of capsules plant<sup>-1</sup>, number of seeds capsules<sup>-1</sup>, capsules length and 1000-seed weight which resulting the highest seed yield (1.59 t/ha<sup>-1</sup>). whereas The lowest seed yield (0.83t/ha<sup>-1</sup>) was recorded in  $S_4$ , treatment So, the results revealed that sowing time ( $S_3=16$  November) had significant influences for getting higher seed yield in Black cumin

## **Nutrient and water management**

### **Growth and yield of black cumin influenced by integrated nutrient management**

M. A. Rahman, M. R. Ali, J. Rahman and Z. H. Prodhan

A field experiment was conducted at the Spices Research Center (SRC), BARI, Shibganj, Bogura during the rabi season of 2022-2023 to know the effect of different nutrient management practices on growth and yield of black cumin. 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) were studied in a randomized complete block design having four replications. The highest black cumin seed yielder (1.51 t/ha) treatment was  $T_4$  with higher level of BCR (1.41). For each Tk. added cost of cultivation would return Tk. 3.99 added benefit to the black cumin farmers (MBCR = 3.99) for adopting IPNS fertilizer management practice with 3 t/ha FYM.

## **Insect and pest management**

### **Management of foot and root rot disease of black cumin**

K. M. Khalequzzaman, M. A. Wadud, A. H. F. Fahim, M. M. Hasan and M. Z. H. Prodhan

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during Rabi season of 2022-23 to find out the effective treatments in controlling foot and root rot of Black cumin. Foot and root rot of Black cumin under different treatments ranged from 9.99 - 37.16%, while the lowest incidence was observed in soil amendment with poultry refuse @5 t/ha (before 3 weeks of seed sowing) + soil drenching with Autostin @2g/litre water at 10 days interval from seedling stage treated plot which was statistically similar to seed treatment with Provax 200 WP (Carboxin + Thiram) @2.5g/litre water and soil drenching with Autostin @2g/litre water at 10 days interval from seedling stage treated plot and the highest incidence was observed in untreated control. Significantly the highest number of capsules per plant (41.54), number of seeds per

capsules (98.45) and weight of seeds per plant (4.60 g) was recorded in soil amendment with Poultry refuse @5 t/ha (before 3 weeks of seed sowing) + soil drenching with Autostin @2g/litre water at 10 days interval from seedling stage treated plots which was followed by seed treatment with Provax 200 WP (Carboxin + Thiram) @0.25% and soil drenching with Autostin @2g/litre water at 10 days interval from seedling stage treated plot and the lowest of these parameters were recorded in control treatment. Soil amendment with Poultry refuse @5 t/ha (before 3 weeks of seed sowing) + soil drenching with Autostin @2g/litre water at 10 days interval from seedling stage treated plots resulted the highest seed yield (1.26 t/ha) which was statistically similar to seed treatment with Provax 200 WP (Carboxin + Thiram) @2.5g/litre water + soil drenching with Autostin @2g/litre water at 10 days interval from seedling stage treated plots and control treatment gave the lowest yield (0.85 t/ha).

#### **Effect of different chemical in controlling pod borer complex of black cumin**

M. R. Islam, M. Z. H. Pradhan, K. M. Khalequzzaman and A. J. M. Obaidullah

The experiment was conducted at Regional Spices Research Centre, BARI, Magura during 2022-2023 to find out the effect of different chemical in controlling pod borer complex of black cumin. The experiment was laid out in randomized complete block design with three replications and six different treatments. Significant differences regarding yield and yield attributes were observed among different treatments. The highest yield (1375.90 kg/ha) was found from T<sub>2</sub>: Proclaim (Eamectine benzoate @ 1g/L) which was significantly higher than those of other treatments. The lowest yield (718.70 kg/ha) was found from control plot T<sub>6</sub>. The highest number of damage capsule (24.02 %) was observe in control plot and the lowest damage capsule (4.11 %) was observed in T<sub>2</sub>: Proclaim (Eamectine benzoate @ 1g/L) treated plot.

#### **Effect of fungicides, bio-agent in controlling alternaria disease of black cumin**

M. R. Islam, K. M. Khalequzzaman, A. J. M. Obaidullah and M. K. Alam

The experiment was conducted at Regional Spices Research Centre, BARI, Magura during 2022-2023 to find out the effect of fungicides, bio-agent in controlling alternaria disease of black cumin. BARI

Kalojira-1 was used as the test variety. The experiment was laid out in randomized complete block design with three replications and six different treatments. Significant differences regarding yield and yield attributes were observed among different treatments. The highest yield (1517.70 kg/ha) was found from T<sub>4</sub> Amistar top (Azoxystrobin + Difenconazole @ 1.5 ml/L) which was significantly higher than those of other treatments. The lowest yield (718.70 kg/ha) was found from control plot T<sub>6</sub>. The highest incidence of alternaria disease (12.16 %) was from in T<sub>6</sub> (control) and the lowest disease incidence (1.18 % in 2022 and 7.32% in 2023) was observed in T<sub>4</sub>: Amistar top (Azoxystrobin + Difenconazole) @ 1.5ml/L).

### **Ajowan**

#### **Varietal development**

##### **Evaluation of ajowan germplasm**

M. M. Hasan, M. A. Alam, S. N. Mazumdar, Hc Mohanta and Z H Prodhan

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during rabi season of 2022-2023 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 ajowan genotypes were evaluated for yield and yield contributing characters. Seed yield and other yield contributing characters were significantly different among the studied genotypes except number of primary branches/plant and umbellets/umbel. The highest plant height was recorded from TA01 (124.40 cm) and the lowest plant height was found in TA05 (99.73 cm). TA03 performed best, the highest seeds yield (668.15 kg/ha).

### **Dill**

#### **Varietal development**

##### **Evaluation of dill germplasm**

M. M. Hasan, M. A. Alam, S. N. Mazumdar, Hc Mohanta and Z H Prodhan

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during rabi season of 2022-2023 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. Nine different dill genotypes with BARI Soluk1 as check were evaluated for yield and yield contributing characters. Seed yield and other yield contributing characters varied significantly due to different genotypes except number of primary branches/plant and 1000- seed weight (g). The highest plant height was recorded from AG10 (144.93 cm) and the lowest plant height was found in AG05(135.87.80 cm). In case of seed yield, AG07 performed best (0.529 t/ha).

## **Black pepper**

### **Varietal development**

#### **Evaluation of black pepper germplasm**

A. H. F. Fahim and M. Z. H. Prodhan

The trial was conducted at Spices Research Centre, BARI, Shibganj, Bogura during 2022-2023 to evaluate the performance of collected black pepper germplasm for releasing a new variety which can be grown all over the Bangladesh. The land was medium-high and the soil was clay loam in texture. The experiment was laid out in a Randomized Complete Block Design with ten replications. One black pepper germplasm PN Bog 001 against BARI Golmorich-1 as check was used for the study. The significant variations were observed among the black pepper line and the variety in respect of yield and yield contributing characters excepts leaf length and petiole length. The highest number of spikes per pillar (227), highest green fruit yield (1.28 kg/pillar) and highest dry fruit yield (0.41 kg/pillar) was recorded from the black pepper line PN Bog 001. The lowest number of spikes per pillar (87), lowest green fruit yield (0.25 kg/pillar) and dry fruit yield (0.04 kg/pillar) was recorded from the check variety BARI Golmorich-1. The black pepper line PN Bog 001 showed better performance than the check variety. The experiment will be continued to the next year for confirmation of the results.

## **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, 2022 to May, 2023. 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. Leaf size was biggest (19.17 cm × 7.27 cm) in CT Jai-001 while CT Jai-003 recorded small sized leaf (13.03 cm × 3.33 cm). Leaf thickness was also high with CT Jai-001. Leaf fresh thickness (0.30 mm) and dry thickness (0.20 mm) found maximum in CT Jai-001. Contrary CT Jai-003 recorded lowest fresh (0.21mm) and dry thickness (0.13 mm) of leaves. Dense leaf was found from CT Jai-001 with 4.33 cm long internode distance. On the other hand CT Jai-003 produced sparse leaves with 6.33 cm long internode distance. Leaf dry weight found maximum (1.47 g) in CT Jai-001 but lowest (0.37g) in CT Jai-003. The highest leaf yield (12.70 kg plant<sup>-1</sup>) was also found from CT Jai-001 but lowest (10.43 kg plant<sup>-1</sup>) at CT Jai-003. In case of pungency CT Jai-001 was moderately pungent, CT Jai-002 was pungent and CT Jai-003 was strongly pungent with aroma.

## **Vanilla**

### **Varietal development**

#### **Characterization and evaluation of vanilla germplasm**

A. H. F. Fahim, M. A. Islam and M. Z. H. Prodhan

The research was carried out at the experimental field of Spices Research Centre, Shibganj, Bogura during 2022-23 to characterize and evaluate the vanilla germplasm suitable for cultivation in Bangladesh. In July 2019 an exposé visit was done in Indonesia under the project “Strengthening of spices crop research in Bangladesh” implemented by the Spices Research Centre (SRC), BARI, Shibganj, Bogura. During that visit, scientists of SRC were able to collect one vanilla sapling from Indonesia. After three years of cultivation, the plant



was flowers. Each flower was hand pollinated to produce vanilla beans. The fruits of the vanilla were harvested 10 to 11 months after hand pollination. Each plant produced 150 g/pillar of fresh vanilla bean. After processing the beans, it was found 50 g/pillar of processed bean. That was the third year of planting. The vanilla plant produced its optimum yield from the fifth year of planting. Thus, the experiment will be repeated in the next year to find out its optimum yield potentiality.

## Cardamom

### Varietal development

#### Collection, conservation, and characterization of small and large cardamom germplasm

F. Ahmed, J.C. Sarker, M.H.M.B. Bhuyan and S.M.L. Rahman

Five 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 (142.33 cm) was recorded from AS Jai-005 whereas the shortest plant in (68.67 cm) in AS Jai-001. The maximum number of tillers clump<sup>-1</sup> (31.00) was found in AS Jai-005 while the minimum number of tillers clump<sup>-1</sup> (2.67) was recorded in both AS Jai-001 and AS Jai-004. AS Jai-005 produced the highest number of leaves tiller<sup>-1</sup> (8.67) while AS Jai-001 produced the lowest number of leaves tiller<sup>-1</sup> (5.00). Longest leaves (43.00 cm) were recorded in AS Jai-005 but shortest leaves (27.67 cm) were recorded in AS Jai-001. The widest leaf (6.47 cm) was noticed at AS Jai-002. On the other hand AS Jai-001 noted the narrowest leaves (3.63 cm).

## Betel leaf

### Varietal development

#### Physio-morphological study on betel leaf

J.C. Sarker, M.H.M.B. Bhuyan, F. Ahmed, and S.M.L. Rahman

An experiment was conducted to find out the promising lines for commercial cultivation in the Sylhet region. Three khasia pan lines designated as PB Jai-001, PB Jai-002 and PB Jai-004 were

evaluated from July 2022 to May 2023. The highest length of the internodes (11.8 cm) was recorded from PB Jai-002 while the lowest (9.4 cm) was found in PB Jai-004. PB Jai-002 produces the maximum (15.6cm×11.2cm) leaf size whereas minimum (14.2cm×9.4cm) in PB Jai-001. The highest fresh weight of 100 leaves (417) was recorded in PB Jai-002 while the lowest (375) in PB Jai-004. The PB Jai-002 produced the highest number of leaves plant<sup>-1</sup> year<sup>-1</sup> (231) while the lowest (215) was recorded in PB Jai-004. The maximum yield (963.27 g plant<sup>-1</sup> year<sup>-1</sup>) was obtained from PB Jai-002 while the minimum yield (806.25 g plant<sup>-1</sup> year<sup>-1</sup>) was recorded in PB Jai-004. Variations also existed among the cultivars in leaf color, leaf shape, leaf tip, and pungency. So, PB Jai-002 seemed to be best line in respect of yield and quality of betel leaf.

## Golmorich

### Varietal development

#### Prospects of BARI golmorich-1 cultivation as bush pepper

M.H.M.B. Bhuyan, F. Ahmed, J.C. Sarker and S.M.L. Rahman

The experiment was conducted at spices Research Sub-station, Citrus Research Station, BARI, Jaintapur, Sylhet from March 2022 to May 2023 under field conditions. There were two treatments viz. (a) T<sub>1</sub> = Planting in pots, (b) T<sub>2</sub> = Planting in the pits. No seedling mortality was found. Higher clamp height was found in T<sub>1</sub> (Planting in pots) compared to T<sub>2</sub> (Planting in pits). Stem growth rate per month was also higher in T<sub>1</sub> compared to T<sub>2</sub>. As a result number of brunches per clamp was also higher T<sub>1</sub>. Planting in pots (T<sub>1</sub>) took 51 days to initiate first spike after plantation, while planting in pits (T<sub>2</sub>) took 65 days. On the other hand T<sub>1</sub> took 63 days to initiate fruits in the spike where we found 45 fruits (berry) per spike. Contrary, T<sub>2</sub> took 78 days to initiate fruits in the spike where we found 32 fruits (berry) per spike.

## 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 2022 to April 2023 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 significant variations among the tested germplasm. Fresh quill thickness recorded maximum (2.92 mm) at CC Jai-001. On the other hand, CC Jai-002 showed the lowest (1.85 mm) fresh quill thickness. There is no significant variation among the germplasm for dry quill thickness. CC Jai-003 produced the thickest (1.29 mm) dry quill whereas CC Jai-002 produced the thinnest (0.98 mm) dry quill. Significant variation noticed at quill fresh and dry weight. Both fresh weight (210.53 g) and dry weight (96.81 g) of quill found maximum in CC Jai-001. On the other hand the lowest fresh weight (108.85g) and dry weight (69.92 g) found at CC Jai-002.

## Fenugreek

### Cultural management

#### Effect of sowing time on the yield and yield components of fenugreek in cumilla region

M Rahman, M. A. Siddiky, M M H Bhuiyan and M O Kaiser

The experiment was conducted at the Regional Agricultural Research Station, BARI, Cumilla during Rabi season of 2022-23 to find out the optimum sowing time for fenugreek in Cumilla region. The experimental treatments include (i) 4 dates of sowing viz.,  $S_1=15$  October,  $S_2=30$  October,  $S_3=15$  November,  $S_4=30$  November. Results revealed that sowing time had significant influences on various crop characters and seed yield. The experiment was laid out in randomized complete block design with three replications. Among the planting time treatments,  $S_2$ , (Sowing on 30 October) was superior in relation to plant height, number of primary branches plant<sup>-1</sup>, number of pods plant<sup>-1</sup>, number of seeds pod<sup>-1</sup>, Pod length

and 1000-seed weight which resulting the highest seed yield (2.73 t/ha<sup>-1</sup>) compared to  $S_1$  and  $S_4$  treatments. So, the results revealed that sowing time ( $S_2=30$  October) had significant influences for getting higher seed yield in Fenugreek.

### Nutrient and water management

#### Plant growth promoting rhizobacteria on the growth and yield of fenugreek

M.N. Yousuf, M.E. Ali, S. Brahma, M.A.A. Khan and R. Ara

An experiment was conducted under field condition during *rabi* seasons of 2022-2023 in the research field of BARI, Gazipur, to study the effect of plant growth promoting rhizobacteria (PGPR) on seed yield and yield contributing characters of fenugreek cv. BARI Methi-3. The experiment was set up in Randomized Complete Block Design (RCBD) with seven treatment combinations were  $T_1=Azotobacter + 40-80-20-3-2$  kgPKSZnBha<sup>-1</sup>,  $T_2=PSB + 100-20-3-2$  kgNKSZnBha<sup>-1</sup>NKSZnBha<sup>-1</sup>,  $T_3=Rhizobium + 40-80-20-3-2$  kgPKSZnBha<sup>-1</sup>,  $T_4=Arbuscular$  mycorrhizal fungi +100-80-20-3-2 kgNKSZnBha<sup>-1</sup>,  $T_5=Azotobacter + PSB + Rhizobium + Arbuscular$  mycorrhizal fungi,  $T_6=100\%$  RDF (100-40-80-20-3-2 kgNPKSZnBha<sup>-1</sup>) and  $T_7=Control$  having three replications. There were significant effects of PGPR on the seed yield, yield contributing characters of fenugreek. The highest seed yield of 2.4 t ha<sup>-1</sup> was obtained from treatment *Azotobacter* + PSB + *Rhizobium* + Arbuscular mycorrhizal fungi and the minimum seed yield (0.9 t ha<sup>-1</sup>) in control (native fertility) treatment. Hence, the *Azotobacter* + PSB + *Rhizobium* + Arbuscular mycorrhizal fungi could be regarded as the best PGPR package for achieving higher fenugreek seed production in Grey Terrace Soil of Madhupur Tract (AEZ-28).

### Insect and pest management

#### Management of rust disease of fenugreek

K. M. Khalequzzaman, M. A. Wadud and M. Z. H. Prodhan

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during Rabi season of 2022-23 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 8.43 - 29.45%, while the lowest incidence was observed in Tilt 250 EC (0.05%) sprayed plot which was statistically similar to Folicur (0.1%) sprayed plot and the highest incidence was observed in untreated control. The highest pod length (11.77 cm) was obtained from Tilt 250 EC (0.05%) which was followed by Folicur (0.1%) and Contaf 5 EC (0.1%) treated plots, and the lowest pod length (9.11 cm) was obtained from control treatment. Fungicides showed significant effect on number of seeds per pod and weight of seeds per pod. The highest number of seeds per pod (23.48) and weight of seeds per pod (0.53 g) were recorded in Tilt 250 EC (0.05%) sprayed plots which was followed by Folicur (0.1%) and Contaf 5 EC (0.1%) treated plots, and the lowest of these parameters were recorded in untreated control. Cost and return analysis showed that the highest gross return (Tk. 3,70,500 ha<sup>-1</sup>), gross margin (Tk. 1,71,742 ha<sup>-1</sup>) and BCR (1.86) were calculated from where fungicide Tilt 250 EC @0.05% was sprayed. The lowest gross return (Tk. 2,28,000 ha<sup>-1</sup>), gross margin (Tk. 31,710 ha<sup>-1</sup>), which was followed by Folicur (0.1%) and Contaf 5 EC (0.1%) treated plots, and BCR (1.16) were calculated from untreated control. Economic point of view, Tilt 250 EC @0.05% was found economically profitable. So, Tilt 250 EC (0.05%) or Folicur (0.1%) or Contaf 5 EC (0.1%) may be used to control rust disease and increase yield of Fenugreek.

## Plum (Alu-bukhara)

### Insect and pest management

#### *Virachola isocrates* on alu bukhara in Bangladesh

MZH Prodhan

Alu Bukhara (*Prunus bokharensis*), perennial small tree, is one of the important minor spice crops in Bangladesh. Fruits of the crop is used in cooking biryani and other spicy foods. It is also used in preparing jam, bar, pickle, candy, chutney, and murobba. Spices Research Centre, BARI released a variety, BARI Alubokhara-1, which is now cultivating in Bangladesh, but no record of insect pests identified earlier.

An insect pest, Fruit borer, *Virachola isocrates* (Lycaenidae: Lepidoptera), also known as pomegranate butterfly, anar butterfly appeared on Alu Bukhara plant at SRC, Bogura, Bangladesh. The population was observed in the 3<sup>rd</sup> week of May 2023. The caterpillars were then brought out to the laboratory; reared and observed their morphology.

*Virachola isocrates* is the most widespread, polyphagous and destructive pest with a wide range of host plants viz., pomegranate, citrus, guava, litchi, aonla, wood apple, apple, ber, loquat, mulberry, peach, pear, plum, sapota, tamarind etc (Khandare *et al.* 2018). The pest is one the most obnoxious pest on pomegranate crop incurring about 65 to 70 per cent of yield loss worldwide (Kumar *et al.*, 2017). The pest is all over India and common in Asia. This is the first record of the pest on Alu Bukhara in Bangladesh.

The larvae bore into the fruits soon after hatching. Once inside the fruit, larvae feed on the flesh and seeds. The bored hole is plugged by the last abdominal segment of the larva. When fully grown, the larva comes out by boring from the fruit. Offensive smell and excreta of caterpillars coming out of the entry holes with excreta stuck around the holes. The fruits rot and drop off. The holes ultimately expose the rest of the fruit to disease, and typically rot off the tree.

Female laid eggs singly on tender leaves, stalks and flower buds. The incubation period varies from 2 to 3 days. Caterpillar, dark brown, having short hairs and white patches all over the body. Larval period varies from 12 to 17 days. Larvae pupates inside fruit but occasionally outside even, attaching themselves to stalk of fruits. Pupal period ranges from 05 to 06 days. The growth from egg to adult was 19 - 26 days with four larval instar stages. Adult longevity of male and female was 03-06; 04-08 days, respectively (Ramana *et al.*, 2016). Male glossy, bluish violet, female brownish violet with an orange patch on forewings.

Control measures include weeding, collect and destroy of damaged fruits, use light trap @ 1/ha to monitor the activity of adults, spray of neem based products at flowering stage, releases *Trichogramma chilonis* and spray of Malathion or Dimethoate at flower formation and fruit set ([https://agritech.tnau.ac.in/crop\\_protection/pome\\_est/pome\\_1.html](https://agritech.tnau.ac.in/crop_protection/pome_est/pome_1.html)). Chemical application of Lambda



chlothrin, Emamectin benzoate and Spinosad are also recommended for effective control (Khan *et al.* 2017, <https://plantix.net/en/library/plant-diseases/600296/pomegranate-fruit-borer/>)

## **Agri. Engg. and post-harvest technology**

### **Suitability study of SRC developed plum in fried rice**

Md. Masud Alam and Md. Zulfikar Haider Prodhan

The plum is the costly spice crop in Bangladesh. In our country normally it is used as spice item for process of preparing and providing food for different types of events, such as weddings, concessions and corporate and social gatherings. But after independency of Bangladesh, it was always imported from abroad. Till now the imported variety normally used in Biryani and as spice item for food processing. The Spices Research Center (SRC), Bangladesh Agricultural Research Institute (BARI) developed “BARI Plum-1” variety in 2018. The developed variety is good to look but it is not tasty in fresh condition. But after mini processing it can use for Biryani and for other food processing. The present study was concerned with the acceptability of SRC developed plum variety in Biryani/fried rice and 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 7.2 to 8.20, ranking ‘like moderately to ‘like very much’. The test score indicated that among three samples, the Biryani; processed by SRC developed plum variety was most acceptable as well as imported plum. The study thus shows that SRC developed plum variety can be used as spice item as like as imported plum variety in Biryani and other for food processing.

## **Technology Validation and Transfer**

### **Performance of different fenugreek varieties in charland area of Cumilla**

M. Rahman, M. A. Siddiky 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 2022-23 to compare the yield performance of BARI released fenugreek varieties against local variety with the aim to replace it by the best one. The fenugreek varieties viz. BARI Methi-2 and BARI Methi-3 were compared with local variety. The experiment was laid out in randomized complete block design with three replications. The highest number of primary branches/plant (4.70), number of pods/plant (16.07), pod length (9.70cm), 1000-seed weight (10.23g) were recorded in BARI Methi-3. The highest seed yield (4.10t/ha) was found in BARI Methi-3. BARI Methi-3 was higher yielder than the check local variety. So, the local variety might be replaced by high yielding BARI Methi-3 variety.

## **Mint**

### **Nutrient and water management**

#### **Development of fertilizer recommendation for mint**

Md. Nasirul Farid and Md. Akhtaruzzaman Sarker

A field experiment was carried out at Spices Research Sub-Centre, Bangladesh Agricultural Research Institute, Lalmonirhat during December 2022 to March 2023 to investigate the fertilizer doses of Mint. The treatments comprised of  $T_1 = N_{90}P_{50}K_{60}S_{25}$ ,  $T_2 = N_{80}P_{40}K_{50}S_{20}$ ,  $T_3 = N_{70}P_{30}K_{40}S_{15}$ ,  $T_4 = N_{60}P_{20}K_{30}S_{10}$  and  $T_5 = N_{50}P_{10}K_{20}S_5$ . The experiment was laid out in RCB design with three replications using BARI Pudina-2 as test material. The application of different doses of NPKS fertilizers affected most the parameters studied. Maximum plant height (47.67 cm) was recorded at treatment  $T_5 = N_{50}P_{10}K_{20}S_5$  and minimum (31.80 cm) was recorded at treatment  $T_1 = N_{90}P_{50}K_{60}S_{25}$ . Branch/plant ranges from (72.0 to 99.67). The highest number of leaf (1414.33) was found at treatment  $T_2 = N_{80}P_{40}K_{50}S_{20}$  and the lowest (1046.0) was found in treatment  $T_4 = N_{60}P_{20}K_{30}S_{10}$ . The maximum fresh weight (0.47 g) was obtained from

treatment  $T_2 = N_{80}P_{40}K_{50}S_{20}$  and the minimum fresh weight (0.39g) of individual plants was obtained treatment  $T_4 = N_{60}P_{20}K_{30}S_{10}$ . Leaves were harvested several times. At first harvesting time among the treatments, the highest yield  $16.53 \text{ tha}^{-1}$  was obtained from treatment  $T_2 = N_{80}P_{40}K_{50}S_{20}$  and the lowest yield was  $14.51 \text{ tha}^{-1}$  from treatment  $T_1 = N_{90}P_{50}K_{60}S_{25}$ . When harvested after two months later the maximum yield ( $13.68 \text{ tha}^{-1}$ ) was found treatment  $T_2 = N_{80}P_{40}K_{50}S_{20}$  and the minimum yield ( $11.60 \text{ tha}^{-1}$ ) was found at treatment  $T_4 = N_{60}P_{20}K_{30}S_{10}$ .

## Socio-economic study

### Baseline survey for generating information on spices production in different areas of Bangladesh

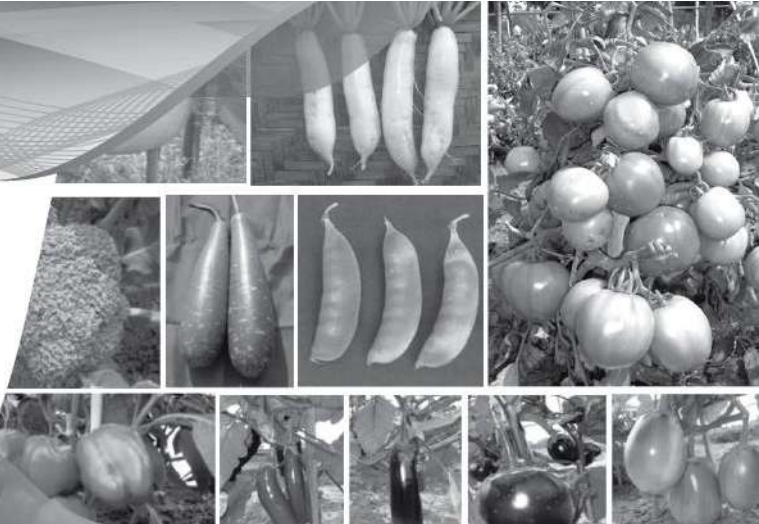
Md. Kamrul Hasan and Shailendra Nath Mozumder

A base line survey is needed to understand existing crop, variety, cropping pattern, input use, cost of production, socio-economic and agro-climatic situation, problems and potentials affecting the present farming systems. This study was conducted to identify the socioeconomic characteristics of the spices growers; find out the present cropping patterns and spices crop variety used by the farmers; estimation the cost and return of different spices crop; determination the amount of consumption of different spices and finally explore the constraints and opportunities related to spices crop production. Descriptive statistics was used for data analysis. The results of the study depicted that a large portion of respondent farmers belonged to the age group of 15-30 years and education level was in primary level. Most of the farmers were in small type of farm category and their main occupation was agriculture. Experience of farmers in agriculture related work was 21.01 years. The annual income of the respondent family came from crops production, business, livestock, fisheries,

service, labour sale, remittance and other sources of income. Crop production was the main source for earning income of the respondent family and 63.61 percent income came from crop production. A total of 840 cropping patterns were observed in the study areas. Boro-Fallow-T.Aman was the most dominant cropping patterns in high and medium high land areas. A total of 350 cropping patterns was fallow land based i.e. crop-fallow-fallow, crop-fallow-crop, fallow-crop-crop and fallow-fallow-crop which covered about 56.03 percent of the total cultivated land. By using these fallow land spices production is possible to increase of country's demand and save valuable foreign currency. Farmers cultivated 21 types of spices and area under spices cultivation was 14.76 percent of the cultivable land. Winter onion covered the largest area of land which was 56.47 percent of the total spices land. The adoption status of BARI developed modern varieties was ranged between 13.38 to 100 percent of their respective cultivated land. Farmers earned net profit per kg of spices range between Tk. 10.43 to Tk. 272.0. The BCR of these spices range between 1.42 to 6.30. Per person per day consumption amount of five major spices was estimated at 58.41 gm and minor spices consumption was estimated at 400.26 gm/person/month. Up to 2018-19, Spices Research Centre of BARI collected three hundred germplasm of 31 spices crops and released 37 number of high yielding spices varieties of 15 spices crops. Except this, a total of 51 numbers of other technologies developed in these periods. Farmers faced various problems related to production, marketing, processing and social aspect. The study suggests that deep wells should be installation at public and private level to reduce the effect of drought, irrigating problem and water surface go downing problems. Agricultural mechanization is essential to solve the labor problem. Government should provide subsidized agricultural machinery to encourage farmers to take up mechanization.

# VEGETABLE CROPS

05



## Eggplant

### Observational yield trial in eggplant

Akm Quamruzzaman, Md. Nazim Uddin, L. Akter and M.H. Islam

An observational trial with eighteen eggplant lines/varieties was conducted at the experimental farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur. During the winter season of 2022-23 to observe the performance of eggplant that relation to yield potential and horticultural traits. Among the lines of eggplant five lines were collected from PGRC, BARI. There was diverged variability observed among the 18 eggplant lines/varieties. There was significant variability observed among the 18 eggplant lines/ varieties. Single fruit weight is an important criterion for selecting a high yielder line. The range of the number of marketable fruit/ plant was vary between 17.0 and 38.0. While the single fruit weight was 82 to 233g. Pest and disease infestation are the main obstacles to the farmers, which are to be addressed during the selection of good eggplant lines. The range of eggplant fruit and shoot borer (ESFB) infestation was 10.3% that is found in SM 553 to 17.5% that is found in BD 2665 and BD 2809. Bacterial wilt infection is an important disease that causes massive losses in eggplant production and 12 lines of eggplant performed zero percent mortality by bacterial wilt and while the other six lines showed only 10% mortality by bacterial wilt. The range of fruit yield was 26.57 to 54.52 t/ha. The maximum fruit yield was found in BD 9546 which was 54.52 t/ha followed by SM 512 eggplant line fruit weight was found 47.58t/ha, SM 553 fruit weight was 44.35t/ha, BD 2652 fruit weight was (45.70t/ha), BARI Begun-4 fruit weight was 53.81t/ha, BARI Begun-6 fruit weight was 45.90t/ha. In other hand, the minimum fruit weight was found in SM 525

line and fruit weight was 26.57t/ha. Considering earliness, high yield, ESFB infestation, BW infection tolerance, fruit shape and color, the lines BD 95465, SM 512, SM 553, and BD 2652 were selected for future use as breeding line.

### Regional yield trial of eggplant lines

AKM Quamruzzaman, M. Nazim Uddin, L. Akter and M.H. Islam

The study was conducted with three green-colored eggplant lines [SM275, SM(I)35, SM332], four purple-colored eggplant lines [SM216, SM233, SM236B, SMP405] and two white-colored eggplant lines [SM333, SM023A] along with check eggplant varieties [BARI Begun-4, BARI Begun-6, BARI Begun-11] at the farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, along with different RARS (Jamalpur and Hathazari) of BARI during the winter season of 2022–23 to develop new high-y variety of eggplant. Significant variation was observed in 12 green, purple, and white-colored eggplant lines/varieties. The range of days to 1st harvest was 100.0-103.0 days. The range of the number of marketable fruit and the average fruit weight was 11.7-48.0 and 73.7-321.7 g, respectively. The range of fruit length and fruit diameter was 9.51-24.8cm and 3.21-9.90cm, respectively In the Gazipur location, the range of fruit yield was vary between 40.04 to 49.56 t/ha. While the highest fruit yield was produced in SMP 405 line which was 49.56 t/ha and then followed by SM275 line which was 43.92 t/ha, BARI Begun-11 varieties which was 45.83 t/ha, SM233 line which was 44.31 t/ha, SM-236B which was 44.34 t/ha and BARI Begun-4 which was 49.38 t/ha. The range of ESFB and BW infestation was 10.07-17.00% and 0.0-3.33 %, all the lines showed 0.0% BW infestation except 3 lines. In Gazipur, the higher fruit yield per hectare



was produced in SMP 405, SM275, SM333, and SM236B and SMP 405, SM233 line was performed best over 3 locations. So, considering earliness, yield, and tolerance to fruit infection by EFSB and bacterial wilt infestation, two lines, viz., SMP 405, and SM233 might be selected for release as new OP eggplant varieties.

### **Inbred development of eggplant [S3-S4]**

Akm Quamruzzaman, L. Akter and M.R. Karim

Twelve eggplant lines were selected from S3 generation of eggplant lines on the basis of number of fruits per plant, individual fruit weight, fruit shape, color which was evaluated in Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2022-23. The lines varied for their response of some characters studied. The seeds were sown on the seedbed on 10 September, 2022. Thirty days old seedlings were transplanted in the main field on 9 October, 2022. The experiment was laid out in RCB design with three replications. The unit plot size was 7.0 x 0.70 m and 10 plants were accommodated in a plot with a plant spacing of 70 cm apart in single row maintaining, row to row distance of 1m with 50 cm drain. Data on days to 1st harvest, number of marketable fruit, average fruit weight, fruit length (cm), fruit diameter (cm), plant height at last harvest (cm), fruit yield/ plant (kg), EFSB infestation (%), bacterial wilt (BW) infection (%), yield (t/ha), fruit colour and fruit shape were recorded from seven randomly selected plants per entry per replication. This experiment was designed to identify the good quality eggplant lines having more fruit number and higher yield as well as with attractive fruit shape, size, color. The number of fruit per plant and single fruit weight were varied from 16.5 to 30.0 and 133 to 240g, respectively. The fruit length and fruit diameter were also varied among the lines according to size of the fruit, which was 10.1 to 23.3cm and 3.1 to 8.5cm, respectively. The plant height at last harvest is an important character which was estimated with 93 to 130cm. EFSB infestation and bacterial wilt (BW) infection were important characters, which play important role for selection an eggplant variety, while the range was 11.0 to 20.7% and 0.0 to 10.0%, respectively. All the lines were selected considering the yield and yield contributing characters as well their attaining homozygosity.

The fruit yield per hectare was varied from 45.21 to 50.16 ton. So these lines may be used for breeding purpose for developing quality eggplant variety.

### **Heterosis study in eggplant hybrids**

AKM Quamruzzaman, M. Nazim Uddin, L. Akter and M. Hasinul Islam

The study was conducted with twenty eggplant hybrids along with standard hybrids (BARI Hybrid Begun-4 and Purabi F<sub>1</sub>) at the farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2022-23 to develop new high yielding hybrids. The seeds were sown on the seedbed on 10 September 2022. Thirty days old seedlings were transplanted in the main field on 10 October 2022. The experiment was laid out in an RCB design with three replications. Average degree of standard heterosis (%) was estimated as the increase or decrease percent of F<sub>1</sub> performance based on standard heterosis = (Mean of F<sub>1</sub> - Mean of standard variety / Mean of standard variety) x 100. Where F<sub>1</sub> was the mean performance of the F<sub>1</sub> hybrid. The range of significant negative heterosis for days to first harvest was -1.96% to -3.92% and -1.94% to -4.85% over standard hybrids BHB-4 and Purabi, while the range for the number of marketable fruit was 9.09% to 54.55% over Puarbi. The average fruit weight is an important trait for the consumers, while the range for significant positive average fruit weight was 18.38% to 90.63% and 4.91% to 6.51%, respectively. A wide range of significant standard heterosis was observed among the hybrids for the fruit yield trait, while the range was 4.17% (F<sub>1</sub> 12X309A) to 27.08% (F<sub>1</sub> 334X83B2) and 5.11% (F<sub>1</sub> 253BX83B2) to 35.56% (F<sub>1</sub> 334X83B2). For EBFB, the significant negative standard heterosis was -7.80% (F<sub>1</sub> 13X333) to -28.03% (F<sub>1</sub> 275X309A) and -12.62% (F<sub>1</sub> 83AX332) to -47.86% F<sub>1</sub> 275X309A, while for bacterial wilt infection, all hybrids sowed zero per cent infection and only two hybrids sowed 10% infection. Considering significant standard heterosis over BHB-4, Purabi six hybrids viz., F<sub>1</sub> 21X220, F<sub>1</sub> 262X220, F<sub>1</sub> 253BX333, F<sub>1</sub> 334X83B2, F<sub>1</sub> 334X83B3 and F<sub>1</sub> 357X309A might be selected for further confirmation.

### Regional yield trial of eggplant hybrids

AKM Quamruzzaman, M. Nazim Uddin, L. Akter and M.H. Islam

The study was conducted with six green colored [ $F_1$  400x333,  $F_1$  357x220,  $F_1$  357x83B3,  $F_1$  275X83B3,  $F_1$  253BX83B3,  $F_1$  262X221B], six purple colored [ $F_1$  5x216,  $F_1$  5x405,  $F_1$  18x405,  $F_1$  18x233,  $F_1$  20x5,  $F_1$  216x359] eggplant hybrid lines and along with check varieties [BARI F1-3, BARI F1-5, BARI F1-6, Purbani F1, Purple king] at the farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur along with different RARS (Hathazari and Moulvibazar) of BARI during the winter season of 2022-23 to develop new high yielding hybrid eggplant variety. Thirty-day old seedlings were transplanted in the main field on the 2nd week of October 2022. The experiment was laid out in an RCB design with three replications. The unit plot size was 7.0 x 0.70 m and 10 plants were accommodated in a plot with a plant spacing of 70 cm apart in a single row, maintaining a row to row distance of 1 m with a 50 cm drain. The range of days to harvest was 99.33-106.00 days, while the number of marketable fruits and average fruit weight were 11.77-36.00 and 96.00-363.67 g, respectively. The range of fruit length and fruit diameter were 9.27-28.27cm and 2.71-11.27cm, respectively. In the Gazipur location, the range of fruit yield was 38.38-53.75t/ha, while the higher yielded hybrids were viz.,  $F_1$  357x220 (53.75 t/ha),  $F_1$  5x216 (51.50 t/ha),  $F_1$  5x405 (51.69 t/ha),  $F_1$  400x333 (50.80 t/ha). The range of ESFB infestation and bacterial wilt was 14.50-20.19% and 0.0-10.0%, respectively. The highest per hectare mean fruit yield for green color was recorded in  $F_1$  357x83B3 (43.77 t/ha), followed by  $F_1$  357x220 (43.66t/ha), while for purple colored eggplant hybrids was recorded in  $F_1$  5x405 (34.47 t/ha) over 3 locations. So, considering earliness, yield, tolerance to fruit infection by EFSB, bacterial wilt infestation two lines viz.,  $F_1$  357x220 and  $F_1$  5x405 might be selected for release as new hybrid eggplant varieties.

### Effect of planting time on yield and quality of BARI Begun-12

E. Mahmud, M. Islam, N. Akter, M. Razzab Ali and A.K.Saha, M. Mohouddin and M. Mostaque Ahmed

In this study, the effects of different planting time on the yield and quality of BARI Begun-12 were

observed in a field experiment. This experiment was laid out in Randomized Complete Block Design with three replications during 2022-2023 at the Regional research Station, BARI, Rangpur. Five planting time ( $T_1$ =1<sup>st</sup> August,  $T_2$ =16<sup>th</sup> August,  $T_3$ =1<sup>st</sup> September,  $T_4$ = 16<sup>th</sup> September and  $T_5$ = 1<sup>st</sup> October) were used as treatment. Results showed that yield component, yield and quality of BARI Begun-12 were performed by different planting time except individual fruit weight (g), fruit length and fruit breadth (cm). Days to 50% flowering (103.00), days to 1<sup>st</sup> harvest (112.00) and days to last harvest (206.00) took less time in respect of  $T_5$ = 1<sup>st</sup> October treatment among the five treatment. Only number of fruits/plant (7.06) responded in higher regarding with  $T_1$ = 1<sup>st</sup> August planting time which is similar to  $T_2$ = 16<sup>th</sup> August planting time (6.86). On the other hand,  $T_1$ = 1<sup>st</sup> August planting time gave better fruit yield (4.10 kg/plant & 57.73 t/ha) followed by  $T_2$ =16<sup>th</sup> August and  $T_3$ = 1<sup>st</sup> September planting time (3.7 kg/plant) and (54.43 kg/ha & 53.13 kg/ha), respectively while the lowest were recorded from  $T_5$ = 1<sup>st</sup> October planting time (2.32 kg/plant & 23.40 kg/ha). If also, individual fruit weight (g) showed non-significant effect among the used treatment, so  $T_1$ = 1<sup>st</sup> August and  $T_5$ = 1<sup>st</sup> October planting time obtained in same highest individual fruit weight (0.853 g) followed by  $T_2$ = 16<sup>th</sup> August,  $T_3$ = 1<sup>st</sup> September and  $T_4$ = 16<sup>th</sup> September planting time.

### Effect of sowing time and spacing on yield and quality of BARI Begun-12

M. Ratna, E. Mahmud, M. Islam, N. Akter, S. Yesmin and M. I. A. Howlader

The experiment was set up in the experimental field of RHRS, Lebukhali, Dumki, Patuakhali during rabi season of 2022-23 to identify the optimum sowing time and spacing of BARI Begun 12 to obtain higher quality fruit and maximum yield. Four sowing time treatments viz.  $T_1$ =1<sup>st</sup> Aug sowing,  $T_2$ =16<sup>th</sup>Aug sowing,  $T_3$ =1<sup>st</sup>Sep sowing and  $T_4$ =16<sup>th</sup>Sep sowing and three spacing treatments  $S_1$  = 80 cm × 120 cm  $S_2$  = 100 cm × 120 cm and  $S_3$  = 120 cm × 120 cm were used. Significant variation in yield and yield contributing characters of BARI Begun-12 were observed due to execution of different sowing dates and plant spacing. Maximum yield (119.12 tha<sup>-1</sup>) was obtained from  $T_1$  (1<sup>st</sup> August sowing) followed by  $T_3$  (96.29tha<sup>-1</sup>) which is statistically similar with  $T_2$  (16<sup>th</sup> August sowing)

(92.81  $\text{tha}^{-1}$ ) but sowing on 16<sup>th</sup> September drastically reduced the yield (44.77  $\text{tha}^{-1}$ ). Shoot and fruit borer infestation was high in 16<sup>th</sup> September sowing. On the contrary, maximum yield (106.84 ton/ha) was recorded from 80 cm  $\times$  120 cm which was followed by  $S_2$  (83.94 ton/ha) and  $S_3$  (73.96 ton/ha). High density gave higher yield because of the higher plant number. But maximum shoot and fruit borer infestation was obtained from  $S_1$  treatment (41.62%) whereas percent infested fruit by brinjal shoot and fruit borer was 37.92% and 36.26% in  $S_2$  and  $S_3$  treatment respectively. The combined effect of sowing date and plant spacing also had significant effect on different yield parameters and yield. Maximum yield was found when seed sowing was done at 1<sup>st</sup> August and plants are grown at 80 cm  $\times$  120 cm spacing but this densely plantation cause more BFSB infestation. So August sowing with 100 cm  $\times$  120 cm spacing or 120 cm  $\times$  120 cm can give better yield with low BFSB infestation in BARI Begun 12.

#### **Effect of marigold as companion plant on growth and yield of brinjal**

A Akter, M A Hossain, H Rahman, R Sultana and Hemk Mazed

The experiment was conducted to study the effect of marigold as companion plant on growth and yield of brinjal at Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during the season of 2022-23. The treatments were: Marigold as companion plant: African marigold, French marigold, Pot marigold and control (No marigold.) Companion planting is a sort of polyculture in which two or more plant species are planted together and are known or thought to promote one other's growth synergistically. The highest number of fruits per plant (25) was produced by companion plant African marigold whereas the lowest number of fruits (20) was from control (without marigold). Maximum individual fruit weight (133 g) was obtained from companion plant African marigold and minimum (123 g) from control (without marigold). Maximum yield per plant (3.24kg), per hectare (32.37 t) was obtained from companion plant African marigold and minimum yield per plant (2.50kg), per hectare (24.97) was found from control (without marigold). Less insect infestation was found from marigold as companion plant with brinjal and more infestation

was found from control (without marigold). From the study we found that more BCR (3.12) was obtained from brinjal cultivation with marigold as companion plant and less BCR (2.66) was found from brinjal without marigold.

## **Tomato**

### **Evaluation of tomato lines (afaci)**

AKM Quamruzzaman, Limu Akter, M.H. Islam and S. Akter

A study was conducted with 36 tomato germplasm/lines [PGRC (19), The Netherland (7), Japan (2), and Bangladesh (9)] with 3 check tomato varieties at research field of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur. During the winter season of 2022-23 to identify promising tomato breeding lines. All the tomato lines showed difference in the most of the parameters studied. The experiment was laid out in non-replicated design having plot size of 4.8X1 m providing plant spacing. The fertilizer application method was followed as per fertilizer recommendation guide. Plant protection, irrigation, pruning, mulching weeding and other intercultural operations were done as and when necessary. There was significant variation was observed among the tomato lines studied. Days to first harvest varied ranged from 95 to 109 days. It indicated earliness was observed among the of tomato lines. The number of flower cluster per plant and number of fruits per cluster also varied among the lines which were 11 to 22 and 3.2 to 26, respectively. The number of fruit per plant and single fruit weight were varied from 15 to 510 and 6.6 to 180 g. The fruit yield per plant and fruit yield per hectare were varied from 1.3 to 4.8 kg and 39 to 144 ton, while the highest fruit yield per hectare was harvested from the lines. The fruit length, fruit diameter and pericarp thickness also varied among the lines according to size of the fruit, which was 2.7 to 6.1cm, 2.3 to 7.6 cm and 0.2 to 0.9cm, respectively. The number of locules, total soluble solid (TSS) and plant height at last harvest were varied from 2 to 6.6, 2.6 to 5.9%, and 66 to 154cm, respectively. The TYLCV infection (%) and leaf sucking pest infestation (%) were observed with a range of 1 to 20% in the field condition in both cases. Considering the plant growth habit, earliness, different horticultural traits, virus and pest



infestation eighteen lines viz., BD 7301, BD 7751, BD 7752, BD 7753, BD 7754, BD 7756, BD 7757, BD 7759A, BD 7759B, BD 7762, BD 8886, BD 9776, BD 10321, BD 10351, NL-1A, NL-4, SLA-19 and SLA-33 were selected as breeding materials for further tomato improvement program.

### **Evaluation of tomato germplasm**

M.R. Karim, M. A. Goffar and M.S. Alam

A study was conducted with tomato germplasm at research field of Olericulture Division of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2022-23 to identify promising tomato lines in respect of high yielding, tolerance to insect-pest and diseases and to identify resistant breeding sources. There were 14 tomato germplasm collected from WVC viz., SL0425, SL0428, SL0429, SL0432, SL0433, SL0434, SL0438, SL0439, SL0801, SL802, SL803, SL804, SL805 and SL806 included for this study while BARI 15 was used as check. The seeds were sown in the seedbed on November 22, 2022. Thirty days old seedlings were transplanted in the main plot. The experiment was laid out in a non-replicated design having plot size of 4.8X1m providing plant spacing of 60x40 cm. All the lines showed differences in most of the parameters studied. There were seven lines- SL0429, SL0432, SL0433, SL0439, SL0805 and SL0806 found to be promising with yield more than 2.5-3.19 kg fruit per plant having average fruit weight 92.0-250.0g. No virus infection found to infect in the field condition. Considering the plant growth habit, flowering trends, and other horticultural traits, eight 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.

### **Regional yield trial of semi determinate tomato lines**

M. A. Goffar, M. R. Karim and M.S. Alam

A regional yield trial with selected semi determinate tomato lines was conducted at Olericulture Division of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur and at three RARS (Akbarpur, Burirhat and Rahmatpur) during the winter season of 2022-23 to study the yield performance and adaptability over locations. There

were five selected semi determinate tomato lines viz., SL0419, SL0420, SL0504, SL0507, GT017 and BARI Tomato-14 (as check) included for this study. The seeds were sown in the seedbed on October 30, 2022. The experiment was laid out in RCB design with three replications having plot size of 4.8X1m providing plant spacing of 60x40 cm. All the lines showed statistically significant difference in all the parameters studied. The line SL0419 contributed the highest per plant yield (3.05 kg) with good shelf life (14.0 days) having 29 days harvestable period. The highest yield per hectare was recorded in GT017 (73.54t). The remaining other lines contributed more than 60 tons yield. It indicated all lines are good yielding tomato lines. The keeping quality attribute showed that a good keeping quality (shelf life) was recorded, and it was marketable up to 9.0-15.67 days under ambient condition prevailing 27-31°C temperature. The number of seeds per fruit varied ranged from 81.0 to 98.0. Virus infection was recorded up to 1.0-7.00% at 75 days after sowing (DAS) under field condition. Based on different traits, all the lines are found to be promising. The variety evaluation committee has recommended SL0419 and GT017 as for proposing as new semi determinate tomato variety for Bangladesh.

### **Regional yield trial of insect and disease resistant dual tomato lines**

M.A. Goffar, M. R. Karim, M. A. Sarker and P. Hanson

A regional yield trial was conducted with four WVC (The World Vegetable Centre-former AVRDC) supplied tomato lines to study the yield, pest and diseases resistance and quality attributes and regional adaptability at the experimental field and laboratory of Olericulture Division of Horticulture Research Centre (HRC), BARI, Gazipur, Bangladesh along with three regional stations of BARI during the winter season of the year 2022-23. The findings of major parameters revealed that, days to 50% flowering were observed uniform that was confined to 51.0-56.0 days. In respect of marketable fruit number per plant, the highest number of fruits (25.0) was counted in line SL0403 and SL04013. In the case of average fruit weight, the largest fruit was harvested from the line SL0403 (86.55g) followed by SL0413 (81.45g). The marketable fruit yield per plant varied from 2.30 to 1.86kg. The highest marketable fruit yield

(55.38t) was obtained from entry SL0413. Though the line SL0411 is low yielding (47.11t) among the lines but due to its earliness, this line may be used in cropping pattern to increase cropping intensity. The length and width of fruits, TSS,  $P^H$ , pericarp thickness and locules number per fruit of different lines varied significantly. The number of seeds per fruit showed a significant difference among the lines studied which ranged from 79.0 to 100.0. Most of the lines showed better performance in terms of pest and disease tolerance. Regarding other qualitative traits, all the lines were found to be promising. The variety evaluation committee has recommended the line SL0411 for proposing as a new dual purpose tomato variety for Bangladesh.

### Regional yield trial of afaci tomato lines

AKM Quamruzzaman, L. Akter and M.H. Islam

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 of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur Bangladesh along with two regional stations (Moulvibazar, Barisal) of BARI during the winter season of the year 2022-23. There were five selected tomato lines viz., AVTO 1008, AVTO 1306, AVTO 1409, AVTO 1705, AVTO 1717 along with two local check BARI Tomato-11, BARI Tomato-15 were included in this study. The experiment was laid out in the randomized complete block design (RCBD) with 3 replications. 5 lines/ variety were randomly allotted in each block. The size of a unit plot was  $4.8 \times 1\text{m}$ , and the plant spacing was  $60\text{cm} \times 45\text{cm}$ . Significant variation was observed in number of fruit/ plant, single fruit weight, fruit yield, fruit length, fruit diameter, TSS, and leaf sucking pests. Days to 1st harvest is an important trait to select an early variety, while the range was 97.33-99.33 days. In case of number of fruit/ plant and single fruit weight, the range was 27.67-166.67 and 10.33-140.0g, respectively. In case of fruit length and fruit diameter, the range was 3.53-6.73 and 2.30-8.17, respectively, which impacts on bigger sized of fruits. Total soluble solids (TSS) is correlate with sweetness, which is preferred by a lot of consumers and there was a higher variation observed (3.30-5.10). Minor infestation was observed for TYLCV infection and leaf sucking

pests, while the range was 0-3.33 and 0-8.33%, respectively. A wide range was observed for fruit yield trait, while the range was 50.52-124.22. The significant higher yield was observed in AVTO 1306 (124.22 t/ha), followed by AVTO 1409 (122.08 t/ha), AVTO 1008 (119.65 t/ha) in Gazipur condition. In the case of mean fruit yield over 3 locations, the lines viz., AVTO 1306, AVTO 1717, and AVTO 1409 performed well, so these three lines can be selected for the release of the new tomato OP variety.

### Observational yield trial of cherry tomato

M. S. Alam and M.A.T. Masud

The experiment was conducted at the experimental field of Olericulture Division, Bangladesh Agricultural Research Institute, Gazipur during the winter season of 2022-23. Eleven cherry tomato germplasm viz. NOR- 001, NOR- 002, NOR- 003, NOR- 004, NOR- 005, NOR- 006, NOR- 007, NOR- 008, NOR- 009, NOR- 010 and NOR- 011 were tested with BARI Tomato-11 as check. From these lines six plants were selected for desired shape, size, colour and Yield. A vast difference was observed among the tested lines as well as within the lines in their shape, size and colour. From the observation it is evident that the collected lines were hybrid. As a result six plants were selected having desired characters for inbreed development to use in breeding program. Selected lines were significantly differed for different traits. Number of flowers per cluster ranged from 10 to 34. Significantly the highest (34) flowers per cluster was found in NOR-006-1 where NOR-004-1 produced the lowest flowers per cluster. The highest (19) number of fruit per cluster was obtained from NOR-006-1 and the lowest (6) was from NOR-004-1. The maximum (186) number of fruits per plant was produced by NOR-008-1 and the minimum (118) from NOR-010-1. The germplasm showed a great variation in fruit size. The highest fruit length (3.8 cm) and fruit breadth (2.7 cm) were recorded from NOR-010-1 and NOR-004-1 respectively. The lowest fruit length (2.3 cm) and fruit breadth (1.7 cm) were recorded from BARI Tomato-11. Single fruit weight ranged from 6.2 g to 13.4 g where the highest (13.4 g) in NOR-010-1 and the lowest in BARI Tomato-11. TSS (%) was the highest (7.1) in BARI Tomato-11 and the lowest in NOR-0011-1. The highest Fruit yield per plant (1.74 kg) was obtained from NOR-

008-1 and the lowest (1.12 kg) was from BARI Tomato-11. Remarkable variation was found in plant height. The tallest (192 cm) plant was observed in NOR-010-1 and the shortest (63 cm) in BARI Tomato-11.

#### **Evaluation of exotic cherry tomato germplasm**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

The experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23 with six cherry tomato germplasms to find out the suitable cherry tomato lines to develop as a variety. The earliest flowering (55 DAT), earliest harvest (75 DAT), maximum number of fruits (198.5), pericarp thickness (3.71), number of fruit/truss (14.57), harvest duration (55 days), yield per plant (2.14 kg) and estimated yield (63.56 t/ha) were observed in SL Rai-002. Its average fruit weight was 10.8 g, TSS 5 % and red in color. This line was superior compared to other lines based on all the characters.

#### **Inbred development of tomato [s3-s4]**

AKM Quamruzzaman, L. Akter and M.H. Islam and S. Akter

Nineteen tomato lines were selected from S3 generation of tomato lines on the basis of number of fruits per plant, individual fruit weight, fruit shape, color which was evaluated in Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2022-23. The seeds were sown in the seedbed on 01 October, 2022. Thirty days old seedlings were transplanted in the main plot on 31 October, 2022. The experiment was laid out in non-replicated design having plot size of 4.8X1 m providing plant spacing. Data on days to 1st harvest, no. of flower cluster per plant, no. of fruit/ cluster, no. of fruit/ plant, single fruit wt. (g), fruit yield (kg/pl), fruit yield (t/ha), fruit length (cm), fruit diameter (cm), pericarp thickness (cm), no. of locules, TSS (%), plant height at last harvest (cm), TYLCV infection (%) and leaf sucking pest infestation (%) were recorded. Other qualitative characters as per descriptor also recorded. This experiment was designed to identify the good quality tomato lines having more fruit number and higher yield as well as with attractive fruit shape, size, color. All the lines were selected considering the yield and yield contributing characters as well their attaining

homozygosity. The days to 1st harvest of tomato plants were varied ranged from 99 to 110 days. The number of fruit per plant and single fruit weight were varied from 20 to 95 and 45.3 to 95g, respectively. The fruit length and fruit diameter were also varied among the lines according to size of the fruit, which was 4.9 to 7.4cm and 3.4 to 6.8cm, respectively. The ranges for pericarp thickness and TSS was 0.3 to 0.7 and 3.0 to 6.4, respectively, while the plant height at last harvest is an important character which was estimated with 80 to 407cm. Leaf sucking pest infestation and TYLCV infection were important characters, which play important role for selection a tomato variety, while the range was 0.0 to 10.0% for both cases. The fruit yield per hectare was varied from 51.0 to 171.5 ton. So the 11 lines viz., AVTO 1315, AVTO 1717, AVTO 1903, AVTO 1907, AVTO 1911, SLA 15-1A, SLA15-1B, SLA-15-2, SLA15-4, SLA 15-6, SLA15-7 which produced more than 95.0 ton/ha and zero percent pest-disease infested may be used for breeding purpose for developing quality tomato variety.

#### **Heterosis study in winter tomato hybrids**

AKM Quamruzzaman, L. Akter and M.H. Islam

The study was conducted with eighteen winter tomato hybrids along with standard hybrid (commercial variety Mintoo Super) at the research farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2022-23 to develop new high yielding winter tomato hybrids. The standard heterosis for 18 winter tomato hybrids over standard hybrid (Mintoo super) was calculated for yield and yield contributing parameters. The seeds of these crosses were sown on the polypot on 01 October, 2022. Thirty days old seedlings were transplanted in the main field on 31 October, 2022. The experiment was laid out in a Randomized Complete Block design with three replications. The unit plot size was 4.8 x 1.0m maintaining 60 x 40 cm spacing and 0.5m drain. Average degree of standard heterosis (%) was estimated as the increase or decrease percent of F1 performance based on standard heterosis =  $(\text{Mean of F1} - \text{Mean of standard variety} / \text{Mean of standard variety}) \times 100$ . Where F1 was the mean performance of the F1 hybrid. Maximum parameters were found to be significant in the study. In case of fruit length and



fruit diameter, the positive heterosis range was 1.72% to 15.17% and 1.89% to 22.64%, respectively over the standard hybrid, which impacts on bigger sized of fruits. Pericarp thickness is an important trait for tomato variety selection, while the positive range was 14.29% to 28.57 % over standard hybrid. Total soluble solids (TSS) is correlate with sweetness, which is preferred by a lot of consumers and there was a higher variation observed over standard hybrid (-13.04% to 30.43%). The range of standard heterosis for days to 1<sup>st</sup> harvest was -3.03% to 14.14%, while for single fruit weight was 0.90% to 12.00%. The positive standard heterosis range for fruit yield trait was 14.94% to 24.94%. The standard heterosis range for TYLCV infection and leaf sucking pests infestation was -100% to 100% and -100% to 0.0%. Considering significant standard heterosis against yield and yield contributing traits, eight hybrids viz., F<sub>1</sub> 1601, F<sub>1</sub> 3201, F<sub>1</sub> 3403, F<sub>1</sub> 4601, F<sub>1</sub> 6801 might be selected for RYT evaluation.

#### Regional yield trial of winter tomato hybrids

AKM Quamruzzaman, L. Akter and M.H. Islam

A regional yield trial was conducted on seven hybrid tomato lines to study the yield, pest and diseases resistance and quality attributes at the experimental field of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur Bangladesh along with one regional station (RARS, Barisal) of BARI during the winter season of the year 2022-23. There were seven selected tomato hybrid lines viz., F<sub>1</sub> 4601, F<sub>1</sub> 3903, F<sub>1</sub> 1501, F<sub>1</sub> 1903, F<sub>1</sub> 3403, F<sub>1</sub> 3701, F<sub>1</sub> 1101 along with local check Mintoo Super was included in this study. Thirty days old seedlings were transplanted in the main plot on 25 October, 2022. In case of fruit length and fruit diameter, the range was 2.83-5.53cm and 2.70-5.37cm, respectively, which impacts on bigger sized of fruits. The range of TSS was 3.10-4.80%. Minor infestation was observed for TYLCV infection and leaf sucking pests, while the range was 0.0-5.0% and 0.0-6.67%, respectively. Significant variation was observed in number of fruit/ plant, single fruit weight, fruit yield, fruit length, fruit diameter, TSS, TYLCV and leaf sucking pests. The range for days to 1<sup>st</sup> harvest was 99.67-102.00 days, while the range for number of fruit/ plant and single fruit weight was 42.67-134.33 and 15.67-92.00g, respectively. The

significant higher yield was observed in F<sub>1</sub> 4601 (119.50 t/ha), Mintoo Super (117.67 t/ha), and F<sub>1</sub> 1501 (109.78 t/ha) in Gazipur condition. In the case of mean fruit yield over 2 locations, the lines viz., F<sub>1</sub> 4601 and F<sub>1</sub> 1501 performed well, so these two lines can be selected for the release of the new hybrid tomato variety.

#### Regional yield trial of semi determinate tomato hybrids

M. A. Goffar, M. R. Karim, M. S. Alam and M. M. R Salim

A regional yield trial with semi determinate hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at three Regional Agricultural Research Station (RARS)- Akbarpur, Burirhat, and Rahmatpur during the winter season of 2022-23 to assess the regional adaptability and yield potentiality. In this study, four semi-determinate type hybrids lines like- P<sub>4</sub>xP<sub>8</sub> (SD), P<sub>5</sub>xP<sub>8</sub> (SD), P<sub>6</sub>xP<sub>8</sub> (SD), P<sub>7</sub>xP<sub>8</sub> (SD) with BARI Hybrid Tomato-9 as check were included. The seeds of these tomato lines were sown in the seedbed on October 30, 2022. Thirty days old seedlings were transplanted in the main plot. The experiment was laid out in the randomized complete block design (RCBD) with 3 replications. Five treatment combinations were randomly allotted in each block. The size of a unit plot was 4.8m × 1m, and the plant spacing was 60cmx40cm. Most of the parameters significantly differed among the entries. The treatment P<sub>7</sub>XP<sub>8</sub>(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<sub>5</sub>XP<sub>8</sub>(SD). The Maximum marketable yield per ha was obtained from the treatment P<sub>7</sub>XP<sub>8</sub>(SD) (96.66 t) followed 94.80 t contributed by the hybrid line P<sub>5</sub>XP<sub>8</sub>(SD). Tomato fruit may be harvested about 45.0 days from most of the entries. Considering the adaptability, yield performance, uniformity and other attributes, the entries P<sub>5</sub>XP<sub>8</sub>(SD) and P<sub>7</sub>XP<sub>8</sub>(SD) were found to be promising. The variety evaluation committee has recommended these two entries for releasing as new semi determinate hybrid tomato varieties for countrywide cultivation.

### Regional yield trial of determinate tomato hybrids

M. A. Goffar and M. R. Karim

A regional yield trial with determinate hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at three other Regional Agricultural Research Stations (RARS/RHRS)- Akbarpur, Burirhat and Rahmatpur during the winter season of 2022-23 to assess the regional adaptability and yield potentiality of these entries. In this study, three determinate type hybrids lines like  $P_1 \times P_2$  (D),  $P_1 \times P_5$  (D),  $P_1 \times P_6$  (D) were included, and BARI Hybrid Tomato-5 and Minto Super were used as check. The seeds of these tomato lines were sown in the seedbed on October 20, 2022. Thirty days old seedlings were transplanted in the main plot. The experiment was laid out in the randomized complete block design (RCBD) with three replications. Five treatment combinations were randomly allotted in each block. The size of a unit plot was  $4.8\text{m} \times 1\text{m}$ , and the plant spacing was  $60\text{cm} \times 40\text{cm}$ . Most of the parameters significantly differed among the tomato entries. The treatment  $P_1 \times P_2$  (D) produced the largest average fruit weight (67.00g). The  $P_1 \times P_5$  (D) treatment exhibited maximum yield per plant (2.94 kg) followed by 2.93 kg harvested from the control (BARI-F1-5). Maximum yield per hectare was obtained from the treatment  $P_1 \times P_5$  (D) (69.58 t) followed 63.77 t contributed from the treatment BARI-F1-5 (control). Considering the adaptability, yield performance, uniformity, and other attributes, the entries  $P_1 \times P_5$  (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. The variety evaluation committee recommended this line for proposing as new tomato variety.

### Regional yield trial of saline tolerant tomato hybrids

M. A. Goffar, M. S. Alam, Afms Ahsan, M.O. Fakir and M.R. Karim

A regional yield trial with saline tolerant hybrids was conducted at the experimental field of Olericulture Division of HRC, BARI, Gazipur and at two Regional Agricultural Research Station (RARS/ARS)- Shatkira and Rahmatpur during the winter season of 2022-23 to assess the regional adaptability and yield performance. Four saline

tolerant tomato hybrid lines-  $P_1 \times P_2$ ,  $P_1 \times P_3$ ,  $P_1 \times P_6$ ,  $P_5 \times P_6$  were included, and BARI Hybrid Tomato-5 was used as check. The seeds of these tomato lines were sown in the seedbed on October 28, 2022. Thirty days old seedlings were transplanted in the main plot. The experiment was laid out in the randomized complete block design (RCBD) with three replications. The lines ( $P_1 \times P_2$ ,  $P_1 \times P_3$ ,  $P_1 \times P_6$ ,  $P_5 \times P_6$ ) were relatively saline tolerant (tasted at physiology Division, BARI in 2019). Most of the parameters significantly differed among the tomato entries. The treatment control produced the largest average fruit weight (56.12 g). The same entry exhibited maximum yield per plant (2.31kg) followed by 2.29 kg fruit harvested from the treatment  $P_1 \times P_3$ . The maximum marketable yield per ha was obtained from  $P_5 \times P_6$  (67.33 t) followed 66.43 t contributed from the hybrid line  $P_1 \times P_3$ . The mean value of virus infection under field condition at 75 DAS was counted 0.0 to 4.0%. The magnitude of virus infection at this stage was not so harmful for commercial harvest. Considering the yield performance (during harvesting, soil salinity was 9.56 ds/m), uniformity and other attributes,  $P_5 \times P_6$  was found to be promising. This is the 3rd year results; therefore, the experiment may be repeated next year at saline prone area for confirming the results.

### Regional yield trial of summer tomato hybrids

M. A. Goffar, M. R. Karim and P. Hanson

A trial was conducted with 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 2022. There were eight selected hybrids viz.:  $P_1 \times P_3$  (S-I);  $P_1 \times P_4$  (S-I);  $P_4 \times P_6$  (S-I);  $P_5 \times P_6$  (S-I);  $P_1 \times P_8$  (S-II);  $P_2 \times P_8$  (S-II);  $P_5 \times P_8$  (S-II);  $P_7 \times P_8$  (S-II) and one local check (BARI Hybrid Tomato-8) was included in this study. All the parameters were found to be significantly differed. There were four hybrid combinations ( $P_1 \times P_3$  (S-I),  $P_4 \times P_6$  (S-I),  $P_1 \times P_8$  (S-II),  $P_5 \times P_8$  (S-II), and  $P_7 \times P_8$  (S-II)) showed good yield which was confined to 28.0-38.0 tones. The incidence of wilt infection was the highest in  $P_1 \times P_4$  (S-I) (10.0%). The other entries were confined between 6.0-8.0% only. The highest virus infection was recorded in treatment  $P_5 \times P_6$  (S-I) (12.0%), while other treatments comprise

between 8.0-10.0% virus. Among the hybrid tomato entries, above mentioned combinations ( $P_4 \times P_6$  (S-I),  $P_1 \times P_8$  (S-II),  $P_5 \times P_8$  (S-II), and  $P_7 \times P_8$  (S-II)) were suitable in terms of yield, pest and diseases tolerance. It will be worthwhile to verify the performance of these promising entries as regional yield trial in the next year to confirm the results and for confirming the results and for studying adaptability in the different agro-ecological zones of Bangladesh adaptability capability in the different parts of the country.

### Regional yield trial of summer tomato hybrids

M Nazim Uddin, M A Goffar, G A Rob, and A K M Quamruzzaman

Seeds of the 4 hybrids, were sown at the olericulture division of HRC, BARI 6 May 2022. The seedlings were transplanted to main field in plastic houses on 2 June 2022. There were 12 plants per row per cross, the plant spacing was 50 cm, and the row spacing was 50 cm. A randomized complete block design with three replicates was adopted. The lowest number of clusters were observed in (4.2) cross. The highest number of fruits per plant was observed in the cross followed by, 3150-A-5\*WP7 (41.5) and the lowest number of fruits were recorded 3125-O-19\*3150-A-5 (10.5). the single fruit wt. was recorded the highest in WP7\*3324 A. Yield per plant was recorded the highest in 3250-A-5\*3324 A statistically similar yield was recorded in 3250-A-5\*3324 A. Lycopene is the important phytochemical in tomato and in this study the highest amount of lycopene was observed in the cross 3250-A-5\*3324 A (21.14) while the lowest was recorded in 3125-O-19\*3241AA. The best crosses for yield per plot and fruit number per plant was fruit ripening stage and soluble solid content, lycopene was 3125-O-19\*C11, 3125-O-19\*3324 A., 31-25-O-19\*C51 were selected for new variety. Virus incidence counting was one of the major objective of the study and out of 21 crosses 13 infected by virus in various scale (%) ranges from 4-17. All the crosses did not show any virus symptom, these are 3125-O-19\*3241AA, 3125-O-19\*3150-A-5, 3125-O-19\*WP7, 3125-O-19\*3324 A, 3241 AA\*3150-A-5, 3241 AA\*C51, 3241 AA\*WP7, 3150-A5\*C51, and these crosses would be the target for further selection.

### Regional yield trial of hybrids of tomato in summer

M.A.T. Masud, T. Hasan and S. Alam

The experiment consisting of four hybrids and three standard check varieties was conducted at three locations of BARI which include Gazipur, Jamalpur and Jashore in the summer season of 2022-23. Significant variation was observed among the hybrids for different characters studied. Results of Gazipur showed that two hybrids WS19 Hybrid-75 and 76 produced moderately higher number of fruits per plant (26 and 24 respectively) than the rest of the test hybrids. AvFwt above 50g is quite appreciable in any summer tomato variety. All the four test hybrids (WS12Hybrid- 50, 53 and WS19 Hybrid-75, 76) produced heavier fruits (60.67-101.67g) while maximum fruit weight was recorded in WS12Hybrid-50 (101.67g) among all the test and check hybrids. Maximum yield was recorded from WS19Hybrid-76 (55.27 t/ha) which statistically followed in WS19Hybrid-75 (48.12 t/ha) and check variety BARI Hybrid Tomat-11 (54.6 t/ha). Variation among the genotypes was less for TSS 4.18-5.2%. Combined results of regional locations (Table 2.) showed that higher yield was observed in two hybrids WS19Hybrid-76 and 75 (48.7 and 47 t/ha respectively) compare to rest of the test hybrids (30.2-31.8 t/ha) and check varieties (37.4-43.8 t/ha). Virus incidence in the test hybrids ranged from 0.0-1.0% and check hybrids 0.0-1.7% while maximum in the check variety BARI Hybrid Tomato-8 (1.7%). Thus, all the hybrids may be considered highly resistant (HR) for virus reaction under field condition (Table 1) (Agrios, 2005). Similarly, incidence of bacterial wilt was less in all the genotypes which ranged from 0.67-2.33%. Considering major yield contributing characters and disease reaction, two hybrids WS19 Hybrid-75 and 76 tested for two to three years were found promising for release as summer hybrid varieties of tomato.

### Regional yield trial of bacterial wilt and tylev disease tolerant tomato lines

M S Alam, M A Goffar and M M R Salim

A regional yield trial of two selected advance disease tolerant tomato lines with BARI Tomato - 14 was conducted at the experimental field of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur, Bangladesh and three regional stations



viz. Jamalpur, Burirhat, Ishurdi during the winter season of 2022-23 to assess the regional yield performance of the selected lines. Two selected tomato lines viz. AVTO 1229 and AVTO 1317 were tested with BARI tomato-14 as check. Fruit number per plant was varied from 25 to 47. The highest (47) number of fruits was counted in AVTO-1317 followed by AVTO-1229 (43). Average fruit weight was ranged from 74 to 91 g among the studied lines, where the highest (91 g) weight was measured in the line AVTO-1317 the lowest fruit weight was observed in check variety BARI Tomato-14 (74 g). Studied lines showed the uniformity in fruit size. The highest fruit length (6.02 cm) and diameter (6.21 cm) was recorded from the line AVTO-1317. The maximum fruit yield per plant was obtained from the line AVTO-1317 (3.40 kg) followed by AVTO-1229 (3.08 kg) while the lowest fruit yield per plant was recorded from the check variety BARI Tomato-14 (1.86 kg). Corresponding per hectare yield showed the similar trend. The maximum yield per hectare was obtained from the line AVTO-1317 (92.52 t) followed by AVTO-1229 (88.40 t) while the lowest yield was recorded from the check variety BARI Tomato-14 (40.25 t). 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 32%. 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.

#### **Development of year-round production packages of cherry tomato under protected and open field**

M.A. Goffar, M.S. Alam, M. R. Karim and P. Hanson

A yield trial of 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 winter season of the year of 2022-23 under net house and open field to assess the yield potentiality, pest and disease reaction and adaptability. The selected (selection was made in the year of 2012-2013 onward) WVC supplied tomato line viz.: SL0068 was considered for this

study, while BARI Tomato-11 was used as check. The seeds of the above-mentioned lines and variety were sown in the on-3rd week of October 2022 and May 2022. Thirty days old seedlings were transplanted in the main plot and under net house. 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 fruit number per plant varied from 173.0 to 147.0. The highest fruit yield per hectare obtained from SL0068 (63.75 tons), while BARI Tomato-11 gave 48.23 tons per hectare. No virus and bacterial wilt found to be infected in the field.

#### **Effect of grafting and mulching method on growth, yield and quality of summer tomato**

M Nazim Uddin, M A R. Gazi and AKM Quamruzzaman

The experiment was conducted at Olericulture Division under BARI during April to October 2022. BARI Hybrid Tomato-8 was used in this experiment. The experiment was laid out in RCB design with four replications. There were six treatments viz. T<sub>1</sub>= No Mulch + Non grafting, T<sub>2</sub>= Polythene Mulch + Non-Grafting, T<sub>3</sub>= Straw Mulch + Non-Grafting, T<sub>4</sub>= No Mulch + Grafting, T<sub>5</sub>= Straw Mulch + Grafting, and T<sub>6</sub>= Polythene Mulch + Grafting. The unit plot size was 1.2 m × 4 m with plant spacing of 60 cm × 40 cm. Twenty-five days old non-grafted and grafted seedlings were transplanted during June to September, 2022. The tested variety was BARI Hybrid Tomato-8 (BHT-8). Significant variations on yield and other related traits were observed among the tested location. It was revealed that non-grafted plant contributed to higher fruit yield over the grafted plants. Mulching has a positive yield response over the non-mulch condition. Between the polythene mulch and straw mulch, straw mulch facilitated higher yield over the polythene mulch. Grafted plants with mulching provided higher fruit yield over non-grafted plants without mulch treatment. The results suggest that grafted plants with mulching exhibited positive response on summer tomato production. However, the trial should be repeated next season with intensive observation and uniform data set across the testing location to

obtain conclusive results. The results revealed that grafted plants with mulching provided higher fruit yield over non-grafted plants without mulch treatment. The results suggest that grafted plants with mulching exhibited positive response on summer tomato production. However, the trial should be repeated next season with intensive observation and uniform data set across the testing location to obtain conclusive results.

#### **Effect of sowing time on the growth and yield of summer tomato**

A Akter, M A Hossain, H Rahman, R Sultana and H E M K Mazed

The experiment was conducted at Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during 2022-23 to find out the suitable sowing time and to increase production and economic return. Three sowing times viz.,  $S_1$ = 1<sup>st</sup> week of January,  $S_2$ = 1<sup>st</sup> week of May and  $S_3$ = 1<sup>st</sup> week of August considered as factor A and tomato variety viz.,  $V_1$ = BARI Hybrid Tomato-8,  $V_2$ = BARI Hybrid Tomato-10,  $V_3$ = BARI Hybrid Tomato-11 and  $V_4$ =Beautiful were considered as factor B. The experiment was laid out in RCBD (Factorial) with three replications. The yield of tomato was significantly affected by different sowing time and tomato varieties. Maximum number of fruits per plant (34) was found from BARI Hybrid Tomato-11 with 1<sup>st</sup> week of August sowing combination ( $S_3V_3$ ) and minimum number of fruits per plant (21) was found from Beautiful with 1<sup>st</sup> week of January sowing combination ( $S_1V_4$ ) and  $S_2V_4$ . BARI Hybrid Tomato-11 with 1<sup>st</sup> week of August sowing combination ( $S_3V_3$ ) was suitable combination for maximum yield of summer tomato (2.19 kg/plant and 45.69 t/ha)

#### **Maintenance of BARI released op and parent's of hybrid tomato varieties**

M.A. Goffar and M.R. Karim

A study was carried out at the experimented field of Olericulture Division of HRC, BARI, Gazipur during winter season of 2022-23. In this study, parents/inbred of four tomato hybrid varieties (BARI Hybrid Tomato-4, Hybrid Tomato-5, Hybrid Tomato-8, & Hybrid Tomato-9) and three OP tomato varieties (BARI Tomato-2, BARI Tomato-14 and BARI Tomato-15) were included. The seeds of these tomato entries were sown in the seedbed on October 25, 2022. 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). Seeds of selfed fruits have been preserved in cold storage at 8°C temperature. This procedure will be done in the next year with the preserved seed.

#### **Effect of rootstock on tomato grafting against bacterial wilt**

S Sultana, T H Tabassum, M A Siddiky And M O Kaisar

Two BW resistant BARI released brinjal varieties-BARI Begun-8 & BARI Begun-10 and one wild species were evaluated as rootstocks for grafting with three BARI released popular tomato varieties as scion under open field conditions. BARI Begun-8 were the best compatible with BARI Hybrid Tomato-4 (90.67%) and BARI Hybrid Tomato-11 (94.03%) as rootstock whereas BARI Hybrid Tomato-8 were found more compatible with BARI Begun-10 (88.10%). The lowest wilting was observed in both BARI Hybrid Tomato-4 and BARI Hybrid Tomato-8 while grafted with BARI Begun-8 (8.33%). Similar to graft compatibility, BARI Hybrid Tomato-8 were found to be less susceptible while grafted with BARI Begun-10 (4.17%) compared to other treatments. Overall, BARI Begun-8 performed better as rootstock in all cases but BARI Hybrid Tomato-8 were found more compatible with BARI Begun-10. Further studies are needed to confirm the field performance.

#### **Effect of stem pruning and different staking methods on growth and yield of tomato**

M.R. Islam, S. Hasna, S.D. Setu, M.G. Rahman and B.C. Kundu

The experiment was conducted at the Horticultural field of Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during 2022-23 to evaluate the response of stem pruning and different staking method on growth and yield of tomato. The treatments consisted of a factorial combination of two staking methods and four levels of pruning, laid out in RCBD with three replications. Plants were pruned to allow two branches ( $B_2$ ), allow three branches ( $B_3$ ) and allow four branches ( $B_4$ ) with no pruning ( $B_1$ ) as control. Plants were staked on single method of staking ( $S_1$ ) and Triangle method of staking ( $S_2$ ). Types of staking had not

much influence on plant height but plant height varied significantly for stem pruning and the treatment B<sub>4</sub> were the tallest (95.49cm) followed by B<sub>3</sub> (91.35cm) and B<sub>2</sub> (89.39cm) treatment while B<sub>1</sub> (no pruning) was the shortest (80.47cm). Four stems plants significantly increased plant height followed by pruning treatment of three stems per plant and two stems per plant, while the non-pruned plants were the poorest. Fruits per plant were found to be statistically significant as influenced by stem pruning. The plants allowed with four stems produced the highest fruits per plant (23.83) and the lowest from the plants pruned with no pruning (18.35). Number of fruits per plant varied remarkably with staking type. The maximum fruits per plant (28.75) were obtained from the treatment S<sub>2</sub> and the minimum were recorded from single staking methods (18.46). Combined effects of staking type and stem pruning showed wide variation in this parameter. It was maximum in the plants managed by combination S<sub>2</sub>B<sub>4</sub> (29.34) followed by combination S<sub>2</sub>B<sub>2</sub> (28.07) and S<sub>2</sub>B<sub>3</sub> (26.97). Individual fruit weight: Individual fruit weight was significantly the largest with S<sub>2</sub> treatment (85.74g) and the lowest with S<sub>1</sub> treatment (74.16g). Stem pruning had the much influence on individual fruit weight. Significantly the highest weight of fruit was obtained from the plant with four stems (72.76g) and the lowest from allow two stem treatment B<sub>2</sub> (63.34 g). Plants grown on combination S<sub>2</sub>B<sub>4</sub> (74.31g) gave the maximum weight of single fruit. Significantly the highest yield (73.57 t/ha) was measured from triangle method of staking i.e. S<sub>2</sub>, while the lowest yield (55.65 t/ha) from single staking method i.e. S<sub>1</sub>. The highest total yield (69.86 t/ha) was obtained from the treatment allow four stem and the lowest (59.62 t/ha) with no pruning. The combination S<sub>2</sub>B<sub>4</sub> produced the highest yield (82.93 t/ha) followed by combination S<sub>2</sub>B<sub>3</sub> (74.57 t/ha) and the combination S<sub>1</sub>B<sub>1</sub> produced the lowest (51.29 t/ha) which was statistically similar to S<sub>1</sub>B<sub>3</sub> (52.86 t/ha) and S<sub>1</sub>B<sub>2</sub> (56.41 t/ha). Plants managed by triangular staking method allowing four stems produced significantly the highest number of fruits per plant and yielded the highest.

## Sweet Pepper

### Observational yield trial of sweet pepper germplasm

MR Karim, Limu Akter, and AKM Quamruzzaman

The experiment was conducted at the experimental field of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur. During the winter season of 2022-23 to evaluate ten sweet pepper germplasm CA0022, CA0024, CA0030, CA0031, CA0033, CA0034, CA0036, CA0038, CA0039 and BARI Mistimorich-1 included as check with a view to search new promising line. The experiment was laid out in RCB design with three replications. The unit plot size was 3.0 m × 1.0 m accommodating 14 plants in each plot having 50 cm × 40 cm plant spacing. For proper growth and production plants were established under tunnel cover which is effective because at night sweet pepper plants covered with nylon net (60 mesh) and polythene shed to prevent cold injury and enhance proper growth and production. The line CA0034 was possessed the maximum number of fruit per plant (20.25) followed by CA0022 (16.32). Average fruit weight was the highest in CA0038 (64.04 g) followed by the line CA0033 (59.25 g). The highest yield/plant was recorded in CA0038 (902.58 kg) and the lowest was obtained by the line CA0024 (609.87 kg). Significant variation in respect to yield among the lines, the line CA0038 gave the highest yield (45.13 t/ha) followed by CA0033 (36.23 t/ha), whereas the lowest yield was obtained from CA0036 (29.66 t/ha). Considering fruit yield and other character five line were selected for advanced yield trial in the next year.

### Advanced yield trial of sweet pepper lines

Limu Akter, A.K.M. Quamruzzaman and M.R. Karim

The experiment was conducted at the experimental field of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur. During the winter season of 2022-23 to evaluate the selected sweet pepper lines for developing a new variety. Six sweet pepper lines and BARI Mistimorich-1 as check was included in the study. Seeds were sown in the seed bed on 8 October, 2022. Ten days after sowings seedlings attained 2-3 leaf stage, after that transferred to the polybag each was 12.75 □ 10.15



cm size and filled with potting media comprising soil. Thirty days-old healthy seedlings were transplanted in the experimental plots on 7 November, 2022. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. For proper growth and production plants were established under tunnel cover which is effective because at night sweet pepper plants covered with nylon net (60 mesh) and polythene shed prevent cold injury and enhance proper growth and production. Significant variation was found in case of days to 50 % flowering among the germplasm. CA0042A-2 responded to earliest flowering (11.85 DAP) which was the desired character in this aspect. Earlier harvest was recorded from the line genotype CA0044A (39.11 DAP). The line CA004-11 was possessed the maximum number of fruits per plant (17.44) followed by CA0042A-2 (16.07). The highest average fruit weight was in CA0044A (103.21g) followed by the check variety (79.54 g). The line CA0042A-2 possessed the highest fruit length (16.21 cm). Per plant yield was highest in CA0044A (850.05g). Significant variation in respect to yield among the lines, where the line CA0044A gave the highest fruit yield (42.50 t/ha) followed by CA0042A-1 (39.46t/ha) and CA004-11 (39.32t/ha). CA0042A-1, CA004-11 and CA0042A-2 line may be selected for further evaluation in the next year for Regional yield trial.

#### Regional yield trial of sweet pepper lines

Limu Akter, A.K.M. Quamruzzaman and M. Moniruzzaman

An experiment was conducted with four sweet pepper line with a check (BARI Mistimorich- 2) at the central Experimental farm of Olericulture Division, Horticulture Research Centre (HRC), Gazipur; RARS, Hathazari, Chattogram and RARS, BARI, Jamalpur, Bangladesh Agricultural Research Institute (BARI), from October 2022 to April 2023. Ten days after sowings seedlings attained 2-3 leaf stage, after that transferred to the polybag each was 12.75 × 10.15 cm size and filled with potting media comprising soil. Thirty days-old healthy seedlings were transplanted in the experimental plots on 7 November, 2022. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. For proper growth and production plants were established under tunnel cover which is effective because at night

sweet pepper plants covered with nylon net (60 mesh) and polythene shed prevent cold injury and enhance proper growth and production. The shortest day (64.05) required for harvesting by the line CA 0046. The highest number of fruits/plant obtained from CA 0044 (9.43) followed by CA 0042A (8.76) and the lowest in BARI Mistimorich-2 (7.52). Highest average fruit weight was obtained from the line CA 0044 (106.32g). The average per plant yield varied from 0.48 to 0.59 kg. The highest yield/plant was obtained from the line CA 0046, whereas the lowest was from the line CA 0043A. The yield (t/ha) was varied from 24.21 to 29.07 t/ha. The highest average yield per hectare was produced by CA 0046 (29.07 ton). The lowest yield per hectare was obtained from CA 0043A (24.21 ton). The fruit colour of CA 0042A was orange red which turned into yellowish at mature stage whereas CA 0046 had the red color fruits turned at the mature stage. Only two categories of fruit shape were found among the varieties under study. CA 0042A produced fruits with conical shape while rest of the varieties had the bell shape fruits. Very minimum infestation of fruit borer, white fly and mite were observed in tested lines/varieties. This was the second year experiment; it will be continued for next year as RYT.

#### Heterosis study in sweet pepper

Limu Akter, A.K.M. Quamruzzaman and M.R. Karim

The study was conducted with twenty-eight hybrids along with their eight parents and standard hybrids at the farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2022-23 to develop new high yielding hybrids. The experiment was laid out in a Randomized Complete Block Design (RCB) with three replications. The unit plot size was 3.2 × 1.0 m and the plants were placed at 50 × 60 cm there were sixteen plants in a unit plot. Average degree of heterosis (ADH%) was estimated as the increase or decrease percent of F1 performance based on standard heterosis = (mean of F1 – mean of standard check variety / mean of standard check variety) × 100. Where F1 was the mean performance of the F1 hybrid. Significant heterotic effects were observed in a number of cross combinations for all the characters studied. The outstanding crosses were  $P_1 \times P_2$ ,  $P_1 \times P_3$ ,  $P_1 \times P_5$ ,

$P_2 \times P_3$ ,  $P_2 \times P_4$ ,  $P_2 \times P_5$ ,  $P_2 \times P_7$ ,  $P_3 \times P_4$ ,  $P_3 \times P_5$ ,  $P_3 \times P_7$ ,  $P_4 \times P_5$ ,  $P_4 \times P_6$ ,  $P_4 \times P_7$ ,  $P_4 \times P_8$ ,  $P_5 \times P_8$ ,  $P_6 \times P_7$ ,  $P_7 \times P_8$  (days to 50 percent flowering);  $P_1 \times P_2$ ,  $P_1 \times P_3$ ,  $P_1 \times P_5$ ,  $P_1 \times P_6$ ,  $P_1 \times P_8$ ,  $P_2 \times P_3$ ,  $P_2 \times P_4$ ,  $P_2 \times P_5$ ,  $P_2 \times P_7$ ,  $P_2 \times P_8$ ,  $P_3 \times P_4$ ,  $P_3 \times P_5$ ,  $P_3 \times P_8$ ,  $P_4 \times P_7$ ,  $P_5 \times P_6$ ,  $P_5 \times P_8$ ,  $P_6 \times P_7$ ,  $P_6 \times P_8$ ,  $P_7 \times P_8$  (days to first harvest);  $P_2 \times P_7$ ,  $P_3 \times P_4$ ,  $P_3 \times P_5$ ,  $P_4 \times P_5$ ,  $P_4 \times P_8$ ,  $P_5 \times P_8$  (number of fruits per plant);  $P_4 \times P_7$  (fruit length);  $P_1 \times P_5$ ,  $P_2 \times P_4$ ,  $P_2 \times P_6$ ,  $P_2 \times P_8$ ,  $P_4 \times P_8$ ,  $P_5 \times P_7$ ,  $P_5 \times P_8$  (fruit diameter);  $P_1 \times P_4$ ,  $P_4 \times P_5$ ,  $P_4 \times P_6$ ,  $P_5 \times P_8$ ,  $P_6 \times P_7$  (average fruit weight);  $P_1 \times P_3$ ,  $P_2 \times P_3$ ,  $P_3 \times P_4$ ,  $P_3 \times P_6$ ,  $P_4 \times P_5$ ,  $P_4 \times P_6$ ,  $P_4 \times P_8$ ,  $P_5 \times P_6$ ,  $P_5 \times P_8$ ,  $P_6 \times P_7$ ,  $P_6 \times P_8$  (fruit yield per plant);  $P_1 \times P_2$ ,  $P_1 \times P_3$ ,  $P_1 \times P_4$ ,  $P_1 \times P_5$ ,  $P_1 \times P_6$ ,  $P_2 \times P_3$ ,  $P_2 \times P_4$ ,  $P_3 \times P_5$ ,  $P_3 \times P_6$ ,  $P_3 \times P_7$ ,  $P_4 \times P_5$ ,  $P_4 \times P_6$  and  $P_5 \times P_8$  (fruit yield t/ha); may be considered for further field evaluation for better hybrid selection.

### Performance of sweet pepper hybrids

Limu Akter, A.K.M. Quamruzzaman and M.R. Karim

Five  $F_1$ 's of sweet pepper ( $P_1 \times P_2$ ,  $P_1 \times P_5$ ,  $P_2 \times P_3$ ,  $P_1 \times P_7$  and  $P_6 \times P_8$ ) with a check ( $F_1$  Syam) were evaluated at the farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the winter season of 2022-23. Thirty days old seedlings were transplanted in the main field on 10 November, 2022. The experiment was laid out in a RCB design with three replications. The unit plot size was 3.0 m  $\times$  1.0 m accommodating 16 plants in each plot having 50 cm  $\times$  40 cm plant spacing. For proper growth and production plants were established under tunnel cover which is effective because at night sweet pepper plants covered with nylon net (60 mesh) and polythene shed prevent cold injury and enhance proper growth and production. There was significant difference in days to harvest and the duration of harvest was 65-75 days. The  $P_1 \times P_2$  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 breadth, the tallest fruit with the highest breadth observed in  $F_1$  Syam was 8.90 and 7.02 cm, respectively. The  $P_2 \times P_3$  took the minimum days to 1st harvest (68.00 days). The highest number of fruits per plant (7.95) was recorded from  $P_2 \times P_3$ . The heaviest fruits (176.67g) were obtained from  $P_1 \times P_2$ . Fruit weight per plant was found maximum

(1.30kg) in  $P_2 \times P_3$  followed by the  $P_1 \times P_2$  (1.06kg) and  $P_1 \times P_5$  (1.02kg). The highest yield was produced by  $P_2 \times P_3$  (36.24 t/ha). The hybrids  $P_2 \times P_3$ ,  $P_1 \times P_5$  and  $P_1 \times P_7$  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

Limu Akter, A.K.M. Quamruzzaman and M. Moniruzzaman

This study of four selected  $F_1$ 's of sweet pepper ( $P_2 \times P_6$ ,  $P_3 \times P_7$ ,  $P_6 \times P_8$  and  $P_8 \times P_{10}$ ) with a check was conducted at the farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur and RARS Hathazari, Chattogram during the winter season of 2022-23. Seeds were sown on seed bed on 4th October, 2022. Ten days after sowings, seedlings attained 2-3 leaf stage, after that transferred to the polybag (12.75  $\times$  10.15 cm) having potting media comprising soil. Thirty days-old healthy seedlings were transplanted in the field on 3rd November 2022. The experiment was laid out in a Randomized Complete Block Design (RCB) with four replications. Treatment means were compared by LSD for interpretation of results. The earliest flowering was observed in the line  $P_2 \times P_6$  (30.31days) and that was the delayed in  $F_1$  (Star) (39.34days). The highest individual fruit weight was found in  $P_3 \times P_7$  (152.13 g) and the lowest was found in  $P_8 \times P_{10}$  (78.00 g). The highest fruit bearing line was  $P_6 \times P_8$  (19.00) followed by  $P_8 \times P_{10}$  (18.66), while that was the lowest in  $F_1$  (Star) (7.09). Average fruit yield per plant as well as per hectare was maximum in  $P_2 \times P_6$  (1.48kg and 40.42t) and the line  $F_1$  (Star) showed minimum fruit yield 0.72kg/plant and 25.12t/ha, respectively. Minimum white fly infested fruits were recorded in  $P_2 \times P_6$  (1.10%) and maximum infested fruits were recorded from  $F_1$  (Star) (2.02%). Minimum mite infested fruits were recorded in  $P_6 \times P_8$  (1.12%) and maximum infested fruits were recorded from  $F_1$  (Star) (1.51%). Among these lines, two hybrids  $P_2 \times P_6$ ,  $P_6 \times P_8$  were found promising for earliness, high yield, color variation and insect pest reaction. So from the three years regional trial, these two hybrids may be recommended for releasing a variety.

### Effect of different mulches on growth and yield of sweet pepper

M. A. Habib, M.A. Sumi, M. S. Alam and M. H. Hossain

This experiment was conducted at the experimental field of RARS, BARI, Moulvibazar during the Rabi season of the year of 2022-23 to assess the effect of different mulches on growth and yield of sweet pepper. Five mulching treatments viz. T<sub>1</sub>= Silver over black polythene mulch paper, T<sub>2</sub>= white polythene mulch paper, T<sub>3</sub>= dry rice husk mulch, T<sub>4</sub>= water hyacinth mulch and T<sub>5</sub> = control (no mulch) and variety BARI Mistrimorich-2 were used for this study. All the mulching treatments significantly influenced the studied parameters except days to 50% flowering, fruit length and fruit diameter. The highest plant height (34.78 cm) was recorded in T<sub>3</sub> (dry rice husk) treatment and the lowest plant height (27.22cm) was recorded in T<sub>5</sub> (control) treatment. The highest number of fruits per plant (10.16) was observed in T<sub>1</sub> followed by (9.80) in T<sub>4</sub> treatment. The lowest number of fruits per plant (6.16) was observed in T<sub>5</sub>. Maximum single fruit weight (85.66g) was obtained from T<sub>1</sub> and T<sub>4</sub> treatment and minimum (69g) from T<sub>5</sub> treatment. The highest fruit yield (28.30 t ha<sup>-1</sup>) was recorded in T<sub>1</sub> (Silver over black polythene) treatment followed by (27.66 t ha<sup>-1</sup>) was recorded in T<sub>4</sub> (water hyacinth) and lowest yield (14.77 t ha<sup>-1</sup>) was recorded in T<sub>5</sub> (control) treatment.

## Bottle gourd

### Regional yield trial of bottle gourd

Akm Quamruzzaman, L. Akter and S. Akter

A study on the performance of five bottle gourd lines with BARI Lau-4 was conducted at the experimental field of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur along with different RARS (Jamalpur, Hathazari, Moulvibazar, Rahmatpur, Jashore) of Bangladesh. As part of bottle gourd breeding programme, a large number of germplasm were collected and evaluated in last five years. From those findings, five advanced lines were selected and need to be evaluated this year in different regional stations of the Bangladesh Agricultural Research Institute (BARI). During the winter season of 2022-23 to develop new high

yielding OP bottle gourd varieties. Twenty days old seedlings were transplanted in the main field on 10 October, 2022. The experiment was laid out in a Randomized Complete Block design with three replications. The unit plot size was 10.0 x 2.0 m maintaining 2.0 x 2.5m spacing and 0.5m drain. Plot means for six quantitative characters were used for the statistical analysis. Significant variation was observed in all parameters in this study. The range for days to 1<sup>st</sup> harvest was 80.33-84.33 days, while the range for number of fruits/ plant was 5.90-10.67 and for average fruit weight it was 1.77-2.43kg. The fruit length and diameter ranges were 25.73–39.50cm and 10.30–16.27 cm, respectively. Highest yield (t/ha) was produced by LS 232 (51.57t/ha), followed by BARI Lau-4 (44.90t/ha), LS 231 (40.93t/ha) in Gazipur condition. On the other hand, the lowest yield was calculated in LS 154 (30.16t/ha) over 6 locations. In the case of mean fruit yield over 6 locations, the line viz., LS 232 performed well, so this line can be selected for release as new bottle gourd OP variety.

### Heterosis study in bottle gourd hybrids

Akm Quamruzzaman, L. Akter and S. Akter

A study was conducted in thirteen bottle gourd hybrids to estimate the magnitude of standard heterosis for six yield and its yield related components. Thirteen hybrids 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 2022-23. Twenty days old seedlings were transplanted in the main field on 20 October 2022. The experiment was laid out in a Randomized Complete Block design with three replications. The unit plot size was 10.0 x 2.0m, maintaining 2.0 x 2.5m spacing and a 0.5m drain. The significance of increase or decrease in F<sub>1</sub> hybrids over standard hybrid "Daiana" was tested by comparing their means with the help of appropriate standard error values in percentage. The formula followed for standard heterosis was = (F<sub>1</sub> - standard variety/standard variety) x 100, where F<sub>1</sub> was the mean performance of the F<sub>1</sub> hybrid. Appreciable standard heterosis was found over thirteen hybrids for all the traits studied. . In the case of days to 1st harvest, only three hybrids (F<sub>1</sub> 146x2, F<sub>1</sub> 171x3, F<sub>1</sub> 231x232) showed significant negative standard heterosis, indicating



early harvest, while the range was -2.41 to 4.82%. There was significant variability observed among the thirteen bottle gourd hybrids. Three hybrids (F<sub>1</sub> 146x2, F<sub>1</sub> 171x3, F<sub>1</sub> 231x232) showed significant negative standard heterosis for days to 1st harvest. The range of significant standard heterosis for average fruit weight was 5.0 to 15.0 per cent, while for fruit length and fruit diameter was 6.06 to 21.21 per cent and 9.09 to 27.27 per cent, respectively. Six hybrids showed significant positive heterotic response for fruit yield and the range was 10.00 to 27.78 per cent. The higher significant positive standard heterosis was observed in hybrids F<sub>1</sub> 1x2, F<sub>1</sub> 231x232 (16.67%), F<sub>1</sub> 3x232 (27.78%). Considering yield contributing characters, the hybrids F<sub>1</sub> 1x2, F<sub>1</sub> 231x232, F<sub>1</sub> 3x232 were found promising and may be recommended for farther evaluations.

#### **Regional yield trial of bottle gourd hybrids**

AKM Quamruzzaman, L. Akter and S. Akter

The performance study of five bottle gourd hybrids was conducted at the experimental field of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur along with different RARS (Hathazari, Rahmatpur, Jashore) of Bangladesh during the winter season of 2022-23 to develop new high yielding bottle gourd hybrid varieties. Twenty days old seedlings were transplanted in the main field on 30 October, 2021. The experiment was laid out in a Randomized Complete Block design with three replications. The unit plot size was 10.0 x 2.0 m maintaining 2.0 x 2.5m spacing and 0.5m drain. Data on days to first harvest, fruit number/ plant, average fruit weight (kg), fruit yield (kg/plant), fruit length (cm), fruit diameter (cm), fruit yield (t/ha), fruit shape, and fruit color were recorded from three randomly selected plants per plot. Significant variation was observed in all parameters and the data on yield, yield contributing characters are shown in Table 1. The range for days to 1st harvest was 79.33-81.67 days. In Gazipur, the highest number of fruits per plant was produced by F<sub>1</sub> B4xB3 and Diana (10.83) followed by F<sub>1</sub> B3xB4 (10.50), while the maximum average fruit weight was produced by F<sub>1</sub> B4xB3 (2.23 kg). The highest fruit yield per hectare was produced by F<sub>1</sub> B4xB3 (48.03), followed by F<sub>1</sub> B3xB4 (45.50t/ha) and Diana (44.03 t/ha). In case of mean performance over 4 locations, the range of fruit

yield of bottle gourd hybrids was 56.05-61.51t/ha, while the higher per hectare fruit yield was recorded from F<sub>1</sub> 155xB2, F<sub>1</sub> B4X B3 over 4 locations. Fruit length and diameter ranged from 33.00 cm (Diana) to 36.0 cm (F<sub>1</sub> B4xB3) and from 10.77 cm (F<sub>1</sub> B3xB4) to 11.40 cm (F<sub>1</sub> B4xB3), respectively. Considering yield potentiality, fruit color, acceptable fruit shape one hybrid viz., F<sub>1</sub> B4xB3 was found promising and may be released as new bottle gourd hybrid variety.

#### **Maintenance of BARI Lau-4 variety**

AKM Quamruzzaman, L. Akter and S. Akter

A study was carried out on maintenance of bottle gourd variety (BARI Lau-4) at the experimented field of Olericulture Division of HRC, BARI, Gazipur during winter season of 2022-23. Twenty days old seedlings was transplanted in the main plot on October 25, 2022. There was 100 plants of that variety. The single unit plot size was 20.0X2m, while 10 plots were accommodated. The crop was fertilized with organic manure, N, P, K, S, B and Zn @ 10000, 80, 45, 88, 25, 1.8 and 4.5 kg/ha, respectively. Three times roughing were conducted during the different growing and developmental stages. All the female flowers were selfed with desire pollen flowers, while the selfed fruits were tagged. Seeds of selfed fruits have been collected carefully and preserved in the cold storage at 8°C temperature.

### **Water melon**

#### **Observational yield trial of water melon**

AKM Quamruzzaman, L. Akter and M.R. Karim

The study was conducted at the experimental field of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur. During the summer season of 2022 to assess the yield and pest-disease performances of 18 water melon lines/ varieties. The seeds of these materials were sown on the polyplot on 15 July, 2022. Twenty days old seedlings were transplanted in the main field on 05 August, 2022. The experiment was laid out in a Randomized Complete Block design with two replications. Plot means for 11 quantitative characters were used for the statistical analysis. Significant variation was observed in this study, while the number of fruit per plant and single fruit

weight were varied from 2.3 to 5.7 and 3.0 to 6.1kg, respectively. The yield and yield contributing performance are discussed herewith. Vine length of watermelon, if left undisturbed, can attain lengths of 3.60 to 4.80 m, and changes in vine length may impact number of leaves, flowers, and fruit number and weight. Vine length and branch number of watermelon plants were varied ranged from 3.0 to 4.1m and 3.6 to 7.3, respectively. Flesh thickness and rind thickness range were 11.5 to 30.0cm and 0.7 to 1.6cm, respectively. The fruit length and fruit diameter were also varied among the lines according to size of the fruit, which was 24.5 to 46.2cm and 13.3 to 32.4cm, respectively. The total soluble solid (TSS) is one of the important character to choose a good quality variety, which was varied 9.50 to 12.60%. The fruit yield per hectare was varied from 30.38 to 48.97 ton. The fusarium wilt and stem blight infection (%) were observed with a range of 0 to 30% and 0 to 10%, respectively, while the thrips and mite infestation were with a range of 0 to 15% and 0 to 10%, respectively in the field condition. Considering number of fruits per plant, single fruit weight, flesh thickness, rind thickness, TSS (%) and fruit yield eight watermelon line viz., CL11B, CL11E, CL12B, CL12C, CL13, CL14, CL15, and CL16 were selected for next watermelon breeding program.

### Heterosis study of watermelon hybrids

AKM Quamruzzaman, L. Akter and Mr. Karim

A study was conducted in watermelon to estimate the magnitude of standard heterosis for yield and its ten yield related components of eight crosses along with commercial standard variety (Sweet Baby) in a Randomized Block Design with three replications at the Olericulture Division, Horticulture Research Center (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh during the summer season of 2022. Appreciable standard heterosis was found over standard variety (Sweet Baby) for all the traits studied in desirable direction. Twenty days old seedlings were transplanted in the main field on 05 August, 2022. The experiment was laid out in a Randomized Complete Block design with two replications. The unit plot size was 10.0 x 2.0m maintaining 1.5 x 2.3m spacing and 0.3m drain. The land was fertilized with organic manure, N, P, K, S, B and Zn. The significance of increase or decrease in F1

hybrids over standard commercial hybrid (Sweet Baby) was tested by comparing their means with the help of appropriate standard error values in percentage. The formula followed for standard heterosis was  $= (F_1 - \text{standard variety} / \text{standard variety}) \times 100$ , where F1 was the mean performance of the F1 hybrid. In the case of vine length, only three hybrids (F1 3×5, F1 7×5, F1 8×21) showed significant positive standard heterosis, indicating bigger sized plant, while the range was 2.63 to 5.26%, while the range for branch number was 6.67 to 24.44%. Higher significant positive standard heterosis for the number of fruits per plant was produced by F1 1×4 (27.14%), F1 7×8 (18.57%), F1 8×21 (15.71%), while it was 2.44 to 4.88 for average fruit weight. The range of positive standard heterosis for flesh thickness and rind thickness was 3.02 to 6.92% and 7.14 to 14.29%, respectively, while it was 1.85 to 8.33% for TSS. Five hybrids for fruit yield showed significant positive standard heterosis, while the range was 1.85 to 30.24 %. The higher significant positive standard heterosis was observed in hybrids F1 1×4 (30.24%), F1 8×21 (18.54%), F1 7×3 (12.86%). Considering yield contributing characters, the hybrids F1 1×4, F1 8×21, F1 7×3 were found promising and may be recommended for RYT.

### Inbred development of watermelon [S3-S4]

AKM Quamruzzaman, L. Akter and M.R. Karim

Eight watermelon lines were selected from different watermelon lines on the basis of number of fruits per plant, individual fruit weight, fruit shape, color, flesh color which was evaluated in Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during the summer season of 2022. Twenty days old seedlings were transplanted in the main field on 05 August, 2022. The experiment was laid out in a Randomized Complete Block design with two replications. The unit plot size was 10.0 x 2.0m maintaining 1.5 x 2.3m spacing and 0.3m drain. The land was fertilized with organic manure, N, P, K, S, B and Zn. Data on number of fruits/plant, single fruit weight (kg), fruit yield/ plant (kg), fruit yield (t/ha), fruit length (cm), fruit diameter (cm), TSS (%), rind thickness (cm), taste, crispiness, fruit shape, flesh color, fruit color were recorded from three randomly selected plants per plot. This experiment was designed to identify

the good quality watermelon lines having more fruit number and higher yield as well as with attractive fruit shape, size, color and also flesh color and higher TSS. Vine length and branch number of watermelon plants were varied ranged from 2.9 to 4.4m and 3.8 to 6.5, respectively. The number of fruit per plant and single fruit weight were varied from 3.2 to 4.8 and 3.3 to 5.2kg, respectively. Flesh thickness and rind thickness were important character, which range was 13.2 to 24.7cm and 0.85 to 1.4cm, respectively, while the total soluble solid (TSS) was varied 10.3 to 11.5%. The fruit yield per plant and fruit yield per hectare were varied from 14.44 to 17.16 kg and 40.43 to 48.05 ton, respectively. All the lines were selected considering the yield and yield contributing characters as well their attaining homozygosity. So these lines may be used for breeding purpose for developing quality watermelon variety.

## **Muskmelon**

### **Observation yield trial of musk melon lines**

K. M. M. Rahman, R. Akter and S. M. M. Rahman

Eleven lines collected and conducted a trial at the research field of Regional Horticulture Research Station, BARI, Shibpur, Narsingdi during the Kharif 1 season of 2023 with a view to develop a new variety. Significant variation was observed almost in all traits. The highest number of fruits per plant (10.00) was recorded from the line BD-2301. The highest identical fruit weight was observed from the line BD-2282 (1.95 kg). Significant variation was also observed in fruit length and breadth. The maximum flesh thickness (1.95 cm) was obtained from BD-2282 followed by BD-2301. Significantly the highest (TSS %) was recorded from BD-2282 (6.63%), BD-2266 (6.50%) and BD-2301 (6.36%) In case of texture, three lines showed sandy and eight lines showed crispy texture. Four line showed round shape and others were oval shaped. The line BD-2282 produced the highest fruit yield (19.54 t/ha) which was identical with BD-2301 (18.84 t/ha) and the lowest was produced by BD-11724(7.04 t/ha). Considering qualitative and quantitative parameters the line BD-2266, BD-2282 and BD-2301 may be selected.

### **Evaluation of year round muskmelon lines at hill valley of chattogram hill tracts**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

The experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23 to find out the suitable muskmelon lines which is year round in character to release as a variety and to utilize in future breeding program of muskmelon. According to fruit qualities and yield performance, among the three lines (CM Rai-009, CM Rai-013 and CM Rai-019), CM Rai-009 was found superior in terms of number of fruits per plant (6.7) and TSS (6%) with no crack on the fruit.

## **Sponge gourd**

### **Evaluation and characterization of sponge gourd germplasm**

Bahauddin Ahmed and A.R. Gazi

Ten sponge gourd genotypes (such as: LC001, LC002, C003(H), LC004, LC005, LC006, LC007, LC008, LC009, LC10) were evaluated at Olericulture Division, HRC, Bangladesh Agricultural Research Institute, Gazipur during the kharif season of 2022. The days to 1<sup>st</sup> female flower and node order to 1<sup>st</sup> female flower was ranged from 58 to 67 days and 25 to 34 nodes, respectively. It indicated that all the genotypes were late flowering. The highest length and breadth of fruits were found in genotypes LC005 (42 and 5cm, respectively). The range of fruit length and fruit breadth was 19.65 to 42.00 cm and 3.5 to 5.0 cm respectively. The individual fruit weight was highest in LC002 which was 270g and ranged of average fruit weight was 180.55 to 270.00g. The total number of fruits per plant was ranged from 52.00 to 91.65, which indicates the variation of the genotypes. The highest yield per plant was obtained from the genotypes LC003(H) which was 22.74kg per plant while the range was 13.10 to 22.74 kg. The yield per plant was also highest in LC003(H) and it was 36.52 ton per hectare. The fruit fly infestation was varied from 2 to 15% among the genotypes and the powdery mildew infection was 0 to 10%. Bitterness was absent in all the tested genotypes. The maximum genotypes were green in color but some of them are whitish in color. The virus infection was also less among the genotypes which were varied from 0-10%. Considering earliness, number of total fruits per plant, fruit



length, fruit breadth, yield per plant, insect and disease reaction the genotypes viz., LC001, LC003(H), LC004 and LC007 were found promising. So these genotypes will be used for advancing generation for future breeding purpose.

## Pumpkin

### Inbred development of pumpkin (S<sub>2</sub>- S<sub>3</sub> & S<sub>4</sub>- S<sub>5</sub>)

Bahauddin Ahmed and M.A.T. Masud

Six pumpkin lines were selected from different lines on the basis of individual fruit weight, flesh thickness and flesh color which were evaluated in Olericulture Division, HRC, BARI, Gazipur during the winter season of 2022 - 23 to develop superior pumpkin inbred lines. Days to 1<sup>st</sup> female flower open ranged from 50.50 to 63.45 days and the line CM12-1 required minimum days for days to 1<sup>st</sup> female flower open (50.50 days). All the lines were significant for days to 1<sup>st</sup> female flower open. The node order of 1<sup>st</sup> female flower was ranged from 9.55 to 13.00. The fruit length and fruit breadth was significantly varied among the different lines and the range of fruit length and fruit breadth was 10.90-52.15 cm and 14.15-23.60 cm, respectively. The flesh thickness was ranged from 2.45-4.30 cm and the line CM001-1-2-(A) showed the highest flesh thickness (4.30 cm). The average fruit weight was significantly differed among the lines. The highest average fruit weight was 6.50 kg from the line BD10063-1-1-7 and the ranged of average fruit weight was 1.12 to 6.50. The fruits per plant and the yield per plant were ranged from 2.5-5.0 and 5.6-19.5 kg, respectively. The highest yield per plant was observed from BD10063-1-1-7 (19.50kg) and the lowest yield per plant was observed from CM12-1 (6.72 kg). The line BD10063-1-1-7 gave the highest yield (39.00 t/ha) and the line CM12-1 showed the lowest yield (13.44 t/ha). The TSS ranged from 9 to 11%. The lines were in different shapes such as round, high round and elliptical. The deep orange type flesh color was dominant among the genotypes. Fruit fly infestation and virus incidence was also observed in these lines. Best individuals from every line were selected and selfed. Seeds of S<sub>3</sub>-S<sub>4</sub> and S<sub>5</sub>-S<sub>6</sub> progenies of pumpkin lines were stored for advancing S<sub>3</sub>-S<sub>4</sub> and S<sub>5</sub>-S<sub>6</sub> progenies in the next year.

### Development of inbred in pumpkin (Set-1: S<sub>2</sub> to S<sub>3</sub>)

S Sultana, T H Tabassum, M A Siddiky and M O Kaisar

The trial was conducted at RARS, BARI, Cumilla in winter 2022. Ten of pumpkin lines were advanced from S<sub>2</sub> generation to S<sub>3</sub> generation to develop variable inbred lines for hybrid production. Variations were found among the lines for the characters studied. In case of female flower opening, the genotype CM Cum 007.2.1 required the minimum days (63 DAS), in opposite to the check BARI Mistikumra -2 which took the maximum days (74 DAS). CM Cum 001.2.2 (33.18 kg), CM Cum 003.2.2 (37.58 kg), CM Cum 008.3.3 (31.53 kg) and CM Cum 009.2 (35.83 kg) gave the satisfactory yield/plant with good numbers of fruits compared to check (21.34 kg). Furthermore, the TSS% ranged from 4%-8.5%. CM Cum 016.1.3 possessed the highest TSS content (8.5%) followed by CM Cum 003.2.2 (7%) and CM Cum 008.3.3 (7%). Best individuals from every line were selected and selfed.

### Development of inbred in pumpkin (Set-2: S<sub>1</sub> to S<sub>2</sub>)

S Sultana, T H Tabassum, M A Siddiky and M O Kaisar

Eight pumpkin genotypes, collected from PGRC (Plant Genetic Resource Centre), BARI were advanced from S<sub>1</sub> generation to S<sub>2</sub> generation to develop variable inbred lines for hybrid production at RARS, BARI, Cumilla during rabi season, 2020-21. BD-2153 and BD-322 took only 61 days to induce 1<sup>st</sup> female flower. The highest no. of fruits per plant was found in BD-273 (9). BD-2150 produced the highest average fruit weight (7.1 kg) but no. of fruits was only 3 which was the best yield giver (17.22kg) followed by BD-268 (16.18kg). In addition, BD-309 (16.04 kg), BD-2153.1 (13.44 kg) and BD-2277 (13.43 kg) found promising and gave comparatively higher yield than BARI Mistikumra-2 (7.81 kg). The highest TSS content was found in BD-2153 and BD-273 (all possessed 7%). Best individuals from every line were selected and selfed.

**Hybridization in pumpkin employing saline tolerant and susceptible lines**

S Sultana, T H Tabassum, M A T Masud, M A Siddiky and M O Kaisar

The experiment was conducted at RARS, BARI, Cumilla during rabi season of 2022-23. During hybridization, two salt tolerant genotype (CM-5-4-12-6-3-9-3-3) & BARI Mistikumra-1 used as donor parents, one popular variety BARI Mistikumra-2 used as a recurrent parent and one susceptible line (CM-75-2-4-5-3-3-4-8) used as a check. The highest no. of fruits per plant was found in BARI Mistikumra-2 (11) and yield (19.20 kg/plant) as well. One of the salt tolerant varieties CM-5-4-12-6-3-9-3-3 produced the highest average fruit weight (2.58 kg) and no. of fruits was only 6 which yielded (15.49 kg/plant). Further backcrossing with respective recurrent parent and selfing will be performed to produce seed up to BC<sub>4</sub>F<sub>4</sub> generation. In every backcross generation, selection will be carried out based on salinity tolerance and similarity to the recurrent parent.

**Maintanance breeding of BARI hybrid Mistikumra -1 and BARI hybrid Mistikumra-2**

Bahauddin Ahmes and M.A.T. Masud

A study was carried out at the experimental field of Olericulture Division, HRC, BAR Iduring the winter season of 2022-23 to maintain the genetic purity of BARI developed two pumpkin hybrids (BARI HYBRID MISTIKUMRA -1 and BARI HYBRID MISTIKUMRA-2). Standard crop management practices were followed for crop production and standard selfing and crossing methods were also followed for seed production. Bagging followed by selfing and crossing was done properly. When the fruits were at mature stage the strong selection was done and marked the mature fruits at different categories such as: triple star (\*\*\*), double stat (\*\*) and single star (\*). While the mature fruits of the individual parent is excellent it ranked the \*\*\*, gradually all the fruits were categories to follow the methods. The fruits were harvested at full ripen stage and allow atleast seven days storage for post harvest ripening. After that the seeds were extracted, washed, dried, weighed and stored properly for future use. About 2.2 kg of BARI HYBRID MISTIKUMRA -1 and 2.6 kg of

BARI HYBRID MISTIKUMRA -1 seeds were produced. At the same time the appreciable amount selfed seeds were also produced the respective parents. Seeds of selfed and crossed fruits have been preserved in cool room at 8°C temperature. These seeds will be used for multiplying the next year and commercial use.

**Ridge gourd****Heterosis study in ridge gourd**

Bahauddin Ahmed, Mar Gazi and M At Masud

A study was conducted in ridge gourd hybrids to estimate the magnitude of standard heterosis for yield and its related components. Five hybrids were generated from four diverged parents which were evaluated in Randomized Complete Block Design with three replications at the Olericulture Division, Horticulture Research Centre (HRC) BARI GAZipur during kharif season of 2022. Standard heterosis in ridge gourd was studied in five hybrids of ridge gourd. Standard hybrid “Bahadur” was used to calculate the standard heterosis for yield and yield contributing characters of the hybrids. In case of 1<sup>st</sup> harvest all the hybrids showed significant negative heterosis, indicating early harvest, while the range was -1.55 to -4.20%. The range of positive heterosis of number of marketable fruits/plant was 11.05 to 36.10% which indicates the higher number of fruits. The highest significant positive heterosis was observed in hybrid 1 (36.10%). The range of positive heterosis of average fruit weight was -2.40 to 13.57% while hybrid 1 and hybrid 2 showed the more than 10% standard heterosis. The range of positive standard heterosis of fruit length and fruit breadth was -6.05 to 15.42 % and -4.10 to 3.22%, respectively. The highest significant positive standard heterosis for fruit length and fruit breadth was 15.42.0% and 3.22%, respectively in hybrid 1. All the tested hybrids except hybrid 4 showed the positive standard heterosis for fruit yield and the range of standard heterosis was -2.19 to 42.75%. Considering the standard heterosis of yield and yield contributing characters, the ridge gourd hybrid 1 and hybrid 2 were found promising and may be recommended for regional yield trial.

## Squash

### Heterosis study in squash

Bahauddin Ahmed and M. S. Alam

A study was conducted in squash to estimate the magnitude of standard heterosis for yield and its related components. Four hybrids were generated from three diverged parents which were evaluated in Randomized Complete Block Design with three replications at the Olericulture Division, Horticulture Research Centre (HRC) BARI Gazipur during winter season of 2022-23. Standard heterosis in squash was studied in four hybrids of squash. Standard hybrid “XL – Super” was used to calculate the standard heterosis for yield and yield contributing characters of the hybrids. In case of 1<sup>st</sup> harvest all the hybrids showed significant negative heterosis, indicating early harvest, while the range was -1.15 to -3.10%. The range of positive heterosis of number of marketable fruits/plant was 17.63 to 25.15% which indicates the higher number of fruits. The highest significant positive heterosis was observed in hybrid 2 (25.15%). The range of positive heterosis of average fruit weight was 3.47 to 12.13% while hybrid 1 and hybrid 2 showed the more than 10% standard heterosis. The range of positive standard heterosis of fruit length and fruit breadth was 2.38 to 4.0 % and 2.37 to 8.93%, respectively. The highest significant positive standard heterosis for fruit length and fruit breadth was 4.0% and 8.93 %, respectively in hybrid 2. All the tested hybrids showed the positive standard heterosis for fruit yield and the range of standard heterosis was 29.31 to 44.22%. Considering the standard heterosis of yield and yield contributing characters, the squash hybrid 2 and hybrid 1 were found promising and may be recommended for regional yield trial.

## Snake gourd

### Hybridization in snake gourd

Bahauddin Ahmed, Ms Alam, Mar Gazi and M.A.T. Masud

A hybridization work was done among the six parents of snake gourd inbreeds (Viz.: TC01-1-9-1, TC01-2-2-6, TC02-1-2-2, TC02-1-7-2, TC03-3-10-5, TC04-1-3-1) at the experimental field of Olericulture division, HRC, BARI Gazipur during the kharif season of 2022 to develop the new

hybrids of snake gourd. All the inbred lines were in homozygous condition and good in different aspects. The crops were grown to follow the standard crop production procedure. The initial fruits were harvested and butter paper bag were used for selfing and crossing. Crossing work was done following the half diallel fashion (single crossing). Fifteen different cross combinations (A x B, A x C, A x D, A x E, A x F, B x C, B x D, B x E, B x F, C x D, C x E, C x F, D x E, D x F and E x F) were occurred where total 32 crossed fruits were found and a total number of 470 cross seeds were preserved in cool room for next year evaluation. The seeds of 15 crosses along with parents were collected and preserved for assessing combining ability and heterosis in next season. The seeds of each cross was dried and preserved. These seed will be used to observe the F<sub>1</sub> performance in next kharif season.

## Cucumber

### Regional yield trials of cucumber

M Nazim Uddin, and A K M Quamruzzaman

The study has been carried out during January to April 2023 at 7 (seven) locations including Gazipur. Three advanced cucumber lines namely, CS0079, CS00115, and CS007M were trialed along with a check variety on trellis following the RCBD factorial design. Unit plot size was 1 m x 20 m each treatment. Seedling were raised in a pot and at 4 leave stage were transferred to main field in the trellis 100 cm x 70 cm of spacing. In case of female flower appearing in plant was found around 3<sup>rd</sup> node in CS007M while CS0079 produces female flower in 7<sup>th</sup> node. The 1<sup>st</sup> harvest were made in CS007M after 35 days while other two required 47 days. The maximum number of cucumbers found in CS007M followed by CS0079 and minimum number were recorded in CS0115. The heaviest cucumber fruits were recorded in CS0115, and the smallest cucumber harvested from CS007M. The highest yield was calculated in CS0079 (24.5 t/ha) while the lowest was in CS0115. In terms earliness the CS007M might selected, on the hand if we want to heaviest fruits there by CS0115 might be option. After subsequent trials one of the genotypes might be selected for releasing.



**Performance of cucumber hybrids**

M Nazim Uddin, M A R Gazi, and Akm Quamruzzaman

The study has been carried out at Olericulture Division, HRC, BARI, Gazipur during January to May, 2023. Seven hybrids namely; 4S × 1C, 2SH × 7A, 7A × 1C, 1C × 4S, 102 × 4S, 79 × 4S and 2SH × 4S were evaluated at open field following the RCBD design with four replications. Unit plot size was 1.0 m x 3 m each treatment. In case of days to first the cross 102 × 4S took the highest days (65) followed by the cross 79 × 4S (62 days) while the cross 2SH × 4S took only 46 to harvest. The maximum number of fruits produced in the cross 1C × 4S (21.6) and the lowest number of fruits produced in the cross 102 × 4S (12). Five cross produced 12-15 number of fruits while 2 cross produced 20-22 fruits. The heaviest fruits were recorded in the cross 102 × 4S and 2SH × 4S amounting 189.3 g and 188.0 g respectively. the cross 1C × 4S and 1C × 4S produced the lightest fruits which weight was 77.8 g and 91.1 g respectively. Yield per plant in g produced the highest by the cross 2SH × 4S (2322.2 g), while the lowest amount by the cross 4S × 1C. the per ha yield calculated the highest in the cross 29.0 t/ha and the lowest in the cross 4S × 1C (18.9 t/ha). Two crosses produced 17-19 t/ha cucumber while 2 crosses produced 20-24 /ha and 28-29 t/ha cucumber. Five crosses recommended for AYT next year.

**Phenotypic recurrent selection in cucumber**

S Sultana, M A Siddiky and M O Kaisar

The experiment was conducted at RARS, BARI, Cumilla during Kharif II season of 2022 to develop high yielding and high-quality cucumber varieties using phenotypic recurrent selection method. The materials used in this study comprised up of eight popular hybrids, three local lines and two lines collected from PGRC, BARI. Yield varied from 10.54 t/ha to 44.21 t/ha. Hybrids were usually quite early and got higher disease susceptibility than local. In terms of wilt and virus infestation, the range was found 0-24.87% and 0-58.35% respectively. During hybridization all possible intercrosses were made among hybrids and also among local lines to produce  $n(n-1)/2$  crosses. Thus, a total of thirty-eight (38) crosses were performed. The superior progenies from

intercrosses in the next season would serve as a germplasm of good agronomic characteristics suitable for use as original selection cycle seeds which would be very useful and indispensable in the continuation of the phenotypic recurrent selection.

**Development of inbred in cucumber (S<sub>0</sub>- S<sub>1</sub> & S<sub>1</sub>- S<sub>2</sub>)**

S Sultana, T H Tabassum, M A Siddiky and M O Kaisar

The present study is designed to develop elite inbred lines of cucumber. The study consisted of five lines of cucumber which were advanced from S<sub>0</sub> to S<sub>1</sub> generation in kharif II and from S<sub>1</sub> to S<sub>2</sub> generation in winter, 2022 at RARS, BARI, Cumilla. In the first season, CS Cum-022 exhibited heavy bearing in nature (10.5) with average yield per plant of 4721.66 g and total yield 44.21 t/ha. CS Cum-007 also performed better in that season and produced 21.74 t/ha. In winter season, only CS Cum-015.2 performed better, gave 6 fruits per plant with average yield per plant of 2579.17 g. However, all the local germplasm from Cumilla were very good in taste, attractive in skin & flesh color. Best individuals from every line were selected and selfed.

**Teasle gourd****Advance yield trial of less seeded teasle gourd lines**

M Nazim Uddin, M A R Gazi, and Akm Quamruzzaman

The study has been carried out at Olericulture Division, HRC, BARI, Gazipur during May to September, 2022 to study the performance of six less-seeded teasle gourd. Selected teasle gourd vines were MD 22-1, MD 9-3-1, MD 21-10, MD 13-3-8, M-1 and MD 9-3-5 planted in a pit. Six plants were treated as one accession and a total six accessions were planted on 20 February 2022 at 4-6 leaves and 1 tendril stage in the pit prepared. Number of fruits (NOF) per plant were recorded the highest in MD 9-3-5 while the lowest MD 21-10. The heaviest fruits were observed in the genotypes MD 9-3-5 (96 g), while the lowest was observed at MD 9-3-1 (46 g). All the genotypes produced oval shape fruits with green, greenish

yellow, and yellowish green. Seed is the major constraints of teasle gourd thereby number of seed considered as important parameter for selecting lines further improvement. The highest yield per plant was recorded in MD 9-3-5 (8kg) while the lowest in MD 21-1 (2.7). It was revealed that the lowest number of seed was recorded in MD 22-1 and the yield was around 5.5 kg per plant.

### **Evaluation of teasle gourd lines at Jamalpur region**

A Akter, M A Hossain, H Rahman, M S Rahman, R Sultana and H E M K Mazed

A study was conducted to evaluate teasle gourd (*Momordica dioica*) lines in respect of yield and quality at HRC field, RARS, Jamalpur during the summer season of 2022 to release a new teasle gourd variety. Five teasle gourd lines viz. MD Jam-001, MD Jam-002, MD Jam-003, MD Jam-004 and MD Jam-005 were evaluated. The higher number of fruits per plant (118) was produced by the line MD Jam-001, whereas the lower number of fruits (69) was noted from the MD Jam-003. The higher individual fruit weight (63.00 g) was noted in the line MD Jam-003 and lower (55.00 g) in the line MD Jam-004. The more fruit yield per plant (7.30 kg) & per hectare (18.24 t) was produced by the line MD Jam-001 and the less 4.35 kg per plant & 10.87 t per hectare was found by the line MD Jam-003.

### **Pointed gourd**

#### **In vitro regeneration of BARI hybrid potol-1 from different explants**

AR Gazi and B Ahmed

A study was undertaken to develop an efficient micropropagation protocol for BARI Hybrid Potol-1. Twigs and nodes of BARI hybrid Potol-1 were collected from research field of Olericulture Division, HRC and planted in the greenhouse of Biotechnology Division, BARI. Twigs and nodes collected from BARI Hybrid Potol-1 were used as explants source. The explants were surface sterilized under running tap water for 20 min. Then put 0.2% Ridomil Gold 68 WG for 20 minutes and washed with tap water. Thereafter, the explants were sterilized with detergent and washed again with tap water for 15 minutes followed by 3-4 times washing with distilled water. The explants

were transferred to sterilized container and brought to the laminar air flow cabinet and sterilized with Clorox solution (60%) with 5 drops of Tween-20 for 20 minutes followed by 3 to 4 times washing with sterile distilled water. There were four different treatments and one control which consist of MS media supplemented with different concentrations of BAP (6-Benzylaminopurine) for shoot regeneration. All media were augmented with 30 g/l sucrose, 8 g/l agar and pH was adjusted in 5.8. Media were autoclaved in 121°C, and 15 psi for 20 min. All cultures were inoculated at  $25 \pm 1^{\circ}\text{C}$  with 16 h photoperiod (2000 lux) provided by cool white fluorescent tubes. The media compositions were T<sub>0</sub> (Control) = MS, T<sub>1</sub> = MS+0.5 mg/l BAP, T<sub>2</sub> = MS+1.0 mg/l BAP, T<sub>3</sub> = MS+1.5 mg/l BAP, T<sub>4</sub> = MS+2.0 mg/l BAP. Shoot bud initiation started at 7 days after inoculation of explant in T<sub>2</sub> and T<sub>3</sub> treatment. The highest shoot regeneration was obtained from T<sub>3</sub> treatment (83.33%) followed by T<sub>4</sub> (73.33%). The maximum number of shoot (3.50) was obtained from T<sub>3</sub> treatment followed by T<sub>2</sub> treatment (2.20). The explants treated with T<sub>0</sub> control treatment where only MS media was used without any growth regulators did not produce any shoot.

### **Country bean**

#### **Observational yield trial of coloured country bean**

M. S. Alam and M A Goffar

The experiment was conducted at the research farm of Olericulture Division, HRC, BARI, Gazipur during the Rabi season of 2022-2023. Six colored country bean lines namely KZ-44, TT-43, SUQ-2, NSR-32, F-7 and HAOR(Ch) were used as planting materials. It was revealed that all the studied characters significantly differed among the lines. Days to flowering ranged from 51 to 104 days after transplanting (DAT). The line HAOR(Ch) required minimum days (51) while maximum days (104) required by TT-43 (Table 1). Days to first harvest varied from 70 to 125 days. The earliest (70 days) harvest was done in HAOR(Ch) where SUQ-2 harvested at the late (125 days). The line KZ-44 produced the maximum number of pods/raceme (16) while SUQ-2 produced the minimum pods per raceme (8). The single pod weight was the highest in NSR-32 (13.4 g) whereas the lowest in KZ-44 (7.4 g). The line TT-43 produced the longest pods

(13.2 cm) whereas line F-7 produced the shortest pods (8.6 cm). The widest pods was recorded from NSR-32 (2.6 cm) whereas the narrowest ones also from NSR-32 (1.6 cm). The highest number of pods per plant (457) were recorded from HAOR(Ch) whereas the lowest number of pods per plant (225) were obtained from NSR-32. The highest pod yield per plant (4.15 kg) and were recorded from HAOR(Ch) whereas the lowest yield per plant (2.86 kg) from NSR-32. 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. The lines TT-43, SUQ-2, and HAOR(Ch) may be selected for further trial.

#### **Advanced yield trial of selected country bean lines**

M S Alam, Bahauddin Ahmed and M A Goffar

The experiment was conducted at the research farm of Olericulture Division, HRC, BARI, Gazipur during the Rabi season of 2021-2022. Twelve country bean lines namely DL (St)-024, DL (St)-032, TT-70, TT-129, SOR-1, NSR-17, NTR-17, HAB-1, Rifa, Higrade, STTR, KER and BARI Sheem-1 were used as planting materials. It was revealed that all the studied characters significantly differed among the lines. Days to flowering ranged from 44 to 124 days after transplanting (DAT). The line STTR required minimum days (44) while maximum days (124) required by HAB-1. Days to first harvest varied from 63 to 143 days. The earliest (63 days) harvest was done in STTR where HAB-1 harvested at the late (143 days). The line DL (St)-032 produced the maximum number of pods/plant (576) while Rifa produced the minimum pods (52). The single pod weight was the highest (23.2 g) in DL (St)-032 whereas the lowest in TT-70 (7.5 g). The line Higrade produced the longest pods (18.5 cm) whereas Rifa produced the shortest pods (7.2 cm). The widest pods was recorded from DL (St)-032 (4.1 cm) whereas the narrowest ones from Higrade (1.7 cm). The highest pod yield per plant (12.47 kg) and yield per hectare (35.24 ton) were recorded from DL (St)-032 whereas the lowest yield per plant (0.65 kg) and yield per hectare (3.75 ton) from Rifa. 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. Mosaic virus infestation was found in the lines.

#### **Evaluation of country bean germplasm**

S Sultana, T H Tabassum, M Rahman, M A Siddiky and M O Kaisar

The study was conducted at RARS, BARI, Cumilla during rabi season 2022-2023 to observe the performance of five lines country bean germplasm collected from different locations of Cumilla against a check variety BARI Sheem -1. Genotypes varied significantly for their response to all the characters studied. Based on time to 1st flowering, the genotypes LP Cum-001 (49.67 days) and BARI Sheem -1 (48.67 days) were significantly early bearer than the rest of the lines. LP Cum-003 had better yield potentiality than the other lines including check despite of being highly susceptible to bean mosaic virus and rust. On the other hand, LP Cum-002 was found to have comparatively higher tolerance to different diseases along with the satisfactory yield performance.

#### **Evaluation and characterization of summer country bean under high rain fall areas of north-eastern region of Bangladesh**

M.A. Sumi, M. A. Habib and M.H. Hossain

An experiment was conducted to study the performance of three summer hyacinth bean genotypes/var. viz. LpAkb 011, LpAkb 021, LpAkb 003 and BARI Sheem-7 as check at vegetable field, RARS, BARI, Akbarpur, Moulvibazar during the Kharif season of 2022. Considering different yield and yield contributing characters evaluated three germplasms did not show significant qualities than BARI Sheem-7, however, the germplasms have showed variation in terms of phenotypic characters as well as have bold seeded characters. The germplasms have been collected and evaluated for the second terms of time, so, the experiment has showed different type and taste of summer bean characters and this summer hyacinth bean germplasm can be used as genetic resources for further variety development projects.

#### **Advanced yield trial of country bean lines in Pabna region**

MMR Salim, M.I. Hassan, M.F. Hossain and M.M. Uddin

The study was conducted at Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2022-23 to evaluate the performance of four hyacinth bean lines for yield and other desirable characters. The experiment was laid out



in RCB design with three replications. Significantly the highest number of pods per plant (405) was recorded in DL Isd-001 while the lowest number of pods per plant (60) was noted in BARI Sheem-6. Nevertheless, significantly the highest marketable yield (29.58 t/ha) was obtained from DL Isd-001 followed by DL Isd-018 (20.35) and DL Isd-004 (19.51) while the lowest (7.51 t/ha) was obtained from BARI Sheem-6. Pod borer infestation was also found the lowest (5.35%) in DL Isd-001 and the highest (9.21 %) in DL Isd-007.

### Hybridization of country bean

A Akter, M A Hossain, H Rahman, R Sultana and H E M K Mazed

A hybridization program was conducted at the Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during the winter season of 2022-23 to observe the performance of yield and yield contributing characters of  $F_2$  from some cross combination of hyacinth bean viz. BARI sheem-6 x BARI sheem-1, BARI sheem-6 x BARI sheem-7, BARI sheem-7 x BARI sheem-1, BARI sheem-7 x BARI sheem-6, BARI sheem-1 x BARI sheem-5. Maximum number of pods per plant (312) was observed from BARI sheem-7 x BARI sheem-1 (2) and minimum (152) from BARI sheem-6 x BARI sheem-7. BARI sheem-6 x BARI sheem-7 gained maximum individual pod weight (14.42 g), whereas; minimum (8.67g) observed in BARI sheem-1 x BARI sheem-5. Maximum pod yield (3.53 Kg/plant, 7.07 kg/plot and 15.71 t/ha) gained from BARI sheem-7 x BARI sheem-6(2) and minimum pod yield (1.92 Kg/plant, 3.85 kg/plot and 8.55 t/ha) obtained from BARI sheem-6 x BARI sheem-1 (2).

### Yard long bean/ velvet bean/ french bean

#### Evaluation of yard long bean lines

MH Rahman, S Paul, Oa Fakir, Ma Habib, S Sultana, Ms Huda, Ma Alam, Ma Hossain and Ku Ahmmad

The experiment was conducted at the research field of six BARI stations to find out the suitable advanced line of yard long bean for winter season in Bangladesh. Two advanced yard long bean lines

viz. JSRVU-002 (green colored), JSRVU-003(purple colored) were evaluated with the variety BARI Borboti-1 (control). The maximum number of pods per plant was counted from JSRVU-002 at Moulvibazar region and the minimum number pod per plant was counted from JSRVU-002 at Cumilla. Similarly, the maximum pod length was recorded from JSRVU-002 at Moulvibazar region and the minimum was found in JSRVU-003 at Satkhira. The highest yield was obtained from JSRVU-002 (23.4  $\text{tha}^{-1}$ ) at Moulvibazar and the lowest yield was from JSRVU-003 (7.7  $\text{tha}^{-1}$ ) at Jashore.

### Effect of spacing and sowing time on the yield and quality of BARI borboti-2

MR Alam, MA Alam and Ku Ahmmad

An experiment was conducted to identify the best suitable spacing and sowing time. The treatments were consisted of four sowing time viz, October, January, April and July and spacing viz. 40×30cm, 40×40cm, 50×40cm, 50×50cm and 60×40cm. The earliest flowering and harvesting date was found from 50×40 cm spacing in April sowing while the latest from 50×50 cm spacing in January sowing. The number of fruits per plot was highest found in October sowing of 40×30 cm spacing closely followed by 50×50 cm spacing. The highest yield was recorded from 40×30 cm spacing in October sowing followed by 50×50 cm spacing. In case of January sowing of 40×30 cm spacing gave higher yield while the lowest yield was recorded from April sowing of 50×50 cm spacing.

### Evaluation of velvet bean at hilly region

S.M. Faisal and R.H. Nitol

An investigation was carried out at HTARS, Ramgarh during the winter of last year. Three velvet bean germplasm, viz. MPRAM001, MPRAM002, and MPRAM003 were used to see their diversities. They took more or less similar time for harvest from flowering except the check variety BARI seem-8. No. of pods/plant and single pod weight was higher in BARI Sheem-8 (94.66) and MPRAM001 (35.10 3 gm) respectively. Wt. of pods/plot was the highest (5.46 kg) in MPRAM001 and the lowest in MPRAM002 (2.66 Kg). The line MPRAM001 gave the highest (6.06 t/ha) yield followed by MPRAM003 (4.60 t/ha).

**Evaluation of exotic french bean lines**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment for evaluation yield trial on French bean lines was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23 to find out the suitable flat French bean lines in order to release as a variety. BARI Jhar sheem-2 was used as check variety. Among the four lines and control BARI Jhar sheem-2, PV Rai-097 was found superior in terms of pod number (31), pod size ( $20.5 \times 1.8 \times 0.7$  cm), pod weight (11 g) and pod yield (49.1 t/ha) compared to control.

**Mushroom****Evaluation of different mushroom strains**

M S Alam and M R Karim

Yield potentialities of five strains of oyster mushroom were studied at the Olericulture Division, Horticulture Research Center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during the months of February-June 2023. Mother spawn packets of five oyster mushroom strains (*Pleurotus* spp.) used in the experiment namely *Pleurotus ostreatus* (Po2), *Pleurotus florida* (Flo), *Pleurotus ostreatus* var. white snow (Ws), *Pleurotus ostreatus* var. Husky (HK) and *Pleurotus sajor-caju* (Psc) collected from NAMDEC, Sobhanbag, Savar, Dhaka. Days to first harvest ranged between 8-11 days where minimum days (8) were required in Po2 and maximum (11 days) in Psc and Flo. The mean number of fruiting bodies per packet exhibited significant difference among different strains. The result showed that the maximum number of fruiting bodies (33) was recorded from Po2 followed by Flo (29) and the minimum (21) from Psc. The results obtained for total yield of oyster mushroom on fresh (wet) basis are highly significant. The results revealed that the maximum yield (325g) was obtained from HK followed by Po2 (314g) and the minimum (212g) from Psc. Marketable yield per packet showed the similar trend. The strain Po2 produced the highest (286g) marketable fruiting bodies and Psc produced the lowest (187g) amount. The variety Po2 produced the largest sized fruiting bodies having 5.2 cm length and 7.1 cm diameter of cap while Flo produced the shortest length (4.1 cm) of cap and Psc produced the shortest (5.2 cm) diameter. The colour of the fruiting body is affected

by the environmental temperature. At low temperatures, mushrooms tend to have a darker colour than at higher temperature. The markets in Europe and the USA prefer dark mushrooms whereas the people of Bangladesh prefer light (even white) mushrooms. It might be that this preference is stimulated by the market as convenience because it coincides with the environmental temperatures used in production systems. We have measured here the lightness of the mushrooms by visual observation. The most strains have a lighter colour except HK which looks darker. The strain Po2 found promising.

**Stem amaranth****Advanced yield trial of year round stem amaranth**

M Nazim Uddin, M A R Gazi, M R Karim and AKM Quamruzzaman

The study has been carried out at Olericulture Division, HRC, BARI, Gazipur during January to May, 2023. Three advanced lines namely, DSM- 6, DSM-8, DSM 10, DSM 11, DSM 12, DSM 13, DSM 18, DSM 22, DSM 23, DSM 24, DSM 25, DSM 29 and DSM 30 were trialed along with a check variety at open field following the RCBD design with four replications. Unit plot size was 1.5 m x 3 m each treatment. In case plant height the tallest plants were recorded in DSM 18 (117 cm) while the dwarf the presented in DSM 11 (74.8 cm). The genotypes DSM 18 have produced the highest amount of biomass followed by DSM 11. The highest leaves have been produced by the genotype DSM 30 followed by DSM 29. The edible stem wt. was produced the highest by the genotypes DSM 18 followed by DSM 23 while the lowest was observed in DSM 12. Considering the traits evaluated DSM 23, DSM 24, DSM 29 and DSM 30 might be selected for RYT.

**Regional yield trial of year round stem amaranth**

M Nazim Uddin, M A R Gazi, M R Karim and AKM Quamruzzaman

The study has been carried out at Olericulture Division, HRC, BARI, Gazipur during April to June, 2023. Three advanced lines namely, BARI Data-1, AT JAM-008, AT JAM-0011, AT JAM-0018, AT JAM-0053, AT JAM-0048, AT JAM-

0047, DSM 23, DSM 24, DSM 29, DSM 30 were trialed along with a check variety at open field following the RCBD design with four replications. Days to harvest at edible stage range from 33-39 days, and the maximum days were required 39 by the accessions AT JAM-0018, while the minimum were 33 days by DSM 30. the tallest plant observed in AT JAM-0018 (108 cm), while the dwarf was found BARI danta 1 (86.7 cm). The line AT JAM-0053 produced the maximum amount of stem wt. (555 g) followed by BARI danta 1 (398.9 g). The line AT JAM-0053 produced the maximum amount of dry matter (41g) followed by DSM 0024 and BARI danta 1, the minimum was recorded in AT JAM-008 and AT JAM-0011. Color of the leaves and stem varied deep green to light green, pink, dark pink and red. The maximum lines produced flower after 35 days after sowing. Considering the yield contributing characters, the line AT JAM-0053, AT JAM-0018, DSM 24 and DSM 29 can be chosen for further AYT.

## Okra

### Performance of okra hybrids against yvmv

S. Yesmin, M. Ratna, E. Mahmud, M. Islam, N. Akter and M. I. A. Howlader

The experiment was conducted at the Regional Horticulture Research Station, BARI, Lebukhali, Dumki, Patuakhali during March to June 2023 to select high yielding okra hybrids. Nine selected okra hybrids 1-5×1-12, 1-5×1-29, 1-12×1-23, 1-33×1-12, 1-33×1-5, 1-12×1-31, 1-33×1-29, 1-31×1-23 and 1-5×1-1 with BARI Dherosh-2 as a check were evaluated in this experiment. Highest plant height was obtained from BARI Dherosh-2 (131.5 cm) whereas the lowest from the hybrids 1-33×1-12 (94 cm). Yield per plant and yield per ha was also highest in BARI Dherosh-2 (0.59 kg plant<sup>-1</sup> and 24.49 tha<sup>-1</sup>) whereas lowest was in line 1-33×1-5 (0.24 kg plant<sup>-1</sup> and 9.76 tha<sup>-1</sup>). No visual virus symptoms was observed. In respect of yield none of the hybrids performed better over the check.

### Screening of okra germplasm against YVMV

S Sultana, T H Tabassum, M A Siddiky and M O Kaisar

This experiment was conducted during kharif season of 2023 in the experimental field of RARS,

Cumilla. One local susceptible lines, five commercial varieties and BARI Dherosh-2 were used in this study to identify the available okra germplasm with resistance to YVMV in order to use in resistance breeding program. Two commercial hybrids were identified as resistant to YVMV which can be used in resistance breeding program as donor parent. Their segregates with desired combination of characters specially resistance to YVMV have been selected in the F<sub>2</sub> generation. In addition, inter-crosses have been made between selected plants in F<sub>2</sub> of these hybrids. The progenies of each selected plants of F<sub>2</sub> and crosses will be maintained in succeeding generations for resistance.

### Effect of topping and mulching on vegetative growth and yield of okra

M.R. Islam, S. Hasna, S.D. Setu, M.G. Rahman, and B.C. Kundu

The experiment was conducted during 2021-22 at RARS, Rahmatpur, Barishal to determine the effect of topping, different mulching color and their interactions on growth and yield of okra plant. The experiment was laid out in a Randomized Completely Block Design with two factors. Factor A: consists of two topping effect i.e. T<sub>1</sub>: No topping, T<sub>2</sub>: topping after 7 leaves and Factor B: consists of four different mulch, i.e. M<sub>1</sub>: Black polythene mulch, M<sub>2</sub>: Blue polythene mulch, M<sub>3</sub>: White polythene mulch and M<sub>4</sub>: without mulch with BARI Dherosh-1 variety. Plant height at significantly between the two-topping treatment of okra. Higher plant height was recorded in treatment T<sub>1</sub> (135.60 cm) and lower from T<sub>2</sub> (118.41 cm). The interaction effect of topping and mulching, the highest plant height (144.00 cm) was recorded from T<sub>1</sub>M<sub>1</sub> followed by T<sub>1</sub>M<sub>2</sub> (139.47cm) while the lowest from T<sub>2</sub>M<sub>1</sub> (115.20cm) and T<sub>2</sub>M<sub>2</sub> (118.80cm). Number of fruit plant<sup>-1</sup> showed statistically significant variation due to topping. BARI Dherosh-2 has produced higher number of fruits in T<sub>2</sub> treatment (21.65) than T<sub>1</sub> treatment (17.75). The effect of mulching, the highest number of fruits plant<sup>-1</sup> (24.32) was recorded in M<sub>1</sub> (Black polythene mulch). On the other hand, the lowest number of fruits plant<sup>-1</sup> (14.93) was found in M<sub>4</sub> (no mulch) treatment. The interaction effect of topping and mulching, the highest number of fruit plant<sup>-1</sup> was recorded in T<sub>2</sub>M<sub>1</sub> (28.03) and the lowest number of fruit plant<sup>-1</sup> (13.57) was found in T<sub>1</sub>M<sub>4</sub>. The effect of topping, higher yield was recorded in BARI Dherosh-2 (23.11 t/ha) in T<sub>2</sub> while T<sub>1</sub> gave



lower value (17.11 t/ha). The effect of mulching, the maximum yield (27.44 t/ha) was recorded in  $M_1$  (Black polythene mulch) treatment. The lowest yield (13.10 t/ha) was recorded from  $M_4$  (no mulch) treatment. (Table 3). The interaction effect of topping and mulching, the maximum yield (32.49 t/ha) was recorded in  $T_2M_1$  (Topping after 7 leaves with black polythene mulch). The lowest yield (11.52 t/ha) was recorded from  $T_1M_4$  (no topping with no mulch) followed by the combination  $T_2M_4$  (14.67 t/ha).

### **Effect of plant spacing on the growth, fruit quality and yield of okra in southern region of Bangladesh**

S. Hasna, S.D. Setu, M.R. Islam, M.G. Rahman and B.C. Kundu

The experiment was conducted at Regional Agricultural Research Station, Rahmatpur, Barishal during 2021-22 to find out the most optimum plant spacing to achieve higher yield and quality seed of okra. The experiment comprised with five treatments i.e.  $T_1 = 45\text{cm} \times 30\text{cm}$ ,  $T_2 = 45\text{cm} \times 40\text{cm}$ ,  $T_3 = 60\text{cm} \times 30\text{cm}$ ,  $T_4 = 60\text{cm} \times 40\text{cm}$  and  $T_5 = 60\text{cm} \times 50\text{cm}$  of plant spacing. Plant spacing effect all the growth and yield contributing parameters in significantly except days to 50% flowering. Highest plant height (107.5 cm) was recorded from the widest spacing ( $60 \times 50\text{ cm}$ ) having maximum length (17.26 cm) and (2.23 cm) diameter of fruit. The lowest plant height (84.0cm) was recorded from closest spacing ( $45 \times 30\text{ cm}$ ) and ( $45 \times 40\text{ cm}$ ). The highest number of fruits per plant (1068.66) was recorded in the spacing ( $60 \times 40\text{ cm}$ ). The lowest number of fruits (790.00) was recorded ( $45 \times 30\text{ cm}$ ). Widest spacing ( $60 \times 50\text{ cm}$ ) was obtained highest individual fruit weight (33.13 g) and lowest individual fruit weight (24.02 g) was obtained from closet spacing ( $45 \times 30\text{ cm}$ ). The highest weight of fruit per plot (14.64 kg) and fruit yield per hectare (13.92 t/ha) was obtained from the widest spacing ( $60 \times 50\text{ cm}$ ) which statistically similar to spacing ( $60 \times 50\text{ cm}$ ) in both two parameters (14.10 kg) and (13.46 t/ha).

### **Effect of apical pinching time on growth and yield of okra**

M. A. Habib, M. A. Sumi, M. S. Alam and M. H. Hossain

This experiment was conducted at the experimental field of RARS, BARI, Moulvibazar, during the Kharif season of the year of 2022 to determining

the effects of apical pinching on the growth characteristics and yield of okra. The highest plant height (157.40 cm) was recorded in  $T_4$  treatment and the lowest plant height (140.53cm) was recorded in  $T_3$  treatment. The highest no. of branches per plant (4.10) was observed in  $T_3$  treatment and the lowest no. of branches per plant (2.90) was observed in  $T_4$  treatment. The highest number of fruits per plant (18.23) was observed in  $T_3$  followed by (15.25) in  $T_2$  treatment. The lowest number of fruits per plant (13.25) was observed in  $T_4$ . The highest fruit yield ( $14.88\text{ t ha}^{-1}$ ) was recorded in  $T_3$  treatment and lowest yield ( $11.95\text{ t ha}^{-1}$ ) was recorded in the treatment  $T_1$ .

## **Cauliflower**

### **Maintenance breeding for cauliflower varieties (BARI fulkopi-1 and BARI Fulkopi-2)**

M Nazim Uddin, And, A K M Quamruzzaman

The study has been carried out at Olericulture division, Horticulture Research Center, BARI Gazipur during August 2022 to April 2023 to res. Seeds of 2 cauliflower variety viz., BARI fulkopi 1 and BAR fulkopi 2 produced in different years including three advanced lines namely CL171, CL 172, & CL 180. The evaluation was carried out also in 4 planting time starting from August 2022, September 2022, October, 2022 and November 2022. Seedling were raised in at seed bed following double transplanting method and at 4 leave stage were transferred to main field in the trellis  $50\text{ cm} \times 50\text{ cm}$  of spacing. A total 52 seedlings were planted in each replication., it was observed the highest integrity observed in BARI fulkopi 1 ranges from 44- 65 percent on the other hand BARI fulkopi 2 were 19-44 percent. The advanced lines of summer cauliflowers, CL 171 and CL 172 observed 45 to 65 percent uniformity. September harvest took 34-38 days while October to December harvest took 22 to 24 days after curd initiation time. The highest marketable curd weight given by BARI fulkopi 1 & 2 (0.6 to 0.8 kg) during November planting. However, selected plants were kept under nylon net and pollinated by bees to attain the varietal uniformity.

### **Evaluation of indigenous microbiome liquid on eggplant, tomato, cabbage and cucurbits**

M Nazim Uddin, M A R Gazi, and Akm Quamruzzaman

The study has been carried out at Olericulture Division, HRC under BARI during April 2021 to

September 2022. Microbiome preparation was done using kitchen waste, vegetable waste, cattle manure, molasses and root biosphere of vegetable (e.g. Eggplant, tomato, cabbage, cucurbits, etc.). Both aerobic and anerobic methods were followed to produce the formulation. The preparation of microbiome briefly was, 2kg of half composted cattle dung and poultry liter, 2 kg rice burn, 1 kg agricultural soil, 1 kg ash, 100 g curd, 1 small left over bread, 10 g of each boric acid, potassium sulphate, calcium sulphate, magnesium sulphate, zinc sulphate, ferrous sulphate, 2 eggs, 200 g left over kitchen waste, 3-4 underground parts of cruciferous, solanaceous, cucurbits. The amount of nitrogen was higher in aerobic one while the lower in an-aerobically produced microbiome. The maximum Ca was observed in leguminous SIM while the lowest in common SIM produced aerobically. The potassium composition ranges 23-26 % and the total phosphorus percent range 1.2 to 1.6 percent. The microbial concentration was measures of the produces like, Bacteria ( $10^6$  CFU / ml solution), Fungal population ( $10^3$  CFU/ml solution), Actinomycetes ( $10^4$  CFU/ml solution), Phosphorus solubilizing micro-organism ( $10^4$  CFU/ml solution), N<sub>2</sub>-fixers (diazotrophs) population (No.  $\times 10^4$  CFU /ml of solution). It was revealed that the concentration of bacterial population followed by fungal, actinomycetes, PSM and diazotrophs. Microbes are the key element of this experiment found adequate amount which needs to assess as field condition.

## Organic

### Evaluation of microbiome on the growth, quality and yield of vegetables under organic conditions

M Nazim Uddin, M A R Gazi and Akm Quamruzzaman

This study investigates the influence of microbiome treatments on the yield and yield-contributing traits of cauliflower and kohlrabi plants. The experiment involved four different treatments (T1, T2, T3, and T4) for each plant species, and various growth and quality parameters were measured. For cauliflower, all traits, including broad leaf size, dry weight, marketable curd, and overall yield, were significantly influenced by the microbiome treatments. Treatment T1 showed the most promising results with the longest broad leaf length

(50.7 cm) and a relatively high broad leaf width (17.97 cm). It also exhibited a dry weight of 21.00%, a marketable weight of 435.7 g, and a yield of 54 t/ha. T2, T3, and T4 followed with slightly varying characteristics. In kohlrabi, the microbiome treatments also had a significant impact on all parameters measured. T2 treatment demonstrated the most favorable outcomes with the longest broad leaf length (46.33 cm) and a relatively high broad leaf width (19.6 cm). It also had a dry weight of 24.38%, a marketable weight of 246.6 g, and a yield of 32.1 t/ha. T1, T3, and T4 showed distinct characteristics compared to T2. The results indicate that microbiome treatments play a crucial role in enhancing the growth and yield of both cauliflower and kohlrabi. These findings have practical implications for agriculture, suggesting the potential of microbiome interventions to improve crop productivity. Further research is warranted to delve deeper into the specific microbial interactions responsible for the observed effects and to optimize the application of microbiome-based approaches for sustainable crop production.

### Evaluation of magic population of tomato under organic condition

M Nazim Uddin, M A R Gazi, and Akm Quamruzzaman

This study has been carried out at organic field of Olericulture Division under Horticulture Research Center (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur during winter 2022-2023 in order to develop self-population of MAGIC lines. A total 20 sets generation tomato lines namely, T1(New 9), T2 ( New 10), T3( CLN 31-25-0-19), T4 ( CLN 3150-A-5), T5(AVTO 1201), T6 (New 13), T7 ( CLN 3324A), T8 (CLN 3241AA), T9 ( New 9 X New 10), T10 (CLN3125-0-19X 3150-A-5), T11 (AVTO 1201 X New 13), T12(3324A X 3241AA), T13 (New 9XNew 10) X(3125-0-19X3150-A-5), T14-(AVTO 1201 \* New 13) X (3324A \* 3241AA), T15- F1, and a total 200 plants were evaluated from F2 population and out of these T16-(F2 V1) , T17F2 V2, T18 (F2 V4), T19(F2 V5), and T20 (F2 V6) were evaluated with three replications. Seeds were sown for seedling in a seedbed on 24 November 2022. MAGIC breeding is an effective approach for improving the genotypes upto desired goal and in this study positive improvement has made to

identify suitable lines for further evaluation in terms of horticultural traits under organic condition. Considering the performance F2 V1, F2 V2, F2 V4, F2 V5, F2 V6 were identified for further evaluation.

### **Effect of trellis type and mulching on the yield and profitability of vine crops in organic cultivation**

M Nazim Uddin, M A R Gazi, and Akm Quamruzzaman

The study conducted at the Olericulture Division, HRC under BARI from October 2022 to April 2023 aimed to investigate the influence of different trellis types and mulching methods on the yield and profitability of vine vegetables in organic cultivation. Four types of trellis and three types of mulches were evaluated for country beans, cucumber, jhinga, and yard long beans. Seedlings were initially raised in pots and later transplanted to various trellis types at the 4-leaf stage in the main field, with mulching applied before planting. The crop sequences followed a randomized complete block design with 12 treatments. The organic fertilizer dose and application method included cow dung, BAOFER, and BARI IMO 1 & 2. Data were recorded on key parameters, such as days to 50% flowering, days to first and last harvest, number of fruits or pods per plant, individual fruit or pod weight, yield per plant and per hectare, virus infestation percentage, wilt infestation percentage, and MBCR. The results showed significant differences in most of the characters studied. The number of pods per cluster emerged as a crucial attribute affecting yield, with the highest number of pods recorded in the bamboo stick trellis (6.9), followed by flat macha (FM) and string support (SS), possibly due to natural damage. Similar trends were observed in pod length and breadth, with significant variations. Pod infestation was identified as the most decisive attribute influencing the quality yield on different trellis types. The bamboo stick trellis showed the highest number of blemish-free fresh pods (105.87), while trellis without support had the lowest quality yield (59.4), with both results statistically comparable. Blemish-free fresh pod yield proved to be desirable for organic cultivation. The flat trellis demonstrated the highest quality yield per plant (0.97 kg/pl), followed by BSS (0.94 kg/pl), whereas the lowest yields were observed in trellis without support and string support (0.61 kg/pl and 0.72 kg/pl, respectively). In conclusion, the choice of trellis

and mulching significantly influenced the yield and quality attributes of vine vegetables in organic cultivation. These findings provide valuable insights for farmers and researchers to optimize trellis and mulching techniques, thereby enhancing crop productivity and quality in organic vine vegetable cultivation.

### **Advanced yield trial of carrot lines in organic condition**

M Nazim Uddin, M A R Gazi, and Akm Quamruzzaman

The experiment was carried out at organic field under olericulture division, Horticulture Research Center, BARI, Gazipur during winter 2022-23 to find out the consistency of carrot genotypes capable to produce seeds. The experiment was set at B block which was converted to organic. All the genotypes induced flower under field condition. Among the accessions, DCO 4 exhibited the highest LW (143.0g), while DCO 29 had the lowest LW (64.8g). In terms of RW, DCO 25 showed the highest value (180.0g), whereas DCO 4 had the lowest RW (87.0g). The RL was highest in DCO 20 (16.2cm) and lowest in DCO 28 (14.1cm). DCO 4 had the highest RC (4.1cm), and DCO 29 had the smallest RC (0.8cm). Interestingly, DCO 4 had no FT, while DCO 20, DCO 26, and DCO 28 all had a FT of 1.2cm. Regarding TSS content, DCO 4, DCO 26, and DCO 29 had the highest values (10.1 °Brix). In terms of seed production ability, all accessions were categorized as (+), indicating that they were capable of producing seeds. In terms of yield per plot, DCO 28 and DCO 25 showed the highest values (16.7kg), while DCO 4 had the lowest yield per plot (7.8kg). Considering yield per hectare, DCO 28 and DCO 25 once again exhibited the highest values (29.6t/ha), while DCO 4 had the lowest yield per hectare (13.9t/ha). Overall, DCO 28 and DCO 25 displayed superior performance in terms of yield parameters, with the highest yield per plot and yield per hectare. DCO 4, on the other hand, had the lowest values in several characteristics, indicating lower productivity. These results highlight the importance of selecting appropriate DCO accessions for improved yield potential in agricultural practices. However, DCO, 20, 25, 26, 27, 28 and 29 also produced flower but took longer time. Considering the seed production ability and the quality parameter the lines DCO, 20, 25, 26 27, DCO 28, DCO 17, DCO 4 were advanced and seed will be further evaluated.



## Hydroponic/soilless culture

### Effect of modified hydroponic nutrient solution for production of high value vegetables

Md Asaduzzaman and Mat Masud

In Bangladesh, the limited availability of commercial-grade hydroponic fertilizer hinders the expansion of hydroponic cultivation techniques. Furthermore, there are restrictions on the import of nitrate fertilizer. Hence, the utilization of affordable and locally accessible fertilizers could be beneficial. The primary aim of this study was to assess the performance of commercially available chemical fertilizers for the hydroponic cultivation of high-value crops. The hydroponic nutrient solutions used in the experiment consisted of three different concentrations of commercial-grade solutions: full strength,  $\frac{3}{4}$  strength, and  $\frac{1}{2}$  strength along with two standard nutrient solutions, namely Enshi-shoo solution (a Japanese formulation) and BARI Hydroponic solution-1 (developed by BARI specifically for hydroponics). Two types of leafy vegetables were selected such as lettuce variety BARI Lettuce-1 and spinach variety BARI Palongshak-2. These vegetables were grown using a deep water culture (DWC) hydroponics system, with healthy seedlings being placed in 15-liter plastic containers. The nutrient solutions were not aerated, and the culture solutions remained unchanged throughout the entire growth period of both vegetables. The electrical conductivity (EC) of each working solution ranged from 1.19 to 2.18 dS/m, pH levels ranged from 6.17 to 8.13, and the solution temperature for spinach was approximately 23.0°C. The leafy vegetables were allowed to grow for a period of 4-6 weeks, following which various growth parameters were measured. The results indicated that BARI Hydroponic solution-1 outperformed the full-strength commercial-grade solution, resulting in a 2-fold increase in fresh weight for lettuce (159.7 g/plant) and a 3-fold increase in fresh weight for spinach (38.0 g/plant). Among the three concentrations of commercial-grade solution, the  $\frac{3}{4}$  strength solution produced higher yields in terms of the number of leaves, shoot fresh weight (126.3 g/plant), dry weight (3.78 g/plant), and root length (33.2 cm) for lettuce, with a similar trend observed in spinach. It was also observed that the  $\frac{1}{2}$  and full-strength commercial-grade solutions yielded similar growth and production results for the studied vegetables.

Consequently, it is recommended to explore the use of medium-strength ( $\frac{3}{4}$ ) commercial-grade solutions to optimize nutrient formulations for hydroponic cultivation of high-value vegetables, including lettuce and spinach.

### IoT enabled ion selective electrode based nutrient management in hydroponic culture of tomato

Md Asaduzzaman

Nutrients contained in standard hydroponic solutions for growing vegetables remain underutilized. In recycled hydroponics, growers commonly employ an electrical conductivity (EC) meter as the basis for nutrient management. However, EC-based adjustments only guarantee the overall ion concentration in the nutrient solution. Therefore, an alternative approach using ion-specific electrodes (ISE) for precise nutrient management is being explored due to real-time measurements and individual nutrient ion sensing. The aim of this study was to assess the effectiveness of nutrient management in tomato cultivation within a recycled hydroponic system by comparing EC-based and ISE-based approaches. Three nutrient solution management methods were employed: conventional nutrient solution culture (50% Enshi-shoo), EC-based management (1.5 dS/m Enshi-shoo) with an EC sensor for automatic adjustment, and ISE-based management (50% Enshi-shoo) involving specific ion measurement and adjustment using  $\text{NO}_3^-$ ,  $\text{K}^+$ , and  $\text{Ca}^{2+}$  electrodes. BARI Tomato-15 was grown in a plastic grow bed accommodating 15 plants. Plants were grown in deep water culture (DWC) system with scheduled recycling of the nutrient solution. In the case of the standard culture group, a 50% Enshi-shoo standard nutrient solution was used. For EC-based management, an EC sensor was inserted into the reservoir, automatically detecting and adjusting the deficient amount of stock solutions. In contrast, the ISE method involved the determination and adjustment of specific nutrients such as  $\text{NO}_3^-$ ,  $\text{K}^+$ , and  $\text{Ca}^{2+}$  using respective ion-selective electrodes. Healthy seedlings at the 3-5 leaf stage were transplanted into the culture boxes, secured with urethane foam blocks to keep the plants upright. Nutrient solutions were circulated using an automatic timer set to operate for 1 minute every 30 minutes. The study found that fruit yield varied among the different nutrient management systems, with plants grown using the ISE-based

approach yielding higher results (234.5 g/plant) compared to those grown using the standard nutrient solution. Fruit quality attributes such as brix and ascorbic acid content remained consistent across the management systems, but acidity levels were approximately twice as high in tomatoes obtained from the EC-based management system. This trial underscores the potential of sensor-based management and IoT-enabled applications and calls for further experimentation and recommendations.

### **Application of iron nanoparticles on the growth, yield and physiological traits of tomato in hydroponics**

Md Asaduzzaman

Nanoparticles exhibit physical, chemical, and biological characteristics related to absorption and activity. The Bangladesh Government has also placed emphasis on the utilization of nanomaterials and nanotechnologies in the field of Agriculture. In Bangladesh, the cultivation of plants through hydroponics and soilless methods often results in iron deficiency due to the use of impure iron fertilizers. In this context, this research aims to investigate the impact of iron nanomaterials on the growth, yield and qualities of tomatoes in a hydroponic system. BARI Tomato-15 was grown in a soilless culture based on coco dust and nourished with BARI Hydroponic solution-1 (EC 1.5-2.5 dS/m) throughout the entire growth period. Healthy seedlings were placed in Styrofoam containers filled with 25 liters of substrate. The supply of BARI Hydroponic solution-1 was facilitated through a drip irrigation system controlled by a digital timer (30 seconds every 2 hours). The EC of the hydroponic solution was maintained within the range of 1.5 to 2.5 dS/m, depending on the growth stage. In this study, five different concentrations of nano-Fe<sub>3</sub>O<sub>4</sub> were applied to explore their effects on the growth, yield, and quality of tomato plants in a hydroponic setup. Fe<sub>3</sub>O<sub>4</sub> nanoparticles were sprayed on the tomato shoots five times throughout the growth period, at biweekly intervals starting from anthesis. The results clearly indicate that the application of iron nanoparticles had a positive impact on the growth and yield characteristics when compared to control plants sprayed only with distilled water. In general, plants treated with iron nanoparticles exhibited increased height, with the greatest height (264.7 cm) observed in the group treated with 100 mg/L. Furthermore, spraying iron

nanoparticles at a dose of 200 mg/L resulted in significantly higher shoot fresh weight (1250 g/plant) and dry weight compared to other nanoparticle groups and the control group. These findings indicate that the application of Fe nanoparticles can lead to an increase in fruit yield of approximately 1.0-1.5 kg/plant. Further trials are recommended to explore higher doses, different nanoparticle types, and optimal application timing for high-value fruit-bearing vegetables cultivated using hydroponic techniques.

### **Effect of biostimulants on the growth, yield and quality of sweet pepper in coco-coir substrate**

Md Asaduzzaman and AKM Ariful Haque

Biostimulants are intricate biological products that originate from nature and exert various effects on plant productivity through diverse mechanisms. They are typically utilized in the cultivation of high-value and greenhouse crops to boost both yield and product quality. In the context of Bangladesh, sweet peppers are considered high-value crops, but its quality is remains inferior due to the indiscriminate use of plant protection measures. In this regard, the cultivation of sweet peppers through hydroponics and the incorporation of biostimulants appear to be promising approaches. The objective of this study was to assess the impact of a specific set of biostimulants on the performance of sweet pepper plants cultivated in soilless culture. Five biostimulants were applied to sweet pepper plants to investigate their effects on the growth and development of sweet pepper. These biostimulants included a control group (distilled water as a spray), Radison, Humi Star, Compelasol, and Azumin. Two independent experiments were conducted considering seedling growth studies and in culture experiment. Biostimulants were applied during the seedling stage into the nursery (bioassay), as well as at the stages of transplanting, anthesis, and bi-weekly intervals during the cultivation phase (culture experiment). BARI Mistimorich-1 was selected as the planting material and was cultivated in a soilless culture based on coco-dust, nourished with BARI Hydroponic solution-1 (EC 1.5-2.0 dS/m) throughout the entire growth period. In the bioassay phase, Humi Star led to a significantly higher shoot fresh weight of 11.3 g/plant when applied during the seedling stage. In the culture experiment, the application of biostimulants had a

significant impact on various growth and yield parameters. Interestingly, the SPAD values and days to anthesis were not affected by the applied biostimulants. Although the number of fruits produced did not exhibit significant differences among the treatment groups, the plants treated with biostimulants generally bore a greater number of fruits (4-8 fruits/plant). Sweet pepper yield was also notably higher in plants treated with Radison (3.1 kg per plant) and Azumin (2.9 kg per plant) in comparison to the control group. Consequently, Radison and Azumin emerge as promising options for sweet pepper cultivation in Bangladesh.

### **Effect of supplemental led on the yield and quality of sweet pepper grown in soilless culture during winter in the greenhouse**

Md Asaduzzaman and Limu Akter

In Bangladesh, sweet peppers are primarily cultivated during the winter season in open fields and also in greenhouses using soilless methods. However, in greenhouses, the availability of light becomes a limiting factor for both fruit quantity and quality. Typically, the sky remains overcast during the winter, resulting in insufficient photosynthetically active radiation (PAR). This condition negatively impacts the rate of photosynthesis and the yield of winter vegetables, including sweet peppers. To address this issue, the study aimed to assess the impact of LED lighting on the yield and quality of sweet pepper varieties during the winter season in the greenhouse environment. Three sweet pepper cultivars: BARI Mistimorich-1, BARI Mistimorich-2, and California Wonder, grown either with or without supplemental LED lighting. LED lights (R:B ::3:1) were placed on above the crop canopy and applied during start of the day for 2-3 hours daily and continued till the final harvest. The sweet peppers were cultivated using a soilless coco-dust substrate and nourished with BARI Hydroponic solution-1 (EC 1.5-2.5 dS/m) throughout the growth period. The results indicated that the addition of LED lighting positively influenced the growth and fruit yield of sweet peppers compared to conditions without supplemental lighting. Among the sweet pepper varieties, BARI Mistimorich-2 showed the highest yield under LED conditions, with higher fruit fresh weight than that of California Wonder and BARI Mistimorich-1 by 361.7 g and 530.4 g, respectively. However, the quality parameters of

the sweet peppers were not significantly improved by the LED supplementation. In terms of fruit quality parameters, including brix, acidity, and vitamin C content, LED supplementation had a notable influence. It was observed that the absence of lighting could lead to increased vitamin C production due to the stress caused by insufficient light. It is important to note that the LED supplementation in this study was manually controlled. Therefore, implementing real-time adjustments and precise LED supplementation could potentially result in even higher yields and improved fruit quality for sweet peppers, especially when dealing with cloudy winter weather conditions in Bangladesh.

### **Production of micronutrient fortified leafy vegetables providing human health benefits through hydroponic cultivation (renew)**

Md Asaduzzaman and AKM Ariful Haque

Zinc, iron and selenium are considered as the essential micronutrients providing human health benefits. In this regards, hydroponic system through its precise control over concentration and composition of culture solution can be used for producing vegetables with enhanced minerals. The present research project has been taken to optimized the doses of Zn, Fe and Se in nutrient solution for producing mineral fortified leafy vegetables. BARI Lettuce-1, BARI Palongshak-2 and BARI Gimakalmi-1 were used as planting material in this study. These leafy vegetables were cultured in hydroponics using 50% 'Enshi' nutrient solution with increased concentration of Zn and Fe were prepared to  $\times 1$ ,  $\times 2$ ,  $\times 3$ ,  $\times 4$ , and  $\times 5$  times nutrient solution, while Se were applied as 0.0, 1.0, 2.0, 4.0 and 8.0  $\mu\text{mol/L}$  of  $\text{Na}_2\text{SeO}_4$ . The selected plants were cultured in hydroponics using 50% 'Enshi' nutrient solution (EC 1.32 dS/m and pH 6.93). Eight seedlings of each vegetable were transplanted in the plastic container fixed with small urethane cubes. The culture was continued for 4 weeks after transplanting. Shoot mass of the vegetables were dried, ground, and digested ( $\text{HNO}_3$ ) for determination of mineral nutrients of shoot mass using atomic absorption spectrophotometer (Z-2310, Hitachi High Tech. Cor. Tokyo, Japan). It was evident that, shoot fresh was not decline until  $\times 10$  Zn in lettuce,  $\times 5$  Zn in spinach, and gimakalmi; improved significantly in  $\times 5$ -10 Fe in lettuce,  $\times 5$ -20 Fe in spinach and not



declined until  $\times 5$ -10 Fe in gimakalmi; while in case of Se it was not differed. Plants grown in nutrient solution with elevated concentration of Zn lead to 5 times higher Zn content in lettuce (0.564 mg/g DW) in  $\times 20$  Zn, 4 times higher Zn content in spinach (0.281 mg/g DW) in  $\times 20$ , and 2 times higher Zn content in gimakalmi (0.203 mg/g DW) in  $\times 20$  Zn. On the other hand, plants grown in elevated concentration of Fe results in 3 times higher Fe content in lettuce (1.00 mg/g DW) in  $\times 20$  Fe, but did not differ significantly in spinach and gimakalmi. In this study, Se was not determined in shoot dry mass due to unavailability instrumental facility. Therefore, considering fresh weight and mineral nutrient uptake,  $\times 10$ -15 Zn and Fe can be applied to the culture solution to produce Zn and Fe enriched leafy vegetables through hydroponics.

#### **Performance of selected vegetables grown in sensor based and iot enabled recycled hydroponics**

AKM Ariful Haue, Mat Masud Md Asaduzzaman

Hydroponic cultivation system provides precise control over plant growth parameters and nutrient supply systems. Nutrient delivery through EC monitoring and adjustment of hydroponic nutrient solution is widely used. Software-based solutions and ion selective electrodes have also been utilized to enhance nutrient levels. Traditionally, digital second timers have been used for efficiently nourishing horticultural crops with water and fertilizers. In this context, high-value fruiting vegetables such as tomatoes and sweet peppers were cultivated in a soilless environment to assess the performance of the timer-based and IoT-enabled nutrient delivery systems. Two nutrient delivery and management approaches were employed to evaluate sweet pepper and tomato varieties grown in soilless cultivation system. The nutrient delivery management systems used were as follows: IoT-enabled EC based management (1.5 dS/m, using BARI Hydroponic solution-1) and digital second timer enabled standard nutrient management. The vegetable varieties used in this study included BARI Mistimorich-1, BARI Mistimorich-2, BARI Tomato-11, and BARI Tomato-17. Coco-dust-based soilless cultivation systems were used for growing these vegetables during the winter season. Two plants were placed in each box with a spacing of 12"  $\times$  9". Healthy seedlings with 5-6 leaves were selected for planting

in styrofoam boxes filled with coco-coir substrate. The plants received nourishment through BARI Hydroponic solution-1 using either a scheduled drip irrigation system controlled by an IoT-enabled automation system or a digital second timer (30 sec/2 hrs; run/stop). Results revealed that number of fruits were recorded lower in plant BARI Mistimorich-1 and -2 (11.2 and 10.6 fruits) in IoT enabled nutrient management system than that of digital second timer-based management, while in case of tomato varieties (about 39.2 and 4.5 fruits in BARI Tomato-11 and -17, respectively) it showed reverse result. Fruit fresh weight of BARI Mistimorich-1 was recorded higher (332.3 g/plant) in IoT enabled nutrient management and BARI Mistimorich-2 had higher fruit yield (812.0 g/plant) in digital second timer-based management system. In case of yield of tomato varieties, BARI Tomato-11 and -17 yield was not differed greatly in either of the nutrient management system. Further research is needed to ensure consistent results in this study.

#### **Effect of different hydroponic nutrient solution on the growth and yield of BARI tomato-11 and BARI tomato-21 grown in coconut substrate under micro garden model**

MAR Gazi and M Asaduzzaman

A study was conducted in the poly net house of Hydroponics and Controlled Environment Agriculture (CEA) research facility of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institution (BARI), Gazipur, Bangladesh to find out suitable level of concentration of BARI hydroponic solution-1 for growing BARI release five vegetable crop varieties (BARI Mistimorich-2, BARI Lettuce-1, BARI Tomato-11, BARI Tomato-17 and BARI Tomato-19) in coconut substrate under micro garden model. Seeds of the selected vegetables were sown cell trays filled with coco-dust. 24 days seedling was transplanted to plastic pot for hardening of plants. After that potted plant were planted in 14-liter plastic pot. Single plant was planted in each plastic pot but 3 plants were grown in each plastic pot with coco-dust based substrate. Studied parameters were SPAD value, anthesis, plant height (cm), number of leaf, shoot fresh weight (g), shoot dry weight (g), number of fruit, fruit fresh weight (g), EC, pH, air temperature ( $^{\circ}$ C) at harvest, moisture (%), acid, brix, vit-C. The

experiment was laid out following completely randomized block design (RCBD) with 3 replications. BARI release five vegetables crop variety were grown in 14-liter plastic pot using coco-dust substrate following soilless culture. Three levels of concentration (1.0 dS/m, 1.5 dS/m and 2.0 dS/m) of hydroponic nutrient solution were applied for nourishment of the plant. Results indicate that each variety can be grown successfully having maximum yield about 839.0 g in BARI Mistimorich-2, 105.0 g in BARI Lettuce-1, 176.3 g in BARI Tomato-17 obtained for application of 2.0 dS/m level of concentration and 901.3 g in BARI Tomato-11 and 1910.7 g in BARI Tomato-19 obtained for application of 1.5 dS/m level of concentration among 3 levels of concentration in this micro garden model experiment. Therefore, result of this experiment indicate that 2.0 dS/m level of concentration of hydroponic nutrient solution application has given the maximum yield of BARI release vegetables crop variety with coco-dust substrate based soilless culture and great potential of supplying fresh, nutrient and antioxidant rich vegetables for individual family level consumption toward nutritional security.

#### **Development of low-cost hydroponic solution for vegetable production**

H E M K Mazed, M A Hossain, H Rahman, A Akter and R Sultana

The experiment was conducted at the Hydroponic net house at Horticulture Research Centre nursery, Regional Agricultural Research Station, Jamalpur during the Sep-May, of 2022-2023 with a view to evaluate the performance of differently formulated nutrient stock solution of BARI. The experiment test was done by two crops and those are BARI Hybrid Tomato11, BARI Lettuce-1, BARI china copi-1 and BARI Lal Shak-1. Two solutions were: “LC solution-1 (A, B, C)” and “LC solution-2 (A, B, C)”. The production cost of this solutions approximately 120-141 tk, and 90-104 tk., respectively. Most of the cases similar production for each crop has been got. By using “LC solution-2” farmers would get higher BCR for some crop. In tomato production the highest yield per plant and yield per m<sup>2</sup> (media area) was found 2.65 kg and 23.85 kg respectively, from “LC solution-2” treatment while 2.55 kg and 22.95 kg respectively, from “LC solution-1” treatment. In Lettuce production the highest edible leaf per plant and

yield per m<sup>2</sup> (media area) was recorded 291 g and 7.27 kg respectively, from “LC solution-2” treatment while 285 g and 7.12 kg from “LC solution-1” treatment. In Chaina cabbage production the highest edible leaf per plant and yield per m<sup>2</sup> (media area) was recorded 386 g and 9.15 kg from “LC solution-2” treatment while 368 g and 8.70 kg from “LC solution-1” treatment. In red amaranth production the highest edible leaf per plant yield per m<sup>2</sup> (media area) was recorded 26.0 g and 3.7 kg respectively, from “LC solution-2” treatment while 24.0 g and 3.4 kg respectively, from “LC solution-1” treatment.

#### **Production of selected vegetables through iot based hydroponic system**

H E M K Mazed, M A Hossain, H Rahman, A Akter and R Sultana

The experiment was conducted at the Hydroponic Net House at Horticulture Research Centre nursery, Regional Agricultural Research Station, BARI, Jamalpur on October-May, 2022-23 with a view to evaluate the performance of commercial tomato variety in automatically programmed hydroponic system using LC hydroponic stock solutions A, B, C. BARI released one tomato variety viz., “Beautiful” was used were for the experimental crop. Total 96 tomato plants were planted in cocodust substrate base media. Three treatments with three replications were applied for the experiment. The treatments were T<sub>1</sub>= cocdust in grow bag on elevated bench, T<sub>2</sub>= cocdust in plastic pot on floor mat, T<sub>3</sub>= cocdust in plastic pot submerged in 2 inch residual nutrient. The maximum single fruit weight was recorded from T<sub>1</sub> (102.33 g) treatment on the other hand the minimum single fruit weight was recorded from T<sub>2</sub> (91.00 g) treatment. The highest yield plant<sup>-1</sup> was obtained from T<sub>1</sub> (2.82 kg) treatment while the minimum was found from T<sub>2</sub> (2.27 kg) treatment.

#### **Suitability test of automatic hydroponic system for year-round production of selected vegetables**

H E M K Mazed, M A Hossain, H Rahman, A Akter and R Sultana

The experiment was conducted at the Hydroponic net house at Horticulture Research Centre nursery, Regional Agricultural Research Station, Jamalpur during the winter season of 2022-2023 with a view to evaluate the performance of different cucumber and lettuce varieties with hydroponic solution. “LC

Hydroponic solution-A, B and C” were used to culture the plants and the circulating system was maintained. Three commercial lettuce varieties were used for the experiment named “BARI Lettuce-1”, “Green Leaf” and “Green wave” and Three capsicum lanes or varieties viz, CA0035, CA0040 and BARI Mistimorich-1 and two cherry tomato variety viz, “BARI Tomato-11” and “Indian Red Star” were used as the planting materials. For the lettuce experiment some rectangular box and PVC pipe (6 inch and 4 inch) were used which were made by wood and thick polythene flim and box were covered by corck sheet. Each cork sheet contained 28 lettuce plant and each PVC pipe contained 14 lettuce plants. For the capsicum 6 inch PVC pipe contained 10 plants. The highest entire single plant weight recorded from Green wave (350 g) followed by BARI Lettuce-1 (340 g) while but the lowest was observed in Green Leaf (314 g). The maximum edible leaf weight recorded from Green wave (295 g) followed by BARI Lettuce-1 (280 g) while but the minimum was observed in Green Leaf (255 g). For the capsicum experiment significantly highest fruit diameter was found in BARI Mistimorich-2 (6.50 cm) while the lowest (6.08cm) found in CA0035. Per plant yield was significant and highest in BARI Mistimorich-2 (544.0 g) and the lowest was obtained by the line CA 0035 (357.6 g). In the cherry tomato the highest yield plant<sup>-1</sup> was obtained from T<sub>1</sub> (1.82 kg) treatment while the minimum was found from T<sub>2</sub> (1.30 kg) treatment. The maximum TSS was obtained from T<sub>1</sub> (8.35) treatment while the minimum was found from T<sub>2</sub> (6.58) treatment.

#### **Production of vegetables under different led light in indoor condition through iot based hydroponic culture**

H E M K Mazed, M A Hossain, H Rahman, A Akter and R Sultana

The experiment was conducted at the Hydroponic laboratory at Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during the winter season of 2022-2023 with a view to evaluate the performance of different leafy vegetables under LED light in indoor condition. “LC Hydroponic solution-A, B and C” were used to culture the plants and the circulating system was maintained. The lab environment is not controlled but protected. LED grow light, LED tube light 40 and 20 watt were used for the plant production.

Two vegetables were selected for the experiment viz., Indian Spinach (BARI Puishak-1) and Kangkong (BARI Gima Kolmi-1). The highest number of edible leaves was found from Indian Spinach (17.0) while the number of edible leaves of kangkong was recorded (15.0). The maximum leaf length was observed in Indian spinach (17.3 cm) which is desirable but the minimum was found in kangkong (13.3 cm). Significant variation was found in leaf breadth also and followed the similar trend. The maximum root length was observed in kangkong (71.0 cm) while but the minimum was found in Indian spinach (41.0 cm). Since kangkong is treated as aquatic plant that’s why root length showed the maximum result. The highest entire single plant weight recorded from Indian spinach (81.0 g) while the lowest was observed in kangkong (35.0 g). The maximum edible part weight recorded from Indian spinach (70.0 g) while but the minimum was observed in kangkong (30.0 g).

#### **Introduction of simplified hydroponic system for growing**

##### **High value vegetables at Jashore region**

MA Alam, Mr Alam and KU Ahammad

The study was carried out at HRC, Regional Agricultural Research Station, BARI, Jashore in a semi-controlled net house during 2022-23. It was conducted on two types of nutrient solution namely BARI Nutrient Solution-1 (BARI NS-1) and Enshi-shoo solution (Japanese formulation) on four crops namely tomato, cucumber, kangkong (Gimakolmi) and lettuce. SCS (soilless culture system) was found better for fruit type vegetables and DWC (deep water culture) was better for leafy vegetables. Considering the earliness, harvesting and yield potentiality the BARI NS-1 was performed better in tomato and cucumber cultivation. But in case of leafy vegetables like kangkong and lettuce, Enshi-shoo solution performed better over BARI NS-1.

##### **Standardization of growing media of year-round vegetable production technique on rooftop**

S. Hasna, S. D. Setu, M. R. Islam, M. G. Rahman, and B.C. Kundu

An experiment was conducted at rooftop of the Farm division Building of Regional Agricultural Research Station, Rahmatpur, Barishal during



2022-2023 to standardization of growing media and to find out its effect on growth and yield of tomato and brinjal crop. Five growing media combinations were used to study their effect on tomato, brinjal and chilli crop. The following growing media were tested in this study,  $T_1$  = Garden soil + Vermicompost (1:1);  $T_2$  = Gaerden soil + Cocodust (1:1);  $T_3$  = Garden soil + Cowdung (1:1),  $T_4$  = Garden soil + Cocodust + Cowdung + Vermicompost (1:1:1:1) and  $T_5$  = Control. Growth and yield of tomato and brinjal was significantly influenced by treatments. The highest yield of tomato and brinjal (71.48 t/ha and 55.64 t/ha) was recorded from treatment  $T_4$ . Lowest yield was in treatment  $T_5$ .

#### **Effect of decomposed water hyacinth on growth and yield of brinjal**

M. A. Habib, M.A. Sumi, M. S. Alam and M. H. Hossain

This 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<sup>-1</sup>) was observed in  $T_3$  treatment and minimum (1.80 kg plant<sup>-1</sup>) in  $T_4$ . Similarly, the highest fruit yield (32.70 t ha<sup>-1</sup>) was recorded in  $T_3$  treatment and lowest yield (21.16 t ha<sup>-1</sup>) was recorded in the treatment  $T_4$ .

#### **Improving productivity and adoption of BARI developed selected vegetable crops through integrated management approaches at char-areas of Bogura and Rangpur districts (IPVC)**

M.A. Goffar and Ms 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. The results revealed that the yield performance of selected crops under IMA contributed the highest yield compared to Non-IMA. The BCR 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 BCR (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 BCR due to use of indiscriminate insecticides and fertilizers. However, this is the 2nd year results; the experiments will be repeated next year to confirm the findings.

### **Research carried out by different sections of HRC**

#### **Vegetable Crops**

##### **Postharvest Management**

##### **Extension of bitter gourd marketable life through modified atmospheric packaging at controlled storage condition**

M.S. Arfin, M.N. Islam, M.F.B..Hossain and M.A. Rahman

Commercially mature bitter gourds (*Momordica charantia* L.) fruits were harvested from the field and wrapped individually with cling film (12.7 µm thick) or packed in 1% perforated polyethylene bags (LDPE) and were stored at 18°C with 85% RH at the Postharvest Technology Laboratory of Horticulture Research Centre, BARI, Gazipur. Marketable life of unwrapped fruit was nine days, where as it was 14 days when packed in 1% perforated LDPE bag. Although 1% perforated LDPE bag found effective in delaying the

appearance of chilling injury symptoms, however with incidence of some rotting. Cling film-wrapped fruit, on the other hand, had the highest marketable life of 17 days having the lowest weight losses, less softening, reduced incidence of postharvest rots, less fruit yellowing and minimal changes in firmness, vitamin C and  $\beta$ -carotene content. Storage of individually cling film-wrapped fruits at 18°C with 85% RH, therefore offers an effective method of prolonging the marketable life of bitter gourd.

#### **Determination of maturity indices and shelf life of broccoli**

M. S. Arfin, M.N. Islam, M. F. B. Hossain and Z.H. Fahad

The experiment was conducted at the field and laboratory of Postharvest Technology Section, HRC, BARI, Gazipur during the winter season to determine the optimum maturity stage and shelf life of broccoli (*Brassica oleracea* L. var. *italica*). BARI Broccoli-1 was grown in the field following recommended production practices. The heads were harvested at different time started on 60 days after transplanting (DAT), 65 DAT and 70 DAT. Thirty days old seedlings of the broccoli variety 'BARI Broccoli-1', sown in 1<sup>st</sup> week of October 2022 were transplanted on 1<sup>st</sup> week of November 2022 in the field. The experiment was laid out in Random Complete Randomized Block Design (RCBD) in field and Complete Randomized Design (CRD) in laboratory 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  $20 \pm 1^\circ\text{C}$  and a relative humidity of 45-62%. The above parameters were measured at initially and then at daily intervals for up to 3 days. For assessing quality changes, the broccoli heads were packed in 1% perforated low density polyethylene (LDPE), non-perforated LDPE bags and newsprint paper wrap and kept for four days at ambient condition ( $23 \pm 2^\circ\text{C}$ ). Broccoli harvested at 65 days DAT and packed in non perforated LDPE bags showed the slower changes in surface colour ( $a^*$  -1.26 to -4.03,  $b^*$  6.38 to

15.58), chlorophyll content (17.46ug/mg) and weight loss (0.606%). Considering all physical and biochemical parameters, broccoli harvested at 65 DAT and packed in non perforated LDPE bags prolonged the shelf-life by up to four days at ambient condition. This was the first year's trial and more trial is needed to generate additional information and further confirmation of the results.

#### **Impact of sodium lauryl sulfate as safe sanitizing agent on postharvest quality of tomato**

M.S. Arfin, M.N. Islam, M. F. B. Hossain and Z.H. Fahad

An experiment was conducted at the field and laboratory of Postharvest Technology Section, HRC, BARI, Gazipur during 2022-23 to find out the effectiveness of Sodium Lauryl Sulfate as a sanitizing agent on physicochemical and quality attributes of tomato. Thirty days old seedlings of tomato variety 'BARI Tomato-21', sown in 1<sup>st</sup> week of October 2022 were transplanted on 1<sup>st</sup> week of November 2022 in the field. Tomato fruits were harvested at turning stage after 127 days after transplanting, transported to the laboratory and randomly divided into four treatment groups for sanitization. Fresh tap water was taken in three 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  $23 \pm 2^\circ\text{C}$  and a relative humidity of 63-77% RH. This study was conducted following CRD with three replications. After washing with the chemicals, tomato fruits were arranged according to design and treatments for 21 days. Sanitizing agents for washing had positive effect on marketable life and shriveling of tomato. 1% Sodium Lauryl Sulfate reduced the shriveling percentage 28.3 % with retaining physicochemical quality weight loss 11.4 %, hue angle  $100.9^\circ$ , firmness 0.7 kg, lycopene content 7.74 mg/g, ascorbic acid 13.9 mg/100g,  $\beta$ - carotene 10.0 mg/g at the last day of storage. Findings of the present study revealed that 1% Sodium Lauryl Sulfate prolong the marketable life of BARI tomato 21 for 18 days where the marketable life of non-washed one was 10 days only at ambient condition ( $23 \pm 2^\circ\text{C}$  and 63-77% RH).

### **Fresh cut processing techniques of broccoli using different packaging materials**

M.S. Arfin, M.N. Islam, M.F.B. Hossain and M.A. Rahman

The experiment was conducted at the laboratory of Postharvest Technology Section, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur. In the experiment, the influence of packaging properties of 1% perforated low density polythene (LDPE) bag, non-perforated LDPE bag, polypropylene (PP) box and without packaging on the quality loss of fresh cut broccoli florets at refrigerator ( $4\pm1^{\circ}\text{C}$ ) was addressed. The results highlighted that fresh cut broccoli packed in polypropylene box had the highest score in sensory evaluation, like 6.84 in appearance, 2.7 in flavor, 6.3 in texture and 6.8 in overall acceptability with biochemical properties of phenol 62.7 mg GAE/g,  $\beta$ -carotene  $1.98\text{ }\mu\text{g/gm}$ , total chlorophyll 0.046 mg/g, carotenoids 0.024 mg/g and vitamin C 20.7mg/100g. Considering all biochemical and sensory quality parameters, fresh cut broccoli packed in polypropylene box prolonged the shelf life by up to six days at refrigerator ( $4\pm1^{\circ}\text{C}$ ).

## **Fruit Crops**

### **Postharvest Management**

#### **Effect of preservatives and drying condition in retaining food quality of mango slice**

M.S. Arfin, M.N. Islam, M. F. B. Hossain and Z.H. Fahad

The experiment was conducted at the laboratory of Postharvest Technology Section, HRC, BARI, Gazipur to investigate the effectiveness of different preservatives such as citric acid, potassium meta bi sulphate (KMS), calcium chloride, table salt and ascorbic acid in the retention of semi solid 'harivanga' mango slice quality prepared through 50, 60 and 70% drying. Full ripe mango fruits were procured from contact grower. 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 ( $1^*$ ) were reduced, redness ( $+a^*$ ) increased and yellowness ( $+b^*$ ) decreased and the rate was higher in control and ascorbic acid treated slices and lower in citric acid and KMS treated slices after 12 month of storage. The maximum colour change was observed in control treatment ( $1^* 54.0$ ,  $a^* 12.87$ ,  $b^* 54.12$ ) and minimum in citric acid and KMS treated slices ( $1^* 66.34$ ,  $a^* 5.42$ ,  $b^* 69.34$ ). Vitamin C decreased with the drying condition and storage time. Control treatment showed the lowest value of vitamin C content 5.71 and 4.71 mg/100g at 60 and 70% drying respectively after 12 months of storage. Furthermore, citric acid and KMS retained the change of vitamin C content and that was 9.87 and 9.60 mg/100g in 60% drying and 6.96 and 7.28 mg/100g respectively in 70% drying condition. Considering all these, citric acid and KMS were found effective for retaining food quality of mango slice at drying condition. However, more research is needed with other varieties to generate additional information and further confirmation of the results.

#### **Standardization of ethylene dose for uniform and safe ripening of banana using low-cost ethylene generator**

M. S. Arfin, M.N. Islam, 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 of banana. Bananas (cv. Sobri) were harvested at matured green stage and exposed to ethylene gas generated from ethephon (48 SL) by low-cost simple 'Ethylene Generator' with concentrations of 20, 30 and 40 ppm at ambient storage ( $27\pm1^{\circ}\text{C}$  and  $70\pm5\%$  RH) for 24 hours. 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. All three concentrations of ethephon found effective in uniform ripening of banana. However, the values of lightness ( $1^* 72.3$ ), greenness ( $a^* 6.5$ ), yellowness



(b\* 2.1) and fruit firmness of 0.6 kgf were found acceptable in fruits treated with 20 ppm ethephon on day 3 of storage. Therefore, 20 ppm, the lowest dose of ethephon used through low-cost ethylene generator may offers an effective method of safe and uniform bulk ripening of banana.

#### **Selection of suitable cutting size and cultivar for semi solid dry mango slices**

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 mango slice drying at 70 and 80%. Full ripe mangoes cv. Langra were procured from the local market. Mangoes were washed with aquas solution of 200 ppm sodium hypochlorite. Fruits were peeled carefully by prewashed stainless-steel knife and cut into desired pieces and kept in prewashed stainless-steel trays and subjected into the two drying conditions. Findings of the present study revealed that cutting size had positive effect on drying of mango slices. Lightness decreased, redness and yellowness increased after 70% and 80% drying in all treatments. Colour change was the highest in 4 slices per mango and the lowest in cubes in case of 70% drying. In 80% drying the change was the highest in 4 slices per mango and the lowest in 2 slices per mango. 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.

#### **Survey on postharvest practices and losses in pineapple value chains**

M. N. Islam, Z. H. Fahad, M. S. Arfin and M. A. Rahman

A study was conducted to accumulate the scenario of existed postharvest practices and assess postharvest losses in the value chain of pineapple from Postharvest Technology Section, HRC, BARI, Gazipur in 2022-2023. Value chain actors were interviewed using with pretested questionnaires. The actors were selected in three intensive growing areas in Moulvibazar, Ranghamati and Tangail districts and three city areas of Chattogram, Dhaka and Gazipur. Postharvest practices were found as stacking the fruits one by one, sorting, grading, trimming of partial crown and bulk transportation through truck to distant market. Postharvest losses

were reported as 3.68%, 9.98%, 9.07% and 6.65% at grower, bepany, arathdar and retailer level, calculated total postharvest loss of pineapple was 29.38%.

## **Flower Crops**

### **Postharvest Management**

#### **Determining optimum storage temperature with packaging for vase life extension of lilium flower**

M. S. Arfin, M.N. Islam, K. Ambia, A. Naznin and M. F. B. Hossain

An experiment was conducted at Postharvest Technology Section, HRC, BARI, Gazipur to optimize the storage temperature and packaging material for prolonging the vase life of Lilium. Bulbs of BARI Lilium-1 were planted on 1<sup>st</sup> 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. Non-perforated and 1% perforated low density polythene (LDPE) bags were used as packaging materials. After packaging, the flowers were stored either at 8°C or 12°C for two days. Flowers keeping with unpacked condition served as control treatment. The experiment was laid out in factorial CRD with three replications. Ten sticks constitute one replication. After treatment flowers were kept in normal water for vase life observation at room temperature (20°±1°C). The maximum vase life of 7.4 days was found for lilium when they were packed in non- perforated LDPE bags and kept in 8°C for two days.

## **RARS Jashore**

#### **Effect of spacing and sowing time on the yield and quality of BARI Borboti-2**

MR Alam, MA Alam and KU Ahammad

An experiment was conducted to identify the best suitable spacing and sowing time. The treatments were consisted of four sowing time viz, October, January, April and July and spacing viz. 40 cm × 30 cm, 40 cm × 40 cm, 50 × 40 cm, 50 cm × 50 cm and

60 cm × 40 cm. The earliest flowering and harvesting date was found from 50 cm × 40 cm spacing in April sowing while the latest from 50 cm × 50 cm spacing in January sowing. The number of fruits per plot was highest found in October sowing of 40 cm × 30 cm spacing closely followed by 50 cm × 50 cm spacing. Considering fruit bearing and yield the sowing time of October and spacing of 40 cm × 30 cm was found best. The sowing time of January and spacing of 40 cm × 40 cm was also found better.

#### **Evaluation of yard long bean lines**

MH Rahman, S Paul, OA Fakir, MA Habib, S Sultana, MS Huda, MA Alam, MA Hossain and KU Ahmmad

The experiment was conducted at the research field of six BARI stations to find out the suitable advanced line of yard long bean for winter season in Bangladesh. Two advanced yard long bean lines viz. JSRVU-002 (green colored), JSRVU-003 (purple colored) were evaluated with the variety BARI Borboti-1 (control). The maximum number of pods per plant was counted from JSRVU-002 at Moulvibazar region and the minimum number pod per plant was counted from JSRVU-002 at Cumilla. Similarly, the maximum pod length was recorded from JSRVU-002 at Moulvibazar region and the minimum was found in JSRVU-003 at Satkhira. The highest yield was obtained from JSRVU-002 (23.4 t ha<sup>-1</sup>) at Moulvibazar and the lowest yield was from JSRVU-003 (7.7 t ha<sup>-1</sup>) at Jashore. From the results, it may be suggested that JSRVU-002 is suitable yard long bean line for winter season in Moulvibazar, Dinajpur and Jamalpur region in terms of yield.

#### **Introduction of simplified hydroponic system for growing high value vegetables at jashore region**

MA Alam, MR Alam and KU Ahammad

The study was conducted at HRC, Regional Agricultural Research Station, Jashore in a semi controlled net house during kharif season of 2022-2023. The experiment is conducted on two types of nutrient solution namely BARI Nutrient Solution-1 (BARI NS-1) and Enshi-shoo solution (Japanese formulation) on three crops namely tomato, cucumber and kangkong (Gimakolmi). SCS (soilless culture system) is found better for fruit type vegetables and DWC (deep water culture) is

better for leafy vegetables. Considering the earliness, harvesting and yield potentiality the BARI NS-1 was performed better in tomato and cucumber cultivation. But in case of kangkong Enshi-shoo solution performed better over BARI NS-1.

#### **Collection and evaluation of Indian dillenia germplasm**

MR Alam, MA Alam and KU Ahammad

A study was carried out at Horticulture Research Center, Regional Agricultural Research Station, from 2022-23 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 Horticulture Research Center, RARS, Jashore for developing as a variety. The germplasm were collected from Jashore region and planted in 2009. The recorded plant heights of the genotypes were 8.7 m and 8.3m. Flowering was started from 25 May 2022. DI Jas-001 produced total 885 fruits in the fifth year of reporting. DI Jas-002 produced total 405 fruits in the second year of reporting. Individual fruit weights were 590.5g and 542.67g respectively. Total yield of the plants were 522.6 kg and 219.8 kg respectively. DI Jas-001 is an excellent germplasm in respect of yield and quality.

#### **RARS Ishurdi, Pabna**

##### **Advanced yield trial of hyacinth bean lines**

MMR Salim, M.I. Hassan, M.F. Hossain and M.M. Uddin

The average yield of hyacinth bean in the country is very low. Lack of high yielding and photo insensitive variety the most important yield limiting factors. High variability noticed in Bangladesh of country bean cultivars. Therefore, the present study was undertaken to evaluate the hyacinth bean lines with a view to recommending varieties with desirable attributes. The study was conducted at Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2022 in RCB design with three replications. Significantly the highest number of pods per plant (405) was recorded in DL Isd-001 while the lowest number of pods per plant (60) was noted in BARI Sheem-6. Nevertheless, significantly the highest marketable yield (29.58 t/ha) was obtained from DI Isd-001 followed by to DI Isd-018 (20.35) and DL Isd-004 (19.51) while the lowest (7.51 t/ha) was obtained from BARI

Sheem-6. Pod borer infestation was also found the lowest (5.35%) in DI Isd-001 and the highest (9.21 %) in DI Isd-007. Considering yield, shape and size, appearance and borer infestation, the line DL Isd-001, DL Isd-018 and DL Isd-004 were found promising. These lines may be selected for regional yield trial.

#### **Regional yield trial of hyacinth bean lines**

MMR Salim, M.I. Hassan, M.F. Hossain and M.M. Uddin

In Bangladesh, various types of country beans are found to be cultivated in different parts of the country with different shape and size. The average yield of hyacinth bean in the country is very low. Variety release is a continuous process because previous varieties are being degenerated after few generations. Therefore, the present study was undertaken to evaluate the hyacinth bean lines with a view to recommending varieties with desirable attributes. The study was conducted at Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2022-23. The experiment was laid out in RCBD design with three replications. Significantly highest average single pod weight (13.34 g) was recorded from LPPK 013 and LPPK 002 (11.75 g) lowest (8.40 g) was in BARI Sheem-1. The highest pod weight per plant (3.36 kg) was obtained from LPPK 013 whereas, the lowest pod weight (2.06 kg/plant) and (2.36 kg/plant) was obtained from LPPK 002 and BARI Sheem-1 respectively. The yield per hectare LPPK-013 (33.60 t/ha) which was statistically higher than BARI Sheem-1 (23.57 t/ha) and LPPK-002 (20.63t/ha). In regarding pod borer infestation, the minimum infestation (6.13%) was observed in BARI Sheem-1 and maximum (13.02%) was in LPPK 002. Considering yield, shape and size, appearance and borer infestation, the line LPPK 013 was found promising. But these trial done with only two lines. Before confirmation, this trial should done with more lines.

#### **Regional yield trial of hyacinth bean lines**

MMR Salim, M.I. Hassan, M.F. Hossain and M.M. Uddin

The average yield of hyacinth bean in the country is very low. High variability noticed in bean cultivars of the country. Therefore, the present study was undertaken to evaluate the hyacinth bean lines with a view to recommending varieties with desirable

attributes. The experiment was conducted at Regional Agricultural Research Station, Ishwardi, Pabna during Rabi season of 2022-23 was laid out in RCBD design with three replications. Four hyacinth bean lines viz., CB Jam 002, CB Jam 004, CB Jam 006, CB Jam 008 and BARI Sheem-6 as a check were included in the study. Number of pods per plant ranged from 60 to 176 and the maximum (176) number of pods per plant was harvested from CB Jam 006 and CB Jam 004 (174) whereas, minimum (60) was in BARI Sheem-6. Nevertheless, insignificantly the highest marketable yield (18.29 t/ha) was obtained from CB Jam 002 and the lowest (11.63 t/ha) was obtained from BARI Sheem-6. Pod borer infestation was also found the lowest (5.35%) in CB Jam 002 and the highest (8.30 %) in BARI Sheem-6. Considering yield all the selected lines was low yielder. Their shape & size, appearance and borer infestation none found promising. Before confirmation, this trial should continue next year.

#### **Regional yield trial of french bean lines**

MMR Salim, M.I. Hassan, M.F. Hossain and M.M. Uddin

French bean is becoming popular for its tender pods and shelled beans. Besides, it maintains soil fertility through biological nitrogen fixation in association with symbiotic Rhizobium prevalent in their root nodules. In hilly region, farmers are generally cultivating local French bean cultivars of different in colour, shape, size and also vary in taste. Some of these are high yielder, disease and drought resistant. To develop more variety the present experiment was undertaken to see the performance of the advanced line at different agro-ecological zones of Bangladesh. The experiment was conducted at Regional Agricultural Research Station, Ishurdi, Pabna during rabi season of 2022-2023. Three promising lines viz. PV pah 001 and PV Rai-005 along with BARI Jharsheem-3 as check were included in the trial. The maximum number of pods per plant was in BARI Jharsheem-3 (13.35) and minimum in PV Rai-005 (8.90). BARI Jharsheem-3 produced the larger pod among the genotypes with 15.28 cm length and 1.35 cm width. The highest individual fruit weight (5.80 g) and hundred green seed weight (43.25 g) were measured from the line PV pah-001. The maximum (70.70 g) pod yield per plant was obtained from BARI Jharsheem-3 and the minimum (66.85g)



from PV Rai-005. BARI Jharsheem-3 produced the highest (9.51 t) per hectare yield. Considering pod yield PV Pah 001 and PV Rai 005 is parallel yielder to BARI Jharsheem-3 but considering seed color PV Rai 005 may be considered as Khaissa variety.

#### **Regional yield trial of bacterial wilt and TYLCV disease tolerant tomato lines**

MMR Salim, M.I. Hassan, M.F. Hossain and M.M. Uddin

Key constraints in adapting tomato varieties are crop pests and diseases. Soil borne and foliar diseases is often deleterious to the tomato which hampered its yield. Farmer usually use pesticide to control but success is very poor. However, the excessive use of pesticides harmful to the environment as causes also health hazard to the growers as well as consumers too. A number of technologies exist and if adopted would improve yield of tomato. One of the key technological components in tomato production is the development of new varieties which are pest and disease resistant/tolerant that would contribute to increase yield. Therefore initiative has been taken to overcome the existing situation by developing disease tolerant variety. For this purpose some disease tolerant tomato lines are collected from AVRDC and evaluated. Regional yield trial of selected advance disease tolerant tomato lines with BARI Tomato -14 as check was conducted at Regional Agricultural Research Station, BARI, Ishurdi, Pabna, Bangladesh during the winter season of 2022-23 to observe the performance of the selected lines. Significant variation was observed among the lines in respect of different characters studied. A range of variation in number of fruits (23-29) per plant was observed. Maximum fruit yield per hectare obtained from the line AVTO 1317 (85.30 tones) followed by AVTO 1230 (79.97 tones). There was no bacterial wilt infestation found in all the lines. No virus infestation was found in the lines AVTO1317 and AVTO1230. The highest virus infestation was observed from BARI Tomato 14 (43%). The result revealed that

considering high yield and disease tolerance the tomato lines AVTO 1317 and AVTO 1229 found to be promising and may be released as variety. The line AVTO 1317 and AVTO 1229 were found high yielder than check variety. Considering pest and diseases tolerance the lines AVTO 1317 and AVTO 1229 were also found promising and may be may be released as variety.

#### **Effects of chemical fertilizer on growth and yield of hybrid pointed gourd**

MMR Salim, M.I. Hassan, M.F. Hossain and M.M. Uddin

Lack of knowledge particularly proper nutrient management in pointed gourd cultivation is the prime reasons for lower yields. Optimum nitrogen, phosphorus and potassium should be supplied to overcome the bottlenecks of production. Hence, the present study was framed out to find better nutrients management for higher growth, yield and quality of pointed gourd. A field experiment was carried out at Regional Agricultural Research Station, Ishurdi, Pabna during rabi season of 2021-22. Six treatments viz.,  $T_1 = 100\%$  of recommended dose ( $N_{100}$ ,  $P_{20}$ ,  $K_{40}$ ,  $S_{18}$ ,  $Zn_2$  and  $B_1$  kg/ha according to FRG 2018),  $T_2 = 125\%$  of RD,  $T_3 = 150\%$  of RD,  $T_4 = 175\%$  of RD,  $T_5 = 200\%$  of RD and  $T_6 =$  Dose of BARI Handbook were included in the study. The experiment was laid out in RCB design with four replications. The highest number of fruits per plant (78) was recorded in  $T_6$  treatment whereas; the lowest number of fruits per plant (64) was recorded from  $T_1$  treatment. However, the highest fruit weight per plant (3.87 kg) followed by  $T_6$  (3.81kg) and the highest yield (22.12 t/ha) was obtained from  $T_4$  treatment and the lowest (17.28 t/ha) was in  $T_1$  treatment.  $T_4$  treatment i.e. 175% of recommended dose of chemical fertilizer according to FRG 2018 produced the highest yield of pointed gourd. This was first year experiment. So, it will be continued next year for further confirmation of the results.

# FRUIT CROPS

06

## Project I: Varietal Development

### Evaluation of jackfruit germplasm at Joydebpur

M. J. Rahman, M. Z. Rahman and M. A. Islam

Twelve jackfruit germplasm 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 and fruit characters of jackfruit. Number of fruits ranged from 12 to 33. The fruit weight ranged from 3.90 to 10.30 kg. Number of bulbs per fruit varied from 56 in AH Joy-204 to 170 in AH Joy-218. Maximum and minimum edible portions were recorded to be 55.0% in AH Joy-203 and 44.6 % in AH Joy-209, respectively. TSS content was noticed to vary from 18.0 to 24.0°Brix. With respect to the number of fruits per plant, fruit weight, edible portion and TSS content AH Joy-078, AH Joy-099, AH Joy-115, AH Joy-210 and AH Joy-218 were found auspicious.

### Evaluation of jackfruit germplasm at Hathazari

M. M. Rahman, A. Tabassum, M. R. Sarkar and M. Moniruzzaman

The study was conducted at the Regional Agricultural Research Station, Hathazari, Chattogram. Sixteen jackfruit germplasm were selected for the study. A wide variability was observed in different parameters such as weight of individual fruit, number of fruits per tree, size of fruit, shape of fruit, number of bulbs or flake in a fruit, percent edible portion and percent TSS among the germplasm studied. Maximum number of fruits per plant was obtained from AH Hat-03 (48.00) and minimum was from AH Hat-10 (1.00). Individual fruit weight was maximum in AH Hat-04 (15.36 kg) followed by AH Hat-09 (15.16 kg) and minimum was in AH Hat-16 (3.90 kg). All germplasm showed depressed stalk attachment. The

highest yield per plant (418.56 kg) was observed in AH Hat-05 and the lowest from AH Hat-10 (8.50 kg). Edible portion was highest in AH Hat-05 (61.32%) and AH Hat-08 (61.17%) while the lowest edible portion was obtained from AH Hat-03 (24.36%). Maximum TSS was recorded in AH Hat-11 (24.50%) and lowest from AH Hat-07 (13.50%). Maximum number of bulbs per fruit was obtained from AH Hat-15 (418) and the minimum was from AH Hat-07 (30).

### Evaluation of existing jackfruit germplasm at Debiganj

B. R. Barman, M. O. Hoque, M. Rahman, M. A. Halim and M. S. Hossain

The experiment was conducted at Breeder Seed Production Center, Debiganj, Panchagarh with a view to select superior early and late Jackfruit germplasm, and to develop good quality and high yielding variety of Jackfruit. Twenty existing Jackfruit germplasm were included in the experiment. Early flowering noted in germplasm AH Deb-004 and germplasm AH Deb-001, whereas of the germplasm started flowering from 1<sup>st</sup> week to 2<sup>nd</sup> week of January. Early fruit harvesting was done from germplasm AH Deb-001, AH Deb-004 and AH Deb-013, whereas fruit of germplasm AH Deb-003, AH Deb-006, AH Deb-007, AH Deb-011 and AH Deb-012 were collected in 3<sup>rd</sup> week of July. The number of fruits per plant was maximum (105) in AH Deb-013, while minimum (5) in AH Deb-003, AH Deb-006. The larger fruit (8.77 kg) was obtained from AH Deb-003 and smaller fruit (2.27 kg) was in AH Deb-012. The germplasm AH Deb-013 produced the highest yield (700kg/plant) and the germplasm AH Deb-019 gave the lowest yield (27.04 kg). The maximum number of bulbs per fruit (230) were recorded from AH Deb-015, while minimum (30) were recorded from AH Deb-005. The germplasm AH Deb-013 gave maximum bulb weight per fruit (4.17 kg), and the germplasm

AH Deb-011 gave minimum bulb weight per fruit (0.78 kg). The excellent taste was observed in AH Deb-004 and AH Deb-013, and not good taste was observed in AH Deb-020, whereas rest of the germplasm was found in good.

#### ***In-situ* evaluation of some selected profuse bearing jackfruit germplasm at Joydebpur**

M. J. Rahman and M. A. Islam

Four jackfruit germplasm viz., AH Joy-261, AH Joy-266, AH Joy-272 and AH Joy-273 were evaluated to identify the superior ones as profuse bearer and family size jackfruit from different locations of Bangladesh. Number of fruits per plant varied from 75 to 332. Age of tree ranged from 19 to 33 years. Fruit weight ranged from 3.60 to 5.20 kg. Fruit length varied from 24.0 to 25.6 cm while diameter varied from 17.2 to 21.0 cm. Maximum and minimum bulb weight per fruit were recorded to be 2.82 kg in AH Joy-261 and 2.10 kg in AH Joy-266, respectively. Number of bulbs per fruit varied from 82 in AH Joy-266 to 155 in AH Joy-273. Maximum and minimum edible portion were manifested to 59.7% in AH Joy-272 and 54.2% in AH Joy-261, respectively. TSS was noticed to vary from 22.0 to 29.0 °Brix.

#### ***Ex-situ* evaluation of some selected heavy bearing family size jackfruit germplasm at Akbarpur**

M. Samsuzzaman, M. S. Alam, M. J. Hussain and M. H. Hossain

Profuse bearing family size jackfruit germplasms were evaluated at Regional Agricultural Research Station, Akbarpur, Moulvibazar. Yield and yield components of the jackfruit germplasm revealed that highest number of fruits was observed in AH Akb-001 and AH Akb-003 (130), followed by AH Akb-005 (80). Maximum percentage of edible portion was observed in AH Akb-022 (55.7%), followed by AH Akb-016 (55.6%), AH Akb-003 (55.36%) and AH Akb-020 (54.54%) respectively. The highest TSS was found in AH Akb-015 (25%), followed by AH Akb-018 (20%).

#### **Evaluation of off-season jackfruit genotypes in Chattogram region**

H. Barua, S. M. K. H. Chowdhury, M.G. Azam and A. S. M. H. Rashid

The experiment was conducted in the fruit orchard of Agricultural Research Station (ARS), Khulshi, Chattogram, with the view of evaluate off season

jackfruit genotypes. In the study, genotype AH Khu 001 exhibited early flowering, which occurred on the 16th of November, 2022. Subsequently, harvesting took place on the 23rd of March, 2023. The weight of the whole fruit was recorded as 2.62 kg, with a length of 23.1 cm and a breadth of 15.00 cm. The combined weight of the fruit's rind and rachis was 1089 grams, and the thickness of the fruit's rind measured 0.97 cm. Each fruit contained 49 bulbs, with the bulb part of the fruit weighing 1.53 kg. The weight of each individual bulb within the fruit was measured at 31.14 grams, with a length of 5.17 cm and a breadth of 3.36 cm. The fruit had an edible percentage of 86.23%. The total soluble solids percentage, representing the sugar content in the fruit, was determined to be 21.85%.

#### **Collection and evaluation of year-round (off-season) jackfruit germplasm in Cumilla region**

M. M. H. Bhuiyan, M. H. Rahman, M. A. Siddiky and M. O. Kaisar

The research aimed to identify, collect, and evaluate year-round and off-season jackfruit germplasm in selected districts of Bangladesh. Six germplasm were identified through surveys, and their flowering and fruiting characteristics were recorded. Fruits from these germplasms were collected from different locations, confirming their year-round and off-season behavior. Subsequently, various fruit attributes, including total weight, length, diameter, number of pulp fruit<sup>-1</sup>, pulp color, aril weight, total pulp weight, and TSS (%), were evaluated in the laboratory. AH Cum-106 displayed the highest number of fruits plant<sup>-1</sup> (50) and the maximum fruit weight (7.0 kg). Notably, AH Cum-106 also exhibited the highest number of bulbs (99) and the heaviest bulbs (352) based on the 10-bulb weight and bulb-seed ratio. AH Cum-101 had the maximum TSS (25.8%). All germplasms produced sweet-tasting, uniform-shaped fruits. This research provides valuable insights for further variety development and cultivation of jackfruit.

#### **Evaluation of jackfruit germplasm in the hilly region**

M. G. Rahman, M. A. A. Malek, M. R. Ahmad and M. A. Hossain

Ten jackfruit germplasm were evaluated at the fruit farm of HARS, Khagrachari 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 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.

#### **Evaluation of colour fleshed jackfruit germplasm in hilly region**

S. M. Faisal

Three-color fleshed jackfruit germplasm has evaluated at HTARS, Ramgarh. The highest plant height (8.90 m) was recorded from AH Ram-003. The maximum number of fruits per plant was obtained from AH Ram-002 (56) followed by AH Ram-003 (43) and the lowest in AH Ram-002 (35). Individual fruit weight was maximum in AH Ram-002 (9.08 kg), followed by AH Ram-001 (8.69 kg) and the minimum was in AH Ram-003 (8.22 kg). The highest yield per plant (508.48 kg) was observed in AH Ram-002, followed by AH Ram-003 (353.46 kg) and the lowest yield was recorded from AH Ram-001 (304.15 kg). Maximum TSS was obtained from AH Ram-002 (22.36%), followed by AH Ram-001 (19.66%).

#### **Comparative performance of BARI released jackfruit varieties in Narsingdi region**

S. M. M. Rahman, A. K. M. M. Rahman, M. H. Rahman and R. Akter

Comparative performance of BARI released three Jackfruit varieties (BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3) were evaluated at the Regional Horticulture Research Station, BARI, Shibpur, Narsingdi. Wide range of variation was observed in plant height, base girth, trunk height, plant spreading and number of main branches/plant. Plant height varied from 2.76 to 3.62 m, whereas trunk height ranged from 0.56m to 0.70m. Base girth ranged from 24.74 cm to 26.34 cm. Plant spreading varied to a large extent. The minimum N-S spreading was found in BARI Kanthal-3 (1.95 m)

and the maximum in BARI Kanthal-2 (2.22 m). The E-W spreading ranged from 1.92 to 2.37 m. The highest no. of main branch was found in BARI Kanthal-1 (5.8).

#### **Evaluation of exotic jackfruit germplasm at Joydebpur**

M. J. Rahman, M. A. Islam and M. M. Islam

Nine exotic year-round jackfruit germplasm and three red jackfruit germplasm were studied at the Fruit Research Farm, Joydebpur. Plant height, base girth, plant spreading and number of fruits were recorded. The average plant height was observed to be 4.87 m. Maximum plant height was recorded in AH Exo-05 (5.6 m) and minimum plant height was recorded in AH Exo-13 (2.4 m). Three germplasm were observed to produce fruit. Two germplasm were recognized as red pulp producing jackfruit. One of the germplasm was found to produce male inflorescences which was the sign of off-season and year round behavior.

#### **Hybridization in jackfruit at Joydebpur**

M. A. Islam, M. J. Rahman and M. M. Khatun

Hybridization in Jackfruit was carried out at the Fruit Research Farm of Horticulture Research Centre (HRC), BARI, Joydebpur, Gazipur to incorporate some important characters like colour, off-season, year-round and regular heavy bearing habit in the desired variety or cultivar. Cross combinations for hybridization were: AH Joy-210×Hazari Kanthal and AH Joy-115×Hazari Kanthal. Initial fruit set was found 2, 1 in AH Joy-210×Hazari Kanthal and AH Joy-115×Hazari Kanthal cross combinations and finally number of fruits was harvested 1, 1, respectively. From the cross combinations AH Joy-210×Hazari Kanthal and AH Joy-115×Hazari Kanthal, 2 fruits were harvested and seedlings have been raised, which will be planted in the main field.

#### **Hybridization in mango at Joydebpur**

M. S. Uddin and B. C. Sarker

Good quality mangoes have huge demand in local and international market. To mitigate the growing demand of popular mango as well as to improve the export potentiality, a hybridization programme was conducted following half-diallel fashion at the Fruit Research Farm, Horticulture Research Centre, BARI, Gazipur to develop superior hybrids with desirable characters of mango. BARI Aam-4 ×

BARI Aam-7, BARI Aam-4 × BARI Aam-3 and BARI Aam-3 × Ruby and BARI Aam-3 × BARI Aam-7. A total of 608 flowers from 138 panicles were emasculated and pollinated. Seventeen fruits were obtained from BARI Aam-3 × BARI Aam-4 and BARI Aam-4 × BARI Aam-3. These 16 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.

#### Hybridization in mango at Binodpur

M. A. Shahed, M. S. Islam, M. H. Waliullah and K. H. Alam

The experiment was conducted at FRS, Binodpur, Rajshahi to develop new mango hybrids having desirable characters like colour, size, off seasonal bearing habit. Crossing combinations were as follows: BARI Aam-14 × Cartimon, BARI Aam-4 × Cartimon, Cartimon × BARI Aam-4, Cartimon × BARI Aam-14, Gopalbhog × MI Raj-008, Gopalbhog × Kalua, Kalua × Gopalbhog, BARI Aam-14 × BARI Aam-4, Langra × BARI Aam-14, BARI Aam-11 × Cartimon, MI Raj-002 × BARI Aam-11, MI Raj-002 × Q-Zai and Cartimon × BARI Aam-11. A total of 2572 flowers from 552 selected panicles from different parents were emasculated where only 2504 flowers were pollinated. Total 22 hybrids were obtained where 10 hybrids from seasonal crossing (four BARI Aam-4 × Cartimon, three from BARI Aam-14 × Cartimon, one from Cartimon × BARI Aam-14, one from Cartimon × BARI Aam-4 and one from MI Raj-002 × Q-Zai) and 12 hybrids from off-seasonal crossing (eight from BARI Aam-11 × Cartimon, three from Cartimon × BARI Aam-11 and one from MI Raj-002 × BARI Aam-11) were obtained in the same year. Ten hybrids from seasonal crossing were harvested at mature stage and were sown in soil for germination and four hybrids were germinated and rest of them are waited to be germinated. But the hybrids from off-seasonal crossing are yet to be harvested. After germination, the hybrid seedlings will be transplanted in the field and evaluation will be conducted in the following seasons.

#### Inter-varietal hybridization of mango at Chapainawabganj

A. S. M. Yousuf Ali, M. K. Islam, M. M. Rahman and M. M. Rahman

A hybridization programme was conducted in the flowering seasons of 2023 at RHRS,

Chapainawabganj. Crossing combinations were as follows: Khirsapat × Quzai, BARI Aam-2 × BARI Aam-3, Langra × Palmer, Ashina × Chakapat and Kartimon × Chakapat. A total of 5770 flowers from 998 panicles were emasculated and pollinated. A total of thirteen hybrid fruits were collected this year. Among these, Four hybrid fruits were obtained from the cross khirsapat × Quzai, Three from the cross BARI Aam-2 × BARI Aam-3, Two from the cross Langra × Palmer, Two from the cross Ashina × Chakapat & Two from the cross Kartimon × Chakapat. These mango hybrid fruits were harvested at mature stage and stones of the fruits sowed 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 at Jashore

M. A. Alam, M. Alam and K. U. Ahammad

A hybridization programme on mango was undertaken at HRC, RARS, Jashore. A total of 384 flowers from 72 panicles were emasculated whereas 374 flowers were pollinated comprising two sets- set-I (BARI Aam-3 × BARI Aam-7, BARI Aam-7 × BARI Aam-3, BARI Aam-4 × BARI Aam-7, BARI Aam-7 × BARI Aam-4, BARI Aam-4 × MI Jas-001 and BARI Aam-3 × MI Jas-001) is for ripe mangoes and set-II (BARI Aam-9 × BARI Aam-4, BARI Aam-9 × BARI Aam-7, BARI Aam-9 × BARI Aam-8, BARI Aam-9 × BARI Aam-11, BARI Aam-9 × BARI Aam-12, BARI Aam-9 × Ashwina and BARI Aam-9 × Bananais) for Kanchamitha mangoes. Four fruits from different crosses were harvested. Among them, three fruits are derived from BARI Aam-3 × BARI Aam-7 and one fruit is derived from BARI Aam-9 × Banana. The stones of the fruits were sown in soil where 3 were germinated. The plants are now growing up.

#### Hybridization in mango at Cumilla

S. Sultana, T. H. Tabassum, M. A. Siddiky and M. O. Kaiser

A hybridization program was conducted at Regional Agricultural Research Station, BARI, Cumilla. The cross combinations were (♀) BARI Aam-1 × (♂) MI Cum-015, (♀) BARI Aam-1 × (♂) MI Cum-008, (♀) MI Cum-004 × (♂) BARI Aam-11 (vice versa) and (♀) BARI Aam-11 × (♂)

Katimon. MI Cum-004 is an off-season line with low fibre and sweetness which was crossed with BARI Aam-11 with a view to develop low fibre and sweet off-season variety from where only three fruits have been collected. In another cross, a heavy bearing line, MI Cum-015, was used as a male parent to be crossed with early variety BARI Aam-1 to transfer profuse bearing nature of the male. Three fruits were collected from those crosses. Other crosses were not successful. A total of 963 flowers from 133 panicles were emasculated and pollinated. Twenty-four fruits from the crosses were set initially but all fruits dropped except six before getting matured.

#### **Hybridization of mango at Chattogram region**

S. M. K. H. Chowdhury, M. G. Azam, A. S. M. H. Rashid

The 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. Out of 53 emasculated flowers, five fruits were developed on inflorescences of crossing between BARI Aam-11 and BARI Aam-3. Considering another reciprocal cross between BARI Aam-3 and BARI Aam-11, only one fruit was developed. One seedling of crossing between BARI Aam-3 and BARI Aam-11 was grown in nursery during 2021-2022.

#### **Morphological characterization of mango germplasm**

S. Sultana, T. H. Tabassum, M. A. Siddiky and M. O. Kaiser

The experiment was carried out on characterization of mango germplasm collected from different parts of the Cumilla region to identify suitable parents for hybridization program at Regional Agricultural Research Station, BARI, Cumilla having 18 mango germplasm. Accessions were characterized based on mango descriptors listed by IPGRI (2006). Forty-nine traits (31 qualitative and 18 quantitative) have been measured per accession. A wide range of variability in respect of various characters viz., plant, leaf, inflorescence, fruit, stone and yield was observed. In essence, seven (07) lines have been identified as promising breeding materials based on their maturity period, off-season bearing nature, profuse bearing nature, TSS content, flesh texture

and fibre content. These identified cultivars may be good donors in future hybridization program to evolve superior varieties.

#### **Evaluation of mango germplasm at Binodpur**

M. H. Waliullah, M. S. Islam, M. A. Shahed, and K. H. Alam

An experiment was conducted at the Fruit Research Station, Binodpur, Rajshahi to identify the promising mango germplasm for higher yield and qualities. Nine mango germplasms namely MI Raj-003, MI Raj-004, MI Raj-005, MI Raj-010, MI Raj-013, MI Raj-014, MI Raj-016, MI Raj-019 MI Raj-020 were identified before and were evaluated. Among them, earliest flowering and harvesting were observed in MI Raj-003 and MI Raj-005 germplasm. The highest edible portion (90.1%) was achieved from MI Raj-016 while the lowest edible portion (51%) was achieved from MI Raj-005. Maximum total Soluble Solids (TSS) (24%) was observed in MI Raj-005 where minimum (12%) TSS was observed in MI Raj-016. The highest yield per tree (38 kg) was produced by MI Raj-004 but the lowest yield per tree (3 kg) was produced by MI Raj-016. MI Raj-014 might be considered as a promising line on the basis of fruit size, yield quality and harvesting time.

#### **Characterization and evaluation of late mango germplasm at Binodpur**

M. H. Waliullah, M. S. Islam, M. A. Shahed and K. H. Alam

An experiment on characterization and evaluation of late mango germplasm was conducted at the Fruit Research Station, Binodpur, 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 which harvested in the late season (September). The germplasm MI Raj-002 produced 186 number and 46 kg of fruits in the mid-season (February- June) production. In case of late season production, the tree bore 155 fruits in number and 27 kg in weight. The individual fruit weight of MI Raj-002 was 270 g in the main season and 182 g in the late season (May-September, 2022). TSS percentage of main season fruit was 17 while it was 21 in late season fruit.



### ***In-situ* evaluation of a late mango germplasm at Chapainawabganj**

A. S. M. Yousuf Ali, M. K. Islam, M. M. Hossain, H. B. Harun and M. M. Rahman

An experiment on in-situ evaluation of A late mango germplasm was carried out at RHRS, Chapainawabganj to know the detailed information on plant growth, fruit characteristics and yield. The maximum tree volume was recorded in MI ChaL-01 (28 m<sup>3</sup>) and the minimum was recorded in BARI Aam-12 (17.5 m<sup>3</sup>). Fruits were harvested from BARI Aam-12. The highest (120) number of fruits per plant were recorded from MI ChaL-01 and the minimum (66) from BARI Aam-12. The fruit yield varied from 22.11 to 37.44 kg. The maximum fruit yield per tree (37.44 kg) was recorded from MI ChaL-01 and the minimum (22.11 kg) from BARI Aam-12. Harvesting time was 1st week of September in MI ChaL-01 and Last week of July in BARI Aam-12. MI ChaL-01 gave the maximum (10 days) shelf life and the minimum (7days) was recorded from BARI Aam-12. MI ChaL-01 showed maximum (25%) TSS percentage while BARI Aam-12 showed the lowest (21%) TSS percentage.

### **Collection and evaluation of early mango germplasm at Chapainawabganj**

A. S.M. Yousuf Ali, M. K. Islam, M. M. Hossain, H.B. Harun and M. M. Rahman

An experiment on collection and evaluation of early mango germplasm was conducted at the Regional Horticulture Research Station, Chapainawabganj. Five genotypes (MI ChaE-01, MI ChaE-02, MI ChaE-03, MI ChaE-04 and MI ChaE-05) were collected from five Upazilas of Chapainawabganj district. BARI Aam-1 was used as check variety. Individual fruit weight (227.5g) was maximum in BARI Aam-1 while the minimum (115) was found in MI ChaE-03. Harvesting time varied from 3rd week of April to last week of May. Harvesting time was 3rd week of April in MI ChaE-05 while last week of May was recorded from both BARI Aam-1 and MI ChaE-04. BARI Aam-1 produced maximum edible portion (69.2%) which was closely followed by MI ChaE-05 (67.3%) whereas the minimum (55.3%) was obtained from MI ChaE-03.

### **Improvement of local mango cultivars**

M. A.Alam, M. R.Alam and K. U.Ahammad

The experiment was conducted at Regional Agricultural Research Station, Jashore. Twenty-three

mangoes collected through 'Aam Karmasuchi' and regular collection programme. Germplasm were collected from different places of Jashore region. Fruit weight was maximum in MI Jas 015 (756 g) followed by MI Jas-014 (511 g). The highest edible portion was got in MI Jas-010 (81%). Maximum TSS was recorded in MI Jas-014 (23.0%). Number of fruits per tree was found maximum in MI Jas-010 (12) followed by MI Jas-017 (9) and (8). The highest yield (3.08 kg) was noted in MI Jas-011, followed by MI Jas-010 and MI Jas-015 (3.024 and 2.268 kg, respectively). The biggest sized fruit was found in MI Jas-015. The highest shelf life (5.67 days) was shown by MI Jas-010, MI Jas-012, MI Jas-017 and MI Jas-018.

### **Evaluation of collected mango germplasm at Akbarpur**

M. Samsuzzaman, M. S. Alam, M. J. Hussain and M. H. Hossain

The experiment was conducted at Regional Agricultural Research station, BARI, Akbarpur, Moulvibazar. Five germplasm (MI Akb-001, MI Akb-002, MI Akb-003, MI Akb-004 and MI Akb-005) were evaluated and two BARI released variety (BARI Aam-3 and BARI Aam-4) were used as check in the study. Ages of the plant were around 4 years. The accession numbers of germplasm are MI Akb-001, MI Akb-002, MI Akb-003, MI Akb-004 and MI Akb-005 was collected from different local nursery and fruit fair and the saplings were planted in June 2018. Wide variations were observed regarding number of fruits per plant, individual fruit weight, percent of edible portion and TSS of different germplasms. The Highest number of fruits per plant (112) was observed in BARI Aam-3, highest individual fruit weight per plant (720.7 g) was obtained from MI Akb-001. Highest pulp weight (486.3 g) was obtained from MI Akb-001. The higher fruit yield was recorded from BARI Aam-3 (12.2 kg). Edible portion was higher in MI Akb-004 (77.04%) and maximum TSS of 21% and 20% was obtained from MIAkb-005 and MI Akb-004, respectively.

### **Evaluation of newly collected mango germplasm at Raikhali**

S. P. Chakma, M. M. Hasan and N. U. Ahmed

An experiment on the evaluation of mango germplasm in hill valley was conducted at the fruit orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District. Twenty-one

germplasm were evaluated. The highest no. of fruits per plant (1500) in MI Rai-040 and lowest number of fruits per plant (10) in MI Rai-029. MI Rai-037 performed better in terms of overall performance like individual fruit weight (712 g), TSS (20%), edible portion (73%), and size and shape compared to other lines. However, MI Rai-040 and MI Rai-029 were also found superior in terms of early harvest and year-round production, respectively.

#### **Evaluation of mango germplasm at Jamalpur region**

M. A. Hossain, 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 grafts of thirty-five mango germplasm like MI Jam-001, MI Jam-002, MI Jam-003, MI Jam-004, MI Jam-005, MI Jam-006, MI Jam-007, MI Jam-008, MI Jam-009, MI Jam-010, MI Jam-011, MI Jam-012, MI Jam-013, MI Jam-014, MI Jam-015, MI Jam-016, MI Jam-017, MI Jam-018, MI Jam-019, MI Jam-020, MI Jam-021, MI Jam-022, MI Jam-023, MI Jam-024, MI Jam-025, MI Jam-026, MI Jam-027, MI Jam-028, MI Jam-029, MI Jam-030, MI Jam-031, MI Jam-032, MI Jam-033, MI Jam-034 and MI Jam-035 were collected from different area of Jamalpur. Grafts were planted in RCB design by maintaining 5m×5m spacing. The highest plant height was recorded from MI Jam-001 (3.60 m) and the lowest was in MI Jam-037 (1.05 m). The maximum base girth was obtained from MI Jam-001 (46.30 cm) and the minimum in MI Jam-037 (9.0 cm). The highest canopy spread was observed in MI Jam-002 (3.51 m x 3.46 m) and the lowest was in MI Jam-032 (0.50 m x 0.60m). The maximum tree volume was obtained from MI Jam-001 (22.15 m<sup>3</sup>) and the lowest was in MI Jam-032 (0.32 m<sup>3</sup>).

#### **Performance of green mango (*kanchamitha*) germplasm at hilly region**

M. A. A. Malek, M. G. Rahman, M. R. Ahmad and M. A. Hossain

An experiment was conducted for the evaluation of one Kanchamitha mango germplasm (MI Kha-001) at Hill Agricultural Research Station, Khagrachari last three years. The full blooming period was end of January. The tree habit was spreading to intermediate type. Last three years Harvesting

period was 02 to 19 May. Average total Soluble Solids (TSS) was recorded 9.77%. Average edible portion was found (78.28%). 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 used as unripe condition.

#### **Evaluation of mango germplasm for green consumption at hill valley in Chattogram hill tracts**

S. P. Chakma, M. M. Hasan and N.U. Ahmed

The experiment was conducted at hill valley of Hill Agricultural Research Station of Raikhali in Rangamati Hill District on the existing eight years old mango orchard with MI Rai-005, MI Rai-006, MI Rai-007, MI Rai-008 and MI Rai-009. The experiment was conducted in a Randomized Complete Block Design (RCBD) maintaining 6 m × 6 m spacing. The highest number of fruits per plant (512) was found in MI Rai-008 and the lowest number of fruits per plant (32) was in MI Rai-009. The heaviest individual fruit weight (240 g) with edible portion (79.17%) were recorded in MI Rai-008 on the other hand lowest individual fruit weight (130 g) was found in MI Rai-009. The maximum TSS (11%) was found in germplasm MI Rai-008 and BARI Aam-9. Germplasm MIR008 and BARI Aam-9 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 superior among all other germplasms under study in Chattogram Hill Tracts.

#### **Evaluation of *kancha-mitha* mango germplasm in Chattogram region**

M. G. Azam, S. M. K. H. Chowdhury, H. Barua and A. S. M. H. Rashid

The experiment was conducted at Mango orchard of Agricultural Research Station (ARS), Khulshi, Chattogram to assess mango genotype 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. Except for BARI Aam-9, which bloomed in March, all genotypes produced flowers in February. The fruit with the highest fruit weight (276.67 g) was MI Pah-020. On the other hand, BARI Aam-9 produced the lowest fruit weight

(148.77 g). MI Pah-020 produced the largest fruit (11.68 cm × 7.18 cm). BARI Aam-9, on the other hand, produced the smallest fruit (9.94 cm × 5.26 cm). MI Pah-020 produced the thickest fruit (6.37 cm), while BARI Aam-9 produced the narrowest fruit (5.06 cm). The highest TSS (11.25%) was obtained from MI Pah-007 which was excellent in taste. The TSS (10.15 %) of MI Pah-010 is relatively low but it was very good in taste. The BARI Aam-9 produced the greatest yield per plant (34.22 kg), while the MI Pah-020 genotype produced the lowest yield per plant (16.60 kg).

#### **Evaluation of local and exotic mango germplasm in Chattogram region**

M. G. Azam, S. M. K.H. Chowdhury, H. Barua and A. S. M. H. Rashid

Seventeen genotypes of mango were evaluated at Agricultural Research Station, Khulshi, Chattogram. Earliest flowering (1st February 2023) in MI Pah-057 and the latest flowering (25 February 2023) in MI Pah-003 was observed. The heaviest fruit (921.50 g) was recorded from MI Pah-011 and the lightest fruit (141.51 g) was recorded from MI Pah-026. The longest fruit (20.13 cm) was obtained from MI Pah-011 followed by MI Pah-056 (18.59 cm) whereas the shortest fruit (8.84 cm) was obtained from MI Pah-026. The maximum number of fruits per plant (301.00) was produced by in MI Pah-019 and the minimum (8.00) was produced by MI Pah-020. The highest edible portion (80.70 %) was recorded from MI Pah-056 followed by MI Pah-053 (79.67%) and the lowest edible portion (59.94 %) was recorded from MI Pah-021. Total Soluble Solids from MI Pah-056 noted maximum (23.90 °Brix) and Total Soluble Solids from MI Pah-020 noted minimum (13.42 °Brix). The highest yield (127.62 kg) was harvested from MI Pah-019 followed by MI Pah-003 (73.48 kg) and the lowest yield (2.69 kg) was harvested from MI Pah-020. There was a great variation in both skin color and flesh color. There was medium fiber in MI Pah-010 and MI Pah-021. The less fiber was obtained from MI Pah-008, MI Pah-019 and MI Pah-020. The remaining germplasm had no fiber in the flesh.

#### **Collection and evaluation of exotic mango germplasm at Chapainawabganj**

A. S. M. Yousuf Ali, M. K. Islam, H. B. Harun and M. M. Rahman

An experiment on collection and evaluation of exotic mango germplasm was conducted at the

Regional Horticulture Research Station, Chapainawabganj. Twelve genotypes (Apple mango, Miyazaki, Nam doc mai, Sandi, Chiang mai, King of chakapat, Four kg, Jian wang, Three taste, Black stone, Banana Mango & Brunei king) were collected from different nursery of Chapainawabganj district and planted in 2023. The experiment will be continued and data on growth, yield, insect pests and diseases will be reported next year.

#### **Collection and evaluation of exotic mango germplasm at Lebukhali**

M. Islam, M. Ratna, E. Mahmud, N. Akter, S. Yesmin and M. I. A. Howlader

An experiment with thirty-one germplasm of mango was conducted at the experimental field of Regional Horticultural Research Station (RHRS), Lebukhali, Patuakhali for the evaluation of superior mango lines in southern region of Bangladesh. The germplasm MI Leb-018, MI Leb-021, MI Leb-032, MI Leb-034 and MI Leb-039 were red skinned and rests were yellow. The germplasm MI Leb-021 was round shaped and rest were elongated. Fiber was present in the fruit pulp of three germplasm MI Leb-010, MI Leb-025 and MI Leb-027 among the thirteen. The heaviest individual fruit (1700g) was recorded in MI Leb-027 whereas the lightest individual fruit (193 g) in MI Leb-040. The maximum edible portion (83.9%) was found in MI Leb-015 followed by MI Leb-021 (82.9%) and MI Leb-018 (81.6%) and the minimum (69.4%) in MI Leb-034. The TSS varied from 11% to 27%. The highest TSS (27%) was recorded in MI Leb-040 followed by MI Leb-039 (26%) whereas the lowest (11%) in MI Leb-027.

#### **Characterization and evaluation of mango chance seedlings obtained from BARI Aam-4**

M. H. Waliullah, M. S. Islam, M. A. Shahed and K. H. Alam

One mango chance seedling obtained from BARI Aam-4 was characterized and evaluated at the Fruit research station, Binodpur, Rajshahi. The individual fruit weight of MI RajCS-01 was noted 426.7 g. The genotype had the capability of late season fruit production. MI Raj CS-01 produced greenish yellow colour with attractive and good quality fruits. MI RajCS-01 having light pleasant pulp flavour. MI Raj CS-01 recorded 73.12% edible portion and 23.33% TSS, respectively. The



germplasm MI Raj CS-01 produced 10 fruits and 4.2 kg of fruits in 2022-23.

#### **Performance of mango hybrids at Joydebpur**

M. S. Uddin and B. C. Sarker

An experiment was carried out at the fruit research farm, HRC, BARI, Gazipur to evaluate the performance of a promising mango hybrids to release as a variety. It was planted in the year 2018 and tree volume 12.96 m<sup>3</sup> was recorded in the MI Joy Hy-001. The average fruit weight (240.0 g), fruit yield (9.12 kg), and edible portion (76.25%) and TSS (26.5.00 %) were recorded. There was no disease and insect infestation. The shelf life of fruit was 8-10 days.

#### **Performance of some mango hybrids at Chapainawabganj**

A. S.M. Yousuf Ali, M. M. Hossain, M.M. Rahman and M. M. Rahman

An experiment on performance of some mango hybrids was carried out with 09 mango hybrids namely MI Cha Hy-030, MI Cha Hy-034, MI Cha Hy-052, MI Cha Hy-058, MI Cha Hy-065, MI Cha Hy-067, MI Cha Hy-098, MI Cha Hy-110 and MI Cha Hy-111 at RHRS, Chapainawabganj to know the detailed information on plant growth, fruit characteristics and yield. The maximum tree volume was recorded in MI Cha Hy-065 (370 m<sup>3</sup>) and the minimum was recorded in MI Cha Hy-098(106 m<sup>3</sup>). Fruit weight was maximum in MI Cha Hy-110(447.2g) while the minimum was in MI Cha Hy-058 (164.8 g). The highest yield of fruit was recorded in MI Cha Hy-065 (273 kg) while the lowest yield was in MI Cha Hy-111(26.15 kg).MI Cha Hy-110 had maximum edible portion (79.51%) followed by MI Cha Hy-034(73.5) whereas minimum (63.4 %) was in MI Cha Hy-067. The highest TSS (23 %) was recorded from MI Cha Hy-058 followed by MI Cha Hy-110(22) while minimum (15%) was in MI Cha Hy-067. Highest fruit fly infestation at the time of harvest was recorded in MI Cha Hy-067(20 %) while low infestation (10 %) was found among MI Cha Hy-034, MI Cha Hy-052 &MI Cha Hy-110. The mango hybrid MI Cha Hy-058 showed the highest disease incidence (20%) while the lowest (10%) was found among MI Cha Hy-052, MI Cha Hy-067 &MI Cha Hy-110 (12%) in natural condition. Stem end rot was absent in all the mango hybrids. Maximum shelf life (7 days) was found among MI

Cha Hy-030, MI Cha Hy-058, MI Cha Hy-065,MI Cha Hy-110 &MI Cha Hy-111 and minimum shelf life (6 days) was found among MI Cha Hy-034, MI Cha Hy-052, MI Cha Hy-067 &MI Cha Hy-098.

#### **Performance of BARI developed mango varieties in Chattogram hill tracts**

S. P. Chakma, M. M. Hasan and N. U. Ahmed

An experiment was conducted with eleven 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, BARI Aam-9, BARI Aam-10 and BARI Aam-11 at hill valley of Hill Agricultural Research Station in Raikhali, Rangamati Hill District on the existing fourteen years old mango orchard with an objective to verify their performance. Among the varieties, BARI Aam-7 performed better in terms of yield followed by BARI Aam-8 and BARI Aam-3. However, in terms of TSS BARI Aam-3 (23%), BARI Aam-4 (22%) and BARI Aam-9 (22%) were superior, and in terms of individual fruit weight BARI Aam-4 was the heaviest (385 g) followed by BARI Aam-5 (366 g).

#### **Clonal selection of banana cv. Amritsagar**

S. M. M. Rahman, M. M. Rahman, A. K. M. M. Rahman, M. H. Rahman and R. Akter

Banana (*Musa sp.*) is the most important and attractive fruits of the tropical world, holds a unique position in the life of the people of Bangladesh. More than five hundred AmritSagar germplasm was collected from ten different locations and planted at the research field of Regional Horticulture Research Station of Bangladesh Agricultural Research Institute, Shibpur, Narsingdi to evaluate and identify the suitable lines/variety and to know regional adaptability of banana. This is fourth year evaluation of fruits of only 5 accessions were considered. Selected germplasm will be evaluated more precisely. Maximum number of leaves was obtained from MS Nar-005 (12.53) whereas MS Nar-030 produced the minimum leaves (9.93). MS Nar-005 got the highest bunch weight (18.23 kg), number of hands/bunch (7.67) and the heaviest hands (3.03 kg). MS Nar-005 got the highest number of fingers per hand (17.50) followed by MS Nar-022 and MS Nar-030 whereas MS Nar-010 got the lowest (14.39). MS Nar-005 produced the highest fruit yield (45.58 t/ha) and MS Nar-030

produced the lowest yield (38.93 t/ha). MS Nar-005 exhibited the highest edible portion (75.53%). TSS was maximum in MS Nar-005 (20.50%) and the lowest was recorded from MS Nar-022 (18.32%). MS Nar-005 exhibited the highest shelf life (7.97 days) as compared to the lowest shelf life in MS Nar-030 (7.01 days).

#### **Collection and evaluation of banana CV. Sabri**

S. M. M. Rahman, A. K. M. M. Rahman, R. Akter and R. A. Rimu

The experiment was conducted at the research field of the Regional Horticultural Research Station, BARI, Shibpur, Narsingdi. MS Nar-002 (13.33) whereas MS Nar-003 produced the minimum leaves (11.67). MS Nar-002 got the highest bunch weight (8.50 kg) and number of hands/bunch (8.50). MS Nar-002 got the highest number of fingers per bunch (91.33) followed by MS Nar-005 and MS Nar-003 whereas MS Nar-004 got the lowest (82.33). MS Nar-002 produced the highest fruit yield (30.74 t/ha) and MS Nar-005 produced the lowest yield (23.03 t/ha). MS Nar-004 exhibited the highest edible portion (79.33%). TSS was maximum in MS Nar-002 (23.17%) and the lowest was recorded from MS Nar-003 (22.20%).

#### **Evaluation of banana germplasm (cv. Sabri) at Jamalpur region**

H. Rahman, M. A. Hossain, A. Akter, R. Sultana and H. E. M. K. Mazed

An experiment was carried out for fruit characteristics of Sabri Kola at the HRC, RARS, Jamalpur. Six local germplasm were included in the study. The highest bunch weight (17.15 kg) was found from the line MS Jam-004 and the lowest (12.17 kg) from MS Jam-002. MS Jam-004 & MS Jam-006 exhibited the highest shelf life (6 days) as compared to the lowest shelf in MS Jam-003 (4 days). MS Jam-006 exhibited the highest edible portion (86.98%). The fruit yield was recorded highest in MS Jam-004 (41.63 t/ha) followed by MS Jam-005 (34.60 t/ha) and the other 4 germplasm exhibited an almost similar yield (29.19-29.98 t/ha).

#### **Evaluation of banana cv. Sabri germplasm at Lebukhali**

M. Islam, M. Ratna, E. Mahmud, N. Akter, S. Yesmin 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, Patuakhali. Six banana germplasm were collected from farmer's orchard or household. The collected germplasm was transplanted at experimental field 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 experiment superior banana (sabri) varieties will be developed.

#### **Hybridization in litchi**

of the Regional Horticultural Research Station, BARI, Shibpur, Narsingdi  
M. J. Rahman, M. A. Islam and M. M. Khatun

Litchi is a popular fruit in Bangladesh. The demand for fresh litchi is always high. But the harvesting period of litchi in Bangladesh is very short and remains mainly limited in the month of May-June. Development of early, late and high yielding litchi variety (s) is very much needed to extend the period of availability. Hence, hybridization in litchi was carried out at the Fruit Research Farm of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to incorporate some important characters like earliness, lateness, fruit colour, bearing habit in the desired variety or cultivar. Cross combinations for hybridization were: Kanthali x BARI Lichu-4, BARI Lichu-2 x BARI Lichu-4, BARI Lichu-2 x Bedana and BARI Lichu-4 x Kadmi. Four fruits were harvested from Kanthali x BARI Lichu-4 and 3 fruits from BARI Lichu-4 x Kadmi cross combinations. Six seedlings were raised from seeds. It is mentionable that fruits were harvested from the F<sub>1</sub> plant of Kanthali x BARI Lichu-4 crossing done in 2014. Shape and colour of hybrids fruits were found like BARI Lichu-4, harvested one week later than original BARI Lichu-4 in Gazipur condition.

#### **Intergeneric hybridization of litchi and longan**

M. J. Rahman, M. A. Islam and M. M. Khatun

Litchi and longan are the members of sapidaceae family. Litchi is a popular fruit in Bangladesh. The demand for fresh litchi is always high. But the harvesting period of litchi in Bangladesh is very short and remains mainly limited in the month of May-June. Longan is harvested in the month of July. So, to develop a fruit variety of longan is needed which may have the taste of litchi. Intergeneric hybridization between litchi and longan was carried out at premises of Horticulture

Research Centre (HRC), Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to incorporate some important characters of BARI Litchi-4 into BARI Longan-2. Ten fruits were harvested from BARI Longan-2 X BARI Lichu-4 cross combinations and three seedlings were raised from seeds. Seedlings were planted in November, 2019 in Fruit Research Farm, Joydebpur, Gazipur. This year F<sub>1</sub> plant produced 12 fruits. The size of fruit was found satisfactory.

#### **Evaluation of local and exotic litchi germplasm**

M. J. Rahman, M. M. Khatun and M. A. Islam

The experiment was conducted at the Fruit Research Farm of Horticulture Research Centre, BARI, Gazipur. Ten local litchi germplasm, namely, BARI Lichu-1, BARI Lichu-2, BARI Lichu-3, BARI Lichu-4, BARI Lichu-5, LC Joy- 17 (Kadmi), LC Joy- 18 (Bedana), LC Joy- 22 (Kanthali), LC Joy- 23 (Bombai), LC Joy- 24 (Madraji), LC Joy- 25 (Mangolbari) and three exotic grafted litchi germplasm which were collected in 2018 from China were included in this study. Harvesting time of litchi germplasm was recorded from 2<sup>nd</sup> week of May to 2<sup>nd</sup> week of June, 2023. The average fruit weight was observed 20.7 g. Maximum fruit weight was recorded in LC Exo-07 (32.0 g) followed by LC Joy-23 (22.2 g) and LC Joy-17 (21.4 g). Minimum fruit weight was recorded in BARI Lichu-2 (17.6 g).

#### **In-situ evaluation of litchi germplasm**

M. J. Rahman, M. A. Islam and M. M. Khatun

One litchi germplasm (LC Joy-21) was evaluated in the village of Mohorganj, Pirganj, Rangpur during 23-24 May 2023. The age of tree was 15 years. Profuse fruit bearing was observed. Fruits were harvested and evaluated. Fruit colour is pinkish red and oval shaped. Number of fruits was about 7000. The weight of individual fruit was 23.40 g and aril weight was 17.60 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.

#### **Hybridization of local guava with improved/exotic guava varieties**

M. R. Karim, B. C. Sarker, M. T. Islam and M. A. Islam

A study was initiated on varietal improvement of guava through hybridization with local improved

and exotic guava varieties at HRC, BARI, Gazipur. Only two fruits (BARI Payara-2 x Sowrupkathi) were harvested after successful crosses. Average plant height of five finally selected F<sub>1</sub> hybrid plants ranged from 252 cm to 318 cm, base girth ranged from 11 cm to 17 cm, East-West spreading ranged from 210 cm to 272 cm and North-South spreading ranged from 170 cm to 250 cm. The highest fruit weight (290 g), fruit length (7.2 cm), fruit diameter (8.2 cm), pulp thickness (2.0 cm) and core length (4.6 cm) were recorded from the F<sub>1</sub> hybrid of plant number 10 of line number 06, followed by the F<sub>1</sub> hybrid of plant number 01 of line number 09. Maximum TSS (13%) was recorded from the F<sub>1</sub> hybrid of plant number 01 of line number 09. Similarly, number of fruits per plant (30 fruits), yield 8.1 kg per plant and yield 2.25 tons per hectare were also recorded from the F<sub>1</sub> hybrid of plant number 01 of line number 09. Finally, the fruit of the F<sub>1</sub> hybrid of plant number 01 of line number 09 had flavour like the parent Sowrupkathi.

#### **Evaluation of colour-fleshed off-season guava germplasm**

A. S. M. M. Uddin

Guava (*Psidium guajava* L.) is one of the important fruit grown in Bangladesh. A lot of colour fleshed guava germplasm exist and it is very popular to younger and old people for their excellent colour and flavour. Ten colour fleshed guava germplasm viz. PG Joy-001, PG Joy-002, PG Joy-003, PG Joy-004, PG Joy-005, PG 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. The tallest plant was found in PG Joy-003 (2.65 m) and the shortest plant was recorded in PG Joy-010 (2.24m) and PG Joy-010 (2.17m). Maximum base girth was found in PG Joy-008 (20.37 cm) and minimum base girth was noted in PG Joy-009 (15.23 cm). Fruit characteristics of 10 colour fleshed guava lines varied wildly. The largest fruit was produced by PG Joy-002 (442.52 g). PG Joy-010 produced the smallest fruit (113.20 g). Maximum number of fruits per plant was recorded in PG Joy-002 (41.33). The highest mesocarp and endocarp TSS was found in PG Joy-002 (9.44% & 11.29%) and minimum TSS was in PG Joy-010 (6.90% & 7.97%).



### Development of population for gynodioecious papaya variety

M. R. Karim, B. C. Sarker, A. Alam, M. T. Islam and M. A. Islam

Papaya is a quick growing and cash generating fruit crop in Bangladesh. The major drawback of this fruit in Bangladesh is lack of gynodioecious variety which ensures 100% productive plants. Hence, development of gynodioecious population for obtaining 100% productive plants was performed at the Fruit Research Farm of Pomology Division under HRC, BARI, Gazipur. Four sets of plants namely S<sub>9</sub> progeny of CP Joy-005, CP Joy-009; BC<sub>7</sub> progeny and S<sub>4</sub> progeny of CP Joy-022 were included in the study. Among the four sets; S<sub>9</sub> progeny of CP Joy-005 produced 80, 17.5 and 2.5 percent andromonoecious, female and male plants, respectively; S<sub>9</sub> progeny of CP Joy-009 produced 62.5, 32.5 and 5 percent andromonoecious, female and male plants; the BC<sub>7</sub> progeny produced 65, 35 and 0 percent andromonoecious, female and male plants, respectively and S<sub>4</sub> progeny of CP Joy-022 produced 60, 40 and 0 percent andromonoecious, female and male plants, respectively. Considering the number of fruits per plants, 28, 22, 26 and 30 fruits were recorded in S<sub>9</sub> progenies of CP Joy-005 and CP Joy-009; BC<sub>7</sub> and finally S<sub>4</sub> progeny of CP Joy-022, respectively.

### Maintenance of dioecious inbred lines of papaya

M. R. Karim, B. C. Sarker, A. Alam, M. T. Islam and M. A. Islam

Papaya (*Carica papaya* L.) belongs to the family Caricaceae and is a polygamous (having male, female or hermaphrodite flowers on the same plant) and diploid species. Shahi papaya is the first dioecious papaya variety in Bangladesh developed by BARI in the year 1992. But the fruit characteristics of this variety was degenerated because of some unavoidable circumstances and more maleness ratio in the population was also another burning problem of this variety. Later on, Pomology Division, HRC, BARI has collected some high yielding dioecious papaya lines from home and abroad to mitigate the maleness ratio problem in the population. Therefore, the study was done every year to purify and maintain the dioecious inbred lines through sib-mating process at the Fruit Research Farm of Horticulture Research Centre, Bangladesh Agricultural Research Institute,

Joydebpur, Gazipur to maintain the dioecious inbred lines of papaya. Seedlings of purified Sib-mated seeds of dioecious inbred lines (Shahi, CP Joy-017, CP Joy-018 & CP Joy-023) were transplanted in the main field on the second week of January 2023 and the Sib-mating process (selfing of two flowers from each plant) for this year was started on 15 April 2023 and being continued. From April to June 2023, a total of 200 flowers of four dioecious inbred lines were Sib-mated, among those flowers 177 fruits have been set.

### Purification of shahi papaya

M. H. Waliullah, M. S. Islam, M. A. Shahed and K. H. Alam

An experiment was carried out at fruit research station, BARI, Binodpur, Rajshahi to purify the Shahi Papaya variety. Seedling of purified selfed seeds were transplanted in the main field on 08 March 2022 and 10 flowers in each plant were selfed (Sib mating) from June to August 2022. The fruit length, fruit breadth, cavity length, cavity breadth, thickness ranged from 21.0-23.3 cm, 12.8-13.8 cm, 11.3-14.5 cm, 6.3-7.1 cm and 3.2-3.6 cm respectively. TSS of this variety ranged from 10.0-12.6 (%). The flesh colour varied from yellowish red to red. The existing cultivated Shahi Papaya showed number of seeds ranged 351-413. The results showed that the plant and fruit characteristics of Shahi papaya under this experiment were almost similar to that of the original Shahi Papaya in the characters under consideration.

### Evaluation of exotic ber germplasm

A. S. M. Mesbah Uddin and B. C. Sarker

Ber (*Ziziphus mauritiana*) is an important and very much popular fruit in Bangladesh. Two sets exotic germplasm (Oblong fruit shape-set A and round fruit shape-set B) of ber were evaluated at the Fruit Research Farm of Horticulture Research Centre, BARI Gazipur during 2022-2023. In each, set four germplasm were included. In set-A, maximum number of fruits was harvested from ZM Joy (KS)-003 (1237.30/plant) and minimum number of fruits was counted in ZM Joy(KS)-002 (1004.20/plant). ZM Joy (KS)-003 had the highest individual fruit weight (27.30 g) and yield (33.84 kg/plant) while the lowest individual fruit weight and yield were manifested from ZM Joy(KS)-002 (22.03 g and

20.49 kg/plant). In set-B, maximum number of fruits was harvested from ZM Joy(BS)-003 (892.67/plant) and minimum number of fruits was counted in ZM Joy(BS)-002 (795.83/plant). The highest individual fruit weight and yield were recorded from ZM Joy (BS)-003 (27.30 g and 29.65 kg/plant) while the lowest individual fruit weight (22.03 g) and yield (24.91 kg/plant) were recorded from ZM Joy(BS)-001 and ZM Joy (BS)-004, respectively. Fruit quality attributes like edible portion, pulp thickness and TSS content were statistically at par among the germplasm.

#### **Evaluation of indigenous ber germplasm at Khagrachari**

M. A. A. Malek, M. G. Rahman, M. R. Mia, M. R. Ahmad and M. A. Hossain

Ber (*Ziziphus mauritiana*) is one of the important and popular fruit of Bangladesh. The experiment was carried out at the existing plantation of Hill Agricultural Research Station at Khagrachari to select superior land races of indigenous ber for commercial cultivation in the hilly areas. After the evaluation in the year of 2021 to 2022, among 32 accessions, 9 accessions were selected which had been evaluated. The evaluated materials were ZM Kha-005, ZM Kha-008, ZM Kha-013, ZM Kha-017, ZM Kha-021, ZM Kha-023, ZM Kha-024, ZM Kha-026, ZM Kha-030. Plant to plant distance was 4m and row to row distance was also 6 m. The plants were about thirteen years old. Thirty fruits from each tree were collected randomly for studying physical characteristics. Average individual fruit weight ranged from 5.25g to 13.08 g. The genotype ZM Kha-013 produced the highest individual fruit weight (13.08g) and lowest in ZM Kha-005 (5.25g). Fruit weight (12 fruits) of different ber genotypes ranged from 63-157g. The genotype ZM Kha-013 produced the highest fruit weight (157g) and lowest (63g). Edible portion (%) ranged 68.34g (ZM Kha-008) to 79.12% (ZM Kha-023). % TSS of ber genotypes varied from 10.2% (ZM Kha-021%) to 25.0% (ZM Kha-024).

#### **Study on floral biology of different ber germplasm**

M. H. Waliullah, M. S. Islam, M. A. Shahed and K. H. Alam

A field experiment was carried out at experimental orchard, Fruit research station, Bangladesh agricultural research institute, Binodpur, Rajshahi

to study the floral biology of ber. Five cultivars of ber planted during 2005 (17 years old plants) at 7 m × 7 m were selected for evaluation. The plants were tagged in the month of April. These cultivars were observed to study the variability in floral biological parameters. The floral parameter such as flowering habit in the selected cultivars was recorded on the leaf axis of secondary branches. Anthesis occurred in forenoon in some cultivars whereas, in afternoon in others. Dehiscence time was observed from 1 to 2.30 hours in different cultivars. Date of initiation of flowering to end of flowering, flowering duration varied as 7 August to mid-November, 53-93 days, respectively.

#### **Collection and evaluation of sour type ber germplasm**

M. H. Waliullah, M. S. Islam, M. A. Shahed and K. H. Alam

The experiment was conducted at the Fruit Research Station, Binodpur, Rajshahi. The experimental materials were matured ripe fruits of ten sour type ber lines namely ZM Raj-001, ZM Raj-002, ZM Raj-003, ZM Raj-004, ZM Raj-005, ZM Raj-006, ZM Raj-007, ZM Raj-008, ZM Raj-009 and ZM Raj-010. Fifty fruits from each plant of each of three replications were plucked randomly which were used for studying physical characteristics. Data on fruit characteristics, stone characteristics, quality, harvesting period and yield were collected. The highest fruit weight (15.5 g) was recorded in ZM Raj-004, followed by ZM Raj-005 (15.00 g) and ZM Raj-010 (14.00 g) whereas, the lowest fruit weight was observed (8.00 g) in ZM Raj-007. Total soluble solid (TSS) of different ber lines varied from 10.66 to 18.66 %. Maximum TSS was recorded in ZM Raj-009 (18.66%) followed by ZM Raj-008 (16.33%). The highest edible portion was found in ZM Raj-004 (93.54%), followed by ZM Raj-005 (93.33%). The highest Yield was recorded in ZM Raj-002 (13.53 t/ha) and minimum was recorded in ZM Raj-008 (10.50 t/ha).

#### **Collection and evaluation of local ber germplasm**

M. H. Waliullah, M. S. Islam, M. A. Shahed and K. H. Alam

The experiment was conducted at the Fruit Research Station, Binodpur, Rajshahi. The experimental materials were matured ripe fruits of

seven ber varieties/lines namely ZM Raj-001 (Apple Kul), BARI Kul-1, BARI Kul-2, ZM Raj-004 (Chapai Kul), ZM Raj-012 (Local Kul Late), BARI Kul-3, and ZM Raj-016 (Umboli Kul). Fifty fruits from each plant of each of three replications were plucked randomly which were used for studding physical characteristics. Data on fruit characteristics, stone characteristics, quality, harvesting period and yield were taken. The highest fruit weight was recorded 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 solid (TSS) was recorded highest in Umboli Kul-1 (17.3%) followed by Apple Kul and BARI kul-1, while that was lowest in BARI kul-2 (12.2%). BARI Kul-3 gave the highest yield (25.47 t/ha) and it was 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).

#### **Evaluation of exotic jamun germplasm at Joydebpur**

M. M. Khatun and B. C. Sarker

Jamun (*Syzygiumcumini*) is one of the most popular minor fruits in Bangladesh. An exotic jamun germplasm (SC Ex-001) was evaluated at the Horticulture Research Center, BARI, Gazipur along with BARI Jam-1 as check variety. This exotic germplasm was collected from Malaysia. Plant height, base girth and number of primary branches were recorded 5.21 m, 58.13 cm and 4, respectively from SC Ex-001. The plant produced 12.50 kg of fruit. Individual fruit weight was 7.53 g and edible portion was 86.45% having TSS 13.50% while 8.90% TSS was noticed in BARI Jam-1. The fruits of SC Ex-001 were black in colour.

#### **Survey, collection and evaluation of jamun germplasm at Binodpur**

M. H. Waliullah, M. S. Islam, M. A. Shahed and K. H. Alam

An experiment was conducted at Fruit Research Station, BARI, Binodpur, Rajshahi to evaluate six Jamun germplasm (SC Raj-001, SC Raj-002, SC Raj-014, SC Raj-015, SC Raj-016 and SC Raj-017) 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 from SC Raj-005 (50 kg) followed by SC Raj-001 (47 kg). Minimum yield per plant was recorded in SC Raj-006 and SC Raj-014 (20 kg).

#### **Evaluation of dwarf coconut in hilly area of Rangamati**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

Coconut (*Cocos nucifera*) is one of the oldest fruits in the world and is confined to seacoast in the humid tropics. It is an important plantation crop in Bangladesh. The climatic condition is suitable for cultivation of coconut. Bangladesh Agricultural Research Institute (BARI) has developed two coconut varieties. But farmer's interest is increasing on dwarf coconut varieties. With these views, the study has been undertaken in order to identify the superior dwarf coconut varieties at Rangamati. Hence, 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. There were six lines from two different varieties, such as Xiem blue and Kerala hybrid under study. Among those lines, the highest number of fruits per plant (52) and number of inflorescence (16) were observed in CN Rai-010. The biggest fruit (18.6 cm × 13.8 cm), heaviest fruit (1512 g) and water volume (180 ml) were recorded in CN Rai-008.

#### **Evaluation of dwarf coconut in Patuakhali region**

M. Islam, M. Ratna, E. Mahmud, N. Akter, S. Yesmin and M. I. A. Howlader

An experiment was conducted with four dwarf coconut varieties hybrid at research field of RHRS, Lebukhali, Patuakhali on the existing six years old dwarf coconut orchard with an objective to verify their performance. Four varieties of dwarf coconut (Vietnam Xiem Blue, Vietnam XiemGreen, Kerala hybrid and Rajasthan hybrid) were included in this experiment. The range of trunk height was recorded 1.0-1.6 m and average was 1.2 m was found in Xiem Blue coconut. To date, maximum number of fruit (35) was harvest in Xiem Blue coconut. A



plant (17) produced huge number of fruit (374). The plant was under Rajsthan hybrid.

#### Hybridization in mandarin

S. M. L. Rahman, F. Ahmed, M. S. Zaman and M. H. M. B. Bhuyan

Mandarin plays an important role in the fruit world for its availability period and high market price. BARI have already released three mandarin varieties and recently there has been an increasing demand for quality mandarin having desirable sweetness. Keeping these points in mind, an inter-specific hybridization program (BARI Komola-1(♀) × BARI Malta-1(♂) and BARI Komola-2(♀) × BARI Malta-1(♂) has been undertaken at the Citrus Research Station (CRS), BARI, Jaintapur, Sylhet. A total of 223 flowers were emasculated and pollinated. Finally, 2 hybrid fruits were obtained from different crosses. These hybrid fruits will be harvested at mature stage and seeds of the fruits were sown in soil for germination. After germination, seedlings of hybrid fruits will be transplanted in the main field and will be evaluated.

#### Hybridization in sweet orange

F. Ahmed, M. H. M. B. Bhuyan, M. S. Zaman and S. M. L. Rahman

Sweet orange plays an important role in the fruit world for its nutritious quality, availability period and high market price. BARI has already released two sweet orange varieties, which has some serious problems, especially in color in early harvesting stage in September-October. The present hybridization program (BARI Malta-1 (♀) × (♂) CS Jai-001 and CS Jai-001 (♀) × BARI Malta-1(♂)) was conducted at the Citrus Research Station (CRS), Jaintapur, Sylhet to transfer yellow color in BARI Malta-1 and sweetness in advance line CS Jai-00. A total of 170 flowers were emasculated and pollinated. Finally, 4 hybrid fruits were obtained from different crosses. These hybrid fruits will be harvested at mature stage and seeds of the fruits were sown in soil for germination. After germination, seedlings of hybrid fruits will be transplanted in the main field and will be evaluated.

#### Hybridization in satkara (*Citrus macroptera*)

S. M. L. Rahman, F. Ahmed, M. S. Zaman and M. H. M. B. Bhuyan

A hybridization program (BARI Satkara-1 (♀) × BARI Batabilebu-3(♂) and BARI Satkara-1(♀) ×

BARI Batabilebu-5(♂)) of satkara was conducted in the flowering season of 2022-23 at Citrus Research Station (CRS), Jaintapur, Sylhet. A total of 210 flowers were emasculated and pollinated. Seventeen 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.

#### Evaluation of mandarin germplasm under north-eastern hilly region of Bangladesh

F. Ahmed, J. C. Sarker, M. H. M. B. Bhuyan and S. M. L. Rahman

The experiment was conducted at Citrus Research Station, BARI, Jaintapur, Sylhet (25.13562° N latitude, 92.13217° E longitude and 36 m of elevation from mean sea level) during 2022 to 2023. Five mandarin germplasm viz. CR Jai-301, CR Jai-302, CR Jai-303, CR Jai-304 and CR Jai-305 were used as the study material along with BARI Komola-1 and Komala-3 as check. The tallest plant (169.33 cm) was recorded at BARI Komola-1 while the shortest plant (83.33 cm) in CR Jai-303. The plant CR Jai-305 spreads maximum (110.00 cm×106.67 cm). On the other hand, CR Jai-303 had the minimum canopy (44.00 cm×41.67cm). Maximum leaf area (15.75 cm) is covered by BARI Komola-1 while minimum (10.83 cm) in BARI Komala-3.

#### Evaluation of sweet orange germplasm in the hilly region

M. G. Rahman, M. A. A. Malek, M. R. Ahmad and M. A. Hossain

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 (227) in BARI Malta-1 while the lowest (142) was in CS Kha-002. Individual fruit weight was also varying from 131.67-168.33g. The biggest (168.33g) fruit

were recorded in CS Kha 002 and the smallest (131.67) was observed in BARI Malta-1. Weight of fruits per plant was the highest (27.53 kg) in BARI Malta-1 while in case of CS Kha-001 it produces yield of 30.04 kg/plant and the lowest (23.87 kg) was in CS Kha-002. Number of seed ranges from 9-20. TSS ranges from 7.6 to 8.5 %. Fruit aroma was strong in all the germplasm.

#### **Evaluation of sweet orange line at Hathazari**

M. M. Rahman, A. Tabassum, M. R. Sarkar and M. Moniruzzaman

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  $1.58 \times 3.47 \text{ m}^2$ ) than BARI Malta-1 (2.7m and  $1.34 \times 2.28 \text{ m}^2$ ) accordingly. Number of fruits/plant and individual fruit weight were higher in Katamalta (234 and 191g) than that of BARI Malta-1 (150 and 117g respectively). The fruit length and fruit diameter were higher in Katamalta (6.96 cm and 7.1 cm) than BARI Malta-1 (5.51 cm and 4.52 cm). The yield of fruits was higher in Katamalta (27.9 t/ha) which was higher than 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 BARI Malta-1 (7.1).

#### **Performance of exotic sweet orange germplasm at Jaintiapur**

J.C. Sarker, M.H.M.B. Bhuyan, F. Ahmed, and S.M.L. Rahman

A study was conducted with four exotic sweet orange germplasm to evaluate their performance at Citrus Research Station, Jaintiapur, 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 (291.6g) was recorded in CS Jai-051 while minimum (140.6g) in CS Jai-209. High juice content and the highest TSS (12%) were recorded in CS Jai-003, while CS Jai-209 attained the lowest TSS (10.3%). The edible portion was recorded maximum (78.53%). Fruit color at maturity of exotic sweet orange germplasm CS Jai-051, CS Jai-003, CS Jai-012, CS Jai-209,

and BARI Malta-1 were found pale green, bright yellow, and greenish-yellow respectively.

#### **Morpho-physiological characterization and evaluation of pummelo germplasm**

M.H.M.B. Bhuyan, J.C. Sarker, F. Ahmed, and S.M.L. Rahman

The experiment was conducted at Citrus Research Station, Jaintapur, Sylhet. All the germplasm showed significant variation in respect of plant height, base girth, and canopy spreading, leaf characters, flower and fruit characters. Fruits from 21 germplasm were harvested. Among the germplasm tested CG Jai-004-2 was superior with plant height (5.0 m) and maximum number of fruits plant<sup>-1</sup> (50). Among the fruit quality attributes maximum fruit weight was found from CG Jai-051 (1104.27 g), but the most attractive pink yellow colored fruit was found from CG Jai-005-3. Unlike, the maximum juice content was found from CG Jai-004-2 (40%). Highest TSS% was found from CG Jai-070 (12.3%) whereas; percent acidity was highest in CG Jai-054 (1.87%). Sugar acid ratio was highest in BARI Batabilebu-2 (1.25).

#### **Collection and evaluation of pummelo germplasm at Narshigdi**

R. Akter, A. K. M. M. Rahman and S. M. M. Rahman

An experiment was conducted at the Regional Horticulture Research Station (RHRS), BARI, Shibpur Narsingdi to select suitable lines of pummelo. All the germplasm showed significant variation in respect of plant height, base girth and canopy spreading attributes. The highest plant height recorded in CG Nar-003 (4.80 m) and the lowest plant height in CG Nar-006 (3.20 m) and CG Nar-008 (3.20 m). Maximum base girth (63.33 cm), biggest canopy size (5.50 m x 5.60 m) was also found from CG Nar-003. Minimum base girth (32.67 cm), smallest canopy size (3.20 x 3.60 m) was recorded in CG Nar-006.

#### **Evaluation of pummelo germplasm at Jashore**

M. A. Alam, M. R. Alam and K. U. 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 Regional Agricultural Research Station, Jashore. The heaviest fruit (2850 g) was found in CG Jas-025 whereas the highest edible portion (63.8%) was got in CG Jas-004. 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). Excellent eating quality was found in CG Jas-007, CG Jas-013, CG Jas-018, CG Jas-023 and CG Jas-029 with bitterless pulp.

#### **Evaluation of pummelo in hilly region of Rangamati**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment with thirteen germplasm of pummelo (CG Rai-006, CG Rai-007, CG Rai-008, CG Rai-009, CG Rai-010, CG Rai-011, CG Rai-014, CG Rai-017, CG Rai-021, CG Rai-028, CG Rai-030, CG Rai-047 and CG Rai-052) was conducted at the existing fourteen years old orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District. The plant height, base girth and canopy size of the germplasm varied from 417 cm to 512 cm, 62 cm to 85 cm, 415 cm x 367 cm to 598 cm x 591 cm, respectively. The earliest flowering (mid-February) was observed in CG Rai-006. The performance of the germplasm can be concluded after the harvest of the fruits.

#### **Evaluation of local pummelo germplasm at Lebukhali**

M. Islam, M. Ratna, E. Mahmud, N. Akter, S. Yesmin and M. I. A. Howlader

An experiment with four germplasm of pummelo (CG Leb-001, CG Leb-002, CG Leb-003 and CG Leb-004) was conducted at the pummelo orchard at the experimental field of Regional Horticultural Research Station (RHRS), Lebukhali, Patuakhali. The maximum number of fruits per plant (10) was observed in CG Leb-004, whereas the minimum (3) in CG Leb-001 and CG Leb-002. The highest weight of individual fruit (2513g) was recorded in CG Leb-001 followed by CG Leb-004 (2253g). Highest edible portion (83%) also found in CG Leb-007 whereas the minimum (53) in CG Leb-002 and CG Leb-003. Maximum TSS (11%) was recorded in CG Leb-006 followed by CG Leb-007 (10%). The germplasm CG Leb-001, CG Leb-006 and CG Leb-007 were found promising.

#### **Evaluation of pummelo germplasm in Chattogram region**

S.M.K.H. Chowdhury, M.G. Azam and A.S.M.H. Rashid

The experiment was conducted at the Agricultural Research Station, Khulshi, Chattogram for the

evaluation of twenty-five pummelo genotypes. Among these genotypes, sixteen genotypes produced fruits. CG Pah-022 gave the maximum number of fruits (56) followed by CG Pah-002 (51). The heaviest fruit (1652.0 g) was recorded from CG Pah-003 followed by CG Pah-014 which weighted 1026.67 g. The largest fruit size (14.5 cm x 16.6 cm) was obtained from CG Pah-003. Maximum edible portion (64.13 %) was calculated from CG Pah-020 followed by CG Pah-014 which was 59.77 %. The highest total soluble solid (11.13%) was counted from CG Pah-012 followed by CG Pah-014 which was 10.92%. CG Pah-025 produced a maximum amount of fruit (42.6 kg/plant) followed by CG Pah-012 (38.44 kg).

#### **In-situ evaluation of year-round pummelo germplasm at Khagrachari**

M. A. A. Malek, M. G. Rahman, M. R. Ahmad and M. A. Hossain

The study was conducted at the Hill Agricultural Research Station, BARI, Khagrachari. One off-season pummelo germplasm (CG Kha-001) was selected for the evaluation along with a normal season control. Mainly year round bearing occurred in the germplasm. Maximum numbers of mature (37) and immature (62) fruits were found in October and June respectively. The 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. With consideration of fruit characteristics, edible quality, TSS, percent edible portion and yield potentialities, the germplasm CG Kha-001 was found promising.

#### **Evaluation of lemon germplasm**

J.C. Sarker, M.H.M.B. Bhuyan, F.Ahmed and S.M.L. Rahman

The study was conducted with seven lemon germplasm (CL Jai-001, CL Jai-002, CL Jai-003, CL Jai-004, CL Jai-005, CL Jai-006 and CL Jai-007) along with BARI Lebu-1 as check at the Citrus Research Station, Jaintapur, Sylhet. The maximum plant height was recorded in CL Jai-001 (223 cm); whereas, the minimum was in BARI Lebu-1 (135 cm). The heaviest fruit (249.33 g) was harvested from CL Jai-006, while the lightest (93.33 g) in CL Jai-002. The highest number of fruits per plant (166) was found in CL Jai-001 while the lowest (68.42) in CS Jai-006. Maximum



(9.97×6.77 cm) fruit size was recorded in CS Jai-006 whereas minimum (6.23×2.97cm) in CL Jai-002. CL Jai-001 produces the highest yield per plant (18.20 kg) whereas the lowest (12.12kg) in CL Jai-002. Maximum TSS content (7.5%) was recorded in BARI Lebu-1 while minimum TSS (5.7%) in CL Jai-005.

#### ***In-situ* morpho-physiological characterization and evaluation of lemon germplasm**

M.H.M.B. Bhuyan, F. Ahmed, J.C. Sarker, and S.M.L. Rahman

Seedless lemons are very important among the citrus fruits of Bangladesh. An effort has been made at the Citrus Research Station, Jaintapur, Sylhet for the morphological characterization and evaluation of seedless lemon germplasm. Variability was observed in different characteristics of the germplasm studied. Among the germplasm, CL Jai-103 was superior with maximum individual fruit weight, large fruit size, the highest number of fruits plant<sup>-1</sup>, fruit yield plant<sup>-1</sup> as well as ha<sup>-1</sup> yield followed by CL Jai-101. On the other hand, the genotype CL Jai-107 produced the lowest yield. The fruit quality attributes also varied among the germplasm tested. Interestingly the genotype CL Jai-101 was found with no seed. But in the other germplasm, were found with seeds.

#### **Evaluation of lime germplasm at Jaintiapur**

J.C. Sarker, M.H.M.B. Bhuyan, F. Ahmed and S.M.L. Rahman

The study was conducted with three lime germplasm (CA Jai-001, CA Jai-002 and CA Jai-003) to evaluate their performance at Citrus Research Station, Jaintapur, Sylhet. BARI Kagzilebu-1 was used as check. Significant differences were recorded among the studied germplasm in terms of growth characteristics. The maximum plant height (230 cm), and base girth (21 cm) were recorded in CA Jai-003; whereas, the minimum was recorded in CA Jai-002. The highest number of fruits per plant (90) was found in CA Jai-003 while the lowest (24) in BARI Kagzi Lebu-1. Tree growth habit was found erect in BARI Kagzi Lebu-1 and CA Jai-001 as well as CA Jai-002 and CA Jai-003 were found drooping and spreading respectively. All the germplasm occupied sparse and dense branching density with good growth conditions.

#### **Collection and evaluation of local lime germplasm at Lebukhali**

M. Islam, M. Ratna, E. Mahmud, N. Akter, S. Yesmin and M. I. A. Howlader

The experiment was conducted at the lime orchard at the experimental field of the Regional Horticultural Research Station (RHRS), Lebukhali, Patuakhali for the evaluation of superior lime lines in the southern region of Bangladesh. Two germplasm of lime (CA Leb-001 and CA Leb-002) were included in the study. In most of the parameters, similarities were found between germplasm CA Leb-001 and CA Leb-002 like time of flowering, fruit shape, fruit base shape, fruit apex shape, skin color, rind thickness, fruit segment, fruit segment uniformity, fruit axis and seed shape. Higher Individual fruit weight (49.3g) was found in germplasm CA Leb-002 whereas lower (35.2g) in germplasm CA Leb-001. But the reverse character was recorded in case of juice content. Higher juice (13.8ml) was found in germplasm CA Leb-001 whereas lower (13.0ml) in germplasm CA Leb-002. Higher TSS (8.5%) was found in germplasm CA Leb-002 whereas lower (6.5%) in germplasm CA Leb-001. On the other hand, higher pH (2.7) was found in germplasm CA Leb-001 whereas lower (2.6) in germplasm CA Leb-002. The experiment will be continued to collect more genetic variation.

#### **Collection and evaluation of lime germplasm in Chattogram region**

M. Moniruzzaman, M. R. Sarkar, A. Tabassum and M. M. Rahman

Six Lime lines viz. CL Hat-001, CL Hat-002, CL Hat-003, CL Hat-004, CL Hat-005 and CL Hat-006 were evaluated at the Regional Horticulture Research Station, Hathazari, Chattogram. The lines were collected and planted in August 2018. Significant differences were observed in all the parameters except tree shape (ellipsoid) during the studied period. The highest canopy size and plant height were observed in (9.1 m<sup>2</sup>) and 4.2m respectively followed by CL Hat-003 (7.89 m<sup>2</sup>) and (3.9 m). The highest number of fruits was observed in CL Hat-003(805) closely followed by CL Hat-002 (605) and the minimum fruit per plant was recorded in CL Hat-001(350). The highest individual fruit weight was recorded in CL Hat-005(93 g) followed by CL Hat-006 (90). The highest juice content was observed in CL Hat-

006(42 ml) closely followed by CL Hat-005(40 ml). Minimum seed per fruit observed in CL Hat-005 (02) and CL Hat-006 (02). The highest brix% was found in CL Hat-001(6) and CL Hat-002 (6).

#### **Collection and evaluation of kagzhi lime**

M.R. Islam, S.D. Setu, S. Hasna, M.G. Rahman and B.C. Kundu

The experiment was conducted at the RARS, Rahmatpur, Barishal. Six germplasm of lime (CA Rah-01, CA Rah-02, CA Rah-03, CA Rah-04, CA Rah-05 and CA Rah-06) were collected from different areas of the southern part of the country and planted in 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 (6.2m) and the lowest one was in CA Rah-06 (2.78m). The highest base girth was found in the germplasm CA Rah-01 (31cm) and the lowest one was CA Rah-04 (14 cm). The highest horizontal spread was found in CA Rah-01 (5.3 m & 4.9 m) and the lowest one was in CA Rah-04 (2.5 m & 3.4 m). The highest total no. of fruit was found in CA Rah-02 (860) and the lowest one was CA Rah-04 (156). In the case of average fruit weight, the heaviest fruit was harvested from CA Rah-02 (46.73g) 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 in CA Rah-04 (6.31 kg/plant).

#### **In-situ evaluation of bael germplasm at Chapainawabganj**

A. S.M. Yousuf Ali, M. K. ISLAM, M. M. Hossain and M. M. Rahman

An experiment was evaluated at Chapainawabganj Sadar and Shibganj Upazila. The study comprised one bael germplasm. BARI Bael-1 was used as a check. The age of the germplasm, AM Cha-001 was 35 years while BARI Bael-1 was 18 years. In the case of plant height, the highest plant height (13m) was recorded in the germplasm AM Cha-001 and the lowest (7 m) from BARI Bael-1. The maximum individual fruit weight (1050 g) was found in AM Cha-001, while the minimum (900 g) was in BARI Bael-1. The percentage of seed varied from 1.52 to 2.11. BARI Bael-1 gave the maximum (2.11) seed percentage whereas the minimum (1.52) from AM Cha-001. The maximum (105) number of fruits per plant was found in the

germplasm AM Cha-001 while the minimum (50) from BARI Bael-1. Considering TSS (38%), pulp percentage (72.10%) and yield /plant (110.25 kg), the germplasm AM Cha-001 was found better.

#### **Collection and evaluation of existing bael germplasm at Chapainawabganj**

A. S.M. Yousuf Ali, M. K. Islam, M. M. Hossain, H.B. Harun and M. M. Rahman

An experiment was conducted at the Regional Horticulture Research Station, Chapainawabganj including 22 bael genotypes to find out a good genotype of bael for commercial cultivation. Germplasm was collected from different places in Chapainawabganj and Rajshahi districts. A wide variation was observed among the genotypes regarding growth, fruit and tree characteristics. Only fifteen genotypes among 22 were produced fruits for this year. Among the fruit characteristics, fruit weight varied from (345-2260 g), fruit length (9.2-15 cm), fruit breadth (8.3-17.4 cm), pulp weight (171-1605.8g), fibre weight (14-80 g), seed weight (14-33 g) and TSS (28-37 %). Total soluble solids (TSS %) in the bael fruit ranged from 28-39%. TSS was maximum (39%) in AM Cha-009 while it was minimum (28%) in AM Cha-013. No of fruits per plant was recorded as the highest from AM Cha-006 (65) and the lowest from AM Cha-015(10). Bitterness was absent in most of the fruit. Considering overall assessment, 5 genotypes AM Cha-02, AM Cha-004, AM Cha-013, AM Cha-014 and AM Cha-015 were found as promising.

#### **Collection and evaluation of bael germplasm at Jaintiapur**

J.C. Sarker, M.H.M.B. Bhuyan, F. Ahmed and S.M.L. Rahman

The experiment was conducted for three years at Citrus Research Station, Bangladesh Agricultural Research Institute, Jaintiapur, 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 the case of different characters of the germplasm tested. AM Jai-002 produced the heaviest fruit of 1245.67g, 1050.6g and 830.6g in all the study years. However, the maximum edible portion (83.61%, 83.61% and 82.56%) was recorded in AM Jai-001 in all the study years. The results on yield showed that the highest number of fruits plant<sup>-1</sup> (120, 141 and 139) was recorded in AM Jai-001 in

three consecutive years whereas the lowest number of fruits plant<sup>-1</sup> was recorded in AM Jai-002 during 2019-20 and 2020-21 but AM Jai-003 recorded in 2021-22 respectively. The highest yield plant<sup>-1</sup> during 2019-20 was recorded in AM Jai-002 (68.88 kg) followed by AM Jai-002, But AM Jai-001 (80.75kg and 80.02kg) in 2020-21 and 2021-22. Among the germplasm, the highest number of fruits, TSS, edible portion and yield/plant were found in AM Jai-001. On the other hand, AM Jai-003 attained relatively poor performance.

#### **Evaluation of bael genotypes at Debiganj**

B. R. Barman, M. O. Hoque, M. Rahman, M. A. Halim and M. S. Hossain

An experiment was conducted at the Breeder Seed Production Centre, Bangladesh Agricultural Research Institute, Debiganj, Panchagarh to develop a good quality and high-yielding variety of bael. Twenty genotypes of bael were evaluated in this study. All genotypes produced flowers and fruits during this season, 18 genotypes' data were reported, but the genotypes' AM Deb-001, AM Deb-003 and AM Deb-019 data were not yet recorded due to lack of maturity. Harvesting was done from 2<sup>nd</sup> week of April to 2<sup>nd</sup> week of June. The fruits of genotypes AM Deb-001 and AM Deb-003 showed late maturity. The maximum (301) number of fruits per plant was obtained from AM Deb-008, which was followed (221) by AM Deb-005, whereas the minimum number of fruits (1) was found in AM Deb-019. Number of seeds ranged from 25 to 120. Fruits of genotype AM Deb-017 contained the maximum number of seeds (120). Color of the pulp varied from light yellow to yellow in most of the cases. The excellent flavor of fruits was noticed in 3 genotypes. The genotype AM Deb-008 produced the highest fruit yield (303.04kg/plant), while the lowest fruit yield (0.85 kg/plant) was recorded from genotype AM Deb-019.

#### **Evaluation of wood apple (*Feronia limonia*) in Sylhet region**

M. Samsuzzaman, M. S. Alam, M. J. Hussain and M.H. Hossain

An experiment was conducted at the Regional Agricultural Research Station, Akbarpur, Moulvibazar with four wood apple germplasm. Wide variations were observed regarding base girth, number of fruits per plant, individual fruit

weight, percent of edible portion and TSS of different germplasms. The highest base girth was observed in FLAkb004. The highest number of fruits per plant (70) was observed in FL Akb003, highest individual fruit weight per plant (250.2 g) was obtained from FLAkb-004 followed by FL Akb 002 (234.4 g) respectively. Higher fruit lengths were observed in FL Akb 004 (7.7 cm) and the lowest one is FL Akb 001 (6.9 cm). The higher fruit yield/plant was recorded from FL Akb 003 (13.67 kg) followed by FL Akb 002 and FL Akb 004 (12.51 kg). The percentage of the edible portion was higher in FL Akb 002 (57.67%) followed by FL Akb 004 (51.71%) and FL Akb 003 (50.02%) respectively. Maximum TSS (13%) was obtained from FL Akb 002 followed by FL Akb 001 and FL Akb 004 (12%) respectively.

#### **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 Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to incorporate some important characteristics 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. A total of 375 flowers were emasculated and pollinated for the hybridization program. The total number of fruits retention at 20, 40, 60, 80, 100 and 110 days after pollination were 25, 22, 15, 10, 5 and 5, respectively from the cross combination between BARI Amra-2. These fruits will be harvested at the proper maturity stage and seeds of the fruits will be sowed in the soil for germination. After germination, seedlings of hybrid fruits will be transplanted in the main field and will be evaluated.

#### **Collection and evaluation of burmese grape germplasm at Joydebpur**

A. S. M. M. Uddin and M. T. Islam

An experiment was conducted at the Fruit Research Farm of HRC, BARI, Joydebpur, Gazipur to know the performance of 10 collected germplasm of burmese grape. The study comprised ten Burmese grape germplasm to find out a suitable high yielding early or late germplasm. Out of 10 germplasm the highest plant height (6.75 m), and base girth (64.1 cm), were noted from BS Joy-010. Maximum



individual fruit weight (24.4 g) was found in BS Joy-002, while the minimum fruit weight (15.00 g) was recorded in BS Joy-005. TSS (18.40%) was noted as maximum in BS Joy-002 and minimum TSS (14.40%) was recorded in BS Joy-006. The maximum edible portion (58.8%) was noted in the germplasm BS Joy-010 and the minimum edible portion (39.87%) was recorded in the germplasm BS Joy-006. The highest yield (63.20kg) was noticed in BS Joy-002 and the lowest yield was noticed in BS Joy-006(37.30kg). Only BS Joy-010 was harvested at 2<sup>nd</sup> week of June, whereas the rest of the germplasm was harvested at 2<sup>nd</sup> week of July. The taste and eating quality of all the germplasm was auspicious. No disease infection was observed in these germplasms, but insect problem was recorded. Such as mite and fruit borer were observed in the germplasm BS Joy-009 and BS Joy -010 but chafer beetle was observed in all germplasm.

#### **Evaluation of burmese grape germplasm at Jaintiapur**

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. Highest plant height, base girth, canopy spreading was found from BS Jai-005. Leaf size was also maximum in this germplasm. Maximum fruit size was found in BS Jai-003 (3.38 cm × 3.41 cm) followed by BS Jai-001 (3.37 cm × 3.11 cm). No disease infestation was observed in BS Jai-001 whereas the others suffer from powdery mildew and sooty mold. Chafer beetle was common in case of all the germplasm but BS Jai-001 and BS Jai-003 was free from fruit borer. Maximum number of fruits plant<sup>-1</sup>, yield plant<sup>-1</sup> and yield ha<sup>-1</sup> were obtained from BS Jai-001. BS Jai-001 was also free from disease where the others suffer from powdery mildew and sooty mould. Chafer beetle and fruit borer was common in case of all the germplasm. Fruit size was highest in BS Jai-003 (3.38 × 3.41 cm) followed by BS Jai-001 (3.37 × 3.11 cm). Flesh color and texture for all germplasm was off white and juicy. Maximum edible portion (47.45%) and per cent TSS (13.65%) was found from BS Jai-001.

#### **Collection and evaluation of bullock's heart genotypes at Jashore**

M.A. Alam, M.R. Alam and K.U. Ahammad

A study was carried out at RARS, Jashore to find out the superior genotypes of bullock's heart. Data

were collected on fruit weight, fruit length, fruit breadth, number of fruits per tree, edible portion, total soluble solids, skin weight, seed weight, number of seeds etc. The heavy fruit (555.0 g) was recorded in AR Jas-013, followed by AR Jas-12 (542.3 g). The highest pulp weight (436.0 g) as well as the highest edible portion (78.6%) was observed in AR Jas-013. The longest (10.3 cm) fruit was obtained from AR Jas-013 whereas the broadest (10.6 cm) fruit was obtained from AR Jas-012. The highest TSS (27.5%) was recorded in AR Jas-013. The highest number of fruits per plant (122.0) as well as the highest yield per plant (50.26 kg) was found in AR Jas-007. ARJas-016 was harvested in first week of July. It is notable that AR Jas-016 was harvested in late season like first week of July. Other varieties were ripe in mid-March to April. Eating quality was excellent in all the genotypes. All the genotypes have excellent eating quality.

#### **Evaluation of bullock's heart (*Annona reticulata* L) germplasm at Raikhali**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment on the evaluation of Bullock's heart in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District. There were eleven promising bullock's heart lines under the study. The plant height, base girth and canopy size varied from 225 to 413 cm, 16 to 39 cm and 145 cm × 124 cm to 376 cm × 341 cm, respectively. The maximum number of fruits per plant (16) was recorded in AR Rai-011. Among those lines, the highest individual fruit weight (390 g), fruit size (118 mm × 90 mm), yield (5.85 kg/tree) and TSS were observed in AR Rai-011. The highest TSS (27 %) was recorded in AR Rai-011 and the lowest was in AR Rai-008 (20 %). The highest yield (5.85 kg) was noticed in AR Rai-011 and the lowest yield was noticed in AR Rai-016 (1.38 kg).

#### **Collection and evaluation of custard apple genotypes at Chapainawabganj**

A. S.M. Yousuf Ali, M. K. Islam and M. M. Rahman

An experiment on collection and evaluation of some custard apple genotypes was conducted at the Regional Horticulture Research Station, Chapainawabganj. Sixteen germplasm were collected from five Upazilas of Chapainawabganj

district. Seeds were sown into seed bed and after germination all of the germplasms were transferred into main field between 2015 and 2016. Twelve germplasms produced fruits among 16 genotypes in this year. In case of plant height, the highest plant height (4.60 m) was recorded in the germplasm AR Cha-11 and the minimum height (2.05 m) was recorded in AR Cha-04. The maximum average fruit weight (210g) was produced by the genotype AR Cha-16 while the lowest (150 g) was given by AR Cha-13. In case of fruit length and breadth, the maximum fruit length (8.5 cm) and the highest fruit breadth (7.6 cm) were observed from AR Cha-16 and the lowest (6.5 cm and 5.9 cm) were recorded from AR Cha-13. The highest (27) number of arils per plant were recorded from the genotype AR Cha-16 and the minimum (19) from AR Cha-13. Weight of single aril varied from 2.9 to 3.4. The highest (1.4 kg) yield per plant was recorded from the genotype AR Cha-07 and the minimum (0.35 kg) from AR Cha-15. The genotype AR Cha-07 gave the maximum TSS (22% Brix), edible portion (58.5%) and yield per plant (1.4 kg).

#### **Collection and evaluation of custard apple germplasm at Binodpur**

M. H. Waliullah, M. S. Islam, M. A. Shahed and K. H. Alam

An evaluation of Seven custard apple germplasm was carried out in at Fruit Research Station, BARI, Binodpur, Rajshahi during the fruiting season. 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). The highest (88.3 g) skin weight was measured in AS Raj-005 and the lowest skin weight was recorded in AS Raj-002 (52.7 g), seed weight was measured highest in AS Raj-006 (42 g) and lowest was AS Raj-005 (05 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 germplasm. Further study is needed to select the superior germplasm for developing variety.

#### **Collection and evaluation of indian dillenia germplasm at Jashore**

M. R. Alam, M. A. Alam and K. U. Ahammad

A study was carried out at Horticulture Research Center, Regional Agricultural Research Station 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 Horticulture Research Center, RARS, Jashore for developing as a variety. The germplasm was collected from Jashore region and planted in 2009. The recorded plant height of the genotypes was 8.7 m (DI Jas-001) and 8.3 m (DI Jas-002). The base girth was noted 1.35 m (DI Jas-001) and 1.2 m (DI Jas-002). Flowering was started from 25 May 2022. DI Jas-001 produced total 885 fruits in the fifth year of reporting. DI Jas-002 produced total 405 fruits in the second year of reporting. Individual fruit weight was 590.5 g and 542.67 g in DI Jas-001 and DI Jas-002, respectively. Total yield of the plant was recorded 522.6 kg and 219.8 kg in DI Jas-001 and DI Jas-002, respectively. Segment number of fruits was 18 and 17 respectively. The average number of seeds per fruit was 22 and 21 respectively.

#### **Collection and evaluation of cowa germplasm at Rahmatpur**

M.R. Islam, S.D. Setu, S. Hasna, M.G. Rahman and B.C. Kundu

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 tallest plant was recorded in GC Rah-04 (7.55 m) and the lowest one was 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 was in GC Rah-05 (5.60). The highest 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). To confirm the findings as well as to determine the yield performance, the experiment will be continued.

#### **Evaluation of star gooseberry (*Phyllanthus acidus* L.) germplasm at Raikhali**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment on the evaluation of star apple in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District. There were four genotypes under study. The plant height and base girth of the lines varied from 350 cm to 660 cm and 41 cm to 80 cm, respectively. PA Rai-002 had maximum 10-fruit weight (40 g), flesh thickness (6.23 mm), TSS (10%) compared to other lines. The maximum fruit number (16376) and yield per tree (52.4 kg) were observed in PA Rai-004. The yield variation was observed due to the age of the plants. PA Rai-001 and PA Rai-003 were sweet in taste with TSS 9% and 10%, respectively, while the other two lines PA Rai-003 and PA Rai-004 were sour in test with TSS 6%. PA Rai-002 had promising fruit and yield characters. The line should be released as a new crop variety.

#### **Evaluation of star gooseberry genotypes in Chattogram region**

S. M. K.H. Chowdhury, M.G. Azam, H. Barua and A.S.M.H. Rashid

An experiment was conducted at Agricultural Research Station, Khulshi, Chattogram to evaluate star gooseberry genotypes. The largest fruit (15.98 mm×21.23 mm) was observed in PD Pah-003 whereas the smallest fruit (13.43 mm×16.97 mm) was found from PD Pah-005. The highest individual fruit weight (4.16 g) was attained from PD Pah-003 and the lowest individual fruit weight (2.28 g) was obtained from PD Pah-005. The maximum edible portion (97.24%) was recorded in PD Pah-003, followed by PD Pah-001 (96.25%) and the minimum edible portion (94.15%) was noted from PD Pah-005. The highest fruit yield was obtained from PD Pah-001 (66.14 kg/plant), whereas PD Pah-005 gave the lowest yield (6.79 kg/ plant). The maximum TSS was found in PD Pah-003 (9.25%), followed by PD Pah-001 (9.18%), which were excellent and very good in taste as there is no bitterness in the sap. The minimum TSS (7.81%) was recorded from PD Pah-005. Based on the TSS (%), fruit size, fruit yield and organoleptic test; PD Pah-001 and PD Pah-003

were supposed found promising. PD Pah-003 was proposed to release as a variety.

#### **Collection and evaluation of local wax apple (jamrul) germplasm**

S. Hasna, M.R. Islam, S.D. Setu, M.G. Rahman and B.C. Kundu

The experiment was conducted at the RARS, Rahmatpur. Four germplasm of wax apple were collected from different areas of the southern part of country. As regards to plant height it was observed that it varied significantly and ranged from 5.00 m to 15.6 m with the mean value of 11.77 m. The tallest plant was observed in accession number SS Rah-004 (15.6 m) which was followed by SS Rah-002 (14.5 m) and smallest plant in accession number SS Rah 003-(5.0 m). The highest total number of fruits per plant was found in SS Rah-004 (438) and the lowest one was SS Rah-003 (225). As regards to average fruit weight, it was observed that it varied significantly and ranged from 0.017 g to 0.045 g with the mean value of 0.033 g. The heaviest fruit was harvested from SS Rah-001 (0.045 g) and the lightest average fruit weight was obtained from SS Rah-004 (0.017 g). In respect of fruit length, significant variations were seen among the fruits of accessions in respect of total soluble solids (TSS), significant variations were seen among the fruits of accessions. The highest TSS (9°Brix) was obtained from the accession number SS Rah-002. On the other hand, the lowest TSS (6 °Brix) was recorded from the accession number SS Rah-003 and SS Rah-004. In this trait the mean value was 6.87. Among four accessions the yield of fruit per plant was varied significantly ranged from 7.00 kg to 16.00 kg. The fruit of accession number SS Rah-001 produced the highest yield of 16.00 kg. On the other hand, the lowest (7.00 kg) fruit yield was recorded in accession number SS Rah-003 and SS Rah-004. In this trait, the mean value was 10.5 kg.

#### **Evaluation of local rose apple (golapjam) germplasm**

M.R. Islam, S.D. Setu, S. Hasna, M.G. Rahman and B.C. Kundu

The experiment was conducted at the RARS, Rahmatpur. Three germplasm of rose apple were collected from different areas of the southern part of country and planted on August 2003 to identify promising local rose apple line with desirable



characteristics. Wide variations in growth characteristics among the germplasm were found. The highest total number of fruits per plant was found in SJ Rah-02 (1360) and the lowest one was SJ Rah-03 (845). In case of average fruit weight, the heaviest fruit was harvested from SJ Rah-02 (12.33 g) and the lightest average fruit weight was obtained from SJ Rah-03 (9.68). The highest TSS (%) was found in the germplasm SJ Rah-02 (13%) and the lowest in SJ Rah-01 (9.5%). The highest yield was found in the germplasm SJ Rah-02 (16.77 kg/plant) and the lowest in SJ Rah-03 (8.18 kg/plant). Wide variation in quantitative and qualitative growth characteristics among the rose apple germplasm indicated the ample scope of crop improvement through selection. To confirm the findings as well as to determine the yield performance, the experiment will be continued.

#### ***In-situ* evaluation of monkey jack germplasm**

M.R. Islam, S.D. Setu, S. Hasna, M.G. Rahman and B.C. Kundu

The systematic collection and characterization of monkey jack germplasm were evaluated by frequent visits in different growing areas in Barishal and enquiries were made from the villagers and officials of state departments of horticulture and agriculture of the study areas to identify the superior types. The trees were characterized *in-situ* for characterization (tree highest, tree canopy, leaf length, leaf width and yield, etc.). The fruits were irregular in shape, ranging between 6.20 cm long and 5.20 cm wide, greenish at early to mature stage and velvety dull yellow during ripe stage. The fruit qualities of all the types were excellent. The thickness of pulp varied from thin and thick with low to high fiber content. Pulp tastes was sweet sour and pulp flavour was strong when it was eaten as fresh (organoleptic taste). The tree was medium in size (6.90 m), deciduous with dark colour bark, large leathery leaves (24 cm long and 15.5 cm wide), green, broadly ovate to oblong, base rounded, unequal and inwards. Male and female flowers were borne separately on the same plant. The flower colour was orange to yellow in early stage and gradually changing in to reddish. The fruit weight was 150 g and fruit yield per tree was 88.50 kg. The numbers of fruits per tree was 590 and pulp weight was 145.33 g, which were fleshy with thin seed coat among the genotypes. TSS (%) of the

fruits was 22. Monkey jack fruit tree is being grown in the homestead orchard garden or is found growing singly in a scatter manner in undulated areas of wastelands.

#### **Collection and evaluation of monkey jack germplasm**

S. D. Setu, M. R. Islam, S. Hasna, M. G. Rahman and B.C. Kundu

The experiment was conducted at the RARS, Rahmatpur, Barishal. Five germplasm of monkey jack were collected from different areas of the southern part of country. Wide variations in growth characteristics among the germplasm were found. Data on base girth, plant highest, length of main stem, main branches per plant, plant spread (north-south and east-west) were recorded at the time of first harvest. The maximum plant height (10.4 m) was recorded in AL Rah-01, followed by AL Rah-05 (7.3 m) and the lowest (5.60 m) in AL Rah-04. The base girth of the plants ranged from 68 cm (AL Rah-05) to 100 cm (AL Rah-01). The consumers always prefer higher edible portion. The highest percentage of edible portion (58%) was recorded in AL Rah-05. The maximum number of fruits per plant was recorded in AL Rah-04 (578), followed by AL Rah-02 (552) and the lowest (480) in AL Rah-01. The single fruit weight in different plants varied considerably ranging from 150.67 to 183.8 g. The highest fruit weight (183.8 g) was recorded in the line AL Rah-01 and lowest in AL Rah-02 (150.67 g). The highest fruit yield (104.16 kg) was recorded in the line AL Rah-04 and the lowest in (82.31 kg) in AL Rah-05.

#### **Collection and evaluation of velvet apple germplasm**

S.D. Setu, M.R. Islam, S. Hasna, M.G. Rahman and B.C. Kundu

The experiment was conducted at the RARS, Rahmatpur. Five germplasm of velvet apple were collected from different areas of the southern part of country. All fruits were considered for number of fruits, mean fruit weight, and yield per plant. Wide variations in growth characteristics among the germplasm were found. The age of plant of different lines varied considerably ranging from 13 to 20 years. The maximum age of plant was recorded in the line DD Rah-001 having 20 years of age, while DD Rah-005 was found to be the youngest plant (13 years). The tallest plant (12.0

m) was recorded in DD Rah-001, followed by DD Rah-003 (10.0 m) and the lowest (7.0 m) in DD Rah-005. The base girth of the plants ranged from 70 cm (DD Rah- 003) to 96 cm (DD Rah-001). The North-South and East-West spreading of the tree ranged from 5.5 m to 7.9 m and 6.0 m to 8.05 m, respectively. The maximum number of main branches per tree was recorded in the lines DD Rah-001 (13) and lowest was DD Rah-004 (6). Tree volume ranged from 144 m<sup>3</sup> (DD Rah- 005) to 300 m<sup>3</sup> (DD Rah-001). The highest percentage of edible portion (56.84%) was recorded in DD Rah-002, which was closely followed by DD Rah-001 (52.33%) and DD Rah-003 (51.54%). The lowest edible portion (48%) was obtained from DD Rah-004. TSS is an important criterion for selection of good quality fruit. The highest TSS (21%) was found in DD Rah-005, which was followed by that of DD Rah-003 (16%), DD Rah-002(15%), DD Rah-004 (15%), and the lowest in DD Rah-001 (14%). The highest fruit yield (137.724 kg) was recorded in the line DD Rah-002 and the lowest in (72.11 kg) in DD Rah-004.

#### **Evaluation of bilimbi (*Averrhoa bilimbi* L.) genotypes in Chattogram region**

H. Barua, M.G. Azam, S.M.K.H. Chowdhury and A.S.M.H. Rashid

The experiment was done in the fruits orchard of Agricultural Research Station (ARS), Khulshi, Chattogram to asses bilimbi genotype to release as a bilimbi variety. Six bilimbi genotypes were evaluated under this experiment. Data were recorded like plant height, base girth, canopy structure (E-W and N-S), fruit weight, fruit length, fruit breadth, TSS % and number of seeds per fruit. Among these genotypes, AB Pah-001 produced the maximum number of fruits per plant, with a count of 1960.00, while AB Pah-004 had the lowest number of fruits per plant at 540.00. The single fruit weight ranged from 29.22 g to 36.51 g, with AB Pah-005 producing the heaviest fruit (36.51 g) and AB Pah-001 producing the lightest fruit (29.22 g). AB Pah-003 had the highest TSS (6.88%) and AB Pah-004 had the lowest TSS (2.83%). AB Pah-001 produce the highest (57.27 kg) fruit yield per plant, followed by AB Pah-002 (54.34 kg) and AB Pah-004 produce the lowest (19.19 kg) fruit yield per plant.

#### **Evaluation of water chestnut germplasm**

M. A.Hossain, M. S.Rahman, H.Rahman, A.Akter, R.Sultana and H. E. M. K.Mazed

Three lines of water chestnut, viz., TB Jam-001, TB Jam-002 and TB Jam-003 were evaluated at the Regional Agricultural Research Station, Jamalpur. Data on different plant and fruit characters viz., stem length, stem colour, leaf length, leaf breadth, leaf colour, petiole length, petiole colour and flower colour were recorded. The highest stem length (2.50 m), leaf length (5.65 cm), leaf breadth (7.58 cm), petiole length (12.55 cm), individual fruit weight (19.0 g) and pulp weight (8.0 g) were recorded in TB Jam-001 and the lowest in TB Jam-003. Fruit length ranged from 2.7 to 3.9 cm. The highest yield per hectare was observed in TB Jam-001 (10.20 t) and the lowest in TB Jam-003 (8.10 t). The highest TSS was found in TB-Jam-001 (5.4%) and the lowest in TB Jam-003 (5.1%). Considering plant growth, yield and yield contributing characters it could be concluded that the line TB Jam-001 performed better. The experiment would be continued.

#### **Evaluation of star apple (*Chrysophyllum caimito* L.) germplasm**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment on the evaluation of star apple in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. Data on growth and fruit characteristics were recorded. There were three genotypes under study. The plant height and base girth of the lines, CC Rai-001, CC Rai-002 and CC Rai-003 were varied from 480 cm to 580 cm and 63 cm to 85 cm, respectively. Among those three lines, CC Rai-002 had maximum number of fruits per plant (175), individual fruit weight (190 g), fruit size (67.86 mm × 68.78 mm), pulp TSS (19%) and yield (33.4 kg/plant) compared to other two lines. The line should be released as a new variety.

#### **Evaluation of para jam (*Antidesma acidum*) germplasm**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment on the evaluation of para jam in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District. Data on growth was recorded. The fruit size, 100-fruit weight and yield of the lines varied from 4.45

mm×4.5 mm to 4.81 mm×4.50 mm, 3.25 g to 3.68 g, and 6 to 7.2 kg/tree, respectively. The ripen fruits TSS was 20% in all the lines. AA Rai-001 was superior in all the characters.

#### **Evaluation of jabuticaba (*Plinia cauliflora*) in hilly area**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment on the evaluation of jabuticaba in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District. There were three genotypes, such as PC Rai-001, PC Rai-002 and PC Rai-003, under study. The plant height, base girth and canopy size were varied from 370 cm to 390 cm, 48 cm to 57 cm, 330 cm×370 cm to 460 cm×480 cm, respectively. The maximum number of fruits per plant (4000), individual fruit weight (7.2 g), fruit size (25.2 mm×24.6 mm), yield (28.8 kg/tree), edible portion (79.2%) was observed in PC Rai-001. The lowest individual fruit weight (5.8 g), fruit size (22.9 mm×22.5 mm), and edible portion (76%) was observed in PC Rai-002. The minimum number of fruits per plant (2000) and fruit yield (12.8 kg/plant) was recorded in PC Rai-003. The TSS of all the three lines were 17%. Based on number of fruits per plant, individual fruit weight, fruit size, edible portion, yield, TSS and taste PC Rai-001 was the superior jabuticaba line and should be released as a new variety in Bangladesh.

#### **Evaluation of fig (*Ficus carica*) germplasm at Joydebpur**

M. M. Khatun and B. C. Sarker

Six fig germplasm were planted in 2019 at the Fruit Research Farm of HRC, BARI, Gazipur and evaluated. Plant and fruit characteristics of six fig germplasm were evaluated and data on number of fruits per plant and fruit characteristics were recorded during the harvesting time. Variation was noticed in terms of number of fruits per plant, fruit characters and pulp characters of fig. Maximum plant height was recorded to be 2.00 m in FC Joy-003 whereas base girth ranged from 10 cm in FC Joy-001 to 12.00 cm in FC Joy-003 and FC Joy-004. The fruit weight ranged from 33.40 to 46.60 g. Fruit length varied from 4.18 to 5.92 cm whether fruit width varied from 3.96 to 4.72 cm. TSS content was noticed to vary from 8.90 to 12.22%. Maximum (61) number of fruits was recorded from FC Joy-005. Oblong and globose shape of fruit was

observed with light purple to purple colour having light pink to pink pulp colour. Considering yield and yield contributing characters, all the germplasm showed better performance. This is second year result; further evaluation is needed for final conclusion.

#### **Evaluation of fig genotypes in Chattogram region**

M.G. Azam, S. M. K.H. Chowdhury, H. Barua and A. S. M.H. Rashid

The experiment was conducted at Agricultural Research Station, Khulshi, Chattogram to evaluate the fig genotypes. FC Pah-001 failed to flower this year. Data on plant height (m), base girth (cm), canopy (m<sup>2</sup>), flowering date, number of fruits, average fruit weight (g), fruit length (cm), fruit breadth (cm), TSS (%) and yield (kg/plant) were taken duly. FC pah-002 genotype produced 105 fruits in total, with average measurements of 165 g, 7.8 cm, and 6.8 cm for weight, length, and breadth, respectively. The TSS was 15.2%, and the fruit production per plant was 17.33 kg. Ripen fruit is suitable for table use. The taste and flavor were good of this fruit. This was the first year's evaluation. So, the evaluation will be continued in next consecutive years.

#### **Hybridization in dragon fruit**

J. C. Sarker, S.M.L. Rahman, F. Ahmed and M.H.M.B. Bhuyan

A hybridization program of dragon fruit was conducted in the flowering season at Citrus Research Station (CRS), Jaintapur, Sylhet to develop new dragon fruit hybrids having desirable characteristics like to transfer the yellow peel color as well as enhance fruit size and profuse bearing habit. Cultural management and other practices were done as per schedule. A total of 30 flowers were emasculated and pollinated. Four hybrid fruits were obtained from different crosses: BARI Dragon fruit-1 (♀) × HM Jai-003 (♂), HM Jai-003 (♀) × BARI Dragon fruit-1 (♂) and HM Jai-003 (♀) × HU Jai-002 (♂). Total number of fruits retention at 10, 20, 30, and 40 days after pollination were 10, 01, 01, and 01, respectively. Developed hybrid fruits were harvested at proper maturity. The seeds were sowed in the seed trays for germination. The seeds germinated and the seedlings are growing in the nursery. One-year-old hybrid



seedlings will be transplanted into the main field and will be evaluated in the following season.

#### **Evaluation of promising dragon fruit germplasm in rangamati hilly area at Raikhali**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment with three germplasms of dragon fruits collected from different parts of the country were conducted at eight years old dragon fruit orchard of Hill Agricultural Research Station, Raikhali, Rangamati. The vines were supported individually by RCC pillar of 2 m height from the base consisting of bicycle tire at the top. the plant vine height varied from 195 cm (HU Rai-003-2) to 320 cm (HU Rai-002). HU Rai-003-2, a round shaped white flesh red skin dragon fruit line, had maximum fruit weight (494 g) and HU Rai-002, an oblong shaped red fleshed red skin fruit line, had maximum number of fruits per pillar (47) and yield (30.98 t/ha), but BARI Dragon fruit-1, a round shaped red flesh red skin dragon fruit variety, had maximum edible portion (75%). The TSS of HU Rai-003 and HU Rai-003-2 was 16% and the TSS of rest of the lines was 14%. The maximum fruit yield (30.98 t/ha) was observed in HU Rai-002 followed by BARI Dragon fruit-1 (22.51 t/ha) and the lowest (7.11 t/ha) was in HU Rai-003-2 because for lower plant age. All the lines were red in skin color. HU Rai-001 and HU Rai-003-2 were white fleshed. HU Rai-003-2 and BARI Dragon fruit-1 were round in shape and the rest of the lines were oblong in shape. In terms of yield and fruit size HU Rai-002 was found superior among the lines.

#### **Collection and evaluation of dragon fruit germplasm at Lebukhali**

M. Islam, M. Ratna, E. Mahmud, N. Akter, S. Yesmin and M. I. A. Howlader

An experiment with sixteen germplasm of dragon fruits was conducted at the experimental field of Regional Horticultural Research Station (RHRS), Lebukhali, Patuakhali for the evaluation of superior dragon fruit lines in southern region of Bangladesh. The maximum individual fruit weight (355 g) was recorded from HC Leb-006 followed by HC Leb-005 (344 g) but the minimum (171 g) in the HC Leb-001. The highest fruit length (10.7 cm) was found in HC Leb-005, followed by HC Leb-006 (10.5 cm). On the other hand, lowest fruit length (6.9 cm) was found in HC Leb-001. The maximum number of spikes per fruit (30) was found in HC

Leb-002 and HU Leb-001. On the other hand, the minimum number of spikes per fruit (12) was recorded in HC Leb-007. The maximum TSS (21.0%) was found in HC Leb-001 while the lowest (13.0%) in HC Leb-006 followed by HC Leb-005 (14.8%). The germplasm HU Leb-001, HU Leb-001 and HM Leb-001 white fleshed fruit but others were red fleshed. All the germplasm were red skinned but only HM Leb-001 yellow skinned fruit. This experiment is on-going and after completion of experiment superior dragon fruit varieties will be developed.

#### **Collection and evaluation of yellow dragon fruit germplasm at Hathazari**

M. Moniruzzaman, M. R. Sarkar, A. Tabassum and M. M. Rahman

Three yellow dragon fruit lines viz., HM Hat-001, HM Hat-002 and HM Hat-003 were evaluated at the Regional Horticulture Research Station, Hathazari, Chattogram during 2022-23. Significant differences were observed in all the parameters. The tallest plant (4.0 m) was observed in HM Hat-003, followed by 3.6 m in HM Hat-002. The highest (40) number of primary branches was observed in HM Hat-003(40), followed by HM Hat-002 (21) as against the minimum primary branches (9) recorded in HM Hat-001. The individual fruit weight was recorded in HM Hat-002 (260 g). The TSS was recorded 16.25% in HM Hat-002. This experiment is one going. After completion of data, it can be concluded.

#### **Performance of exotic pummelo, pomegranate, olive and pineapple germplasm at Joydebpur**

M. R. Karim, M. A. Haque and B. C. Sarker

Exotic germplasm of pummelo, pomegranate, olive and pineapple was evaluated at the Fruit Research Farm of Pomology Division under HRC, BARI, Gazipur during the period from November 2019 to till to date with a view to develop high yielding and superior variety. The average fruit weight of pummelo germplasm was recorded 850 g and 900 g during 2020-21 and 2021-22, respectively, with no seed in 2020-21 and less number of seed (8-10 seed/fruit) last year. The pomegranate possessed an average fruit weight of 189.33 g last year with white colour aril. The olive germplasm is at vegetative stage for last four years and not

performing any flower. The average fruit weight, TSS and edible portion of pineapple germplasm were recorded 854 g, 18.33% and 70%, respectively.

#### **Preliminary yield trial of exotic pineapple germplasm**

M. A. Haque and M. R. Karim

One exotic pineapple germplasm (AC Joy Ex-001) was evaluated during 2022-23 to observe its performance at Pomology Division of HRC, BARI, Gazipur. The average plant height was observed 55 cm and the counted number of leaves was 28. Length and width of the D leaf was measured 47 and 4.52 cm, respectively. The plants are in vegetative stage.

#### **Collection and evaluation of cashew nut germplasm at Raikhali**

S.P. Chakma, M.M. Hasan, N.U. Ahmed and M.A. Hossain

An experiment on the evaluation of cashew nut in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. The higher cashew nut weight (9.71 g) was observed in AO Rai-024. The higher cashew kernel size was observed in AO Rai-037, AO Rai-032, AO Rai-030 and AO Rai-024, which were 2.95 g, 2.78 g, 2.74 g and 2.69 g, respectively. Based on nut weight, nut size, and kernel weight; AO Rai-024, AO Rai-037, AO Rai-030, AO Rai-034, AO Rai-018, AO Rai-009, AO Rai-036, AO Rai-032, AO Rai-031 and AO Rai-002 were selected for further evaluation.

#### **Evaluation of promising cashew nut germplasm at Ramgarh**

S. M. Faisal and R. H. Nitol

Twenty promising cashew nut germplasm were evaluated at Hill Tracts Agricultural Research Station, Ramgarh during the year 2022-23. The line AO Ram-013 produced the maximum number of fruits/plant (600), while a bigger nut (7.33 g) was obtained from AO Ram-018 and AO Ram-049. The maximum nut yield (2.20 kg/plant) was obtained from line AO Ram-013, while the maximum edible portion of nut (37.5%) was recorded from line AO Ram-005.

#### **Evaluation of cashew nut germplasm at Hathazari**

M.M. Rahman, A. Tabassum, M.R. Sarkar and M. Moniruzzaman

The study was conducted at the Regional Agricultural Research Station, Hathazari, Chattogram during 2022-2023. Seven cashew nut germplasm were selected for the study. A wide variability was observed in different parameters. The highest yield per plant (8.67 kg) was observed in AO Hat-001, while the lowest from AH Hat-004 (2.23 kg). The highest nut yield per plant (1.25 kg) was observed in AO Hat-001 as compared to the lowest from AO Hat-004 (0.40 kg). Weight of apple and nut varied from 28.8 g (AO Hat-003) to 48.8 g (AO Hat-002) and 3.90 g (AO Hat-005) to 5.88 (AO Hat-002). Maximum TSS was recorded in AO Hat-006 (12.70%), followed by AO Hat-004 (12.68 %), whereas the lowest from AO Hat-007 (9.20%). Apple color was recorded brownish red to light yellow.

#### **Evaluation of cashew nut germplasm in North-eastern hilly region of Bangladesh**

J.C. Sarker, F. Ahmed, M.H.M.B. Bhuyanand S.M.L. Rahman

An experiment was conducted at CRS, Jaintiapur to find out the promising germplasm for commercial cultivation in the region. All the germplasm differed in their growth characters. Among five germplasm, the tallest plant was recorded in AO Jai-003 (3.38 m); whereas, the shortest plant was recorded in AO Jai-002 (2.80 m). Similarly, maximum stem girth was recorded in AO Jai-003 (21.67 cm), followed by AO Jai-004 (21.00 cm), while the minimum was recorded in AO Jai-001 (19.00 cm). The maximum canopy spread in the east-west (176.67 cm), as well as north-south (210.00 cm) direction was recorded in AO Jai-005 as against the minimum (160 and 160 cm in east-west and north south, respectively) in AO Jai-001. Final conclusion can be made after collection of all data.

#### **Evaluation of egg fruit (*Pouteria campechiana*) in hilly area**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment on the evaluation of egg fruit or tisa in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District

during 2022-23. There were four different tisa genotypes, such as PC Rai-001, PC Rai-002, PC Rai-003 and PC Rai-004 under the study. Among those genotypes, the maximum number of fruits per plant (300), individual fruit weight (193 g), fruit size (8.50 cm×6.8 cm), pulp thickness (1.5 cm), edible portion (80%) and yield (57.9 kg/plant) were obtained from PC Rai-001, compared to other genotypes.

#### **Evaluation of exotic date palm (*Phoenix dactylifera* L.) genotypes in Chattogram region**

H. Barua, S.M.K.H. Chowdhury, M.G. Azam and A.S.M.H. Rashid

The experiment was conducted in the fruit orchard of Agricultural Research Station (ARS), Khulshi, Chattogram to find out a suitable date palm genotype. Seventeen exotic date palm genotypes were evaluated under this experiment. Among them, three genotypes produce female (PD Pah-007, PD Pah-008 and PD Pah-021), three produce male flower (PD Pah-006, PD Pah-013 and PD Pah-019), while rest of the genotypes didn't produce flower. The germplasm PD Pah-001 is tissue cultured plant, PD Pah-005 is sucker plant and they did not produce flower and rest of the plants are found from seed. In case of male flower, date of spathe emergence ranged from mid-January to mid-February, and in case of female flower date of spathe emergence ranged from mid-February to mid-March. Among the accessions, PD Pah-021 has the highest number of fruits per bunch (1525), while the lowest number of fruits per bunch has produced by PD Pah-008 (185). The germplasm PD Pah-007 exhibits the highest fruit weight (12.50 g), as compared to the lowest (4.90 g) in PD Pah-021. The maximum TSS (29.10%) was observed in PD Pah-008 in comparison to the minimum (21.60%) in PD Pah-021. The highest edible portion constitutes 92.00% in PD Pah-007, while the lowest (63.00%) in PD Pah-021.

#### **Evaluation of exotic passion fruit (*Passiflora edulis*) germplasm**

S.P. Chakma, M.M. Hasan and N.U. Ahmed

An experiment on the evaluation of passion fruit in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. The growth conditions of the passion fruit lines were satisfactory. Only BARI Passionfruit-1 started flowering as it was grown

directly from vine, while the other lines did not produce any flower as those were propagated directly from seeds.

#### **Evaluation of grape germplasm at Joydebpur**

M. J. Rahman, M. M. Islam, M. A. Islam and M. M. Khatun

Four grape germplasm viz., VV Joy-001, VV Joy-002, VV Joy-003 and VV Joy-004 were collected from different plant nurseries of Gazipur and planted in the Fruit Research Farm of BARI Gazipur in 2021. Two germplasm produced plenty of fruits or berry this year and other two germplasm produced few fruits. The weight of fruits per plant was recorded to be 11.42 kg in VV Joy-001 and 10.56 kg in VV Joy-002. The colour of fruits or berries were green in colour. The taste of these germplasm was sour sweet.

#### **Collection and evaluation of coffee germplasm at Raikhali**

S.P. Chakma, M.M. Hasan, N.U. Ahmed and M. A. Hossain

An experiment on the evaluation of coffee (*C. arabica* and *C. canephora*) in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. The maximum 100-fresh berry weight (120.47 g), 100-dried filled seed weight (11.96 g), fresh berry yield (7.12 t/ha) and dried seed yield (1.20 t/ha) of *C. arabica* were obtained in CA Rai-012, while the highest 100-fresh berry weight (150.65 g), 100-dried filled seed weight (12.88 g), fresh berry yield (4.60 t/ha) and dried seed yield (0.74 t/ha) of *C. canephora* were found in CC Rai-063.

#### **Evaluation and adaptability of promising coffee germplasm at Ramgarh**

S. M. Faisal and R. H. Nitol

The experiment was carried out at the existing plantation of HTARS, Ramgarh from 2022 to 2023 in order to develop high-yielding, better-quality, and adaptive to local environment coffee variety. Twenty-five genotypes of *Coffea canephora* were selected and evaluated randomly for the study. The line CC Ram-075 has maximum yield/plant (1320 g). The CC Ram-098 is recorded as an early-matured line with maximum hundred fruit weight (115 g) and seed weight (69 g).



### **Collection and evaluation of coffee germplasm in Chattogram region**

M.G. Azam, S. M. K.H. Chowdhury, H. Barua and A. S. M. H. Rashid

An experiment with twenty coffee genotypes was conducted at Agricultural Research Station, Khulshi, Chattogram during 2022-2023 to identify the best genotype for releasing as variety. The genotype CA Pah-016 provided the maximum base girth (6.45 cm), while the minimum base girth (5.75 cm) was noted from CA Pah-002 and CA Pah-003. The canopy ranged from 1.48 to 2.75 m in the north-south direction and 1.54 to 2.35 m in the east-west direction. The CA Pah-004 plant produced the highest number/plant (3145), whereas the CA Pah-013 produced the lowest (80) number per tree. The genotype CA Pah-008 produced the highest individual fruit weight (1.41 g), while genotype CA Pah-006 produced the lowest weight (0.81 g). The germplasm CA Pah-008 produced the heaviest dry bean (0.62 g), whereas CA Pah-016 produced the lightest (0.24 g). The plant with the highest fresh bean production per plant (3805.45 g) was noted in CA Pah-004, whereas the lowest fresh bean yield per tree (88.80 g) was in CA Pah-013. Moreover, the CA Pah-004 plant produced the maximum (1352.35 g) dry bean yield per plant, whereas the CA Pah-013 tree produced the lowest (33.60 g) dry bean yield per tree.

### **Evaluation of coffee (robusta) germplasm in the north-eastern hilly region of Bangladesh**

J.C. Sarker, F. Ahmed, M.H.M.B. Bhuyanand S.M.L. Rahman

Evaluation of coffee (robusta) germplasm was conducted at Citrus Research Station, Jaintiapur, Sylhet to study its performance. Among the three germplasm, the maximum tree height was recorded in CR Jai-002 (1.82 m); whereas, the minimum was recorded in CR Jai-003 (1.73 m). Similarly, maximum (9.67 cm) stem girth was recorded in CR Jai-001 and CR Jai-003, while the minimum (9.00 cm) was recorded in CR Jai-002. The maximum canopy spread in the east-west 130 cm as well as north-south direction 136 cm was furthermore recorded in CR Jai-001 as compared to the minimum (113 cm in east-west and 106 cm in north-south directions) in CR Jai-002.

### **Study on floral biology of avocado**

A. Anwari and B. C. Sarker

An experiment was performed at the Fruit Research Farm of Horticulture Research Centre, BARI, Gazipur during February-March, 2023 to gather knowledge about particular floral biology (protogynous dichogamy) of avocado to optimize yield, perform appropriate crosses and also preserve pollen of avocado for future breeding programs. The germplasm PA Joy-006 had A-type flower (female opens first only for 2-3 hours in the morning of day one and then closes). The flowers reopen in the next day afternoon and shed pollen as male organ and remain open for 3-4 hours, then closes permanently. Temperature has an immense effect on flowering of avocado. Some male and female flowers were opened at the same time due to low temperature, as it delayed female flower opening and overlapped with male opening which was synchronized. Anther dehiscence was found delayed in some cases. Synchronization also found at high temperature.

### **Hybridization in avocado**

A. Anwari and B. C. Sarker

Hybridization in Avocado was carried out at the Fruit Research Farm of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during the flowering season of 2023 to incorporate more desirable traits (earliness, colour, bearing habit, fruit size and dwarfness) in BARI Avocado-1. Cross combinations for hybridization were BARI Avocado-1×PA Joy-004 and BARI Avocado-1×PA Joy-006. In the case of BARI Avocado-1×PA Joy-004, only five fruits were set from 33 crosses. Pollens were preserved in the desiccator. Four fruits dropped at marble and pea stage. Only one fruit retained and grew up to medium size and then dropped. Another two fruits were set in the cross combination of BARI Avocado-1×PA Joy-006, but all the fruits dropped at pea stage.

### **Evaluation of avocado germplasm at Debiganj**

B. R. Barman, M. O. Hoque, M. Rahman and M. S. Hossain

The study was conducted at the Breeder Seed Production Centre (BSPC), BARI, Debiganj, Panchagarh during 2022-23 with a view to identify and select the most desirable avocado germplasm;

and to develop a high yielding, good quality avocado variety. Two avocado germplasm viz., PA Deb-001 and PA Deb-002 was included in this study. Both the germplasm provided fruits in this year. The maximum number of fruit (235) was counted from PA Deb-001, whereas the minimum (3) was observed in PA Deb-002. The average fruit weight was found maximum (701.33 g) from PA Deb-001, as against minimum (316 g) was in PA Deb-002. In PA Deb-001, fruit length and diameter was measured higher 12.90 cm and 11.20 cm, respectively. The shortest (11.75 cm) and narrowest (7.70 cm) fruits was recorded from in PA Deb-002 germplasm. The highest fruit yield per plant (164.81 kg) was obtained from PA Deb-001, while the lowest (0.95 kg) was in PA Deb-002.

## Project II: Propagation Technique

### Effect of grafting time on BARI developed jackfruit varieties

M. J. Rahman and M. A. Islam

An experiment was conducted at the Fruit Research Farm, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur to study the effects of time and variety on the grafting success of jackfruit. There were two factors in the experiment viz., time of grafting (February, March, April, May, June, July, August, September, October, November, December, and January) and variety of jackfruit (BARI Kanthal-1, BARI Kanthal-2 and BARI Kanthal-3). The combined effect of time of grafting and variety influenced the success of grafting and the days required for sprouting. The highest grafting success (82.3%) was recorded in January grafting with BARI Kanthal-3 followed by that of January grafting with BARI Kanthal-2 (78.4%). But they were statistically similar. In the case of January grafting, BARI Kanthal-1 took the maximum time (33 days) to sprout, and grafting in September with BARI Kanthal-3 took the minimum time (17.0 days). Considering grafting success, January was the best time for cleft grafting in jackfruit.

### *In-vitro* production of BARI Kola-5

S. R. Haque and M. K. Jamil

BARI Kola-5 which was collected from the fruits field of the Pomology Division of HRC. Shoot tips were separated from those suckers and washed with

running tap water for 30 minutes. All the shoot tips died after inoculation in the different treatments containing culture media. It may be due to Fusarium wilt (FW) disease caused by the soil-borne fungus *Fusarium oxysporum*. The experiment is in its first year. So, it needs to be continued, and have to collect Fusarium wilt disease-free BARI Kola-5 shoot tip to obtain a better result of the experiment.

### Micro propagation of papaya (*Carica papaya* L.)

M. K. Jamil and S. R. Haque

To develop a suitable and reproducible protocol for micropropagation of papaya, shoot tips of BARI papaya-1 were cultured on MS medium supplemented with different concentrations (0, 1.0, 2.0, 3.0, 4.0, and 5.0) mg/l of BAP with 4% sugar. The responses of the explant were varied at different concentrations of BAP. Among the treatments, BAP at 3.0 mg/l (T<sub>4</sub>) along with 4% sugar was found better for shoot induction of the explants. But shoot multiplication and elongation were found better in another treatment (T<sub>5</sub>) which consists of (0.25 mg/l BAP + 0.4 mg/l GA<sub>3</sub>).

### Performance of BARI strawberry varieties during *in-vitro* propagation with leaf

S. R. Haque and M. K. Jamil

Shoot tip and parts of leaf explants of BARI Strawberry-3 and BARI Strawberry-2 were cultured on MS medium supplemented with different concentrations and combinations of hormones. T<sub>3</sub> (4 mg/l BAP) was found most suitable for shoot tip elongation for both BARI Strawberry-3 and BARI Strawberry-2. In the case of leaf explants, both treatments T<sub>4</sub> (4 mg/l BAP + 0.5 mg/l IBA) and T<sub>5</sub> (4 mg/l BAP + 0.25 mg/l IBA) produced callus for both BARI Strawberry-2 and BARI Strawberry-3. Among the treatments, the highest survival percentage was obtained from T<sub>3</sub> treatment for both BARI Strawberry-2 (15%) and BARI Strawberry-3 (50%). The lowest percentage of explant survival (0%) was found in the control treatment i.e., without hormone on MS media. Leaves were cultured in three different concentrations of hormones for callus formation. The highest percentage of explant-produced callus (30%) in the T<sub>4</sub> treatment is followed by treatment T<sub>5</sub> (25%) for BARI Strawberry-2. On the other hand, for BARI Strawberry-3 the highest

percentage of explant produced callus (22%) also in T<sub>4</sub> treatment which is followed by treatment T<sub>5</sub>.

### **Study on the performance of grafted cashew nut saplings**

S. P. Chakma, M. M. Hasan, N. U. Ahmed and M. A. Hossain

An experiment on the performance of grafted cashew saplings in a hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. The plant height varied from 48cm in T<sub>2</sub> (Cleft Grafting) to 110cm in T<sub>1</sub> (Seedling). The base girth varied from 4cm in T<sub>2</sub> (Cleft Grafting) to 8cm in T<sub>1</sub> (Seedling). The canopy size varied from 47cm x 40cm in T<sub>2</sub> (Cleft Grafting) to 70cm x 98cm in T<sub>1</sub> (Seedling). The growth performance of cashew saplings directly from seed (T<sub>1</sub>) was found to be superior compared to cleft grafted saplings in terms of success survivability (96%).

## **Project III: Cultural Management**

### **Effect of canopy management on growth and yield of mango**

B. C. Sarker and M. S. Uddin

The experiment was conducted at the Fruit Farm of HRC, BARI, Gazipur with three BARI-released varieties such as BARI Mango-3, BARI Mango-4, and BARI Mango-8 to standardize the canopy architecture of mango plants planted at closer spacing. The experiment was set following a randomized Complete Block Design with 5 replications. Adequate care and management of the plants in the experiment were taken as per requirement. Maximum canopy spread (3.82 m and 3.92 m, respectively) as well as tree volume (36.97 m<sup>3</sup>) was recorded in BARI Mango-8 and minimum canopy dimension was noticed in BARI Mango-4. The maximum number of fruits per plant (118.86) was recorded in BARI Mango-3 and the minimum number of fruits per plant (58.65) was counted in BARI Mango-8. The highest yield (51.18 kg) was recorded from BARI Aam-4 and the lowest yield (17.00 kg) from BARI Aam-8. The highest average individual fruit weight (513.0 g) was recorded from BARI Aam-4 while the lowest fruit weight (225.0 g) from BARI Aam-3. The highest TSS 22% was recorded from BARI Aam-3 while the lowest (20%) from BARI Aam-8. The relation between the

yield and the tree volume indicates that tree size management by tip pruning can give a higher yield from per unit area of a closer-spaced mango orchard. Thus, pruning at an appropriate level could be one of the most important tools for structuring mango orchards to a desired canopy architecture as well as yield.

### **Effect of time and level of pruning on growth, yield and quality of BARI Aam-4**

M. S. Uddin and B. C. Sarker

An experiment was conducted at the fruit research field, Pomology Division, Horticulture Research Centre, BARI, Gazipur during the period. Pruning is an important practice for obtaining quality mango production and controlling tree size as well as yield of mango. Essentially pruning should maintain a good balance between growth and fruiting. In this experiment, five different time of pruning was exercised such as T<sub>1</sub>=25 July, T<sub>2</sub>=10 August, T<sub>3</sub>=25 August, T<sub>4</sub>=10 September, T<sub>5</sub>=25 September, and control (no pruning). For all treatments except control 30 cm stem was cut off from the apex. The highest tree volume was recorded at T<sub>5</sub> (122.52 m<sup>3</sup>) while the minimum was in T<sub>6</sub> (50.88 m<sup>3</sup>). The highest yield was recorded in T<sub>1</sub> (68.44 kg) followed by T<sub>2</sub> (59.56 kg) and the lowest yield was recorded in T<sub>5</sub> (24.90 kg). From the experimental results, it is revealed that, just after fruit harvest pruning is more effective compared to late pruning at BARI Aam-4 variety.

### **Effect of different types of fruit bag on growth, yield and quality of BARI Aam-4**

M. S. Uddin and B. C. Sarker

An experiment on different types of fruit bags was conducted at the Horticulture Research farm, BARI, Gazipur during 2022-23. The fruits were bagged 40 days after the fruit set. Five treatments were used viz., T<sub>1</sub>-brown color double layer paper bag, T<sub>2</sub>-maroon color double layer paper bag, T<sub>3</sub>-white color single layer bag (35 GSM), T<sub>4</sub>-white color single layer bag (55 GSM) and T<sub>5</sub>-control (No bag use). Maximum (10%) percentage of cracked fruit recorded at single layer white color bags since minimum at double layered bags. Maximum shelf life (12 days) was recorded at double layered bags followed by 10 days' white color bags and the minimum was recorded from control treatment. There was 60 percent fruit fly infestation recorded at non-bagging mangoes since



5 percent was recorded from single layer white (35 GSM) and 3.0 per from white bag (55 GSM). All double-layer paper bags changed fruit color to yellow and no disease infections were found. However, the white color single-layer bag did not change the fruit color and developed different types of spots on mangoes. These results indicate that double-layered fruit bags can improve fruit quality through a reduction in disease and insect-pest attacks and the shelf life of mangoes.

**Effect of different doses of paclobutrazol on off-season flowering, fruiting, yield, and fruit quality of mango cv. BARI Aam-3 and BARI Aam-4**

M. H. Waliullah, M. S. Islam, M. A. Shahed and K. H. Alam

An experiment was conducted at the FRS, Binodpur, Rajshahi. Paclobutrazol, a plant growth retardant, was used in combination with thiourea for producing as well as breaking flower buds. The rate of paclobutrazol application depends on the size of the tree canopy. For most cultivars, the rate of paclobutrazol applied is generally determined by multiplying the diameter of the tree canopy (expressed in meters) with 1.0-1.5 g. of active ingredients of paclobutrazol. At 120 days after the application of paclobutrazol, 0.5% thiourea is sprayed on the tree for bud breaking. Using this method, inflorescences are visible within 7.5 to 8 months after the paclobutrazol application depending on the cultivar. However, after the application of paclobutrazol (1.5g/m<sup>2</sup> tree canopy), the highest yield was recorded in BARI Aam-4 (48 Kg/tree) contrary to the control (31 kg/tree).

**Brick kiln smoke causes black tip on mango, an emerging threat, survey, and identification in the actual condition of Rajshahi region**

K. H. Alam, M. S. Islam, M. H. Waliullah and M. A. Shahed

An observation on the black tip of mango caused by brick kiln emitted fumes was undertaken at Rajshahi region of Bangladesh where a total of seventy-one brick kilns was surveyed. Though this type of work was done before the actual information in Bangladesh is not updated. This study revealed that the black tip of mango was not associated with any pathogen and it was related to the close presence of brick kilns which was one

kind of physiological disorder. The highest percentage of mango orchards (90%) was affected by the black tip in the case of the lowest chimney height (40-50 ft). Most of the brick kilns were using coal (96%) as their energy source for brick burning. The highest percentage of mango orchards (70%) affected by brick kilns emitted gas-causing black tips located on the Northern side of brick kilns but the symptoms were absent in the orchards located on the Eastern side of brick kilns in the study area. In this context, it is essential to find out the best alternative to traditional brick production technology for Bangladesh's condition. 'Concrete block brick' technology (already started in Bangladesh) may be the best choice as an eco-friendly brick production resulting in saving the mango orchard as well as agriculture.

**Manipulation through grafting and pruning for the dwarf shape of BARI released mango variety**

A. S. M. Yousuf Ali, M. K. ISLAM, H. B. Harun and M. M. Rahman

A study on manipulation through grafting & pruning for the dwarf shape of BARI-released mango variety was conducted at RHRS, Chapai Nawabganj. The experiment was laid out in RCB design with three replications having 4m X 5m plant spacing. The study comprised seven treatments. The first grafting in all treatments was done on 29 May 2018. The second grafting was done in the four treatments on 29 May 2019. Triple grafting was done in the two treatments (T<sub>4</sub> & T<sub>7</sub>) on 20 May 2020. Among the remaining three treatments, Cutting the main stem 5 inches above grafting was done in the treatment T<sub>5</sub> on 29 May 2019. Cutting the main stem 5 inches above grafting was done (on 20 May 2020) in treatment T<sub>6</sub> while Cutting the main stem 5 inches above grafting was done in treatment T<sub>3</sub> on 29 May 2021. The highest plant height (4 m) was recorded in T<sub>1</sub> and the minimum height (2.25 m) was recorded in T<sub>3</sub>. The maximum tree volume was recorded in treatment T<sub>1</sub> (17.1 m<sup>3</sup>) and the minimum was recorded in treatment T<sub>3</sub> (4 m<sup>3</sup>). In the case of branches per plant, the highest (12.5) number of branches per plant was recorded from the treatment T<sub>3</sub> and the minimum (7.5) from T<sub>1</sub>, T<sub>4</sub> & T<sub>6</sub>, respectively. and the maximum yield per plant (12.32kg) was found from the treatment T<sub>3</sub> which was closely followed by T<sub>1</sub>(11.1kg) as minimum (6.8kg) from T<sub>4</sub>.

### Development of management approach against red-banded mango caterpillar, *Deanolis sublimbalis*

M. M. Rahman, G. M. M. Bari and M. Mijanur Rahman

Seven treatments such as- T<sub>1</sub>= Sanitation +Application of soil recharge@5g/L; T<sub>2</sub>= Sanitation +Application of soil recharge@5g/L + D-limonene (Bioclean) @1ml/L; T<sub>3</sub>= Sanitation +Application of soil recharge@5g/L + Biotrine (Matrin) @ 1.4 ml/L; T<sub>4</sub>= Sanitation +Application of soil recharge@5g/L + Spinosad (Success) @ 1.2 ml/L; T<sub>5</sub> = Sanitation +Application of soil recharge@5g/L + Fenitrothion (Sumithion) @ 2 ml/L; T<sub>6</sub>= Sanitation +Application of soil recharge @5g/L + Deltamethrin (Desis) @ 1 ml/L and T<sub>7</sub> = Untreated Control were evaluated on mango at Regional Horticulture Research Station (RHRS), Bangladesh Agricultural Research Institute (BARI), Chapainawabganj to develop a suitable management technique against red banded mango caterpillar (RBMC), *Deanolis sublimbalis*. Results indicated that the highest fruit infestation was 9.7 % in untreated control and that of the lowest (2.4%) was obtained from T<sub>5</sub> treated tree followed by T<sub>6</sub> (3.2%) and T<sub>4</sub> (3.6 %). The highest reduction of fruit infestation over control (75.30%) was found in T<sub>5</sub> followed by T<sub>6</sub> (67%), T<sub>4</sub> (62.9%), T<sub>3</sub> (36.1), T<sub>2</sub> (26.8%), and T<sub>1</sub>(8.2%). Treatment T<sub>5</sub> produced the highest yield (153.33 Kg/tree) of mango which was a 162.9% increase over control followed by T<sub>6</sub> (157.2%) and T<sub>4</sub> (114.3%). The marginal benefit-cost ratio was also calculated highest (5.2) from T<sub>5</sub> which was almost similar to T<sub>6</sub> (5.1) followed by T<sub>4</sub> (3.0).

### Effect of coco dust as growing media for mango sapling production

M. K. Islam, M. M. Hossain, A. S. M. Y. Ali, H. B. Harun and M. M. Rahman

The experiment was conducted at Regional Horticulture Research Station, BARI, Chapainawabganj during 2021-22 and 2022-23 to develop soilless mango sapling production and to facilitate transport/export. The treatments were T<sub>1</sub>: Coco dust 100%, T<sub>2</sub>: Coco dust 75% + Cow dung 25%, T<sub>3</sub>: Coco dust 50% + Cow dung 50% and T<sub>4</sub>: CD 50% + Soil 50% (control). The highest plant height (78.65cm), number of branches per plant (3.00), internode length (11.28cm), stem diameter (0.98cm), number of leaves per plant (54.00), and leaf area were found in the treatment T<sub>4</sub>, CD 50% +

Soil 50% (control), which was statistically at par with treatments having coco dust plus cow dung i.e., T<sub>2</sub> and T<sub>3</sub> but significantly higher than T<sub>1</sub> i.e., the coco dust only. The result indicated that the mango sapling can be grown soilless in coco dust medium in addition to 25% cow dung to facilitate sapling export.

### Effect of ultra-high-density plantation of mango at varying spacing on yield and return

M. K. Islam, M. M. Hossain, A. S. M. Y. Ali, H. B. Harun and M. M. Rahman

The experiment was conducting at Regional Horticulture Research Station, BARI, Chapainawabganj during 2021-22 to find out the optimum spacing for ultra-high density plantation (UHDP) of mango. The treatments were T<sub>1</sub>: Traditional spacing 8m × 8m, T<sub>2</sub>: UHDP spacing 3m × 3m, T<sub>3</sub>: UHDP spacing 3m × 2m, T<sub>4</sub>: UHDP spacing 2.5m × 2.5m and T<sub>5</sub>: UHDP spacing 2m × 2m. The highest yield (1.24 t/ha) was in the lowest spacing T<sub>5</sub> (2m×2m) and the lowest yield (0.097/ha) was found in the highest spacing (8m×8m). The result indicated that the spacings of 3m×3m and 3m×2m can give higher yield in early years of ultra high density mango orchard. 2m×2m will be over crowded as it already attained 75 % canopy coverage.

### Effect of length of heading back in ultra high density plantation on growth, stature and yield of mango

M. K. Islam, M. M. Hossain, A. S. M. Y. Ali, H. B. Harun and M. M. Rahman

The experiment was conducting at Regional Horticulture Research Station, 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<sub>1</sub>: at 60+30 cm heights, T<sub>2</sub>: at 60+45 cm heights, T<sub>3</sub>: at 60+60 cm heights, T<sub>4</sub>: at 60+75 cm heights and T<sub>5</sub>: No heading back. Second heading back at 45 cm and 60cm (T<sub>2</sub> and T<sub>3</sub>) produced reasonably lower canopy of around 20% at the end of 2nd year. It indicates if maintenance pruning done properly/regularly it may need many years (may be 10-15 years) to spread full canopy and up to then successful yield and handsome return is possible.

The experiment needs to be continued to generate more data over years.

#### **Effect of GA<sub>3</sub> on seed size, fruit weight and fruit yield in litchi**

M. A. Islam, M. J. Rahman and M. M. Khatun

The experiment was carried out at the Fruit Research Farm of Horticulture Research Centre, BARI Gazipur to determine the effect of GA<sub>3</sub> on seed size, fruit weight and fruit yield in BARI Lichu-1. In this study GA<sub>3</sub> @ 300 ppm were applied at 0 (water spray only) 5, 10, 15 and 20 days after fruit set (DAFS). Maximum individual fruit weight was obtained when GA<sub>3</sub> was applied at 15 DAFS (23 g) whereas minimum individual fruit weight was noted in 10 DAFS (16 g). Panicle length varied from 18.2 cm to 28.1 cm, the highest length was found in 15 DAFS (28.1cm) and minimum panicle length was recorded in 10 DAFS (18.6cm). Maximum number of fruits were observed in the treatment 15 DAFS (16.3) and the least number of fruit was recorded in 10 DAFS (10.8). Big seed size was observed in control (4.4g) and the small seed size was recorded in 10 DAFS (0.5 g). Maximum pericarp weight was recorded from 15 DAFS (1.8 g) and the minimum pericarp weight was noted in 10 DAFS (1.5 g). Percent edible portion was obtained maximum from 10 DAFS (87.5%) and minimum edible portion was obtained from control (70.0%).

#### **Survey and monitoring on fusarium wilt (panama) and sigatoka disease of banana in Narsingdi region**

M. H. Rahman, S. M. M. Rahman, A. K. M. M. Rahman and R. Akter

The survey was conducted major banana growing areas at Shibpur upazila of Narsingdi District in Bangladesh. The six areas were Chokoria, Machimpur, Gorbari, Manikdi doripara, Simulia and Lakpur villages at Dulalpur upazila under the districts of Narsingdi. Major diseases of banana were Fusarium wilt (Panama), Sigaoka and leaves burning around edges. The highest Fusarium wilt disease incidence of 48.3% was found in Gera kola variety of Chokoria village. The highest sigatoka disease incidence of 86.6% was recorded in Sabri and Chapa kola in Manikdi doripara.

#### **Development of bio-rational management package(s) for fusarium wilt and sigatoka diseases of banana**

M. H. Rahman, S. M. M. Rahman, A. K. M. M. Rahman and R. Akter

The experiment was conducted at Regional Horticulture Research Station, Bangladesh Agricultural Research Institute, Shibpur, Narsingdi. The study was aimed to find out the effective management package against fusarium wilt and sigatoka disease of banana. Three treatments combinations and farmer's practices were compared. No Fusarium wilt was found in the tested treatments. In case of sigatoka, the highest disease severity of 7.33% was recorded in T<sub>3</sub> (Farmers practices) plants at 240 days after planting and the lowest was in T<sub>1</sub> (BARI Tricho-compost + Sucker treatment with Dynamic + foliar spray with Dynamic) treated plants.

#### **Effect of foliar spray of gibberellic acid on yield and quality of guava in off- season**

M. T. Islam, B. C. Sarker, A. S. M. M. Uddin and M. Islam

An experiment was carried out at the Fruit Research Farm of Horticulture Research Centre, BARI, Gazipur. BARI Peyara-2 was used in the study as variety. The experiment was laid out in a randomized complete block design with 3 replications. There were five levels of gibberellic acid doses as T<sub>1</sub>: Control (0 ppm), T<sub>2</sub>: 25 ppm, T<sub>3</sub>: 50 ppm, T<sub>4</sub>: 75 ppm, T<sub>5</sub>: 100 ppm and two times of spraying as I<sub>1</sub>: first spray at pea stage and I<sub>2</sub>: second spray at one month after first spray (pea stage) were considered as treatments. The results revealed that the highest fruit yield (26.08 kg plant<sup>-1</sup>) of guava was recorded with the combination of GA<sub>3</sub> 100 ppm and second spray at one month after first spray (pea stage) (T<sub>5</sub>I<sub>2</sub>) treatment and the least yield (11.81 kg plant<sup>-1</sup>) was recorded from T<sub>1</sub>I<sub>1</sub> (Control or GA<sub>3</sub> 0 ppm and first spray at pea stage) treatment combination.

#### **Growth, yield and quality of ber as influenced by irrigation**

A. Akter, M. A. Hossain, H. Rahman, R. Sultana and H. E. M. K. Mazed

The study was carried out at Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur. The treatments were: Irrigation time I<sub>1</sub>:



Irrigation at fruit set stage (November to December), I<sub>2</sub>: Irrigation at fruit development stage (January to February), I<sub>3</sub>: Irrigation at fruit set stage to harvesting stage (November to February) and I<sub>4</sub>: Control (No irrigation). In terms yield contributing characters and yield of BARI Kul-2, maximum individual fruit weight (31.60g) was obtained from I<sub>3</sub> and minimum (21.63g) was found from no irrigation treatment (I<sub>4</sub>). Maximum yield per plant (123 kg), percent edible portion (94.29) and percent dry matter (14.87) was obtained from I<sub>3</sub> treatment and minimum yield per plant (76.67 kg), percent edible portion (90.77) and percent dry matter (10.50) was found from no irrigation treatment (I<sub>4</sub>).

#### **Evaluation of organic fertilizers for safe lemon (*Citrus limon* (L.) production**

M. H. M. B. Bhuyan, F. Ahmed, J. C. Sarker, and S. M. L. Rahman

The experiment was conducted at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a Randomized Complete block design (RCBD) with six treatments, each replicated three times. The treatments include T<sub>1</sub>: Native nutrients (soil without manures and fertilizers), T<sub>2</sub>: Farmers practice (RDF according to FRG from manure and chemical fertilizers), T<sub>3</sub>: Farmyard manure (30 kg tree<sup>-1</sup> year<sup>-1</sup>), T<sub>4</sub>: Vermicompost (15 kg tree<sup>-1</sup> year<sup>-1</sup>), T<sub>5</sub>: Poultry manure (18 kg tree<sup>-1</sup> year<sup>-1</sup>), T<sub>6</sub>: Mustard oil cake (10 kg tree<sup>-1</sup> year<sup>-1</sup>). From the experiment it was found that T<sub>2</sub> (farmers' practice) performed best compared to the organic treatments, the organic treatments are very closer to the farmers' practice. Among the organic treatments, T<sub>4</sub> (Vermicompost) performed best-regarding growth, yield contributing characters, yield and fruit quality attributes of BARI Lebu-5.

#### **Controlling disease and pest for safe lemon (*Citrus limon* (L.) osbeck Cv. BARI Lebu-5) production for enhancing the export potentiality**

M. H. M. B. Bhuyan, F. Ahmed, J. C. Sarker and S. M. L. Rahman

The experiment was conducted on six year old BARI Lebu-5 orchard planted in 3×3m spacing during the year 2016 at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a Randomized Complete block design (RCBD) with five treatments, each replicated thrice. The total number of plant units subjected to the study was fifteen (15). The treatments include

T<sub>1</sub>: Control (Spraying only water), T<sub>2</sub>: Farmers practice (Spraying chemical pesticides), T<sub>3</sub>: Mahogany seed extract +Garlic extract (spray), T<sub>4</sub>: Neem oil+Garlic extract (spray), T<sub>5</sub>: Mahogany seed extract+Neem oil+Garlic extract (spray). The results illustrated that there were significant differences among the treatments. But among the organic treatments, T<sub>5</sub> performed better regarding all the parameters especially individual fruit weight (200.4 g) and marketable yield (23.30 t ha<sup>-1</sup>).

#### **Evaluating beneficial microorganisms for safe and quality lemon (*Citrus limon* (L.) osbeck Cv. BARI Lebu-5) production**

M. H. M. B. Bhuyan, F. Ahmed, J. C. Sarker, and S. M. L. Rahman

The experiment was conducted at Citrus Research Station, BARI, Jaintapur, Sylhet. The experiment was laid out in a Randomized Complete block design (RCBD) with four treatments, each replicated three times. The treatments include T<sub>1</sub>: Control (water spray), T<sub>2</sub>: Spray of effective microorganism, T<sub>3</sub>: Soil application of *Bacillus* sp., T<sub>4</sub>: Spray of Clybio (Japanese formulation). The results illustrated significant differences among the treatments. A maximum increment in plant height was found from T<sub>3</sub> (15.5%), highest increment in base girth and canopy spreading was found from T<sub>4</sub> (4.0% and 8.5×8.8 % respectively). On the other hand maximum yield plant<sup>-1</sup>, and yield ha<sup>-1</sup> were found from T<sub>2</sub> (22.90 kg and 25.44 t ha<sup>-1</sup> respectively) followed by T<sub>3</sub> (22.68 kg and 25.20 t ha<sup>-1</sup> respectively).

#### **Integrated approaches to mitigate die-back disease of citrus**

M. H. M. B. Bhuyan, J. C. Sarker, F. Ahmed and S. M. L. Rahman

The experiment was conducted at citrus research station, BARI, Jaintapur, Sylhet on BARI Malta-1. Most of the plants in this orchard were infected by die-back disease. The experiment comprises 5 treatments with 8 replications. There were variations among the treatments regarding plant height, base girth, spreading, number of fruits per plant and the overall growth condition of the fruits. The results showed that T<sub>3</sub> was superior with highest plant height(1.2 m), base girth (0.015 m), largest canopy T<sub>3</sub> (1.2×1.3 m) and maximum number of fruits per plant (18), whereas T<sub>1</sub> performed worst. Growth condition of the plants

received T<sub>1</sub> was not satisfactory, while the rest of the plants are in satisfactory growth condition.

#### **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 was performed at the fruit research farm of Horticulture Research Centre, BARI, Gazipur. Four treatments were considered in the study with different levels of fertilizer as T<sub>1</sub>: control or farmer's practice, T<sub>2</sub>: 100 % of 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), T<sub>3</sub>: 125 % of 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 T<sub>4</sub>: 150 % of 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). The results revealed that the highest fruit yield (70.70 kg plant<sup>-1</sup>) due to the highest individual fruit weight (58.67 g) and maximum number of fruits per plant (1205) was found in the treatment T<sub>4</sub> (150 % of recommended fertilizer dose per plant) and the least fruit yield was observed in T<sub>1</sub> (control or farmer's practice) (56.15 kg plant<sup>-1</sup>). The highest increase in terms of all the growth parameters of BARI Jamrul-3 over control was noted from the treatment T<sub>4</sub> (150 % Recommended fertilizer dose per plant).

#### **Effect of stem pruning on the growth and yield of dragon fruit**

A. Akter, M. A. Hossain, H. Rahman, R. Sultana and H. E. M. K. Mazed

The study was carried out at Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur to study the effect of stem pruning on the growth and yield of dragon fruit. The treatments were: T<sub>1</sub>: Only Mother stem allowed up to trellis; T<sub>2</sub>: Two stems allowed up to trellis (with mother stem); T<sub>3</sub>: Three stems allowed up to trellis (with mother stem); T<sub>4</sub>: Four stems allowed up to trellis (with mother stem); T<sub>5</sub>: Five stems allowed up to trellis (with mother stem) and T<sub>6</sub>: Control (no pruning). 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 (246 g, 248 g and 241 g, respectively). Maximum yield per plant (3.86 kg) was found from only mother stem allowed up to trellis (T<sub>1</sub>) and minimum yield (1.33 kg) was found from control (T<sub>6</sub>). Maximum edible portion (64.51 %) was found from four stems allowed up to trellis (with mother stem).

#### **Integrated nutrient management for increasing the yield of BARI Dragonfol-1 in Sylhet region**

M. Samsuzzaman, M. A. M. Miah and M. H. Hossain

A study was carried out at Regional Agricultural Research Station, Akbarpur, Moulvibazar with four different fertilizer packages. No significant variation was observed in plant height, canopy spread, fruit length, fruit breadth, peel weight and TSS among the treatments. Highest harvest duration days observed in treatments T<sub>2</sub> (154) and lowest duration were in T<sub>3</sub> (94.3). Number of fruits per plants were higher in T<sub>2</sub> (24.3) and the lower one is T<sub>4</sub> (14.3). Higher individual fruit weight was obtained from T<sub>1</sub> (285.5 g) and the lower one is T<sub>2</sub> (235.2 g) only. Rind weight observed higher in T<sub>1</sub> (206.9 g) and the lower one is T<sub>2</sub> (155.9 g). Percent of edible portion were higher in T<sub>3</sub> (73.49 %), where the lower one is T<sub>2</sub> (64.3 %) only. The higher fruit yield/plant were recorded from T<sub>2</sub> (4.5 kg) followed by T<sub>4</sub> (2.6 kg), respectively.

#### **Methods of pollination for increasing the yield and quality of dragon fruit production in Bangladesh**

M. Samsuzzaman, M. J. Hussain and M. H. Hossain

A study was carried out at Regional Agricultural Research Station, Akbarpur, Moulvibazar, with four methods of pollination. No significant variation was found in plant height, canopy spread (m), harvest duration (days), fruit length (cm), fruit breadth (cm), peel weight (g) and TSS (%) within the treatments. But, variation was observed in number of fruits/plant, individual fruit weight (g), fruit length (cm), fruit breadth (cm), rind weight (g), fertilization success (%) and yield/4plant (kg). Highest number of fruits/4plants were in recorded T<sub>4</sub> (18) treatment and higher individual fruit weight was also obtained from T<sub>4</sub> (410.5 g). Highest fruit length (cm) and breadth (cm) was observed in T<sub>4</sub> (9.8 and 8.5). Higher peel weight was found in T<sub>4</sub> (78.8 g) and T<sub>3</sub> (76.6 g) and the lowest one was in

T<sub>2</sub> (68.6 g) and T<sub>1</sub> (60.2 g). Fertilization success were higher in treatment T<sub>4</sub> (90 %) followed by T<sub>2</sub>, T<sub>3</sub> (75 %) and T<sub>1</sub> (70 %). Higher edible portion was observed in T<sub>4</sub> (80.1 %) followed by T<sub>1</sub> (75 %), T<sub>3</sub> (72.2 %) and T<sub>2</sub> (72 %). The higher fruit yield/plant were recorded from T<sub>4</sub> (7.4 kg) followed by T<sub>3</sub> (4.1 kg), T<sub>2</sub> (3.7 kg), T<sub>1</sub> (3.3 kg).

#### **Effect of gibberellic acid (GA<sub>3</sub>) on seedlessness of rambutan (*Nephelium lappaceum*, Linn.)**

A. S. M. M. Uddin, M. T. Islam and B. C. Sarker

A study was performed at the nursery near Horticulture Research Centre, Gazipur to know the effect of GA<sub>3</sub> on seedlessness of rambutan. GA<sub>3</sub> were applied at full bloom stage. Seven concentration of gibberellic acid i.e T<sub>1</sub>: 0 ppm (control), T<sub>2</sub>: 50 ppm, T<sub>3</sub>: 100 ppm, T<sub>4</sub>: 200 ppm, T<sub>5</sub>: 300 ppm, T<sub>6</sub>: 400 ppm and T<sub>7</sub>: 500 ppm were used as treatments. Harvested fruit shape was oval, skin colour was red and surface texture was hairy and smooth. Pulp and albedo colour was off-white and the texture of pulp was observed soft. Variation was observed with respect to fruit weight, fruit length, breadth, pulp and seed weight among the treatments. The maximum individual weight of fruit was noted from T<sub>5</sub> (54.13g), whereas the minimum fruit weight was noted in T<sub>1</sub> (39.80g). The largest fruit was observed in T<sub>5</sub> (5.10 x 4.57cm) and the smallest fruit was noted in T<sub>1</sub> (4.70 x 3.93cm). Pulp weight varied from 19.50g. to 31.03g which was obtained from the treatments T<sub>1</sub> and T<sub>5</sub> respectively. Seed weight was recorded higher in T<sub>1</sub> (3.20g) and lower in T<sub>4</sub> (2.47g) which decreased 22.81% over the control. Total soluble solids were recorded maximum in T<sub>5</sub> (19.00) and minimum total soluble solids was recorded in T<sub>1</sub> (16.40). Highest increasing percent of edible portion was noted from T<sub>5</sub> (16.79%) and the lowest was in T<sub>2</sub> (8.42%) over control.

#### **Effect of pruning on growth, yield and quality of coffee**

M. A. A. Malek, M. R. Ahmad and M. A. Hossain

The experiment was carried out at the existing plantation of Hill Agricultural Research Station at Khagrachari to find out the pruning method for maintaining tree size and impact of pruning on yield and quality of coffee. *Coffea canephora* (syn. *Coffea robusta*) commonly known as robusta coffee from the existing coffee orchard of HARS, Khagrachari was selected for the

study. All treatments produced higher yield than control treatments. Maximum yield was found in P<sub>3</sub> (9.14 kg/plant) followed by P<sub>5</sub> (8.86 kg/plant). On the other hand, control treatments produced lowest amount of coffee per plant. All treatments showed higher yield than control treatment. Yield increased maximum 49.7% found in P<sub>3</sub> treatment over control. In a nutshell the present finding shows that pruning increase yield potentiality of old coffee orchard.

### **Project IV: Physiological Studies**

#### **Incidence of spongy tissue in BARI Aam-3**

R. Khatoon, M. Moniruzzaman, M. S. Uddin and B. C. Sarker

A study was conducted to determine the incidence of spongy tissue formation in BARI Aam-3 from June to September 2023. The spongy tissue was visible only when the ripe fruit was cut into two halves. At the 1<sup>st</sup> harvest during the last week of June, the maximum percentage of spongy tissue (4.17%) was found in the fruits collected from Plant-1, Plant-2, Plant-3, Sample-4, and Sample-5. In spongy fruit, the TSS% was found the lowest (16.5% in affected fruit and 13.5% in affected portion) compared to healthy fruit (20.67%). At the 3<sup>rd</sup> harvest during the 2<sup>nd</sup> week of July, the maximum spongy tissue percentage (29.16% from both sides of stones, 8.33% from one side of the stone) was found from Plant-3. The minimum TSS% of 16.5% and 13.0% was obtained from Sample-6 and Sample-8, respectively.

### **Project V: Urban Horticulture**

#### **Effect of different growing media for dragon fruit production on the roof**

M. Islam, A. Anwari, T. Islam and B. C. Sarker

The experiment was carried out on the rooftop of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experiment had been divided into two sets. In set-1, the tallest plant was found in treatment T<sub>1</sub> (282.0 cm). In case of number of fruits/pillar as well as yield kg/pillar, the treatment T<sub>4</sub> exhibited the highest result by 13.67 and 3.83 kg/pillar respectively. In set-2, number of



branches/pillar, canopy spread both N-S and E-W, the highest results (22.33, 161.7 cm and 155 cm respectively) were observed in T<sub>1</sub> treatment. Treatment T<sub>1</sub> also produced the maximum no of fruits/pillar (24.67) and also the highest yield (9.39kg/pillar).

#### **Evaluation of strawberry production in different growing methods on the roof**

M. Islam, A. Anwari, T. Islam and B. C. Sarker

An experiment was conducted on the rooftop of Horticulture Research Centre, BARI, Joydebpur, Gazipur. There were four treatments in the experiment viz; T<sub>1</sub> (Column system), T<sub>2</sub> (Vertical wall mount system), T<sub>3</sub> (Horizontal bed system) and T<sub>4</sub> (Pot culture). The results revealed that most of the growth and yield parameters were significantly varied among the treatments. The tallest plant was noticed in the treatment T<sub>3</sub> (12.25 cm). The highest no. of fruits/plant (17.00) was harvested from the treatment T<sub>3</sub> followed by T<sub>4</sub> (13.35). Likewise, the heaviest fruit (23.88 g), the highest yield g/plant (405.96 g/plant) and also the highest TSS (7.3%) were obtained from the treatment T<sub>3</sub>. Considering all the growth and yield characteristics, horizontal bed system could be the best option for strawberry production on the roof.

### **Project VI: Adaptive Trial**

#### **Performances of BARI developed jackfruit varieties**

M. J. Rahman and M. A. Islam

To evaluate the performances of grafted saplings of BARI Kanthal-1, Kanthal-2 and Kanthal-3, orchards were established in two research stations of BARI and in the farmer's field of four districts of Bangladesh e.g., Gazipur, Khagrachari, Narshingdi and Mymensingh. Mother orchards were established in one district (Gazipur); in the year 2019, 2 districts (Khagrachari and Narshingdi) in the year 2020-21, one district (Mymensingh) was taken for orchard establishment at the farmer's level. In each district, 150 saplings of each variety of jackfruit were planted in 30 farmers in a village and its nearest places. Five orchards were taken to evaluate the fruit yield and yield characters during 2022-23. From the fruiting season of 2022, grafted plants of BARI Kanthal-2 started to produce fruits.

This year, all the varieties were found to produce fruit.

#### **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 best adaption in Narshingdi region at the research field of Regional Horticulture Research Station, BARI, Shibpur, Narshingdi 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 (4.76 m), base girth (0.29m), canopy spreading (3.54 × 3.53 m<sup>2</sup>) were noted from the BARI Lebu-5. Maximum yield (17.77 t/ha) was obtained from BARI Lebu-5. On the other hand, minimum yield (9.11t/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 the variety. Fruit size was the highest in BARI Lebu-5 (13.53 × 7.81 cm<sup>2</sup>) followed by Local (12.08 × 6.12 cm<sup>2</sup>). The highest edible portion (73 %) and TSS (8.00 %) was noticed in BARI Lebu-5.

### **Project VII: Soil and Water Management**

#### **Effect of foliar application of boron on growth, yield and quality of dragon fruit (*hylocereus costaricensis*)**

M. A. Rahman, M. A. Quddus, M. J. Hossain and B. C. Sarker

The study was initiated at the research field of Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur. There were five levels of boron (0, 0.1, 0.2, 0.3 and 0.4% B) from boric acid applied as foliar at four months interval starting from six-month age of the plants. Each treatment was replicated thrice following randomized complete block design. The treatments of 0.3 and 0.4% B application gave equally better result in respect to vegetative growth and number of fruits/plant. Highest yield was recorded from 0.3% B application attributed to bigger fruit size. B application @ 0.3% is preferable under experimental soil condition.

## Project VIII: Disease Management

### Efficacy of chemical, biological and cultural approach on management of foliar and fruit rot disease in strawberry

M. M. Rahman, L. Yasmin and M. Afroz

The experiment was conducted in the Plant Pathology Section, HRC, BARI, and Gazipur to observe the performance of different treatments for the management of foliar and fruit rot diseases on strawberry. There were seven treatments, such as: i) Propiconazole 5EC (0.05%) ii) Carbendazim fungicide (0.2%); iii) Mencozeb 75 WP (0.2%) iv. Neem oil. (18) v. Iprodione @ 0.2% at a 15-day interval; vi. Plastic mulch + soil drenching with carbendazim vii. Untreated control There were no significant differences among the treatments in reducing disease incidence, seedling mortality, or yield in the field. However, the lowest disease incidence was found in the propiconazole (0.05%) treatment compared to the control. The treatment with propiconazole (0.05%) gave the highest yield compared to the control. Moreover, hexaconazole (0.2%), copper oxycloeride (0.2%), and *Bacillus subtilis* 38 were able to suppress the mycelium growth of the pathogen.

## Project IX: Insect-pest Management

### Development of integrated management package against red banded mango caterpillar

M. S. Hossain, A. Mohammad, M. M. Rahman, A. S. M. Y. Ali and M. I. Islam

A field experiment was conducted at Fruit Farm, Pomology Division, HRC, BARI, Gazipur to find out effective control measures against the red-banded mango caterpillar following a randomized complete block design (RCBD) with three replications. Two mango varieties (Fazli and BARI Aam-4) and seven IPM packages were evaluated in the experiment, viz. P<sub>1</sub>=Sanitation+ application of soil recharge @ 5g/litre of water, P<sub>2</sub>=Sanitation+ application of soil recharge @ 5g/litre of water + Bioclean (D-lemonene) @ 1ml/litre of water, P<sub>3</sub>=Sanitation+ application of soil recharge @ 5g/litre of water + spraying of Matrion (Biotrine 0.5%) @ 1.4ml/litre of water, P<sub>4</sub>=Sanitation + application of soil recharge @ 5g/litre of water + spraying of Banglade (Success 2.5EC) @

1.2ml/litre of water, P<sub>5</sub>=Sanitation + application of soil recharge @ 5g/litre of water + spraying of Fenitrothion (Sumithion 50 EC) @ 2ml/litre of water, P<sub>6</sub>=Sanitation + application of soil recharge @ 5g/litre of water+ Spraying of Decis 2.5 EC (Deltamethrin) 1ml/liter of water, P<sub>7</sub>=Untreated control. Among IPM packages, package 4 (sanitation + application of soil recharge at 5 g/liter of water + spraying of Banglade (Success 2.5 EC) at 1.2 ml/liter of water) performed best in reducing infestation, increasing marketable yield, and providing economic benefit.

### Survey and monitoring of insect pests of cashew nut and coffee in Bangladesh

M. S. Hossain, A. Mohammad, A. Hossain, S. Chakma, M. S. Hossain and S. N. Trisha

A field survey was conducted at RARS Akbarpur, RARS Hathazari, and HARS Raikhal research fields to document the major and minor insect pests of cashew and coffee. Five types of insect pests, namely the tea mosquito bug (TMB), Chafer beetle, Tussok moth, spiraling whitefly, and mealybug, were found to attack cashew nut and chafer beetles, coffee stem borer, scale, and mealybug, which were observed in coffee plants during the study period. Among them, the tea mosquito bug (TMB) caused major damage to cashew and chafer beetles, and the mealybug caused major damage to coffee plants.

### Survey and monitoring of insect pests of rooftop garden

A. Mohammad, M. S. Hossain and M. I. Islam

The survey was carried out at the roof garden of the Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur. Guava, mango, lemon, pumelo, dragon fruit, etc. were the available crops at the HRC roof garden, where insect/leaf and percent leaf infestation data were collected from visual observation. It was observed that mealybugs and spiraling whiteflies were found in guava, mango, lemon, and pumelo plants, where mealybug populations were higher than spiraling whitefly populations. Leaf miner infestations were observed in lemon and pumelo. The percentage leaf infestation rate was higher in lemon compared to pumelo. Mealybugs and leaf miners were low in the winter, and after that, their populations and infestations increased.

### **Development of bio-rational management of guava mealybug and spiraling whitefly at rooftop garden**

A. Mohammad, M.S. Hossain and M. I. Islam

The experiment was carried out on the rooftop garden of the Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, to develop an eco-friendly, sustainable, and bio-rational management approach against guava mealybug and spiraling whitefly. The experiment was laid out in an RCB design with three replications. There were five treatments: T<sub>1</sub>: hand removal of heavily infested leaves + spraying of soapy water, T<sub>2</sub>: hand removal of heavily infested leaves + spraying of potassium salt of fatty acid (Fytoclean) @ 10 ml/liter of water, T<sub>3</sub>: hand removal of heavily infested leaves + spraying of D-lemonene (Bioclean) @ 1ml/litre of water, T<sub>4</sub>: farmer's practice, spraying of imidacloprid (Imitaf) @ 0.5 ml/liter of water; and T<sub>5</sub>: untreated control. Results revealed that treatment T<sub>3</sub> (hand removal of heavily infested leaves + spraying of D-lemonene) and treatment T<sub>2</sub> (hand removal of heavily infested leaves+ spraying of potassium salt of fatty acid) both perform the best to control mealy bugs and spiraling whiteflies at the rooftop garden's guava plant.

## **Project X: Postharvest Management**

### **Effect of preservatives and drying condition in retaining food quality of mango slice**

M.S. Arfin, M.N. Islam, M. F. B. Hossain and Z.H. Fahad

The experiment was conducted at the laboratory of Postharvest Technology Section, HRC, BARI, Gazipur to investigate the effectiveness of different preservatives such as citric acid, potassium meta bi sulphate (KMS), calcium chloride, table salt and ascorbic acid in the retention of semi solid 'harivanga' mango slice quality prepared through 50, 60 and 70% drying. Findings of the present study revealed that preservatives had positive effect on drying of mango slice 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 was higher in control and ascorbic acid treated slices and lower in citric acid and KMS treated slices after 12 month of storage. The

maximum colour change was observed in control treatment (L\* 54.0, a\* 12.87, b\*54.12) and minimum in citric acid and KMS treated slices (L\* 66.34, a\* 5.42 b\* 69.34). Vitamin C decreased with the drying condition and storage time. Control treatment showed the lowest value of vitamin C content 5.71 and 4.71 mg/100g at 60 and 70% drying respectively after 12 months of storage. Furthermore, citric acid and KMS retained the change of vitamin C content and that was 9.87 and 9.60 mg/100g in 60% drying and 6.96 and 7.28 mg/100g respectively in 70% drying condition. Considering all these, citric acid and KMS were found effective for retaining food quality of mango slice at drying condition. However, more research is needed with other varieties to generate additional information and further confirmation of the results.

### **Standardization of ethephon dose for uniform and safe ripening of banana using low-cost ethylene generator**

M.S. Arfin, M.N. Islam, M. F. B. Hossain and M.A. 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 of banana. Bananas (cv. Sobri) were harvested at matured green stage and exposed to ethylene gas generated from ethephon (48 SL) by low-cost simple 'Ethylene Generator' with concentrations of 20, 30 and 40 ppm at ambient storage (27±1 °C and 70±5% RH) for 24 hours. All three concentrations of ethephon found effective in uniform ripening of banana. However, the values of lightness (L\* 72.3), greenness (a\* 6.5), yellowness (b\* 2.1) and fruit firmness of 0.6 kgf were found acceptable in fruits treated with 20 ppm ethephon on day 3 of storage. Therefore, 20 ppm, the lowest dose of ethephon used through low-cost ethylene generator may offers an effective method of safe and uniform bulk ripening of banana.

### **Selection of suitable cutting size and cultivar for semi solid dry mango slice**

M.S. Arfin, M.N. Islam and M. F. B. Hossain

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 mango slice drying at 70 and 80%. Full ripe mangoes cv. Langra were procured from the local market. Mangoes were washed with aqueous solution of 200 ppm sodium hypochlorite. Fruits were peeled carefully by prewashed stainless-steel knife and cut into desired pieces and kept in prewashed stainless-steel trays and subjected into the two drying conditions. Findings of the present study revealed that cutting size had positive effect on drying of mango slices. Lightness decreased, redness and yellowness increased after 70% and 80% drying in all treatments. Colour change was the highest in 4 slices per mango and the lowest in cubes in case of 70% drying. In 80% drying the change was the highest in 4 slices per mango and the lowest in 2 slices per mango. 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.

#### **Survey on postharvest practices and losses in pineapple value chains**

M. N. Islam, Z. H. Fahad, M. S. Arfin and M. A. Rahman

A study was conducted to accumulate the scenario of existed postharvest practices and assess postharvest losses in the value chain of pineapple. Value chain actors were interviewed using with pretested questionnaires. The actors were selected in three intensive growing areas in Moulvibazar, Rangamati and Tangail districts and three city areas of Chattogram, Dhaka and Gazipur. Postharvest practices were found as stacking the fruits one by one, sorting, grading, trimming of partial crown and bulk transportation through truck to distant market. Postharvest losses were reported as 3.68%, 9.98%, 9.07% and 6.65% at grower, beary, arathdar and retailer level, calculated total postharvest loss of pineapple was 29.38%.

#### **Project XI: Socio-economic Studies**

##### **Adoption and profitability of BARI Dragonphol-1 at farm level in the Chattogram hill tracts of Bangladesh**

R. Islam, S.M.A. Shiblee and E. Jahan

The study was proposed to gain an in-depth understanding on the adoption and profitability of BARI Dragonfol-1 at farm level in the Bandarban,

Khagrachari and Rangamati districts of Chattogram hill tracts of Bangladesh. A total of 85 Dragon farmers were selected by taking 30 farmers from Khagrachari and Rangamati and 25 farmers for Bandarban. 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 dragonfol-1 as their high value crop. BARI dragonfol-1 as considering a new variety of fruit, it is mostly cultivated in the study areas. Farmers' consciousness about BARI dragonfol-1 cultivation was found increasing. Gross margin per hectare were Tk. 2279124, Tk. 3300268 and Tk. 2440000 for Rangamati, Khagrachari and Bandarban areas respectively on cash cost basis. Per hectare net return from dragon cultivation were Tk. 2229524, Tk. 3245268 and Tk. 1642407 for Rangamati, Khagrachari and Bandarban areas respectively. Major reasons for dragon cultivation were higher yield, regular fruit bearing, high demand and better price due to attractive colour and size. The dragon farmers facing problems for adopting like shortage of quality sapling, 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 cultivation.

#### **Project XII: Agroforestry**

##### **Intercropping of pineapple with citrus**

F. Ahmed, M. H. M. B. Bhuyan, J. C. Sarker and S. M. L. Rahman

Intercropping of pineapple has significant effect on citrus tree. BARI Lebu-5 recorded maximum plant canopy (291.67 cm × 306.67 cm) when intercropping with pineapple. On the other hand, mandarin intercropping with pineapple recorded lowest plant canopy (92.67 cm × 84.33 cm). Pineapple intercropping with BARI Lebu-5 recorded the tallest plants (72.00 cm) but pineapple intercropping with seedless lemon recorded the shortest plants (67.80 cm). The number of leaves plant<sup>-1</sup> was found maximum (23.80) at pineapple intercropping with seedless lemon while the lowest number of leaves plant<sup>-1</sup> (17.40) was noted at pineapple intercropping with BARI Lebu-5. Pineapple intercropping with BARI Lebu-5 recorded the longest leaves (63.40 cm) but

pineapple intercropping with mandarin recorded the shortest leaves (59.20 cm).

#### **Year-round crops production under agroforestry system in the hill slope**

M. A. A. Malek, B. C. Sarker, M. Islam and M. A. Hossain

The experiment was carried out at hill agricultural research station Khagrachari hill districts to scale up farm productivity throughout the year and farmer's income under fruit based agro forestry. Different high value vegetables crops such as Cabbage, Cauliflower, Radish, Broccoli, Amaranth and Red amaranth were selected for growing with mango orchard for year-round vegetables production technology. All treatments showed the highest fruit equivalent yield (t/ha) than sole mango.

### **Project XIII: Maintenance and Conservation of Fruit Germplasm**

#### **Maintenance of different germplasm at HRC, RARS, Jamalpur**

M. A. Hossain, H. Rahman, A. Akter, R. Sultana and H. E. M. K. Mazed

HRC, RARS, Jamalpur is maintaining 3047germplasm of 56 different crops both indigenous and exotic in the field gene bank. The fruit germplasm are mango, litchi, banana, guava, jackfruit, jujube, aonla, bael, bilimbi, coconut, bullock's heart, rose, cactus, orchid, lily, etc. The vegetable germplasm is drumstick. The exotic germplasm are avocado, pear, sweet tamarind, Coffee, Cashew nut, dragon fruit and tisa etc. The intercultural practices were done as and when necessary.

#### **Enrichment and maintenance of fruit tree repository**

M. Islam, M. Ratna, E. Mahmud, N. Akter, S. Yesmin and M. I. A. Howlader

Regional Horticultural Research Station (RHRS), Lebukhali, Patuakhali is maintaining 921germplasm of 45 different crops both indigenous and exotic in the field gene bank. The fruit germplasm are mango, litchi, banana, guava, jackfruit, jujube, aonla, bael, bilimbi, coconut, bullock's heart etc. The exotic germplasm are avocado, longan, sweet tamarind, Coffee, dragon

fruit and egg fruit etc. The intercultural practices were done as and when necessary.

### **RARS Jashore**

#### **Inter-varietal hybridization of mango**

MA Alam, MR Alam and KU Ahammad

A hybridization programme on mango was undertaken in the flowering season of 2023 at HRC, RARS, Jashore. A total of 384 flowers from 72 panicles were emasculated whereas 374 flowers were pollinated comprising two sets- set-I is for ripe mangoes and set-II is for kanchamitha mangoes. Four fruits from different crosses were harvested. Among them, three fruits are derived from BARI Aam-3 × BARI Aam-7 and one fruit is derived from BARI Aam-9 x Banana. The stones of the fruits were sown in soil where 3 were germinated. The plants are now growing up. The emerged and grown up hybrid mango plants will be evaluated in the following seasons for their performance and may be released as a variety(s) according to their yield and quality as they are desired.

#### **Improvement of local mango cultivars**

MA Alam, MR Alam and KU Ahammad

Germplasm were collected from different places of Jashore region. Fruit weight was maximum in MI Jas 015 (756 g) followed by MI Jas 014 (511 g). The highest edible portion was got in MI Jas 010 (81%). Maximum TSS was recorded in MI Jas 014 (23.0%). Number of fruits per tree was found maximum in MI Jas 010 (12 nos.) followed by MI Jas 017 (9) and (8). The highest yield (3.08 kg) was noted in MI Jas 011 followed by MI Jas 010 and MI Jas 015 (3.024 and 2.268 kg, respectively). The biggest sized fruit was found in MI Jas 015. The highest shelf life (5.67 days) was shown by MI Jas 010, MI Jas 012, MI Jas 017 and MI Jas 018. Among the germplasm, MI Jas 010, MI Jas 014, MI Jas 017 and MI Jas 018 found better.

#### **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 Regional Agricultural Research Station, Jashore during 2022. The heaviest fruit (2850 g) was found in CG Jas-025 whereas the highest edible portion (63.8%) was got in CG Jas-004. 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). Excellent eating quality was found 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.

### **Collection and evaluation of bullock's heart genotypes**

M.A. Alam, M.R. Alam and K.U. Ahammad

A study was carried out at RARS, Jashore to find out the superior genotypes of bullock's heart (*Annona reticulata* L). The heaviest fruit (555.0 g) was recorded in AR Jas-013 followed by AR Jas-12 (542.3 g). The highest pulp weight (436.0 g as well as the highest edible portion (78.6%) was observed in AR Jas-013. The longest (10.3 cm) fruit was obtained from AR Jas-013 whereas the broadest (10.6 cm) fruit was obtained from AR Jas-012. The highest TSS (27.5%) was recorded in AR Jas-013. The highest number of fruits per plant (122.0) as well as the highest yield per plant (50.26 kg) was found in ARJas-007. AR Jas-016 was harvested in first week of July. All the genotypes have excellent eating quality.



# FLOWER CROPS

07

## **Collection, evaluation and maintenance of gladiolus**

M. M. R. Bhuyin, F. N. Khan, A. Naznin, K. Ambia and M. T. Rashid

A study was conducted at Floriculture Farm, Horticulture Research Centre, BARI, Joydebpur, Gazipur during the period from November 2022 to May 2023 for evaluation of ten gladiolus lines. 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.

## **Collection and evaluation of tuberose (*polianthes tuberosa* L.) Genotypes**

M. M. R. Bhuyin, F. N. Khan, K. Ambia, A. Naznin and M. T. Rashid

Six tuberose genotypes with BARI Tuberose-1 as check variety were evaluated at the Floriculture Research Field of HRC, BARI, Gazipur during 2022- 2023. 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 (2,70,000 sticks) were recorded in TR-003. The heaviest (32.23 g) and the largest bulbs (3.49 cm) were recorded by TR-001. BARI Tuberose-1 remained fresh for the longest time (14.75days) in the field and also in the vase (7.12

days). The highest percentage of florets (68.83%) was opened in the vase by the genotype TR-004.

## **Collection, evaluation, characterization and maintenance of lilium**

K. Ambia, F.N. Khan, M. R. Islam and M.T. Rashid

Twenty seven genotypes of lilium including BARI Lilium-1 and BARI Lilium-2 were evaluated under lilium shade at floriculture Division, Horticulture Research Centre, BARI during 2022-23. The longest stalk was recorded in Lil-034 (92.5cm). The maximum number of florets per stalk (11.0) was produced by BARI Lilium-1. Maximum vase life was observed in BARI Lilium-2 (11.0 days).

## **Collection and evaluation of chrysanthemum genotypes**

K. Ambia, A. Naznin, M.M.R. Bhuyin, M. T. Rashid and F.N. Khan

Eleven chrysanthemum genotypes with BARI Chrysanthemum-1 and BARI Chrysanthemum-3 as check were evaluated at the Floriculture field of Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur during winter season of 2022-23. There were variation among the genotype in respect of plant height (20.0-45.0 cm), number of flowers per plant (22.0-92.0), diameter of flower (3.6-6.5 cm), stalk length (11.0-25.0cm) and vase life of flowers (7.0-13.0 days). Among the genotypes, CM-005 was found superior for cut flower production.

## **Collection and maintenance of cactus and succulents**

K. Ambia, F.N. Khan, N. T. Hasan

Thirty cactus and twenty-three genotype of succulents were collected and maintained at Floriculture Field of HRC, BARI, Gazipur. Wide variation in respect of vegetative and floral traits

was observed. Succulent genotypes also showed wide variation in different growth characters.

#### **Collection, 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.

#### **Collection, evaluation and maintenance of heliconia**

A. Naznin, K. Ambia, F. N. Khan and M. T. Rashid

A study on the performance of seven heliconia germplasm was conducted at Floriculture Field of HRC, BARI, Gazipur during 2022-2023. 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 and H-007 were identified as good genotypes.

#### **Collection and maintenance of climbing plant at Jamalpur region**

R. Sultana, M. A. Hossain, H. Rahman, A. Akter and H. E. M. K. Mazed

A study on the performance of nine climbing plant germplasm was conducted at Regional Agricultural Research Station, Jamalpur during the year 2022-2023. Wide range of variations for all qualitative and quantitative characters were observed.

#### **Collection and maintenance of cactus and succulents**

R. Sultana, M. A. Hossain, H. Rahman, A. Akter and H. E. M. K. Mazed

Nineteen cactus and Sixteen succulent genotypes were collected and maintained at the Regional Agricultural Research Station, Jamalpur during the year 2022-2023. A large variation was found in shape, size and colour of the observed genotypes. Among the genotypes, Cac Jam - 005, Cac Jam -12, Cac Jam -17, Cac Jam -19 and S Jam -002, S Jam -003, S Jam -006, S Jam -011 exhibited distinctly more vigorous than the others.

#### **Collection and evaluation of foliage and ornamental plants**

M. M. R. Bhuyin, F. N. Khan, A. Naznin, K. Ambia and M. T. Rashid

A study on the performance of some germplasm was conducted at Floriculture Field of HRC, BARI, Gazipur during 2022-23. The genotypes of foliage and ornamental plants were collected and evaluated that showed wide range of variation for the traits under studied.

#### **Collection, evaluation and maintenance of water lily**

F.N. Khan, M.R. Islam, K. Ambia, M.T. Rashid and N. Tabassum

A study on the performance of twenty water lily germplasm was conducted at Floriculture Field of HRC, BARI, Gazipur during 2022-23. Wide range of variations for all qualitative and quantitative characters were observed.

#### **Collection, evaluation and maintenance of amaryllis**

M. R. Islam, F.N. Khan, K. Ambia, M.T. Rashid and N. T. Hasan

A study on the performance of eighteen selected amaryllis lily germplasm was conducted at the field of Floriculture Division, HRC, BARI, Gazipur during the year 2022-2023. Wide range of variations for all qualitative and quantitative characters were observed.

#### **Collection and evaluation of tulip (*Tulipa sp*) genotypes**

F.N. Khan, M.R. Islam, K. Ambia, M.T. Rashid and N. Tabassum

An observational study on the performance of six Tulip germplasm was conducted at Floriculture Field of HRC, BARI, Gazipur during the winter season of 2023. Wide range of variations for all qualitative and quantitative characters were observed.

#### **Collection, evaluation and maintenance of orchid**

R. Sultana, M. A. Hossain, M. H. Rahman, A. Akter and H. E. M. K. Mazed

The present investigation was carried out to study the performance of eight genotypes of Dendrobium orchid coded from V<sub>1</sub> to V<sub>8</sub> (Dendrobium Alba,

Dendrobium Red, Dendrobium Sonia, Dendrobium Asian Beauty, Dendrobium Paradise, Dendrobium. Piyaraddi, Dendrobium Aggrigatum, and Dendrobium Oncidium respectively) under shade net house conditions. Vegetative and few flowering characters varied significantly.

#### **Collection and evaluation of orchid germplasm in Sylhet region**

M.A. Sumi and M. H. Hossain

This experiment is being conducted at the Nursery of RARS, Moulovibazar from October 2022 to till date to evaluate the variation and diversity of wild orchid germplasms of Sylhet region. Till date six germplasms (OR Akb 001, OR Akb 002, OR Akb 003, OR Akb 004, OR Akb 005 and OR Akb 006) has been collected from different reserve forests of Moulovibazar. All the collected germplasms have established with vigor and showing variation with different leaf characteristics. However, all the accessions have not shown any flower yet and are in vegetative growth stage on till date.

#### **Collection, evaluation and maintenance of rose germplasm at Jamalpur region**

A. Akter, F. N. Khan, M. A. Hossain, H. Rahman, R. Sultana and H. E. M. K. Mazed

An experiment was conducted to collect and evaluate the performance of collected rose germplasm and their categorization based on color, fragrance, and use. Fifty-six rose germplasm were collected and maintained at Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during season of 2022-23. Collected germplasm coded from RS Jam-001 to RS Jam-056. A large variation was found in floral characters specially in colour of the observed germplasm.

#### **Collection, evaluation and maintenance of indoor foliage plant germplasm at Jamalpur region**

A. Akter, F. N. Khan, M. A. Hossain, H. Rahman, R. Sultana and H. E. M. K. Mazed

An experiment was conducted to collect and evaluate the performance of collected indoor foliage germplasm at Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during season of 2022-23. A large variation was found in foliage characters specially in shape, size, and colour of the observed germplasm.

#### **Hybridization in gladiolus flower**

F.N. Khan, M.R. Islam, K. Ambia, Mt. Rashid and N. Tabassum

A hybridization program on gladiolus was conducted in the flowering season November, 2016 to June, 2023 at Floriculture Farm, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur. Fifteen crossing were done among some attractive gladiolus genotypes and pods were successfully produced. A large number of cormels were produced from a single cross from first generation. After a successive year of maintenance 15 new gladiolus hybrids have been found.

#### **Morphological study of *bougainvillea* lines of floriculture field based on dus test characters**

M. T. Rashid, F. N. Khan, M. R. Islam, K. Ambia and N. T. Hassan

The experiment was carried out during 2022-23 to estimate the morphological variability of 14 Bougainvillea lines at experiment field of floriculture division, HRC, BARI, Gazipur. Out of the 14 lines, four had lanceolate leaf blade shape while seven lines had medium ovate. Two lines had non-persistent leaves and rest were persistent. The results suggested that the characterization data of these lines can be used as a reference for registration of new varieties under PPV&FR Act, 2001. This investigation may also be helpful to the researchers with respect to breeding of Bougainvillea varieties for particular traits. Moreover, ornamental plant growers can also get benefited with regards to selection of suitable varieties of their interest.

#### **In vitro propagation of liliium (*lilium longiflorum*)**

S. R. Haque, A. Naznin, F. N. Khan and M. K. Jamil

The experiment was commenced with a view to develop a suitable protocol for *in-vitro* propagation of BARI Lilium-1 and Lilium-28. Treatment T<sub>2</sub> (4 mg/l BAP) and T<sub>3</sub> (1 mg/l BAP+1 mg/l NAA) both caused shoot proliferation of BARI Lilium-1 and Lilium-28 where survival percentage were 90% for all. Treatment T<sub>2</sub> (4 mg/l BAP) caused early days to shoot initiation for both BARI Lilium-1 (13 days) and Lilium-28 (9 days). Treatment T<sub>2</sub> also the highest shoot height for BARI Lilium-1 (6.1 cm) and highest shoots per explant the highest shoot height for Lilium-28 (4.2 and 5.2 cm)



***In vitro* propagation of gladiolus hybrids**

S. R. Haque, A. Naznin, F. N. Khan and M. K. Jamil

The eight hybrids of gladiolus which were collected from the field of Floriculture Division, HRC during 2022-23. All the node and bulb explants died after inoculation in the different treatments containing culture media. It is occurred may be due to lack of proper sterilization of node and bulb explants before inoculation.

**Effect of bulblet size and planting depth on the bulb production of liliun from bulblets**

A. Naznin, K. Ambia, M. M. R. Bhuyin, F. N. Khan, and M. T. Rashid

An experiment was conducted at Floriculture Division of HRC, BARI to find out suitable bulblet size and planting depth for production of liliun bulb through bulblets during 2020-2. three different diameters of bulblets, 12-14mm (S<sub>1</sub>), 15-17mm (S<sub>2</sub>) and 27-30mm (S<sub>3</sub>) and four level of depth of planting, 3cm (D<sub>1</sub>), 6cm (D<sub>2</sub>) and 9cm (D<sub>3</sub>) were used as treatments and bulblets of BARI liliun-1 was used as planting materials. Among the various treatments, large sized bulblet (27-30mm) and planting depth of 6 cm is best for producing quality liliun bulb.

**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

Tissue cultured seedlings of some commercial cultivars of gerbera were collected from from different available sources and evaluated from 2021-2023 to see the performance in respect of quality and yield potential. Variation was observed for all quantitative and qualitative characters under study. Based on the studied characteristics, gerbera collected from KF-bioplants showed better performance for cut flower production.

**Performance of chrysanthemum cutting influenced by different dates and media**

K. Ambia, F. N. Khan, M. R. Islam, N. T. Hasan and M. T. Rashid

Effect of different media and dates were studied with combinations of four different dates (June 15, July 1, July 15 and August 1) and three different

media (sand, coco dust and equal combination of sand+ cocodust). Minimum days required for rooting was recorded in M<sub>1</sub>D<sub>3</sub> (6.00days). Root length was maximum in M<sub>1</sub>D<sub>3</sub> (8.30cm). Minimum days for new vegetative bud was recorded in M<sub>1</sub>D<sub>3</sub> (11.40days). Mortality percentage was observed lowest in M<sub>1</sub>D<sub>4</sub> (23.23%).

**Influence of planting dates on the production of asiatic liliun under protective condition**

F.N. Khan, M.R. Islam, K. Ambia, M.T. Rashid and N. Tabassum

An experiment was conducted at Floriculture Research Field, HRC, BARI during October, 2022 to June, 2023 to find out the optimum planting time for better flower production and to extend the flowering duration of liliun. Liliun 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 (72.70cm). Liliun bulbs planted at November 15 produced the maximum number of florets per spike (10.50) followed by all the planting dates except 1<sup>st</sup> and 15 February planting which produced only 8.03 and 7.03 florets/spike, respectively. Bulb planting at 15 November produced the heaviest and largest bulbs (25.27g & 5.13cm, respectively) and the maximum number and weight of bulblets/plant (4.63 & 5.53g, respectively).

**Effect of potting media on growth and yield of spider lily**

M. T. Rashid, F. N. Khan, M. R. Islam, K. Ambia, and N. Tabassum

An investigation was conducted on the effect of potting media on growth and yield of spider lily (*Hymenocallis speciosa* L.) in the Floriculture field of Horticulture Research Centre, Bangladesh Agricultural Research Institute during 2022-23. The experiment was laid out in a completely randomized design with 6 treatments and each treatment replicated thrice. Maximum plant height (70.0 cm), leave number (28.3), leaf length (58.0 cm) and width (5.8 cm), days to spike emergence (94.5), spike no. (6), flowering duration (20.6) were found with T<sub>4</sub>-Cocodust + Vermicompost (1:1) treatment. Poor performance of all characteristics of spider lily was exhibited in only soil (T<sub>1</sub>).

**Germination and seedling quality of zinnia and aster influenced by seed priming**

K. Ambia, M. S. Rahman, N. T. Hasan and F. N. Khan

Effect of five different seed priming treatments (soaking in water for 0 hr, 6 hrs, 12 hrs, 18 hrs and 24 hrs) were studied in zinnia and aster seeds. In Zinnia seeds, germination percentage and germination speed was observed maximum in T<sub>2</sub> (81.0% and 87.45 respectively). Seedling vigor index was recorded highest in T<sub>3</sub> (520.80). In case of aster seeds, germination percentage and germination speed was maximum in T<sub>4</sub> (83.50% and 79.71 respectively). Seedling vigor index was found maximum in T<sub>4</sub> (151.13).

**Performance of marigold at different pinching times**

A. Akter, F. N. Khan, M. A. Hossain, H. Rahman, R. Sultana and H. E. M. K. Mazed

An experiment was conducted on the effect of pinching on growth and flower production of marigold at the Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during 2022-23. Marigold variety viz., V<sub>1</sub>= African marigold, V<sub>2</sub>= French marigold were considered as factor A and four pinching times viz., P<sub>1</sub>= Pinching at 01 Days After Transplanting (DAT), P<sub>2</sub>= Pinching at 15 DAT, P<sub>3</sub>= Pinching at 30 DAT, P<sub>4</sub>= Control (No pinching) considered as factor B. Analysis of data revealed that pinching had a significant effect on most of the attributes of marigold. Maximum number of branches (14.93) was found from pinching at 15 DAT (V<sub>1</sub>P<sub>2</sub>) with African marigold and minimum number of

branches (8.93) was found from no pinching with French marigold (V<sub>2</sub>P<sub>4</sub>). Maximum number of flowers (154) was observed from pinching at 15 DAT with French marigold (V<sub>2</sub>P<sub>2</sub>).

**Observation trial of seasonal flowers under live shade**

A. Akter, F. N. Khan, M. A. Hossain, H. Rahman, R. Sultana and H. E. M. K. Mazed

An experiment was conducted on the effect of live shade on growth and flower production of seasonal flowers at the Horticulture Research Centre, Regional Agricultural Research Station, Jamalpur during 2022-23. Live shade viz., LS<sub>1</sub>= Bottle gourd, LS<sub>2</sub>= Hyacinth bean and LS<sub>3</sub>= control (no live shade) was considered as factor A and five seasonal flowers viz., V<sub>1</sub>= African marigold, V<sub>2</sub>= French marigold, V<sub>3</sub>= Calendula, V<sub>4</sub>= Gladiolus and V<sub>5</sub>= Chrysanthemum considered as factor B. Maximum number of flowers (98) was found from LS<sub>3</sub>V<sub>2</sub> and minimum (1) was found from LS<sub>1</sub>V<sub>4</sub>. From the study we found that more BCR (3.92) was obtained from flower production under both live shade condition and less BCR (1.77) was obtained from flower production without live shade.

**Adaptive trial of liliun variety at farmers field**

Trials were conducted at Gazipur, Savar, Jashore and Rangpur during rabi season of 2022-2023 to observe the performance of BARI released liliun varieties under farmer's field condition. BARI liliun-1 and BARI liliun-2 getting higher yield and better market price at all locations.

# CEREAL CROPS

08

## Characterization of oat germplasm

A.H. Akhi, A.K. Alam, S. Begum, M.M. Rohman And R. Sultana

Ten oat genotypes belonging to *Avena sativa* species were characterized on the basis of observations recorded for twenty different morphological characters as per the guidelines of IPBGR for the conduct of test for distinctiveness, uniformity and stability. The observations were recorded on five randomly selected plants in each genotype for the following twenty morphological traits. Characterization of oat genotypes provides the important information about morphological and agronomical aspects of the material that is essential for future breeding program. The outcome of these traits tells us about the genetic architecture of the genotypes and their interaction within a specified environment for further improvement.

## Hybridization of barley

M.M. Rohman, S. Begum, I.M. Ahmed And R. Sultana

The experiment was conducted at the research field of Plant Breeding Division, Bangladesh Agricultural Research Institute, Gazipur during rabi 2022-23 to obtain new recombinant for developing early, dwarf, high nutrient content and high yielding hull-less barley variety. Ten parental genotypes (variety and advanced lines) were crossed following 10×10 half diallel fashion. All the crosses successfully produced seeds which have been preserved and will be grown for confirmation trial in the next year.

## Growing of F<sub>1</sub> generation of barley

M. M. Rohman

This study was conducted to confirm F<sub>1</sub> population and identify the better cross combinations obtained from a 9×9 half diallel mating design at BARI,

Gazipur. Nine Parents and their 30 F<sub>1</sub>s progenies were grown in single row in family block during rabi 2022-2023. Two back crosses BB-7×F<sub>1</sub> (BC<sub>1</sub>) and BB-9×F<sub>1</sub> (BC<sub>1</sub>) were also evaluated. Variation was observed among the genotypes for most of the traits studied. Analysis of standard heterosis over BARI Barley-9 revealed that 19 crosses showed positive and significant heterosis for yield/plant. Based on earliness and yield per plant eight crosses were selected for next year experiments.

## Growing F<sub>2</sub>, F<sub>3</sub>, F<sub>4</sub>, F<sub>5</sub> and F<sub>6</sub> generation of barley

M. M. Rohman, M.M. Billah, Z.A. Talukder And R. Sultana

Twelve F<sub>1</sub> population were advanced to F<sub>2</sub> generation, thirty F<sub>2</sub> population advanced to F<sub>3</sub> generation and 189 F<sub>4</sub> population were advanced to F<sub>5</sub> generation. From F<sub>1</sub> population, 51 individual plants, from F<sub>2</sub> population, 56 individual plants, from F<sub>3</sub> population 56 and from F<sub>4</sub> generation 154 individual plants were selected based on earliness, tillering number and yield. Moreover, in different segregating generation of barley, selected bulk method was followed during selection based on earliness, short stature, hull-less and high yield. In F<sub>5</sub> generation 47 families were selected from 52 families and in F<sub>6</sub> generation 4 lines were selected from 5 lines.

## Advancing of F<sub>2</sub>, F<sub>3</sub> and F<sub>4</sub> generations for developing saline tolerant barley line

M.M. Rohman And H.Z. Raihan

Fourteen F<sub>2</sub>, 26 F<sub>3</sub> and 60 F<sub>4</sub> populations were evaluated in Benarpota, Satkhira and Koira Khulna to select saline tolerant barley genotypes. Additionally, 12 F<sub>2</sub> populations were screened in artificial saline soil under greenhouse condition to obtain saline tolerant segregates. Based on phenotypes and stress tolerance markers, 28



individual plants, yield ranging 10.5-48.5 g/plant, were selected. In F<sub>3</sub> generation, 16 individual plants (yield range 16.5-42.4 g/plant) were selected while in F<sub>4</sub> generation, 37 families having single plant yield with 10.9-30.5 g. On the other hand, in green house condition, 71 saline tolerant segregates were selected.

#### **Observation trial of barley lines**

M.S. Akter, M.M. Billah, M.M. Rohman And R. Sultana

This study was performed to investigate the performance of the selected lines and identify short duration and high yielding barley lines. The experiment was laid out in randomized block with nineteen barley lines including two check varieties BARI Barley-5 and BARI Barley-9. Considering yield potentiality and yield contributing characters, genotypes IBON-22/E18, BB7xE-1/15, IBYT-ASA-22/E18, IBYT-FFM-22/E21 and IBYT-FFM-22/E23 were found promising and selected for future breeding programme.

#### **Preliminary yield trial of hull less barley**

M.M. Rohman, A.N.M.S. Karim And R. Sultana

This study was performed to investigate the performance of the selected lines as preliminary yield trial and identify short duration and high yielding barley lines. The experiment was laid out in randomized block with fifteen barley lines including three check varieties BARI Barley-7, BARI Barley-8 and BARI Barley-9. Considering yield potentiality and yield contributing characters, genotypes E69, E84, E96, E22, E28 and E4 were found promising and selected for next year trial.

#### **Advanced yield trial of hull-less barley**

M.M. Rohman, A.N.M.S. Karim, M.S. Kobir, B. Sarker And M.S. Hossain

Seven genotypes along with three check varieties (BARI Barley-7, BARI Barley-8 and BARI Barley-9) of barley were assessed for their yield performance in three different locations during rabi 2022-23. Significant variation was found among the genotypes for all the traits. Considering, yield performance, genotype E17, E11, E19, E7 and E10 can be considered for regional yield trial in the next year.

#### **Regional yield trial of barley**

H. Z. Raihan, M. S. Kabir, M. Rahman, M.I. Riad, B. Sarker And R. Sultana

The experiment was conducted using five barley advanced lines including two check varieties, BARI Barley 7 and BARI Barley 9 across 5 locations (Gazipur, Jamalpur, Panchagarh, Jashore and Rangpur) of Bangladesh during 2022-23. The objective of this study was to find out early matured, high yielding stable barley lines and to verify the influence of the environments on the yield at different locations of Bangladesh. Environments mean sum of squares were highly significant for all the trait studied. The highly significant effects of environment indicate high differential genotypic response across the different environments. Interaction of G×E was found non-significant for all the trait studied except yield (t/ha). Based on the AMMI stability parameter, earliness and yield potentiality IBON-HI- 19 E24 (2.4 t/ha) was the most stable high yielding lines across the environments.

#### **International barley yield trial for arid and semi-arid regions (IBYT-ASA-23)**

M.S. Akter, M. M. Rohman, M.M. Billah And R. Sultana

Twenty-three barley entries received from ICARDA and one standard check BARI Barley-8 was evaluated at BARI, Gazipur, during rabi 2022-2023 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 short stature, yield and yield contributing characters seven lines were selected from the 23 barley entries for next year trial.

#### **International barley observation nursery (IBON-23)**

M.S. Akter, M. M. Rohman, M. M. Billah And R. Sultana

One hundred and twenty barley entries received from ICARDA along with one standard checks BARI Barley-8 were evaluated at BARI, Gazipur during rabi 2022-2023 to select better performing early, dwarf and high yielding barley lines. Considering short stature, yield and yield contributing characters ten lines were selected from the 120 barley entries for future breeding program.

### **Screening of barley entries/lines against spot blotch disease caused by *bipolaris sorokiniana* through artificial inoculation**

M.M.E Rahman, A.H. Akhi, M.M. Rohman, A.K. Saha And R. Sultana

Spot blotch is caused by fungus *Bipolaris sorokiniana* is one of the major diseases of barley. Varying level of disease resistance was recorded against spot blotch of barley during screening at RARS, BARI, Rangpur in 2022-23 growing season. No entry/line of barley was observed either immune or resistant against spot blotch disease. Among the 187 entries, only 62 entries showed moderately susceptible and rest of the entries was found susceptible to highly susceptible.

### **Induced mutagenesis in foxtail millet (*setaria italica* L.) To develop variable population**

M.M. Billah, Z.A. Talukder, S.H. Omy And R. Sultana

Two foxtail millet varieties (BARI Kaon-2 and BARI Kaon-4) were chemically treated by EMS to create or encourage variability.  $M_1$  seeds of different treatments were harvested and kept separately for further investigation.

### **Growing of $m_1$ generation of foxtail millet for identification and selection of mutants for desirable traits**

M.M. Billah, Z.A. Talukder, S.H.Omy And R. Sultana

Ethyl methane sulphonate (EMS) in chemical mutagens and Gamma radiation in physical mutagens are most effective and frequently used for induction of economically desirable mutants in several crops. In the present investigation, two foxtail millet varieties (BARI Kaon-2 and BARI Kaon-4) were chemically treated by EMS to create or encourage variability in two varieties. EMS treatments alone have been proved efficient for most of the character in  $M_1$  generation. There were very little mutagenic effects showed in some of the treatment i.e. short plant height, early to late flowering, and number of seed per plant.  $M_1$  generation has sown and  $M_2$  seeds of different treatments were harvested and kept separately for future breeding program.

### **Regional yield trial of foxtail millet**

M.M. Billah, M.B. Sarker, M.I. Riad And M.S. Kobir

Six genotypes along with two check varieties of foxtail millets viz. BARI kaon-2 and BARI kaon-4 was assessed for genotype environment interaction (GEI) and stability for selection of the best Foxtail millet line in four different locations during rabi 2022-23. The AMMI (additive main effect and multiplicative interaction) model was used to analyze the genotype-environment interaction over four locations to select the foxtal millet genotypes having higher yield and other potential attributes. Regarding Genotypes (GEN) and Environments (ENV), significant variation was found in most of the traits. Considering the mean, bi and  $S^2di$  for grain yield, it was evident that all the genotypes showed different response of adaptability under different environmental conditions. Among the tested Foxtail millet lines E1 showed high yield and E4 and E5 were more stable and selected for further evaluation.

### **Evaluation of proso millet lines**

S.H. Omy, M. M. Rohman And R. Sultana

The experiment was conducted with 20 exotic and locally collected proso millet lines along with one check variety. Each line was grown, characterized and monitored carefully under normal condition in one location (Gazipur). Among the studied lines seven (7) lines were found promising for further breeding programs.

### **Preliminary yield trial of proso millet**

S. H. Omy, B. Sarker, S. Kobir And M. M. Rohman

Preliminary yield trial of eight proso millets lines with one check variety were executed at Gazipur, RARS, Jashore and RARS, Rangpur during rabi season 2022-2023 to find out the suitable lines for next year trial. Analysis of variance for all characters showed significant genetic variability among lines except days to maturity and panicle length. Considering yield and yield contributing characters three lines i.e., BD-1399, BD-1447 and BD-777 were selected for the next year trial.

**Advanced yield trial of proso millet**

S.H. Omy, B. Sarker, M.I. Riad, S. Kobir And R. Sultana

Advanced yield trial of eight proso millets lines with one check variety were executed at Gazipur, RARS, Jamalpur; RARS, Jashore and RARS, Burirhat during rabi season 2022-2023 to find out the suitable lines for variety development. 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-1402 and BD-1446 found more promising.

**Advanced yield trial of finger millet**

M.M. Rohman, Z.A. Talukder And A.N.M. Sajedul Karim

The present study was conducted with five finger millets genotypes at Gazipur, Jashore and Rangpur in randomized complete block design with three replications during rabi 2022-2023 cropping season for 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, finger length, finger number, 1000-grain weight, yield and lodging. Analysis of variance for different characters among the genotypes showed significance variation for all the traits except tiller number and finger number for location, and for genotype, yield was not significantly different like other traits. The genotype IE-3392 showed lowest days for heading and maturity and plant height. It was also the highest yielder (2.99 ton/ha) with minimum lodging (7%).

**Development of base population in sorghum**

Z.A. Talukder, M.M. Billah, A.N.M.S. Karim, A.H. Akhi, M. K. Alam And R. Sultana

The experiment was conducted with balanced bulk 3<sup>th</sup> cycle sorghum 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 BARI Joydebpur during rabi 2022-23 for the development of source populations in sorghum. For the purpose of advancing, finally 300

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.

**Evaluation of sorghum genotypes for waterlogging stress tolerance and understanding of physiological mechanism**

Z. A. Talukder, A.N.M.S. Karim, M.M. Billah, M.K. Alam And M.M. Rohman

Waterlogging is one of the most important constraints for sorghum production and productivity in summer-rainy season in Bangladesh. A total 10 sorghum genotypes were evaluated for development of waterlogged tolerant sorghum varieties with higher yield. At pre-flowering stages sorghum plants were exposed to waterlogging for 30 days. Waterlogging remarkably declined the plant growth, yield and yield related traits of all the sorghum genotypes compared to control. The waterlogged plants showed delayed flowering and maturity compared with the control plants. Antioxidant enzyme activities like Catalase (CAT), Ascorbate peroxidase (APX) and Superoxide dismutase (SOD) were inconsistent in the present study but most of the antioxidant enzyme activities showed an increasing trend in waterlogged plant than that of control plant in all the genotypes. Considering overall performance among the 10 genotypes, Entry-2, Entry-3, Entry-5 and Entry-8 showed better waterlogging tolerance.

**Screening of m<sub>3</sub> generation of oat for yield and quality traits**

A.H. Akhi, M.M. Rohman And R. Sultana

Gamma, EMS and gamma+ EMS treated seeds of M<sub>3</sub> generation of germplasm BOL-1 and released variety BARI Oat-1 was evaluated to select desired mutant for oat variety development. In M<sub>3</sub> generation, mutants were grouped into short height, early flowering excellent grain, broad leaf and Machine dehuskable grain. The individual plants from each group were harvested separately and kept for growing in the next rabi season for further evaluation



### Evaluation of oat germplasm for early and high yield

A.H. Akhi, M.K. Alam, M.M. Rohman And R. Sultana

The field experiment was laid out in a randomized complete block design with three replications to evaluate the seed yield performance of five oat genotypes during rabi 2022-23. Genotypes in the trial were BOL-1, BARI Oat-1, BOL-3, BOL-4 and BOL-5. The genotypes showed significant variation for days to first flowering, days to 50% flowering and days to maturity. Among the five genotypes BOL-5 showed early flowering (76 days) and maturity (106 days) followed by BARI Oat-1 in which flowering and maturity observed in 82 days and 118 days, respectively. The genotype BOL-1 produced the shortest plant height (92.0 cm) and BARI Oat-1 produced the maximum height (92.0 cm). Genotype BOL-1 showed higher seed yield, number of fertile tiller, 1000 grain weight, yield per plant and harvest index. Therefore, the genotype BOL-1 could be recommended for seed yield and BOL-5 recommended for early maturity

### Multilocation yield trial of chia (*Salvia hispanica* L.)

S. Begum, M.M. Rohman, B. Sarker, M.S. Kobir And R. Sultana

Six genotypes (BCH-1, BCH-2, BCH-3, BCH-4, BCH-5 and BCH-6) of chia were evaluated at three locations (Gazipur, Rangpur and Jashore) to assess genotype environment interaction and yield performances. The analysis of variance revealed that among the genotypes had significant variation for inflorescence length, 1000-grain weight and grain yield while environment was greatly responsible for the variations of all the traits under study except grain yield. On the other hand, genotype and environments interactions were significant for all the traits except number of branches per plant and inflorescence length. Considering the mean data, the genotype BCH-3 was selected as the best line in view of inflorescence length, 1000-grain weight and grain yield.

### Induced mutagenesis in buckwheat to develop variability

M.S. Akter, M.M. Rohman, A. H. Akhi And R. Sultana

In this experiment, two buckwheat genotypes (Bogura-1 and BD-4272) were treated chemically

with Ethyl methane sulphonate (EMS) to induce variability. The doses of 0.1% (EMS), 0.3% (EMS) and 0.5% (EMS) treatments have been proved to be more efficient for most of the characters especially yield and yield contributing characters in M<sub>2</sub> generation in both genotypes compared to both controls. M<sub>2</sub> seeds of different treatments were harvested and kept separately for future breeding program.

### Advanced yield trial of quinoa

H. Z. Raihan, M.M. Rohman And R. Sultana

Three genotypes along with a check variety (SAU Quinoa 1) of quinoa were assessed for genotype environment interaction (GEI) and stability to select the best quinoa lines in four different locations (Gazipur, Jashore, Moulvibazar and Rangpur) during rabi 2022-23. The analysis of variance revealed that environment was greatly responsible for the variations of the traits under study. while genotypes-environments interaction was nonsignificant for all of the characters. Considering stability and mean yield potentiality, genotype BQL 1 (1.28 t/ha) could be selected as stable and high yielding genotype for further evaluation.

### Genetic diversity analysis of sorghum (*Sorghum bicolor* L.) Genotypes for drought tolerance using SSR markers

Z.A. Talukder, A.N.M.S. Karim, S.H. Omy, M.M. Mrohman And R. Sultana

Sorghum (*Sorghum bicolor* L.) (Moench) is considered as a model species for drought tolerance due to its inherent drought tolerant characteristics. The best characterized form of drought tolerance during crop growth is “stay-green” trait. Genetic diversity analysis carried out with 30 sorghum genotypes for drought tolerance using 8 stay-green specific polymorphic SSR markers revealed high level of polymorphism among the genotypes. The polymorphic loci clearly discriminate all the genotypes. The genotypes were grouped into different clusters elucidating a high level of genetic diversity. Cluster analysis categorized the drought resistant and drought susceptible genotypes in to separate clusters. Most of the genotypes in the cluster C had the better stay-green score. The genotypes G1, G11, G13, G15, G16, G18 and G19 exhibited drought tolerance phenomenon and were

grouped as drought tolerant under molecular level of genetic diversity.

#### **Screening of sorghum genotypes (*Sorghum bicolor* L) for drought tolerance at seedling stage using polyethylene glycol**

Z.A. Talukder, A.N.M.S. Karim, S.H. Omy, M.M. Rohman And R. Sultana

Thirty different genotypes of sorghum (*Sorghum bicolor* L) were evaluated for their genetic potential to drought tolerance at seedling stage. Water stress was simulated by non-ionic water soluble polymer polyethylene glycol of molecular weight 6000. After ten days of water stress data were recorded for easily measurable seedling traits as shoot length, root length, fresh shoot weight, dry shoot weight, fresh root weight and dry root weight under control as well as water stress conditions. Significant differences were observed among the genotypes, treatments and their interactions for evaluated plant traits suggesting a great amount of variability for drought tolerance in sorghum. Drought stress reduced the phenotypic expression of all the seedling traits SL, RL, FSW, DSW, FRW, and DRW. Considering seedling traits, among 30 sorghum genotypes, G-16, G18, G11, 19, G13 and G1 was more tolerant to simulated drought stress with PEG-6000 than other sorghum genotypes.

#### **In silico genomic characterization of the aquaporin gene (AQP) family in sorghum bicolor (L.) Using bioinformatics tools**

Z A. Talukder, S.H. Omy And R. Sultana

The aquaporin (AQP) gene family constitutes the most conserved class of gene families and plays a key role in water transport and conservation in plants. Although Sorghum genome sequencing has been completed, a comprehensive study of AQP genes in *Sorghum bicolor* is lacking. In the present study, we identified and characterized Sorghum AQP genes using a genome-wide scale. A total of 37 non-redundant AQP genes were identified and classified into four subfamilies (PIPs, TIPs, NIPs and SIPs). Genetic analysis of sorghum revealed that AQP genes were clustered into the same four subfamilies as in maize (*Zea mays*) and rice (*Oryza sativa*) and that residues determining the AQP channel specificity were largely conserved across

species. In summary, our genome-wide analysis of SbAQP genes provides a valuable resource for functional analysis aimed towards understanding their role in stress adaptation.

#### **Modulation of drought induced oxidative stress in finger millet by trehalose and methyl jasmonate**

M.M. Rohman And Z.A. Talukder

This study was undertaken to examine drought induced oxidative stress and its manipulation by Trehalose (Tre) and Methyl jasmonate (J). Five treatment, control (C), drought (D), D+Tre (1 mM), D+J (100  $\mu$ M) and D+ Tre (0.5mM)+J(50  $\mu$ M), were applied drought as seed treatment and foliar application at 15 days, 22 day and 29 days after emergence (DAE). Drought stress was started at 15 DAE, and maintained approx 7.5% of field capacity (FC) till harvesting. Biochemical and enzymatic data were taken at flowering stage. Drought stress increased CAT and APX activity suggesting important role in  $H_2O_2$  metabolism by induced activity in drought in presence or absence of Tre and J. Importantly, accumulation of proline under drought with Tre and J indicated its role in osmoregulation.

#### **Nutritional analysis of different barley varieties**

M.M. Rohman, S. Sultana, M.H.K. Siraji And Z.A. Talukder

Minerals like, Zn, Mn, Cu, Ca, Fe, Mn, Ca, Mg, P and K were analysed in three important barley varieties, BARI barley-7, BARI barley-8 and BARI barley-9. The Zn content varied significantly among the varieties. Likewise, Cu, Mn, Ca, Mg and K were also varied significantly. Zn content ranged 42.3-56.2 ppm while Cu 779-11.8 ppm, Fe 48.2-558ppm, Mn 11.5-14.6ppm, Ca 261.5-315.9 ppm, Mg 1854.3-2011.4 ppm, P 0.41-0.45% and K 0.48-0.58%.

#### **Characterization of pumpkin (*Cucurbita moschata*) genotypes based on dna marker and $\beta$ -carotene content**

M.Z.A. Talukder, A.N.M.S. Karim, S.H. Omy, M.M. Rohman, R.F. Chhanda And R. Sultana

This experiment was conducted in the molecular laboratory of Plant Breeding Division, BARI,

Gazipur. Seventy-nine pumpkin genotypes were characterized based on  $\beta$ -carotene content and molecular marker. High variability was observed for  $\beta$ -carotene content in the studied genotypes. Pumpkin genotypes possessed an average of 100.9  $\mu\text{g/g}$   $\beta$ -carotene (range: 45  $\mu\text{g/g}$  to 172  $\mu\text{g/g}$ ) and 8.4 TSS (range: 6-14). Most of the molecular marker used in this study was monomorphic among the genotypes. Among the genotypes, SRSR-11, ASHI-21, SNQ-21, SNQ-47, NSR-72 and SSR-54 contains maximum amount  $\beta$ -carotene which might be utilized in breeding program. These pumpkin genotypes rich in a  $\beta$ -carotene hold significant promise for nutritional security.

#### **Identification of bean common mosaic virus (bcmv) resistance genes in country bean through dna marker and determination of bcmv strain in bangladesh**

**M.Z.A. Talukder, A.N.M.S. Karim, S.H. Omy, M.M. Rohman And R. Sultana**

Bean common mosaic virus (BCMV) and bean common mosaic necrosis virus (BCMNV) are economically important virus species infecting common bean. The use of resistant plant cultivars is the most effective way to control these viruses. In this study, 92 country bean genotypes were tested for resistance to BCMV and BCMNV. Three SCAR markers (SW13, SBD5 and ROC11) were used for identification of the *I*, *bc-1*<sup>2</sup> and *bc-3* genes, which provide host plant resistance to BCMV. Most of the genotypes were found to carry the *bc-1* gene whereas twelve of the genotypes had the recessive genes *bc-3*. Dominant *I* gene was not found in any genotypes. Among 92 genotypes, 6 genotypes (G3, G32, G42, G43, G81 and G92) had combine *bc-1*<sup>2</sup> and *bc-3* genes, which would be used in country bean breeding program for virus resistance.

#### **Breeder seed production of barley, foxtail millet, proso millet, sorghum, oat and chia variety**

M.K. Alam, M.M. Billah, M. Rahman, M.M.H. Khan, M.R Islam, M.S Huda, M.B Sarkar, M.I Riad, M.S Kabir

To disseminate and popularize as well as to increase pure seed stock of released barley, foxtail millet, proso millet, sorghum, oat and chia varieties

were produced at different locations. Total 1674kg breeder seed of barley seed viz. BARI Barley 5, BARI Barley 6, BARI Barley 7, BARI Barley 8 and BARI Barley 9 were produced at six locations (Gazipur, Burirhut, Rahmatpur, Ishurdi, Dinazpur and Debigonj), 368 kg breeder seed of foxtail millet (BARI Kaon-1, BARI Kaon-2, BARI Kaon-3 and BARI Kaon-4), 83 kg Proso millet (BARI Cheena-1), 364 kg of Sorghum (BARI Sorghum-1), 84 kg of oat (BARI Oat-1) and 90 kg of chia (BARI Chia-1) were produced at Gazipur, Jessore, Rahmatpur, Debigonj, Dinajpur, Jamalpur and Burirhut during rabi season 2022-2023. After threshing and proper drying seed stored for further use.

#### **Maintenance of barley, foxtail millet, proso millet, pearl millet, oat, chia, buckwheat, quinoa genotypes**

M.k. alam and m.m. rohman, m.m. billah, m.k. alam, a.n.m.s. karim, s.h. omy, a.h. akhi, s. Begum, m.s. akter, h.z. raihan and r. Sultana

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. Moreover, availability of enough seed is prerequisite to conduct various breeding program to develop better variety. Hence, the experiment was conducted with 29 barley lines, 12 exotic foxtail millet lines, 98 proso millet lines, 121 pearl millet lines, five oat lines including BARI oat-1, six chia lines, eight lines of buckwheat and four quinoa lines including SAU Quinoa 1. Each line of each crop was investigated carefully and off type, diseased and weak plants were rouged out. A total of 7.76 kg seed of barley lines, 35.7 kg seeds foxtail millet, 0.5k g seeds of pearl millet, 2.0 kg seed of oat, 0.5 kg seed of chia, 0.17 kg seed of buckwheat and 5.59 kg of quinoa were produced. After proper drying all seeds were 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, sorghum, buckwheat, quinoa, chia proso millet, foxtail millet, pearl millet and finger millet. This division has also given more emphasized 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 2022- 23 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. Two farmers training on Crop Production and dissemination of minor cereals were conducted with total 60 farmers at Faridpur and Jamalpur. Demonstration trials were

set at Munshigonj, Rangpur, Tangail, Bogura, Jamalpur, Noakhali, Rajshahai, Gaibandha, Faridpur, Manikgonj, Satkhira and Khulna. Besides, one seminar workshop was held at BARI, Gazipur and 2 field days were arranged at Khulna and Gaibandha. Twelve varieties were transferred throughout the countries. Three new varieties (BARI Barley-10, BARI Cheena-2 and BARI Chia-1) were released, one annual report and two leaflet (BARI Cheena-1 & BARI Raghi-1) were published from the division.

# AGRONOMY

09

## Growth and yield of barley as influenced by spacing and seed rate

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The experiment was conducted at the Research Field of Agronomy Division, Bangladesh Agricultural Research Institute, Gazipur during *rabi* season of 2021-2022 and 2022-2023 to find optimum seed rate and row spacing of barley. Two rows spacing viz,  $R_1 = 20$  cm row spacing with continuous sowing,  $R_2 = 25$  cm row spacing with 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. The experiment was laid out in a randomized complete block design with three replications and the unit plot size was  $3\text{ m} \times 3\text{ m}$ . Seed of BARI Barley-9 was used in the experiment. Seeds were sown on 24 November 2021 and 29 November 2022. Fertilizers were applied @ 80-28-60-12-3.0 kg/ha (FRG' 2018) of N-P-K-S-Zn, respectively as Urea-TSP-MoP-gypsum and zinc sulphate. Half N and full dose of other fertilizer was applied as basal during land preparation. Remaining N was top dressed at 25 DAS after irrigation and mixed thoroughly with the soil as soon as possible for better utilization. For dry matter estimation, 5 plants were sampled started from 30 DAE at 20 days interval, then dried at  $80^\circ\text{C}$  in oven for 72 hours and finally dry weight taken. Barley was harvested on 24 March 2022 and 12 March 2023. At harvest yield and yield contributing character's data were taken from 5 randomly selected plants from each plot and statistically analyzed and means were adjusted by LSD test at 5% level of significance using "STAR" software package. Economic analysis was done considering local market price.

Plants/ $\text{m}^2$ , plant height, and seeds/spike varied significantly due to variation of treatments. All parameters except straw yield significantly varied

from each treatment. Highest plant population i.e., plants/ $\text{m}^2$  (44.33) found in  $R_1 \times S_5$  (180 kg seed/ ha and 20 cm row with continuous sowing) treatment and lowest plants/ $\text{m}^2$  (33.33) found in  $R_2 \times S_1$  (100 kg seed/ ha and 25 cm row with continuous sowing) treatment. Maximum plant height (73.73 cm), seeds/spike (36.07), 1000- grain weight (35.49 g), straw yield (3.98 t/ha) and grain yield (2.81 t/ha) found in  $R_2 \times S_1$  treatment. Treatment  $R_2 \times S_5$  (180 kg seed/ ha and 25 cm row with continuous sowing) showed lowest values for yield and yield attributes. The highest gross return (Tk. 140740.74/ha), gross margin (Tk. 78745.74/ha) and benefit cost ratio (2.81) obtained from  $R_2 \times S_1$  (seed rate 100 kg /ha with 25 cm row spacing and continuous sowing) treatment. Whereas, lowest BCR (1.11) found in  $R_2 \times S_5$  treatment. Results revealed that 100 kg /ha seed rate with 25 cm row spacing and continuous sowing would be optimum for getting higher yield and economic return in barley.

## Effect of sowing dates on growth and yield of oat

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The experiment was conducted at the Agronomy Research Field, Bangladesh Agricultural Research Institute, Gazipur during *rabi* season of 2022–2023 to observe the growth behavior and yield of oat as influenced by prevailing air temperature based on sowing time. The soil was silty clay in texture at experimental site (AEZ-28). 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  $3\text{ m} \times 3\text{ m}$ . Oat seeds (var. BARI Oat-1) were sown as per treatment in line with maintaining 20 cm row to row spacing. Fertilizers were applied @ 90-25-20-27-2-2 kg/ha NPKSZnB

(Rahman *et al.*, 2021). Yield contributing characters were recorded from one linear meter at the time of harvest. Yield data were recorded by harvesting ten square meter area excluding border. Collected data was analyzed statistically following STAT-10 software package and means were compared using LSD test at 5% level of significance.

Crop growth duration was influenced by prevailing temperature variations. Temperature is an important factor of flowering in oat. The late sown crops flowered earlier with reduced vegetative durations than those of early sown ones. Highest crop growth duration was recorded (134 days) in 20 November sowing due to prevailing lower av. min. and max. temperature (16.19°C- 28.65°C). Crop growth duration of 10 November and 30 November sowings were longer due to low temperatures (Min. 16.00 - 16.45 °C and Max 28.69 - 28.80 °C) prevailed at those time that might prolonged the crop growth period (132-130 days). On the contrary, 20 December and 10 December sowings received high temperatures (Min 16.40- 16.66 °C and Max 28.83- 29.16 °C) that shorten the crop growth period. Among the different sowing time, 20 November sowing accumulated maximum GDD of 1676 °C for the events of maturity but took the lowest GDD of 1497 °C for the events of maturity was recorded in 20 December sowing. The highest (15) number of panicle/ plants was recorded in November 20 sowing, which was significantly higher than those of December 10 and December 20 sowings. Same number of panicle/ plants was produced by November 10 and November 30 sowings. The lowest number (9) of panicle/ plant was recorded in December 20 sowing. The highest (41) number of spikelet /panicles was recorded in 20 November sowing which was statistically similar to November 10 and November 30 sowings. Thousand-grain weight decreased with delay sowing. The highest 1000-grain weights (39.43g) was recorded in November 20 sowings, which was statistically identical to November 10, November 30 and December 10 sowings. The lowest weights (30.35g) in 1000-grain were recorded in December 20 sowing. Grain yield decreased significantly beyond December 10 sowing which might be due to prevalence of higher temperature at the reproductive stage. November 10 to December 10 sowings gave statistically similar grain yield, which were significantly higher than those of 20

December sowing date. However, the highest grain yields (1.38 t/ ha) were recorded in November 20 sowing and the lowest (1.17 t/ha) in December 20 sowing. The results revealed the 20 November to 10 December sowing would be the optimum sowing date for oat in relation to air temperature. The crop would become suitable for harvest after receiving a thermal sum of 1676 GDD (°C).

#### **Growth and yield of chia (*Salvia hispanica*) as influenced by sowing time and row spacing at different AEZs**

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A field experiment was undertaken at the Agronomy Research Field, Gazipur, RARS, Jashore, RARS, Jamalpur, RARS, Burirhat, RARS, Hathazari, ARS, Rajbari and OFRD, Shampur of Bangladesh Agricultural Research Institute, during *rabi* season of 2022-23 to study the effect of yield and yield contributing characters of chia seeds as affected by sowing date and spacing at different location. The experiment site (Gazipur) was located Chhiata Series under Agro-Ecological Zone-28 (AEZ-28) latitude 23°59' N and longitude 90°24' E. The meteorological data of the experimental site revealed that the highest temperature prevails in March-April and the lowest in December to January. Maximum rainfall was received during the months of March. The crop received 133 mm rain showers from November to March in 2022-23 years. The average maximum temperature (32.08 °C) was found in the month of March during the crop growing season and minimum (12.77 °C) temperature in the month of January during the crop growing season. The experiment consisted of three sowing date viz. (15 Nov., 30 Nov., 15 Dec. and 30 Dec.) and two spacing viz. (30 cm × continuous in solid line and 40 cm × continuous in solid line) were used in the study. There were 8 treatment combinations as follows: D<sub>1</sub>×S<sub>1</sub>, D<sub>1</sub>×S<sub>2</sub>, D<sub>2</sub>×S<sub>1</sub>, D<sub>2</sub>×S<sub>2</sub>, D<sub>3</sub>×S<sub>1</sub>, D<sub>3</sub>×S<sub>2</sub>, D<sub>4</sub>×S<sub>1</sub> and D<sub>4</sub>S<sub>2</sub>. The experiment was laid out in a RCBD design with three replications. The unit plot size was 3.6 m × 3.0 m. The crop was fertilized with 60-15-30 -5 N-P-K-S kg /ha, respectively (Karim *et al.*, 2015). The crop was harvested on 1 March to 4 April 2023 in Gazipur; 2 March to 5 April 2023 in Jashore; 7 March to 8 April 2023 in Burirhat; 2 March to 5 April 2023 in Jamalpur; 5



March to 7 April in Shyampur, Rajshahi; 2 March to 3 April 2023 in Rajbari and 2 March to 5 April 2023 in Hathazari. At harvest, the yield data was recorded plot wise. Data were analyzed statistically and means were compared using LSD test at 5% level of significance.

The days required for 50% flowering was differed by sowing time in chia crop. The maximum days required for 15 November sowing (71, 67, 54, 67, 67, 67 and 62 at Gazipur, Jamalpur, Jashore, Burirhat, Hathazari, Shyampur and Rajbari, respectively). On the other hand, 30 December sowing time took minimum days for 50% flowering (57, 55, 50, 55, 55, 55 and 49 at Gazipur, Jamalpur, Jashore, Burirhat, Hathazari, Shyampur and Rajbari, respectively). The days for maturity was also varied by sowing time in chia crop. November 15 sowing took maximum days (109, 108, 106, 112, 108, 110 and 108 at Gazipur, Jamalpur, Jashore, Burirhat, Hathazari, Shyampur and Rajbari, respectively), and 30 December sowing took minimum days for maturity for all locations.

Among the different sowing time, 15 November sowing accumulated maximum GDD of (792.2, 632, 657, 716.99, 998.25, 605.1 and 598.55 at Gazipur, Jamalpur, Jashore, Burirhat, Hathazari, Shyampur and Rajbari, respectively) for the events of 50% flowering but took the lowest GDD for 50% flowering were recorded in 30 December sowing in all locations. On the other hand, 15 November sowing accumulated maximum GDD of (1274.85, 1068.5, 1328.5, 1184.19, 1468.05, 1165.6 and 1073.2 at Gazipur, Jamalpur, Jashore, Burirhat, Hathazari, Shyampur and Rajbari, respectively,) for the events of maturity but took the lowest GDD for maturity were recorded in 30 December sowing in all locations.

Yield and yield contributing characters of chia were significantly influenced by sowing date and row spacing. Significantly the highest number inflorescences/plant (13, 23, 28, 18, 12, 12 and 14 at Gazipur, Jamalpur, Jashore, Burirhat, Hathazari, Shyampur and Rajbari, respectively) was obtained from 15 November sowing with 40 cm row spacing whereas 30 December sowing with 40 cm row spacing significantly the lowest number of inflorescences/plant in all locations. The highest 1000-grain weight (1.27g, 1.04g, 1.23g, 1.24g, 1.48, 1.3 g and 1.27g at Gazipur, Jamalpur, Jashore, Burirhat, Hathazari, Shyampur and Rajbari,

respectively) was recorded in 15 November sowing with 40 cm row spacing and the lowest grain weight was recorded in 30 December with 30 cm row spacing in all locations. Significantly the highest grain yield (1059.41 kg/ha, 620 kg/ha, 449.63 kg/ha, 1037.94 and 328.8 kg/ha at Gazipur, Jamalpur, Jashore, Burirhat and Hathazari, respectively) was obtained from 15 November sowing with 30 cm row spacing followed by 30 November with 40 cm row spacing (1001kg/ha and 998 kg/ha at Gazipur and Burirhat) but at Shyampur and Rajbari, 15 November sowing with 40 cm row spacing (1273 kg/ha and 1327.00 kg/ha) gave statistically similar to 15 November sowing with 30 cm row spacing. December 30 sowing with 40 cm row spacing gave significantly the lowest yield (359.57 kg/ha, 150 kg/ha, 20.74 kg/ha, 633.92 kg/ha, 33.87 kg/ha, 167 kg/ha and 237.06 kg/ha at Gazipur, Jamalpur, Jashore, Burirhat, Hathazari, Shyampur and Rajbari, respectively). Results revealed that November sowing with 30 cm and 40 row spacing would be optimum for higher yield of chia.

#### **Growth and yield of chia (*Salvia hispanica* L.) under different nutrient management**

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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 and 2022-2023 to assess the growth and yield of chia crop under different nutrient management. Treatments included in the experiment were: T<sub>1</sub>=N<sub>30</sub> P<sub>20</sub> K<sub>25</sub> S<sub>6</sub> Zn<sub>0.5</sub> B<sub>0.5</sub> kg/ha, T<sub>2</sub>=N<sub>60</sub> P<sub>40</sub> K<sub>50</sub> S<sub>8</sub> Zn<sub>0.5</sub> B<sub>0.5</sub> kg/ha, T<sub>3</sub>=N<sub>90</sub> P<sub>60</sub> K<sub>75</sub> S<sub>10</sub> Zn<sub>0.5</sub> B<sub>0.5</sub> kg/ha, T<sub>4</sub>=N<sub>120</sub> P<sub>80</sub> K<sub>100</sub> S<sub>12</sub> Zn<sub>0.5</sub> B<sub>0.5</sub> kg/ha and T<sub>5</sub>=Control. The soil of the research area belongs to the Chhahata series under AEZ-28. The meteorological data of the experimental site revealed that the highest temperature prevails in March-April and the lowest in December to January. Maximum rainfall was received during the months of March. The crop received 133 mm rain showers from November to March in 2022-23 years. The experiment was laid out in a randomized complete block design with three replications and the unit plot size was 6m × 3m. Seeds (BARI Chia-1) were sown on 5 December, 2021 and on 24 November, 2022 at Gazipur and on

27 November, 2021 and on 15 November, 2022 at Jashore. Data on growth parameters like leaf area and dry matter accumulation were measured at different dates with 15 days' interval. Different plant parts of the collected samples were separated and then oven dried at 80°C for 72 hours. Leaf area was measured by an automatic leaf area meter (L13100 c, LICOR, USA). The yield component data was collected from randomly selected ten plants prior to harvest from each plot. At harvest, the yield data was recorded plot wise. Data were analyzed statistically and means were compared using LSD test at 5% level of significance.

Maximum LAI (3.29) was recorded at 60 DAE in T<sub>4</sub> (N<sub>120</sub>P<sub>80</sub>K<sub>100</sub>S<sub>12</sub>kg/ha) treatment followed by T<sub>3</sub> (N<sub>90</sub>P<sub>60</sub>K<sub>75</sub>S<sub>10</sub>kg/ha) and T<sub>2</sub> (N<sub>60</sub>P<sub>40</sub>K<sub>50</sub>S<sub>8</sub>N<sub>120</sub>P<sub>80</sub>K<sub>100</sub>S<sub>12</sub>kg/ha) treatment. The lowest leaf area index (2.83) was found at 60 DAE in T<sub>5</sub> treatment followed by T<sub>1</sub> treatment. The pattern of TDM accumulation in chia over time was influenced by different fertilizer levels in two years pooled data only at Gazipur. The highest (1121g/m<sup>2</sup>) TDM accumulation/m<sup>2</sup> was obtained from T<sub>4</sub> (N<sub>120</sub>P<sub>80</sub>K<sub>100</sub>S<sub>12</sub>kg/ha) at 90 DAE and it was higher throughout the growing period except at 30 and 45 DAE followed by T<sub>3</sub> treatment. The lowest TDM (510.36 g/m<sup>2</sup>) was recorded in T<sub>5</sub> treatment.

Significantly the highest number of inflorescences/plant (16) was recorded in T<sub>4</sub> (N<sub>120</sub>P<sub>80</sub>K<sub>100</sub>S<sub>12</sub>Zn<sub>0.5</sub>B<sub>0.5</sub>kg/ha) treatment which was statistically similar to T<sub>2</sub> and T<sub>3</sub> treatments and the lowest (9) in T<sub>5</sub> treatment. Similar trend was observed in floret/inflorescence, seed/inflorescence (no.). The highest 1000-grain weights (1.23g) was recorded from T<sub>4</sub> treatment, which was statistically identical to T<sub>2</sub> and T<sub>3</sub> treatments. The lowest 1000-grain weights (0.86g) were recorded in T<sub>5</sub> (Control) treatment. Significantly the highest chia yield (1115.06kg/ha) were recorded in T<sub>4</sub>(N<sub>120</sub>P<sub>80</sub>K<sub>100</sub>S<sub>12</sub>Zn<sub>0.5</sub>B<sub>0.5</sub>kg/ha) which was statistically similar with all other treatments except T<sub>5</sub> and T<sub>1</sub> treatments. Among the treatments, the highest gross return (Tk.223011/ha) was observed in T<sub>4</sub> treatment (N<sub>120</sub>P<sub>80</sub>K<sub>100</sub>S<sub>12</sub>Zn<sub>0.5</sub>B<sub>0.5</sub>kg/ha) and it was close to T<sub>3</sub> (N<sub>90</sub>P<sub>60</sub>K<sub>75</sub>S<sub>10</sub>Zn<sub>0.5</sub>B<sub>0.5</sub>kg/ha). The highest cost of cultivation (Tk.60804/ha) was recorded in T<sub>4</sub> treatment which was close to T<sub>3</sub> (N<sub>90</sub>P<sub>60</sub>K<sub>75</sub>S<sub>10</sub>Zn<sub>0.5</sub>B<sub>0.5</sub>kg/ha) due to involvement of higher fertilizer rates and labor costs for cultivation. Among the treatments, the highest

benefit cost ratio (4.18) was obtained from T<sub>2</sub> (N<sub>60</sub>P<sub>40</sub>K<sub>50</sub>S<sub>8</sub>Zn<sub>0.5</sub>B<sub>0.5</sub>kg/ha) which was similar to T<sub>3</sub> (N<sub>90</sub>P<sub>60</sub>K<sub>75</sub>S<sub>10</sub>Zn<sub>0.5</sub>B<sub>0.5</sub>kg/ha) treatments (3.80). T<sub>2</sub> (N<sub>60</sub>P<sub>40</sub>K<sub>50</sub>S<sub>8</sub>Zn<sub>0.5</sub>B<sub>0.5</sub>kg/ha) and T<sub>3</sub> (N<sub>90</sub>P<sub>60</sub>K<sub>75</sub>S<sub>10</sub>Zn<sub>0.5</sub>B<sub>0.5</sub>kg/ha) treatments were found as the most suitable dose for obtaining higher yield and economic benefit in chia cultivation.

#### Determination of seed rate and row spacing for potential yield of chia

J.A. Chowdhury, A.A. Begum, S.S. Kakon, M.R. Karim, S.T. Zannat and M.A.H.S. Jahan

The field experiment was conducted at the Research Field of Agronomy Division, Bangladesh Agricultural Research Institute, Gazipur during *rabi* season of 2021-2022 and 2022-2023 to determine optimum seed rate and row spacing for potential yield of chia seeds. The experiment consisted of 9 treatment combinations are as: S<sub>1</sub>R<sub>1</sub>= 4 kg seed/ha with 30 cm spacing, S<sub>1</sub>R<sub>2</sub>= 4 kg seed/ha with 40 cm spacing, S<sub>1</sub>R<sub>3</sub>= 4 kg seed/ha with 50 cm spacing, S<sub>2</sub>R<sub>1</sub>= 5 kg seed/ha with 30 cm spacing, S<sub>2</sub>R<sub>2</sub>= 5 kg seed/ha with 40 cm spacing, S<sub>2</sub>R<sub>3</sub>= 5 kg seed/ha with 50 cm spacing, S<sub>3</sub>R<sub>1</sub>= 6 kg seed/ha with 30 cm spacing, S<sub>3</sub>R<sub>2</sub>= 6 kg seed/ha with 40 cm spacing, S<sub>3</sub>R<sub>3</sub>= 6 kg seed/ha with 50 cm spacing. The experiment was laid out in a RCB design with three replications. The unit plot size was 4 m × 3 m. The crop was fertilized with 60-15-30 -5 N-P-K-S kg/ha, respectively (Karim *et al.*, 2015). The seeds were sown on 22 November 2021 and 24 November 2022 and harvested on 29 March 2022 and 16 March 2023. Data of plant population was recorded from three places of 1 m<sup>2</sup> area of each treatment. Yield components were recorded from 10 randomly selected plants. Yield data 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.

The highest plant population was obtained when 6 kg/ha seeds were sown with 30 cm spacing (T<sub>7</sub> treatment). Plant population was higher in lower spacing in all seed rate. That means in higher spacing plant population is lower than lower spacing because in higher spacing plant density is relatively higher within a row which caused mortality of some plant than lower spacing. Such observations have been recorded for other crop species as well (De Bruin & Pedersen, 2008) suggesting decrease in the plant population by

increasing row spacing caused by the intra-row competition between plants. The maximum number of inflorescences/plant (15), floret/inflorescences (13) and seed/inflorescences (390) were obtained from T<sub>1</sub> treatment (4 kg/ha seed with 30 cm spacing). The lowest number of these parameter was obtained from T<sub>9</sub> treatment (6 kg/ha seed with 50 cm spacing). 1000 seed weight of different treatment ranges from 1.88 to 1.37 gm. The largest size of seed (1000 seed wt. 1.88 g) was produced from T<sub>4</sub> treatment (5 kg/ha seed with 30 cm spacing) whereas the smallest size seed (1000 seed wt. 1.37g) was produced from T<sub>9</sub> treatment (6 kg/ha seed with 50 cm spacing). There are reports of thousand seed weight ranging from 1.21 grams to 1.31 grams, in field trials in Argentina (Rovati *et al.*, 2012). The highest seed yield (1138kg/ha) was found from T<sub>7</sub> treatment when seed was sown with 6 kg/ha with 30 cm spacing might be due to highest plant population which was statistically similar with t<sub>4</sub> treatment (5 kg/ha seed with 30 cm spacing). The lowest seed yield (774.89 kg/ha) was recorded with 4 kg seed/ha and 50 cm row spacing might be due to lower number of plant population, inflorescences/plant and seed/inflorescences. These findings agree with Wojahn *et al.* (2018). Results revealed that 30 cm row spacing and 5 kg seed/ ha requiring the least inputs, were found to be the optimum, among the tested seed rates and row spacing levels, for better yield of chia.

#### **Effect of irrigation on growth and yield of chia**

D.A. Choudhury, S.S. Kakon and M.A.H.S. Jahan

The field experiment was conducted at Agronomy Research Field of Bangladesh Agricultural Research Institute during *rabi* season of 2022-2023 to assess the growth and yield of chia crop under irrigation management. Treatments included in the experiment were: I<sub>0</sub>=No irrigation, I<sub>1</sub>=Irrigation at vegetative stage, I<sub>2</sub>=Irrigation at vegetative stage+ flower initiation stage and I<sub>3</sub>=Irrigation at vegetative stage+ flower initiation stage +florete formation stage. The experiment was laid out in a randomized complete block design with three replications and the unit plot size was 6m × 3m. The crop was fertilized with 60-15-30 -5 N-P-K-S kg /ha, respectively (Karim *et al.*, 2015). Data on different parameters were subjected to analysis of variance and the treatment means were compared by Least Significant Difference (LSD) test. Economic analysis was also done.

The highest number of inflorescences/plant (16) was recorded in I<sub>3</sub> (Irrigation at vegetative stage+ flower initiation stage +florete formation stage) treatment which was similar to I<sub>2</sub> treatment and the lowest (11) in I<sub>0</sub> (Control) treatment. Treatment I<sub>3</sub> (Irrigation at vegetative stage+ flower initiation stage +florete formation stage) produced the highest 1000-grain wt. (1.26 g) which was followed by I<sub>2</sub> and the lowest 1000-grain wt. (0.94) was recorded in I<sub>0</sub> treatment. Significantly the highest chia yield (1135 kg/ha) was recorded in I<sub>3</sub> (Irrigation at vegetative stage+ flower initiation stage +florete formation stage) which was statistically similar to I<sub>2</sub> treatment and the lowest yield (480 kg/ha) in I<sub>0</sub> treatment. Similar results have been reported by Chakraborty *et al.* (2021). the highest gross return (Tk.226986.67 /ha) and gross margin (Tk.174196/ha) were observed in I<sub>3</sub> treatment. The highest cost of cultivation (Tk.52790.16/ha /ha) was recorded in I<sub>3</sub> treatment due to involvement of higher number of irrigation and labor costs for cultivation. Among the treatments, the highest benefit cost ratio (4.54) was obtained from I<sub>2</sub> which was followed by I<sub>3</sub> (4.30) treatment. Results revealed that irrigation at vegetative stage+ flower initiation stage and irrigation at vegetative stage+ flower initiation stage +florete formation stage might be suitable irrigation level for obtaining higher yield and economic benefit in chia cultivation.

#### **Effect of fertilizer dose and variety on the yield and yield attributes of sunflower in Rangpur region**

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The experiment was conducted at RARS, Burirhat, BARI, Rangpur during *rabi* season of 2022-2023 to find out the best fertilizer dose and variety for optimum yield of sunflower and higher economic return in Rangpur region. The experiment was laid out in split plot design with three replications Four fertilizer doses viz T<sub>1</sub>: Recommended dose (RD: 90-35-85-30-3.6- 1.8 of N-P-K-S-Zn-B kg/ha respectively), T<sub>2</sub>: 30% more than RD, T<sub>3</sub>: 40 % more than RD and T<sub>4</sub>: Farmer dose (FD: 70-25-65-20of N-P-K-S) in the sub plot and varieties of sunflower such as V<sub>1</sub>: BARI Shurjomukhi-2 and V<sub>2</sub>: BARI Shurjomukhi-3 in the main plot were used in the experiment. Fifteen



days before sowing dolochun (4 kg/decimal) were applied due to low pH (5.05). Seeds were sown on 27 November, 2022. Unit plot size was 3.5m × 4m at the spacing of 50cm × 25cm. Fertilizers were applied as per treatment combinations. Full amount of triple super phosphate, muriate of potash, gypsum, zinc oxide, boric acid and half of urea were broadcasted at the time of final land preparation. The rest half of urea was applied in equal two splits at 30 & 55days after sowing (DAS). The crop was harvested at maturity from 16 March to 23 march, 2023 Data on yield and yield contributing characters were recorded and analyzed statistically using Statistics 10 program.

Fertilizer dose and variety had significant effect on the yield and yield attributes. Significantly higher yield (2.28 t/ha) was obtained from V<sub>1</sub> (BARI Shurjomukhi-2) with T<sub>3</sub> (40% more than RD) followed by V<sub>1</sub>T<sub>2</sub> (BARI Shurjomukhi-2 with 30 % more than RD), V<sub>1</sub> T<sub>1</sub> (BARI Shurjomukhi-2 with recommended fertilizer dose) treatments. The lowest seed yield was obtained from V<sub>2</sub> T<sub>4</sub> (BARI Shurjomukhi-3 with farmer dose). Supply of sufficient amount of nutrients necessary for better growth and plant development which resulted in higher yield due to plant height (203.47cm), stem diameter (8.14cm), head diameter (19.77cm), number of seed/head (681.67) and 100 seed wt. (6.88g). BARI Shurjomukhi-2 (V<sub>1</sub>) gave the higher yield than BARI Shurjomukhi-3 (V<sub>2</sub>) irrespective of fertilizer dose. BARI Shurjomukhi-2 had less seed gap in the middle of the head and that was only 2.68 to 3.57% head of sunflower. The rest of the head of BARI Shurjomukhi-2 were full of seed. On the other hand, we observed that more gap in the middle of the head of BARI Shurjomukhi-3 and that was 96.43 - 97.33%. Only 2.67 to 3.57% of the head of BARI Shurjomukhi-3 was full with seed. The maximum gross return (Tk.182400. ha<sup>-1</sup>) was obtained from BARI Shurjomukhi-2 with 40 % more than RD (V<sub>1</sub>T<sub>3</sub>) and the lowest from BARI Shurjomukhi-3 with farmer dose. But the highest benefit cost ratio (1.86) was recorded from V<sub>1</sub>T<sub>1</sub> and the lowest from V<sub>2</sub>T<sub>4</sub>. The result of the experiment revealed that fertilizer dose and variety had significant effect on the yield. The highest seed yield (2.28 tha<sup>-1</sup>) was observed from BARI Shurjomukhi-2 with 40% more than recommended dose (V<sub>1</sub>T<sub>3</sub>).

### Effect of folic acid as seed treating chemical on growth and yield of sunflower

M. R. Karim, J.A. Chowdhury, A.A. Begum, S.S. Kakon, M.Z. Ali and M.A.H.S. Jahan

The experiment was conducted at the Research Field of Agronomy Division BARI, Gazipur (AEZ 28) to find out the effect of seed treatment with folic acid on growth and yield of sunflower. Five treatments viz. T<sub>1</sub> = No folic acid, T<sub>2</sub> = 25 µM folic acid, T<sub>3</sub> = 50 µM folic acid, T<sub>4</sub> = 75 µM folic acid and T<sub>5</sub> = 100 µM folic acid were laid out in a RCB design with 3 replications. The unit plot size was 3.0 m x 3.0 m. BARI Surjomukhi-3 as experimental materials were sown with 50 cm × 25 cm spacing. Fertilizer application and all other intercultural operations were done as per crop requirement. Data on phenotypic and yield contributing characters were collected and statistically analyzed with R.

The highest plant height was found in T<sub>2</sub> (100 cm) which is statistically similar with all other treatments. It means seed treatment with folic acid has no or less effect on plant height of sunflower. The highest head diameter was found in T<sub>2</sub> (13.35 cm) which was statistically similar with all other treatments except T<sub>3</sub> in which the lowest diameter (11.37) was found. It means seed treatment with folic acid has no or less effect on head diameter of sunflower. The highest seed per head was found in T<sub>5</sub> (547 no.) which was statistically similar with all other treatments except T<sub>1</sub> in which the lowest seed per head (428) was found. It means seed treatment with folic acid has significant effect on seed per head of sunflower. The highest thousand seed weight was found in T<sub>4</sub> (56.51 g) which was statistically similar with all other treatments except T<sub>1</sub> in which the lowest thousand seed weight (46.68 g) was found. It means seed treatment with folic acid has significant effect on seed weight of sunflower. The highest seed yield was found in T<sub>5</sub> (2.27 t/h) which is statistically similar with all other treatments except T<sub>1</sub> in which the lowest seed yield (1.60 t/ha) was found. It means seed treatment with folic acid has significant effect on seed yield of sunflower. Seed treatment with folic acid has no or less effect on plant height and head diameter but has significant effect on seed per head, seed weight and seed weight of sunflower. So, seed treatment with folic acid may increase yield of sunflower.

### Nutrient management in sunflower for Rangpur region

M.A.I. Sarker, A.K. Saha and M.A.H.S. Jahan

The experiment was conducted at RARS, Burirhat, Rangpur during *rabi* season of 2022-23 to determine the nutrient management practices on the productivity and economic of sunflower. The soil of the experimental field belongs to the agro-ecological zone of Tista Meander Floodplain Soil. The experiment consisted of 6 treatments viz. T<sub>1</sub>: Fertilizer dose on STB, T<sub>2</sub>: IPNS based on STB with 1.5 t/ha Poultry manures (PM), T<sub>3</sub>: IPNS based on STB with 3.0 t/ha Poultry manures (PM), T<sub>4</sub>: IPNS based on STB with 1.0 t/ha vermicompost, T<sub>5</sub>: IPNS based on STB with 3.0 t/ha vermicompost and T<sub>6</sub>: RFD (120-42-80-28-3-2 NPKSZnB kg/ha and 5 t/ha CD) + 20% extra than RFD, (FRG, 2018). The design was RCB with three replications and the unit plot size was 4m × 3.5m. The var. BARI Surjamukhi-3 was used in this experiment. Seeds of sunflower were sown on 25 November 2022 in line with spacing of 50 cm x 25 cm. Half of urea and all of the fertilizers were applied at the time of final land preparation. The remaining urea was divided into two equal parts and applied in two separate applications. At 25 days after sowing (DAS), half of the urea was applied as top dressing, and the remaining urea was applied at 45 DAS. Data on yield contributing characters of sunflower were taken from randomly selected 5 plants from each plot. Yield of the crop was taken from whole plot area. Sunflower was harvested at 22 March 2023. Data were compiled and analyzed with STAR version 2.0.1 (Statistical Tool for Agricultural Research; 2014) package program and mean separation was done with the help of Least Significant Difference (LSD) Test.

Yield and yield contributing characters of sunflower varied significantly due to different nutrient management. The highest plant height (83.03 cm) was found in T<sub>6</sub> treatment which was statistically identical with T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> treatments and the lowest (75.00 cm) from T<sub>1</sub> treatment. Head diameter showed all most similar result as like as plant height. Treatment T<sub>6</sub> showed the highest number of seed/head (609.) which was statistically similar with T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> treatments. The highest weight of seed/plant and 1000 seed weight were found in T<sub>6</sub> treatment and it was statistically similar with T<sub>4</sub> and T<sub>5</sub> treatments. The highest seed yield (1.94 t/ha) was found with T<sub>6</sub> followed by T<sub>5</sub>

(1.90 t/ha) treatment. Treatments T<sub>6</sub> produced the highest yield might be due to the effect of highest value of number of seeds/head, seed weight /plant and 1000 seed weight. Moreover 20% extra nutrient enhanced the yield contributing parameters. Significantly the lowest seed yield was found in T<sub>1</sub> treatment which was statistically identical with T<sub>2</sub> treatment. The highest gross return (Tk. 164536/ ha) was recorded from T<sub>6</sub> treatment and the lowest (Tk. 112200/ha) from T<sub>1</sub> treatment. The highest total cultivation cost was recorded from T<sub>6</sub> which might be due to higher fertilizer cost. The highest net return (Tk. 88989/ha) as well as MBCR (2.47) were obtained from T<sub>4</sub> treatment (IPNS with 1.0 t/ha vermicompost). It might be due to cultivation cost of T<sub>4</sub> treatment was lower than that of T<sub>5</sub> and T<sub>6</sub> treatments. The treatment T<sub>6</sub> (2.01) gave the lowest MBCR. Result revealed that IPNS with 1.0 t/ha vermicompost (T<sub>4</sub> treatment) would be economically the optimum fertilizer dose for sunflower cultivation.

### Effects of spacing and fertilizer dose on transplanted sunflower under zero tillage condition in Barishal region

M.A. Rahman, M.M. Rahman and M. Ahmed

The experiment was conducted at RARS, BARI, Rahmatpur, Barishal during *rabi* season of 2021-22 and 2022-2023 to find out the optimum spacing and fertilizer dose for getting higher yield of T. sunflower under zero tillage condition. Treatment of the experiment consisted of two factors viz., Factor A. Three spacing (S<sub>1</sub> = 50 cm x 25 cm, S<sub>2</sub> = 40 cm x 25 cm and S<sub>3</sub> = 30 cm x 25 cm) and Factor B. Four doses of fertilizer (F<sub>1</sub> = 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 (BARC, 2018); F<sub>2</sub> = RD + 10% RD; F<sub>3</sub> = RD + 20% RD and F<sub>4</sub> = RD + 30% RD). The sunflower seedlings were transplanted under zero tillage condition just after harvest of T. *aman* rice. The experiment was laid out in randomized complete block design with three replications. Seedlings of 14-day old of open pollinated variety namely BARI Surjomukhi-2 were transplanted as per treatment specifications. Data were analyzed statistically using windows-based computer software of Statistix 10 version and then the mean differences were adjudged with Duncan's Multiple Range Test (DMRT).

In 2021-22, all the studied plant characters of sunflower differed statistically significantly due to interaction of plant spacing and fertilizer dose. Number of seed/head (filled) was the highest (605.68) in  $S_3F_2$  combination and it was statistically similar with  $S_2F_1$  (599.32),  $S_2F_2$  (517.30) and  $S_2F_3$  (511.59). Interaction of  $S_3F_4$  gave the lowest number of seed/head (355.51). The yield of seed reached to the highest (2665 kg/ha) due to application of  $S_2F_4$  treatment combination and it was statistically similar to that of  $S_2F_2$  interaction (2664 kg/ha). Similar yields were also obtained from the interactions of  $S_2F_3$  (2575 kg/ha),  $S_3F_3$  (2531 kg/ha),  $S_3F_2$  (2476 kg/ha) and  $S_1F_3$  (2400 kg/ha). Combination of  $S_1F_1$  produced the lowest yield of seed (1856 kg/ha). In 2022-23, the highest number of plants was observed in treatment  $S_3F_4$  (12.25) and lowest in treatment  $S_1F_1$  (7.06). Number of seed/head (filled) was the highest (546.44) in  $S_1F_3$  combination which was statistically similar with  $S_1F_4$  (482.33),  $S_2F_2$  (450.63) and  $S_2F_3$  (477.98) combinations. Interaction of  $S_3F_1$  gave the lowest number of seed/head (299.93). Weight of 1000-seed was found in statistically non-significant. The yield of seed reached to the highest (2284 kg/ha) due to application of  $S_2F_3$  treatment combination and it was statistically similar to that of  $S_2F_2$  combination (2664 kg/ha). Similar yields were also obtained from the combinations of  $S_2F_3$  (2161 kg/ha),  $S_3F_4$  (2196 kg/ha) and  $S_2F_1$  (2024 kg/ha). Interaction of  $S_1F_1$  produced the lowest yield of seed (1547 kg/ha). Results revealed that sunflower seedling (14-day old) transplanted with spacing of 40 cm x 25 cm ( $S_2$ ) as well as fertilizer dose RD + 20% RD ( $F_2$ ) or RD + 30% RD ( $F_3$ ) may produce higher yield.

Among the treatment interactions,  $S_2F_4$  gave the highest gross return of Tk. 194427/ha. The lowest gross return was found in  $S_1F_1$  (Tk. 54196/ha). The gross margin exhibited the highest value (Tk. 104020/ha) by  $S_2F_3$  combinations that was close to those combinations of  $S_2F_4$  (Tk. 103089/ha),  $S_2F_2$  (Tk. 103662/ha) and  $S_3F_3$  (Tk. 97510/ha). The lowest margin was obtained from  $S_1F_1$  (Tk. 54196/ha). Results revealed that sunflower seedling transplanted with the application of  $S_1F_3$  treatment combinations was more profitable than that of other treatment combinations. Sunflower can be cultivated through seedling (14-day old) transplanting with plant spacing 40 cm x 25 cm

along with 10-20% more RD (RD: 200-180-170-170-10-12 kg/ha) in Barishal region.

### **Improvement of lentil productivity through increasing potassium (K) fertilizer**

M.R. Islam and M.M. Uddin

The field experiment was executed at Regional Agricultural Research Station, Ishwardi, Pabna, Bangladesh to know the effect of K on productivity of lentil under late and optimum sown condition. The trial was conducted in a split-plot design with three replications. Two sowing time were placed in the main plots as Factor A: viz. i) Nov 15, ii) Dec 15, whereas five potassium fertilization levels were placed randomly in the sub-plots as Factor B: 1) Recommended fertilizer dose (RFD), 2) RFD + 25% additional K, 3) RFD + 50% additional K, 4) RFD + 75% additional K and 5) RFD + 100% additional K. The fertilizers were applied @ 21-18-20-10-2 kg ha<sup>-1</sup> of N-P-K-S-B (BARI, 2019) in the form of urea, triple super phosphate, gypsum, and boric acid, respectively. Potassium (K) fertilizer was incorporated in soil as per treatments in the form of muriate of potash. The full amount of N-P-K-S-B were applied during final land preparation. Lentil seeds were sown in continuous seeding maintaining 30 cm line apart row at the seed rate of 40 kg ha<sup>-1</sup>. Plots were kept weed free for whole growing period. No irrigation was done during the crop growing period. Lentil was harvested at 13 -15 March in optimum sown condition, and 20-23 March in late sown condition, respectively. Data on growth, bio-physiological, yield and yield contributing traits were recorded, and analyzed statistically with the help of 'R' program. Mean separation was done by LSD at 5% level of significance.

Relative water content (RWC), total chlorophyll (Tchl) and Proline content (mg g<sup>-1</sup> FW) was affected by the incorporated different K levels in lentil under both late and optimum sown condition. Higher RWC and Tchl were obtained in optimum sown condition than late sown, which was 3%-6% and 26.49%-31.88% depending on different treatments. Increase K fertilizer with RFD ( $T_2$ - $T_5$ ) increase the RWC and Tchl in both the condition, which was 1.0, 1.5, 1.9, 2.2% and 3, 5, 8, 9% in optimum sown, and 2.48, 3.35, 4.80, 5.32% and 3, 7, 13, 18% in late sown, respectively. Proline content significantly increased under late sown condition than optimum sown condition which was



51%-72% depending on different treatments. Data revealed that increasing K fertilizer reduced a considerable amount of proline accumulation under late sown condition. This means it alleviate the terminal heat stress of lentil. However, application of additional K fertilizer under optimum and late sown condition @ 25, 50, 75, and 100 % with RFD significantly reduced the proline content of 3%, 7%, 11%, 15%, 34%, and 15%, 25%, 27%, 29% in the treatment T<sub>2</sub>-T<sub>5</sub>, respectively.

Late sowing considerably reduced the traits values compared to optimum sowing, and the lentil plants that received more K (25%-100%) positively improve the traits performance in both sown conditions. Besides, seed yield was also considerably varied due to sowing time, increasing potassium levels and their interaction. The maximum seed yield was recorded in optimum sown condition than late and optimum sown, and the difference was 0.96-1.05 t ha<sup>-1</sup> depending on different treatments. However, increase of K at 25, 50, 75 and 100% more with RFD positively influenced the seed yield of lentil, which showed 5, 8, 10, 11% higher yield in optimum sown and 3, 8, 9, 11% higher in late sown condition, respectively. The increase in the seed yield was mainly associated with improves the growth, bio-physiological and yield characters due to applied additional K with RFD. Potassium fertilizer improves the plant water status, chlorophyll content, and alleviates the terminal heat stress through accumulation of proline content. Consequently, improve the productivity of lentil under late and optimum sown condition.

#### **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 and M.H. Hossain

The experiment was conducted at Regional Agricultural Research Station, Akbarpur, Moulvibazar during the *kharij*-II season of 2022-23 to know the yield performance and popularize BARI blackgram varieties in semi hilly Moulvibazar area. The soil belongs to the “Khadimnagar” soil series sandy loam in texture having moderate organic matter content (1.45%), N 0.80%, K 0.07m mol100<sup>-1</sup>g of soil, P was 25 µg<sup>-1</sup> of soil and S was 10µg<sup>-1</sup> of soil with P<sup>H</sup> value 4-5. Five blackgram varieties viz. BARI Mash-1, BARI Mash-2, BARI Mash-3,

BARI Mash-4 and Local variety were sown on 22 September, 2022. Seeds were sown in line with 30cm line spacing. Unit plot size was 3.0 m × 3.0 m. The experiment was laid out RCB Design with 3 replications. Fertilizers were applied as basal at 40-85-40-50 kg ha<sup>-1</sup>, of N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, S, in the form of Urea, TSP, MOP, Zypsum and 10 tha<sup>-1</sup> well decomposed cowdung, respectively. Weeding was done at 20 days after emergence of the crop. The disease and insects were controlled properly. Grain yield was calculated from the whole plot technique. Yield and yield contributing characters were taken from 10 randomly selected plants from the middle rows of each plot. Data on different parameters were subjected to analysis of variance and the treatment means were compared by Least Significance Difference (LSD) test.

All the BARI released varieties took the same period for initiation which was 5 DAS and took the 68-74 DAS to attain the physiological maturity. Number of pods plant<sup>-1</sup>, pod length, no of seed pod<sup>-1</sup>, plant population m<sup>-2</sup> and seed yield at harvest were significantly different among the variety. The highest number of pods per plant was recorded in BARI Mash-4 (48.55) while the lowest (24) was in local variety. The highest pod length was recorded in BARI Mash-4 (5.45) while the lowest (4.27) was recorded in local variety. The highest (7.05) no of seedspod<sup>-1</sup> at BARI Mash-4 was observed and the lowest one was 5.7 at local variety. The highest no of plant population m<sup>-2</sup> was recorded in BARI Mash-4 (41) and the lowest (32) was recorded in local variety. The highest yield was recorded in BARI Mash-4 (1.80tha<sup>-1</sup>) while the lowest (0.91 tha<sup>-1</sup>) was recorded in local variety. The result revealed that BARI Mash-4 followed by BARI Mash-3 could be recommended for the Moulvibazar area under rainfed condition.

#### **Influence of foliar application of boron and humic acid on yield of blackgram at acid soil of Moulvibazar**

M.A.M. Miah, S.S. Nasreen, M.S. Alam, M. Shaheenuzzamn and M.H. Hossain

The experiment was conducted at RARS, Akbarpur, Moulvibazar during the *kharij*-II season of 2022-23 to observe the influence of boron (B) and humic acid (H) on the seed yield and yield contributing character of blackgram. The soil belongs to the “Khadimnagar” soil series sandy loam in texture having moderate organic matter content (1.45%), N

0.80%, K 0.07m mol  $100^{-1}$ g of soil, P was  $25 \mu\text{g g}^{-1}$  of soil and S was  $10 \mu\text{g g}^{-1}$  of soil with  $\text{pH}$  value 4-5. Annual rainfall was 256cm at the experimental site. There were 16 treatment combinations comprising four levels each of Boron (0, 0.5, 1, 2 g/L) and Humic acid (0, 0.5, 1, 2 g/L) along with a recommended fertilizer dose. Blackgram seeds were sown on 22 September, 2022. Seeds were sown in line with 30cm line spacing. Unit plot size was 3.0 m  $\times$  3.0 m. The variety was BARI Mash-3. The experiment was laid out in RCB Design with 3 replications. Fertilizers were applied as basal at 40-85-40-50  $\text{kg ha}^{-1}$ , of N,  $\text{P}_2\text{O}_5$ ,  $\text{K}_2\text{O}$ , S, in the form of Urea, TSP, MOP, Zypsum and 10  $\text{tha}^{-1}$  well decomposed cowdung, respectively. Weeding was done at 20 days after emergence of the crop. The disease and insects were controlled properly. Grain yield was calculated from the whole plot technique. Yield and yield contributing characters were taken from 10 randomly selected plants from the middle rows of each plot.

The highest plant height (41.33 cm) was recorded with the dose  $T_{13} = B_{2.0} \times H_{2.0}$  and lowest (26.8cm) in  $T_8 = B_{0.5} \times H_0$ . Days to maturity was highest (74) with  $T_{13} = B_{2.0} \times H_{2.0}$  and lowest (70) for  $T_1 = B_0 \times H_0$ . Number of pod per plant was highest (32.8) with the dose  $T_9 = B_{1.0} \times H_{1.0}$  and lowest (10.53) in  $T_5 = B_{0.5} \times H_{0.5}$ . The highest shoot dry weight was found (12.08g) for the treatment  $T_9 = B_{1.0} \times H_{1.0}$  and the lowest shoot weight (3.59g) in  $T_8 = B_{0.5} \times H_0$ . The highest root dry weight was recorded in (0.34g) for the treatment  $T_9 = B_{1.0} \times H_{1.0}$  and the lowest value recorded (0.14) for  $T_8 = B_{0.5} \times H_0$ . The highest 1000 seed weight (55.33g) was in the treatment  $T_9 = (B_{1.0} \times H_{1.0})$  and lowest 42.67g in control condition. The highest seed yield ( $1.61 \text{tha}^{-1}$ ) was obtained from  $T_9 = B_{1.0} \times H_{1.0}$  and lowest ( $1.09 \text{tha}^{-1}$ ) from  $T_8 = (B_{0.5} \times H_0)$ . The highest biomass yield was ( $2.40 \text{tha}^{-1}$ ) from the treatment  $T_9 = B_{1.0} \times H_{1.0}$  and the lowest biomass yield was recorded ( $1.64 \text{tha}^{-1}$ ) in the treatment  $T_8 = (B_{0.5} \times H_0)$ . The combination of 1.0g per liter boron and 1.0g per liter humic acid might be considered as an optimum dose for black gram cultivation in acidic soil of Moulvibazar area.

#### **Effect of plant spacing on the yield of mukhikachu at Moulvibazar**

M.A.M. Miah, M. Samsuzzaman, M.S. Alam, and M.H. Hossain

The experiment was carried out at RARS, Akbarpur during March-November 2022 to find out

the optimum plant spacing for maximum yield of mukhikachu. The crop was planted following RCB design with 3 replications at 24 March, 2022. The soil with pH value 4-5. The unit plot size was 3 m  $\times$  4.5 m maintaining line to line distance 60 cm and plant to plant distance 45 cm in general condition. But here four spacing such as 60cm $\times$ 30cm, 60cm $\times$ 35cm, 60cm $\times$ 40cm and 60cm $\times$ 45cm. The crop was fertilized with a dose of 275-125-250-125-14-10  $\text{kg ha}^{-1}$  of N,  $\text{P}_2\text{O}_5$ ,  $\text{K}_2\text{O}$ , S, Zn, B, in the form of Urea, TSP, MOP, Zypsum, Zinc sulphate, Boric Acid respectively and 10  $\text{tha}^{-1}$  of cowdung. Half of MOP and full dose of TSP, Gypsum, Zinc sulphate, Boric acid and cowdung were applied in plot during the final land preparation. Rest of MOP and half of urea were top dressed at 60 days after planting (DAP) and the rest half of urea was applied at 90 DAP. Other intercultural operations were done as per schedule. The disease and insect's infestation were controlled properly. Data were collected properly. Total tuber yield was calculated from the whole plot technique. Yield and yield contributing characters were taken from 10 randomly selected plants from the middle rows of each plot. The data were calculated by statistix-10 statistical software.

Plant height was increased with the advancement of time but it was minimum in 90 and maximum in 150 days after planting (DAP). In 150 DAP; the highest length of the biggest leaf 60cm $\times$ 40cm spacing (41.9cm) was obtained in 60cm $\times$ 40cm spacing followed by 60cm $\times$ 30cm (40 cm). The highest breadth of the biggest leaf (30.13cm) was attained in 60cm $\times$ 30cm spacing which was statistically similar with 60cm $\times$ 35cm spacing (30.01cm). The lowest breadth of the biggest leaf (24.8 cm) was observed in 60cm $\times$ 45cm where 60cm $\times$ 35cm spacing was recorded (25.40cm). The data shows that the number of green leaves per plant was obtained mostly varied 2.30 to 4.43 in number of four spacing in 90 to 150 days after planting. The highest number of corms per plant (367) was obtained by 60cm $\times$ 35cm spacing on the other hand (250) corm was recorded in 60cm $\times$ 35cm spacing. The weight of corm per plant (8.34kg) was higher in 60cm $\times$ 35cm spacing on the other hand 4.68 kg in 60cm $\times$ 35cm spacing. The range of weight of cormel per plant was 0.92kg to 1.99kg. The results revealed that the highest yield ( $40.00 \text{t ha}^{-1}$ ) was recorded in 60cm $\times$ 35cm spacing on the other hand the lowest yield ( $32 \text{tha}^{-1}$ ) was

obtained from 60cm×45cm spacing. It can be concluded that the plant spacing 60cm×35cm would be optimum (yield 40.00  $\text{tha}^{-1}$ ) for Mukhikachu in Moulivibazar.

### Effect of planting time on the yield of onion varieties at Dinajpur

M.M. Khanum, M.S. Huda, M.Z. Ali, S.S. Kakon and M.A.H.S. Jahan

The experiment was conducted at the research field of Agricultural Research Station, Bangladesh Agricultural Research Institute (BARI), Rajbari, Dinajpur during *rabi* season of 2022-23. The experiment was laid out in a randomized complete block design with three replications with the objectives to find out the suitable variety and optimum seedling transplanting time on the yield of onion bulb. The unit plot size was 4.8  $\text{m}^2$  (4m×1.2m) and spacing 15cm×10cm were maintained. This factorial experiment comprising: A. Two varieties viz.  $V_1$ = BARI Piaz-4,  $V_2$ = BARI Piaz-6 and B. Four planting time viz.  $P_1$ =10 December,  $P_2$ =30 December  $P_3$ =10 January and  $P_4$ = 30 January. The soil was fertilized with  $N_{150}P_{45}K_{60}S_{30} Zn_2B_2 \text{ kg ha}^{-1}$  and cow dung 3  $\text{t ha}^{-1}$  (BARC, 18). The entire amount of cowdung, P, S, Zn, B and half of N and K were applied at the time of final land preparation. The remaining N and K were top dressed in equal two splits at 25 and 50 days after planting (DAP) followed by irrigation. The crops were weeded two times at 20 and 35 DAP and loosened the soil one time after the irrigation, while five times sprayed with Rovral 50 WP, Ridomil gold, Amistar top 325 SC for controlling purple blotch (*Alternaria porri*) and leaf burn diseases (*Fusarium oxysporum*) as well as Tido plus, confidor and Vertimec were done to control thrips and mite.

Transplanting seedlings on December 10 with the variety BARI Piaz-4 demonstrated the maximum plant height (56.70 cm) significantly followed by December 10 × BARI Piaz-6 (55.06 cm). While the combined effect of December 10 × BARI Piaz-4 showed higher number of leaves (9.10) and incidence of bolting (7.5%) and split bulb (11.00%). The higher bulb length (4.83cm), diameter (5.21 cm), individual bulb weight (57.85 g) and bulb yield (19.41  $\text{tha}^{-1}$ ) were noted from December 10 × BARI Piaz-4. The lowest bulb length (3.08cm), diameter (3.11 cm), individual bulb weight (41.18 g) and yield of bulb (10.28  $\text{tha}^{-1}$ )

<sup>1)</sup> were recorded from the combined effects of January 30 × BARI Piaz-6. No incidence of flowering stalks obtained from January 10-30×BARI Piaz-4 and BARI Piaz-6 transplanting might be due to higher temperature prevailing that reduced growth of onion plant. Maximum temperature started rising after 15 December and continued up to the end of crop season.  $V_1P_1$  produced the highest bulb yield might be due to the effect of bulb length, bulb diameter, individual bulb weight. Interaction of varieties and planting dates had significant on plant height, bulb diameter (Alamin *et al.*, 2017). Kandil *et al.* (2013) and Boyhan *et al.* (2009) observed significant variation among the combination of varieties and date of transplanting on incidence of bolting, percent split bulb, bulb weight and yield of onion. The maximum gross return (Tk. 679350  $\text{ha}^{-1}$ ) and the gross margin (Tk. 519100  $\text{ha}^{-1}$ ) were obtained from  $V_1P_1$  which was followed by that  $V_2P_1$  treatment combination. The lowest gross return (Tk. 374850  $\text{ha}^{-1}$ ) and gross margin (Tk. 199900  $\text{ha}^{-1}$ ) was obtained from  $V_2P_4$ . The result revealed that BARI Piaz-4 and BARI Piaz-6 with December 10 planting might be suitable combination for maximum yield of onion.

### Yield performance and storage quality of onion under integrated nutrient management at AEZ-9

M.R. Ali, J. Rahman, M.A.H.S. Jahan and M.M. Kadir

The experiment was conducted at Regional Agricultural Research Station (RARS), Jamalpur during two consequence years 2021-22 and 2022-23 to find the suitable integrated nutrient management for yield performance and storage quality of onion under integrated nutrient management. The experiment consisted of seven treatments viz.,  $T_1$ =Recommended fertilizer dose (FRG, 2018): 70-30-60-24-2-1  $\text{kg/ha}$  NPKSZnB,  $T_2$ = 94-38-75-30-2.5-1.25  $\text{kg/ha}$  NPKSZnB (125% RFD),  $T_3$ = Integrated plant nutrient system (57-20-46-24-2-1  $\text{kg/ha}$  NPKSZnB+ 3  $\text{t/ha}$  poultry manure (PM),  $T_4$ = Integrated plant nutrient system (66-28-53-24-2-1  $\text{kg/ha}$  NPKSZnB+ 3  $\text{t/ha}$  farmyard manure (FYM),  $T_5$ = Integrated p plant nutrient system (30-4-35-24-2-1  $\text{kg/ha}$  NPKSZnB+ 3  $\text{t/ha}$  vermicompost (VC),  $T_6$ = Integrated p plant nutrient system (60-27-57-24-2-1  $\text{kg/ha}$  NPKSZnB+3  $\text{t/ha}$  husk ash and  $T_7$ =Farmers'



practice (69-19.69-40-9 kg/ha NPKS). The treatments were tested in randomized complete block design with 3 dispersed replications. The unit plot size was 3 m × 3 m and spacing 15cm × 10cm. BARI Piaz-4 was used. Seedlings were transplanted on 12 December 2021 onion harvested on 28 March 2022. FYM and N as per treatment and 45-90-30-3-1.4 kg/ha of P-K-S-Zn-B (BARC, 2018). All FYM, P, S, Zn, B and ½ of N and K were applied as basal during final land preparation. The remaining N and K were applied in two equal splits at 25 and 50 DAT. Weeding, irrigation and other intercultural operations were done as and when necessary. Yield was calculated in tons per hectare considering the whole plot as harvest area. Ten plants of onion from each plot were selected randomly to collect data on yield components. The bulb was kept in the laboratory of RARS under ambient room condition for the period of April 2021 to December 2022 and April 2022 to December 2023. Collected data were analyzed statistically with the help of STAR programme.

The result indicated that all the yield attributes were influenced due to integrated plant nutrient management. The tallest plant (50.88 cm) was recorded from IPNS through 3 t/ha poultry manure and the shortest plant (39.17 cm) was found from farmer's practice. Similar trends were found in the case of bulb length, bulb breadth, number of bulb/m<sup>2</sup>, single bulb wt. and bulb weight/m<sup>2</sup>. The highest yield (21.24 t/ha) was achieved from IPNS through 3 t/ha poultry manure and the lowest yield (10.52 t/ha) was recorded from farmer's practice. The highest yield obtained from integrated plant nutrient system through poultry manure because poultry manure contains higher amount of N, P and K than other components. Farmers' practice gave the lowest yield because they used lower amount nutrient. The highest gross return (Tk. 7,43,400/ha), gross margin (Tk. 4,83,033/ha) and benefit cost ratio (2.86) was found from IPNS through 3t/ha poultry manure and the lowest gross return (Tk. 3,68,200/ha), gross margin (Tk. 1,28,177/ha) and benefit cost ratio (1.53) was from farmers' practice. It was found that weight loss had a significant effect on each of the treatments during the storage period. The highest weight loss (84.95%) was achieved from farmers' practice and lowest (64.84%) was achieved from IPNS with 3t/ha poultry manure. It was found that onion dry matter and onion bulb damage had significant effect on

each of the treatments during the storage period April 2022 to December 2022. The highest dry matter (9.42 g/100 g fresh weight) was achieved from IPNS through 3t/ha poultry manure and the lowest (7.63 g/100 g fresh weight) was found from farmers' practice. The highest onion bulb damage (61.90%) was found from farmers' practice and lowest (16.16%) was achieved from IPNS with 3t/ha poultry manure. It was found that onion bulb sprouting had significant effect on each of the treatments during the storage period April 2022 to December 2022. The highest onion bulb sprouting (28.57%) was found from farmers' practice and lowest (10.00%) was achieved from IPNS with 3t/ha poultry manure. The highest dry matter, lowest weight loss (%), lowest number of bulb damage, and lowest number of bulb sprouting was obtained from integrated plant nutrient system through poultry manure because poultry manure contains higher amount of N, P and K than other components. Farmers' practice gave the lowest yield because they used lower amount nutrient. From two years of study (2021-22 and 2022-22) it may be concluded that IPNS integrated plant nutrient system (57-20-46-24-2-1 kg/ha NPKSZnB) + 3 t/ha poultry manure would be the best treatment considering higher yield, economic return and good storage quality of onion.

#### **Effect of management practice for year-round production of coriander as condiment in relation to weather condition**

J. Rahman, M.R. Ali, M.A.H.S. Jahan and M.M. Kadir

The experiment was conducted at the research field of RARS, Jamalpur to determine the suitable management practice for year-round coriander production as condiment and demand during off season, nutrition supply and higher market price. 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. The design of the experiment was split plot design 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 (BARC, 2018) kg/ha of N-P-K-S. All of P, K, S and ½ of N will be applied as basal during final land preparation. Remaining N will be applied at 20 DAS. Weeding

was done when necessary. The yield of coriander leaves was calculated from the whole plot area. Yield contributing characters were taken from 5 randomly selected plants from the middle rows of each plot. 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. Significantly highest plant  $m^{-2}$  (242) found from December  $\times$  shade net and lowest (34) from August  $\times$  raised bed because of seed germination rate. A perusal of data revealed that different combinations showed their significant influence on plant height and weight of leaf per  $m^2$ . Significantly the highest yield ( $10.96 \text{ t ha}^{-1}$ ) was registered under December  $\times$  shade net and it was found statistically at par December  $\times$  raised bed ( $9.93 \text{ t ha}^{-1}$ ) while July  $\times$  shade net was recorded the lowest ( $0.44 \text{ t ha}^{-1}$ ) in cause of climatic condition and crop management. Since the weather was terrible in April and September there was no sowing. For the initial cost of a shade net which is estimated to be typical each month. The highest gross return (Tk. 986000/ha), gross margin (Tk. 956000/ha) and MBCR (32.9) were observed in October  $\times$  raised bed followed by August  $\times$  raised bed and the lowest gross return (162800), gross margin (Tk. 120987 /ha) and MBCR (3.9) were observed in Tk. July  $\times$  shade net /ha. In contrast to weather circumstances, the study found that yield of coriander as a condiment was considerably affected by sowing time and management. Different sowing times influenced shade net or raised bed management practices. Although not always necessary, shade nets work best from May to October. This practice may be beneficial for any sort of farmer or homestead area producer due to year-round market price variances.

#### **Effect of seed priming with gibberellic acid on growth and yield of black cumin**

M.S. Huda, M.M. Khanum, M.Z. Ali and M.A.H.S. Jahan

The experiment was conducted at the research field of ARS, Dinajpur during *rabi* season of 2022-23 to determine appropriate concentration of  $GA_3$  and time of sowing for treating black cumin to promote vigor/rapid seed germination and plant growth to improve its productivity. The experiment was laid out in a RCB design with three replications. The unit plot size was 4 m  $\times$  2.4 m. Treatments were

$T_1=30 \text{ m } 00 \text{ ppm}$ ,  $T_2=30 \text{ m } 50 \text{ ppm}$ ,  $T_3=30 \text{ m } 100 \text{ ppm}$ ,  $T_4=30 \text{ m } 150 \text{ ppm}$ ,  $T_5=60 \text{ m } 00 \text{ ppm}$ ,  $T_6=60 \text{ m } 50 \text{ ppm}$ ,  $T_7=60 \text{ m } 100 \text{ ppm}$  and  $T_8=60 \text{ m } 150 \text{ ppm}$ .  $GA_3$  were dissolved at 70% alcohol and different concentration of  $GA_3$  were prepared by adding water. Seeds were soaked in  $GA_3$  solution after 20 hr. soaking in water. For fertilization 40-16-30-10-1.0-0.7 kg/ha of N-P-K-S-Zn-B were used (BARC, 2018). All of P, K, S, Zn and B were applied as basal during final land preparation. N was applied in two equal splits as top dressed at 30 and 55 DAS. The collected data were analyzed statistically and means were adjudged by LSD test at 5% level of probability using R software package.

The time for germination of black cumin treated with different concentrations of  $GA_3$  with different soaking times varied significantly among the treatment. The maximum time for germination (14 DAS) was recorded from  $T_1$  (0 ppm  $GA_3$  + 30 minutes making time). The minimum time for germination was recorded from  $T_7$  (100 ppm  $GA_3$  + 60 min. soaking time), which is statistically similar with  $T_6$  (50 ppm  $GA_3$  + 60 min. soaking time). But in case of plant height, branch no per plant, root length, no of pod per plant. Number of seeds per pod and straw weight were not differ significantly among the treatment. The significantly variation was also recorded at in yield among the different treatment. The maximum yield ( $1.32 \text{ tha}^{-1}$ ) was recorded from  $T_4$  (30 min.+150 ppm  $GA_3$ ) which is statistically similar with  $T_3$  (30 min.+ 100ppm  $GA_3$ ) ( $1.29 \text{ tha}^{-1}$ ) and  $T_6$  (60min.+50 ppm  $GA_3$ ). The minimum yield ( $0.75 \text{ tha}^{-1}$ ) was recorded from  $T_5$  (the 60 minutes soaking time in 0 ppm  $GA_3$ ). There may be due to the highest pod yield was recorded from  $T_4$  (30 minutes +150 ppm  $GA_3$ ) and also  $T_3$  (30 minutes +100 ppm  $GA_3$ ). Moreover, the maximum TSW (11.82g) was recorded from  $T_7$  (60 minutes +100 ppm  $GA_3$ ). From the above result and discussion, it may be concluded that soaking of black cumin seeds for 30 minutes in 100-150 ppm  $GA_3$  was suitable for even germination and yield.

#### **Growth and yield of black cumin influenced by integrated nutrient management**

M.R. Ali, J. Rahman, M.A.H.S. Jahan and M.M. Kadir

The experiment was conducted at Regional Agricultural Research Station, Jamalpur during 2021-2022 and 2022-23 to find out the suitable

integrated nutrient management for higher yield and economic return of black cumin under the AEZ-9. The experiment consisted of five treatments, viz.,  $T_1$ =Recommended fertilizer dose (RFD): 60-24-45-15-2-1.4 kg/ha of NPKSZnB (BARC, 2018, 2018),  $T_2$ =125% RFD (75-24-48-15-2-1.4 kg/ha of NPKSZnB),  $T_3$ = Integrated Plant Nutrient System (42-14-45-15-2-1.4 kg/ha of NPKSZnB) + 3 t/ha PM,  $T_4$ =Integrated Plant Nutrient System (50-22-40-15-2-1.4 kg/ha of NPKSZnB) + 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 dispersed replications. The unit plot size was 3 m  $\times$  4 m and spacing was 30 cm  $\times$  5 cm. BARI Kalogira-1 was used. Seed sown on 13 November 2022 and harvested on 23 March 2023. FYM and N as per treatment and 60-24-45-15-2-1.4 kg/ha of P-K-S-Zn-B (BARC, 2018). The full amount of cowdung and recommended dose of P, K, S, Zn, B was applied during final land preparation. N was applied into two equal splits at 30 and 55 DAS. Weeding, irrigation, and other intercultural operations were done as and when necessary. Yield was calculated in tons per hectare considering the whole plot as harvest area. Ten plants from each plot were selected randomly to collect data on yield components. Collected data were analyzed statistically with the help of a computer package program STAR and the means were adjusted by Least Significance Difference (LSD) test at 5% level of significance.

All the yield attributes were influenced due to integrated plant nutrient management. The tallest plant (78.00 cm) was recorded from IPNS through 3 t/ha poultry manure and the shortest plant (51.00 cm) was found from farmer's practice. Similar trends were found in the case of primary branches/plant. The highest number of capsule/plant (25.78) and seed/capsule (66.15) was found from Integrated Plant Nutrient System with 3 t/ha PM and lowest were recorded from farmer's practice. The highest 1000 grain weight (1.88 g) was achieved from Integrated Plant Nutrient System with 3 t/ha PM and lowest (1.15 g) were recorded from farmer's practice. The highest yield (1.52 t/ha) was recorded from IPNS through 3 t/ha poultry manure and the lowest yield (0.50 t/ha) was recorded from farmer's practice. The highest yield obtained from integrated plant nutrient system through poultry manure because poultry manure

contains higher amount of N, P and K than other components. Farmers' practice gave the lowest yield because they used lower amount of nutrient. Moreover, the highest yield was obtained in  $T_3$  might be due to the effect of yield contributing parameters like no. of capsule per plant, seed per capsule, 1000 seed weight. The highest gross return (Tk. 3,80,000 /ha), gross margin (Tk. 2,94,480/ha) and benefit cost ratio (4.44) was found from IPNS through 3t/ha poultry manure and the lowest gross return (Tk. 1,25,000/ha), gross margin (Tk. 60,545/ha) and benefit cost ratio (1.94) was from farmers' practice. From pool data of two years' study (2021-22 and 2022-23) it may be concluded that integrated plant nutrient system (42-14-45-15-2-1.4 kg/ha of NPKSZnB) with 3 t/ha poultry manure would be the best combination for higher yield and good economic return.

#### Performance of bitter gourd varieties at Dinajpur region

M.S. Huda and M.M. Khanum

The experiment was conducted at ARS, Dinajpur during *kharif-I* season of 2022 to evaluate the performance of BARI released bitter gourd varieties in Dinajpur region. The experiment was laid out in a RCBD design with three replications. BARI Korola-1, BARI Korola-2, BARI Korola-3, BARI Korola-4 were cultivated with a check variety (Local- Ranipokor35). The unit plot size was 4.5 m  $\times$  2.6 m. The seeds were sown directly in pit on 29 March, 2022. The spacing was maintained 1.5 m  $\times$  1.0 m. The experimental plots were fertilized @ 75-30-45-15-1-1 kg/ha of N-P-K-S-Zn-B (BARC, 2018) along with 5.0  $\text{tha}^{-1}$  of cowdung. All amount of TSP, MoP, Gypsum, Zinc sulfate and Boron were applied in pit 5-7 days before planting and mixed thoroughly with the soil. N was applied around the plant as side dressing at 20, 40 and 60 DAT. To control pumpkin beetle Nitro @ 2 ml  $\text{L}^{-1}$  water was sprayed. Fruit rot was observed in the field. To control the disease fruit rot and powdery mildew Autostin @ 2g  $\text{L}^{-1}$  water and Thiovit @ 5g  $\text{L}^{-1}$  water was sprayed respectively. Fruits were harvested from 15 May to 25 June, 2022. Data were statistically analyzed to find out the levels of significance of the experimental results by using the statistical computer package program, MSTAT-C (Russell, 1986).



Among the varieties flower initiation were ranges 32 to 41 days after sowing. The first flowering was in BARI Korola-2 at 32 days after sowing but local variety needed 41 days after sowing. Similarly, Among the varieties, the first fruiting was ranges 36 to 45 days after sowing. The first fruiting was in BARI Korola-2 at 36 days after sowing but local variety needed 45 days after sowing. Fruit length were varied significantly among the varieties. The highest fruit length (28.67 cm) was recorded from BARI Korola-2. The maximum yield was recorded from BARI Korola-2 (47.88 ton/ha) which was statistically similar with BARI Korola-4 (41.24 t/ha). These may be due to maximum fruit number per plant (44.44) and maximum fruit weight per plant (7.18 Kg) from BARI Korola-2.

Maximum gross return was obtained from BARI Korola-2 (Tk. 1675800 ha<sup>-1</sup>) while the minimum (Tk. 1040200 ha<sup>-1</sup>) from BARI Korola-1. The highest gross margin was also recorded from BARI Korola-2 (Tk. 1381210 ha<sup>-1</sup>) while the lowest from BARI Korola-1 (Tk. 745610 ha<sup>-1</sup>). Benefit cost ratio (BCR) was also the highest in BARI Korola-2 (4.7). Considering the yield and return, BARI developed bitter gourd varieties viz. BARI Korola-2 was profitable and could be cultivated in a large scale in the farmers' fields at the Dinajpur region.

#### **Effects of apical steam cutting on the yield of sweet gourd at Rangpur region**

M.N. Sarker, S. Hasan, M.A.I. Sarker, M.M. Sheikh and A.K. Saha

The experiment was carried out at the research field of Agronomy Division, RARS, BARI, Burirhat, Rangpur, during *rabi* season of 2022-23 to find out the proper vine pruning stage. The experiment consisted four treatments which was laid out in randomized complete (RCD) design with three replications. The variety was BARI Hybrid Mistykmura-2. The seeds of sweet gourd were sown in poly bags on 18th November 2022 and the seedlings were transplanted in the main field on 4 December 2022. The unit plot size was 4 m x 4 m maintaining 2 m x 2 m spacing. The land was fertilized with cow dung, N, P, K, S and Zn @ 10000, 80.65, 35, 75, 18.18 and 4.4 kg/ha, respectively. The total amount of cow dung, P, S and Zn and 1/3rd of each of N and K were applied during final land preparation and in the pit. The rest of N and K were applied in four equal installments at 20, 40, 55 and 70 days after transplanting.

Pruning started at 35 days after transplanting when first fruit setting was done. Data were recorded from three randomly selected plants per treatment per replication on number of fruits/plants, Individual fruit weight(kg), Vine yield (t/ha), Fruit diameter (cm), Peel thickness (cm), TSS (%) and fruit yield (t/ha). The collected data on different characters were statistically analyzed using open-source software "R" and mean differences were determined by Least significant difference (LSD) Test at 5% level of probability

The highest number of ripen fruits were recorded in T<sub>3</sub> treatment (12.83/plant) followed by T<sub>4</sub> (11.57/plant) and the lowest in T<sub>1</sub> treatment (8.5/plant). The highest individual fruit weight was found in T<sub>3</sub> treatment (4.65 kg) and lowest in T<sub>2</sub> treatment (3.12 kg). The highest vine yield was recorded in T<sub>3</sub> treatment (1.10 t/ha) and the lowest yield was in T<sub>2</sub> treatment (0.37 t/ha). The maximum fruit diameter was shown by T<sub>3</sub> treatment (18.54cm) followed by T<sub>4</sub> treatment (17.17cm) and minimum was from T<sub>1</sub> treatment (15.10cm). On the other hand, highest peel thickness observed from T<sub>2</sub> treatment (4.36cm) followed by T<sub>4</sub> treatment (4.13cm) and lowest thickness from T<sub>4</sub> treatment (3.15cm). Percent TSS showed non-significant variations among the tested treatments and the value ranging from 7.90 to 9.37. Finally, highest fruit yield was obtained from T<sub>3</sub> treatment (43 t/ha) followed by T<sub>4</sub> treatment (40.77 t/ha) and lowest fruit yield was from T<sub>1</sub> treatment (37.15 t/ha). Our study showed the significantly different results for studied parameters at different stages of apical stem cutting. Positive and significant correlation was present between female flower and number of fruits (Senthilkumar *et al.*, 2015). From the economic point of view, the highest gross return (GR) was obtained from T<sub>3</sub> treatment (Tk.665750/ha) and lowest from T<sub>1</sub> treatment (Tk.557250/ha). In case of gross margin (GM) highest value was given by T<sub>3</sub> treatment (Tk.424250/ha) and lowest from T<sub>1</sub> treatment (Tk.324850/ha). Lastly maximum BCR was given by T<sub>3</sub> treatment (2.75) as this treatment is the high yield performer and minimum from T<sub>2</sub> treatment (2.36). Removal of terminal shoots at 45 days after transplanting i.e., at fruit setting stages can be recommended as better vine production and more fruit setting for sweet gourd. The farmers of charland will be benefited by practicing this technique.

### Effect of vermicompost and rice husk ash on the yield of summer tomato

M.M. Khanum, M.S. Huda, S.S. Kakon, A. Barman and M.A.H.S. Jahan

The experiment was conducted at ARS, Rajbari, Dinajpur following a Randomized Complete Block Design (RCBD) with three replications to find out the effect of vermicompost and rice husk ash on the yield of summer tomato. Six different treatments were employed in the study viz.  $T_1$ =STB Recommended chemical fertilizers (BARC, 2018),  $T_2$ =STB +Vermicompost 1  $\text{tha}^{-1}$ ,  $T_3$ =STB + Vermicompost 1.5  $\text{tha}^{-1}$ ,  $T_4$ =STB+ Vermicompost 2.5  $\text{tha}^{-1}$ ,  $T_5$ =STB+ Rice husk ash 1.5  $\text{tha}^{-1}$  and  $T_6$ =STB+ Rice husk ash 2  $\text{tha}^{-1}$ . BARI hybrid Tomato-8 was used in this experiment. Firstly, seeds were sown in seedbed and then thirty days old healthy seedlings were transplanted into the main field according to the treatments maintaining 60cm $\times$ 40cm spacing between and within rows on 10 August, 2022. Half of vermicompost and rice husk ash and all PSZnB was applied as basal during final land preparation and half organic manures were applied in pits before planting of seedling. N and K was applied in 3 equal splits at 20, 40 and 60 DAT as ring method around the plants and mixed thoroughly with the soil followed by irrigation. Intercultural operation like weeding were done two times at 30 DAT and 45 DAT. Tomato one (Joar) hormone was sprayed at 1-2 days' interval in the morning. Leaf curl was a viral disease and is spread by white flies. Since the virus was spread by whitefly infestation to control white fly sprayed Admire/ Tido plus or Emitaf 0.5ml/L of water at least twice in 15 consecutive days from one week after planting to flowering.

The higher number of fruit plant $^{-1}$  (40.99  $\text{tha}^{-1}$ ) was recorded in  $T_4$ = STB + Vermicompost 2.5  $\text{tha}^{-1}$  followed by that in  $T_6$ =STB + Rice husk ash 2  $\text{tha}^{-1}$  (35.94  $\text{tha}^{-1}$ ) and the lowest in  $T_1$  where STB Recommended chemical fertilizers (26.19  $\text{tha}^{-1}$ ) (BARC, 2018) was applied. Higher fruit length of summer tomato was observed in  $T_4$ = STB + Vermicompost 2.5  $\text{tha}^{-1}$  (4.66 cm) followed by that in  $T_6$ = STB + Rice husk ash 2  $\text{tha}^{-1}$  (4.65 cm) and the lowest (4.50 cm) in  $T_1$ = STB Recommended chemical fertilizers (BARC, 2018) treatment and diameter was noticed highest in  $T_4$  (4.62 cm) and the lowest (4.53cm) in  $T_1$  where STB Recommended chemical fertilizers (BARC, 2018) was applied. Similarly, the highest individual fruit

weight was obtained in  $T_4$  (60.90 g) followed by that in  $T_6$ = STB + Rice husk ash 2  $\text{tha}^{-1}$  (59.38 g) and the lowest in  $T_1$ = STB Recommended chemical fertilizers (50.30 g) (BARC, 2018) treatment. The highest fruit yield (38.75  $\text{tha}^{-1}$ ) was recorded in  $T_4$ =STB+ Vermicompost 2.5  $\text{tha}^{-1}$  followed by that in  $T_6$ =STB+ Rice husk ash 2  $\text{tha}^{-1}$  (35.31  $\text{t ha}^{-1}$ ) and the lowest (26.79  $\text{tha}^{-1}$ ) in  $T_1$ = STB Recommended chemical fertilizers (BARC, 2018) treatment in 2022-23. These results were obtained might be due to the irrespective effect of comparatively higher number of all parameters especially average fruits weight and no. of fruits per plant. The highest gross return (Tk. 4650000  $\text{ha}^{-1}$ ) as well as gross margin (Tk. 3352500  $\text{ha}^{-1}$ ) and BCR (3.58) was obtained in  $T_4$ =STB+ Vermicompost 2.5  $\text{tha}^{-1}$  treatment and the lowest (GR: 3214800, GM: 1979800 and BCR: 2.60) were obtained from the treatment  $T_1$ =STB Recommended chemical fertilizers (BARC, 2018) treatment. The results indicated that  $T_4$ =STB + Vermicompost 2.5  $\text{tha}^{-1}$  treatment and  $T_6$ = STB + Rice husk 2  $\text{tha}^{-1}$  were found suitable for total productivity and economic return of the system.

### Effect of planting date and nutrient management on yield of broccoli

M.M. Khanum, M.S. Huda, S.S. Kakon and M.A.H.S. Jahan

The experiment was conducted at ARS, Rajbari, Dinajpur to find out optimum planting time and fertilizer dose of broccoli. This experiment comprising: A. Three Planting times viz.  $P_1$ =30 October,  $P_2$ =15 November,  $P_3$ =30 November and 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  $\text{tha}^{-1}$  (80-20-50-15-1-1 kg/ha NPKSZnB),  $T_4$ = IPNS with vermicompost 3  $\text{tha}^{-1}$  (76-18-45-15-1-1 kg/ha NPKSZnB). The experiment was laid out in randomized completely block design (Factorial) with three replications. The unit plot size was 7.5  $\text{m}^2$  (3m $\times$ 2.5m) and spacing 50cm $\times$ 50cm were maintained. BARI Broccoli-1 was used in this experiment. Firstly, 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 during first 4-5 days after transplanting of seedlings. Vermicompost will be applied at the time of final

land preparation. All of phosphorus, sulphur, zinc and boron were applied during final land preparation, while the nitrogen and potassium were applied in three equal splits at 15, 30, and 50 DAT as ring method around the plants and mixed thoroughly with the soil followed by irrigation. Intercultural operation like weeding were done two times at 20 DAT and 35 DAT. Insecticide Acimix 55EC 1ml/L water was sprayed at every 15 days' interval to control cut worm and Fungicide Rovral 50 WP @ 2gm/L water was sprayed at every 15 days' interval to control leaf spot and on broccoli.

The maximum plant height (62.06 cm) of broccoli was measured from plants grown under IPNS with vermicompost 3  $\text{tha}^{-1}$  with 30 October planting ( $P_1T_4$ ) treatment combination and the minimum plant height (51.80 cm) was recorded from STB Recommended chemical fertilizer with 30 November planting ( $P_3T_1$ ) treatment combination. The maximum number of leaves (20.10) was recorded in the IPNS with vermicompost 3  $\text{tha}^{-1}$  with 30 October planting ( $P_1T_4$ ) treatment combination and the lowest number of leaves (15.83) was observed in the STB Recommended chemical fertilizer with 30 November planting ( $P_3T_1$ ) treatment combination. The maximum curd diameter and curd length (16.94 cm and 25.16 cm) were obtained from the treatment combination  $P_1T_4$  and the lowest from  $P_3T_1$  treatment combination. The highest (6.40) number of secondary curds was also observed in  $P_1T_4$  treatment combination. The highest terminal curd weight (463.93 g) was recorded from the treatment combination  $P_1T_4$  and the lowest (332.80 g) from  $P_3T_1$  treatment combination. The highest yield (18.56  $\text{tha}^{-1}$ ) was produced by the treatment combination  $P_1T_4$  and the lowest yield (13.31  $\text{tha}^{-1}$ ) was recorded from the combination  $P_3T_1$ . Moreover, these results were obtained might be irrespective effects of yield contributing parameters like no. of secondary curd, terminal curd weight, secondary curd weight. The highest benefit cost ratio (3.17) was recorded from IPNS with vermicompost 1.5  $\text{tha}^{-1}$  when planted on 30 October ( $P_1T_3$ ) followed by IPNS with vermicompost 3  $\text{tha}^{-1}$  when planted on 30 October ( $P_1T_4$ ) BCR (3.13) due to higher price of vermicompost and for early planting when the demand and price of broccoli are higher on the market. From an economic standpoint, IPNS with vermicompost 1.5  $\text{tha}^{-1}$  when planted on 30 October ( $P_1T_3$ ) might be more profitable and economically

feasible for broccoli growers in the Dinajpur region.

### **Off-season sweet gourd production under different field management**

J. Rahman, M.R. Ali, M.A.H.S Jahan and M.M. Kadir

The experiment was conducted at the research field of RARS, Jamalpur during rabi season of 2022-2023 to determine the off-season sweet gourd production under different field management for find out the technology for off-season production and available market during lean period. Treatments included in the experiment were:  $T_1$  = Open field;  $T_2$  = Open field with black plastic mulch;  $T_3$  = Sack with trellis and  $T_4$  = Raised bed. The design of the experiment was RCB with 3 replications. Each treatment was sown in unit plot having 2m  $\times$  2m with the spacing of 20 cm  $\times$  5cm. 50-24-40-14-1-0.7kg/ha N-P-K-S-Zn-B (BARC, 2018). Fertilizers were applied at the rate of 50-24-40-14-1-0.7 kg/ha of N-P-K-S-Zn-B (BARC, 2018). All cowdung, P, S, Zn and B applied in pit 5-7 days before planting; N fertilizer was applied to plant as side dressing at 15, 35, 55 and 75 DAT under moist soil. The yield of sweet gourd was calculated from the whole plot area. Yield contributing characters were taken from each plot. Weather data (air temperature and rainfall) were collected from the Weather Station, RARS, Jamalpur. Seedlings were transplanted on 05 February 2023 and harvested on April 02, 2023 to April 26, 2023. Data were analyzed with the help of a computer package program, STAR and means were separated following LSD test at 5% level of significance.

Significantly the highest number of fruit/plot (07) was obtained from open field with black plastic mulch and lowest (03) from sack with trellis. A perusal of data revealed that the highest yield (16.41  $\text{t ha}^{-1}$ ) was recorded under open field with black plastic mulch while sack with trellis was recorded the lowest (5.52  $\text{t ha}^{-1}$ ). The highest yield was obtained might be due to the effect of weed suppressed as well as bright sunshine which enhanced the photosynthesis property. Considering gross return, total variable cost, gross margin and benefit cost ratio, open field with black plastic mulch grew well in contrast to proper management practice. The yield of sweet gourds produced in the off-season under different field management



techniques is greatly impacted. An open field with black plastic mulch is one of the more effective techniques for off-season output, including weed control management and labor cost reduction.

#### **Effect of soil amendments on tomato growth yield and soil characteristic in acid soil at Moulvibazar**

M. Shaheenuzzamn, M.S. Alam, M.A.M. Miah, M. Rasheduzzaman and M.H. Hossain

The experiment was conducted at RARS, BARI, Akbarpur, Moulvibazar during *rabi* season of 2022-23 to find out the effects on tomato growth, yield and soil properties at acidic soil condition. The 5 (five) treatments were as follow: T<sub>1</sub>=FRG, BARC (2018), T<sub>2</sub>= FRG with phosphorus (60 kg/ha), T<sub>3</sub>= FRG with Lime (2 ton/ha), T<sub>4</sub>= FRG with phosphorus (30 kg/ha +Lime (2 ton/ha), and T<sub>5</sub>= FRG with Lime (2 ton/ha) +Trichoderma (2 ton/ha). The experiment was laid out in RCBD with three replications. The unit plot size was 3 m × 2.75 m. The seedlings of tomato (variety: BARI Tomato-15) were transplanting on 18 November, 2022. Half of the quantity of Organic fertilizer, entire P and half of K, entire zine and boron were applied during land preparation. The remaining half of the Organic fertilizer were used during pit preparation. The rest of K and entire N were applied at two equal installments at 15 days and 30 days after transplanting. Fertilizer dose were calculated based on average value of low fertility level of soil (FRG, BARC, 2018). Before applying the fertilizer doses, the chemical properties of the experimental plots were recorded. Intercultural operations were done as and when necessary, following the recommended production technologies of the Tomato crops (BARI, 2020). Agronomic data were subjected to the analysis of variance (ANOVA) using SAS, 9.2 version (SAS, 2009), and mean separation was carried out using LSD.

The results highlighted that the T<sub>4</sub> and T<sub>5</sub> treatments shows the highest responses in terms of improvement of soil pH and Organic matter (OM) in all treatment by soil amendments during 2022-23. The results showed that the effect on plant height, branches/Plant, no. of fruits/Plant, yield per hectare and shelf life of tomato were significantly ( $P < 0.05$ ) influenced by soil amendments applied at acidic soil in Moulvibazar. In this study, the trend of tomato plant height (PH) under different

soil amendments was observed. T<sub>5</sub> treatment showed highest plant height of tomato (111.47 cm). The results indicated that the soil amendment with fertilizer were utilized by tomato plant to promote growth height, resulting in significant increase in plant height and so yield (Ortas, 2013). Plants applied with different soil amendments had significantly high number of branches than the control at acidic soil. T<sub>2</sub> was recorded the highest number of branches (9.00 nos.). The number of tomato branches were positively influenced by soil amendments due to enhance vegetative growth. Therefore, the yield enhanced by it. T<sub>2</sub> was recorded highest number of fruits/Plant (55.00 nos.) of tomato. The variation in number of fruits per plant observed was probably attributed to differences in nutrient release of the soil amendments applied. T<sub>2</sub> treatment (60 kg/ha) was recorded highest number of fruits /Plot (922.00 nos.) which actively increases the yield of tomato. T<sub>2</sub> was recorded highest yield per hectare (50.25 t/ha) of tomato. Results revealed that yield contributing characters were higher in soil amendment applied plants over control plants. T<sub>3</sub> and T<sub>4</sub> was recorded highest shelf life after harvest (33.00 and 32.00 days, respectively) of tomato. Concluded with the best treatment on the basis of yield & yield components, the soil acidity produces complex interactions on plant yield and yield contributing characters which limits the physical, chemical and biological properties of the plant. Based on the above results, the soil amendments might be improved the soil pH, organic matter and others soil properties at acidic soil of Sylhet. As the results indicated that the soil amendments application positively influenced the yield and yield contributing characters and quality of tomato at acidic soil, the soil amendment should be emphasized and practiced at acidic soil of Moulvibazar as well as Sylhet region.

#### **Efficacy of different herbicide for controlling weeds in mustard field**

J.A. Chowdhury, A.A. begum, S.S. Nasreen, M.A.H. Khan, M.R. Karim and M.A.H.S. Jahan

The field experiment was conducted at Agronomy research field of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, during *rabi* season of 2022-2023. The experiment was undertaken to find out the optimum dose and weed control efficiency of different herbicide for controlling weed in

mustard field. The treatments of the field trial were:  $T_1$  = Quizaforce 10 EC @ 500 ml/ha at 3-5 leaf stage of weed,  $T_2$  = Quizaforce 10 EC @ 650 ml/ha at 3-5 leaf stage of weed,  $T_3$  = Super action 22.5 EC @ 250 ml/ha at 3-5 leaf stage of weed,  $T_4$  = Two hand weeding at 25 DAS and 40 DAS and  $T_5$  = Control (No weeding). The target weed to control was Durba, Ghagra, Masur chhana, Bon masur, Bothua, Bon palong, Shetodron and Tridhara. The crop was fertilized with cowdung @ 5 t/ha and 90-27-60-10-2.5-1.0-0.5 kg/ha of NPKSZnB, respectively. Seeds of mustard were sown on 22 November 2022. Results showed that the highest weed population 146 and 162/m<sup>2</sup> was recorded in control plot at 25 and 50 DAS, respectively. The lowest weed population 13 and 20/m<sup>2</sup> was recorded in  $T_2$  treatment at 25 and 50 DAS, respectively. The highest WCE 92.9% and 83.11% was found in  $T_2$  treatment at 25 and 50 DAS, respectively. The highest seed yield (1.70 t/ha) was obtained from  $T_2$  treatment. The highest gross return (Tk. 85000/ha) and gross margin (Tk 36450/ha) were observed in  $T_2$  treatment. The highest BCR (1.75) was also obtained from  $T_2$  treatment. The lowest BCR (1.31) was obtained from  $T_5$  (control) treatment. The result revealed that application of herbicide Quizaforce 10 EC @ 650 ml/ha at 3-5 leaf stage of weed would be effective for weed control in mustard cultivation at Joydebpur (AEZ 28).

#### Effect of integrated weed management on sunflower

M.R. Islam, A.A.M.M. Mustakim and M.M. Uddin

The trial was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during *rabi* season of 2022-2023 to find out suitable weed management method for sunflower. Five treatments viz;  $T_1$ : Post sowing application of Pandamithalin;  $T_2$ : Post sowing application of Pandamithalin + one hand weeding at 20 DAE;  $T_3$ : Post sowing application of Pandamithalin + one hand weeding at 40 DAE;  $T_4$ : Two hand weeding at 20 and 40 DAE;  $T_5$ : Control (no weeding); were tested in the experiment. The design of the experiment was RCB and replicated thrice. Herbicides were applied at post-sowing condition. Unit plot size was 4m x 3 m. The test crop variety was BARI Sunflower 3. Fertilizers were used @ 90-35-80-30-3.6 and 1.8 kg/ha of N P K S Zn and B, respectively as a form of urea, TSP, MP, Gypsum, Zinc sulphate and Boric acid. Half of the

Urea and full amount of the other fertilizers need to be applied at the time of final land preparation and to be mixed with soil by laddering and cross laddering. Rest half of the urea was top dressed at 25 DAS and 45 DAS followed by irrigation. Seed were sown in line on 25 November 2022 maintaining 50 cm x 30 cm plant spacing, and harvested on 19 March 2023. Results showed insignificant variation among the measured traits in different treatments. However, numerically the treatment  $T_2$  produced the highest seed yield (2.16 t ha<sup>-1</sup>) followed by  $T_4$  (2.11 t ha<sup>-1</sup>), which were 29% and 26% higher than the control. Likewise, treatment  $T_1$  and  $T_3$  gave 9% and 19% higher seed yield compared to control. In economic point of view,  $T_2$  treatment produced the higher gross margin (79981 Tk ha<sup>-1</sup>) and MBCR (2.61) than the others treatments.

#### Effect of integrated weed management on sunflower in barishal

M. Ahmed, M.A. Rahman and M.M. Rahman

The field experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal during *rabi* season of 2022-23 to find out the suitable methods and cost-effective management options for sunflower weed control weed in the southern region of Bangladesh. The experiment was conducted in randomized complete block design with 10 treatments and three replications. Treatments were:  $T_1$ -Pendimethalin @ 0.75 kg a.i/ha as pre-emergence (PE),  $T_2$ -Pendimethalin @ 0.75 kg a.i/ha as PE + one Inter-Cultivation (IC) at 20 DAS followed by Hand weeding (HW) at 40 DAS,  $T_3$ -Pendimethalin @ 1.0 kg a.i/ha as PE,  $T_4$ -Pendimethalin @ 1kg a.i/ha as PE + one Inter-Cultivation (IC) at 20 DAS followed by HW at 40 DAS,  $T_5$ -Pendimethalin @ 1.0 kg a.i/ha as PE + One HW at 20 DAS,  $T_6$ -One HW @ 30 DAS,  $T_7$ -Pendimethalin @ 1.0 kg a.i/ha as PE + One weeding by weeder at 35 DAS,  $T_8$ -One weeding by weeder at 35 DAS,  $T_9$ -Weed free (HW at 20 and 40 at DAS) and  $T_{10}$ -Un-weeded. The seeds of BARI Surjomukhi-3 cultivar of sunflower were sown by hand dibbled method with spacing of 50 cm x 25 cm. Significantly highest yield (2.08 t/ha), highest plant height (108.33 cm), and lowest weed dry matter (84 g/m<sup>2</sup>) were recorded with weed free treatment (twice hand weeding at 20 and 40 DAS) whereas, highest gross return (50590 tk./ha) and B:C ratio (1.74) were found in treatment Pendimethalin

@ 1.0 kg a.i/ha as pre-emergence (PE). Among the chemical treatments, application of Pendimethalin @ 1.0 kg a.i/ha as PE and Pendimethalin @ 0.75 kg a.i/ha as PE proved equally effective for enhancing seed yield, net return and B:C ratio but the magnitudes of increase in seed yield, net return and B:C ratio were highest under Pendimethalin @ 1.0 kg a.i/ha as PE. Hence, this treatment is recommended for better yield and higher economic return in sunflower.

#### **Determination of crop weed competition of lentil**

S. Paul, M.H. Rahman, M.S. Kobir and K.U. Ahmmad

The experiment was conducted at Regional Agricultural Research Station, BARI, Jashore during *robi* season, 2022-2023 in randomized complete block design with three replications. This research was undertaken to know the critical period of weed control (CPWC) of BARI Masur-9 (lentil) which will help to manage the weed effectively. Here two set of treatments were imposed where first one was consisted of weed-free periods: weed free up to 15, 30, 45, 60, 75 days after sowing (DAS). Second set was comprised of weedy periods: weedy up to 15, 30, 45, 60, 75 days after sowing (DAS). Weeding was done fortnightly from the time of emergence until the above-presented time, after which no additional hand weeding was done. For weedy period treatments, ambient weed populations were allowed to grow from crop sowing until the above-mentioned period and then weeding was done by fortnightly manually until harvest. In addition, season long weedy and weed free treatments were added. The unit plot size was 4.0m × 2.0m. Planting was done on 7 November, 2022 with 30 cm × continuous sowing. Fertilizer was applied according to FRG, 2018. The crop and weed emerged at 5 DAS. The crop was harvested during 8 February 2023. The critical period of weed control (CPWC) of BARI Masur-9 was between 7 to 43 days after sowing (DAS) based on a 5% yield loss threshold with the highest yield 966.25 Kg ha<sup>-1</sup>.

#### **Effect of integrated weed management on sorghum in *kharif* season**

A.A. Begum, S. Kundu, S.S. Kakon, J.A. Chowdhury and M.A.H.S. Jahan

The experiment was conducted at the Research Field of Agronomy Division BARI, Gazipur (AEZ

28) during March, 2023 to June, 2023 to select the suitable herbicide for controlling weeds in sorghum field. The treatments were as follows: T<sub>1</sub> = Two HW at 20 and 45 DAS, T<sub>2</sub> = Atrazine @ 2 L/ha at 3 DAS+1 HW at 25 DAS, T<sub>3</sub> = Atrazine @ 2 L/ha at 20 DAS+1 HW at 45 DAS, T<sub>4</sub> = Atrazine @ 2 L/ha at 3 DAS & 45 DAS, T<sub>5</sub> = Pendimethylene @ 3 L/ha at 3DAS + 1 HW at 5 DAS, T<sub>6</sub> = Pendimethylene @ 3 L/ha at 20DAS + 1 HW at 45 DAS, T<sub>7</sub> = BARI weeder at 20 and 45 DAS, T<sub>8</sub> = Spading at 20 and 45 DAS, T<sub>9</sub> = No weeding. The experiments were set up in randomized complete block design with three replications. The unit plot size was size: 2.4 m x 12 m. Seeds of sorghum (BARI Sorghum-2) were sown on 02 March 2023 and finally harvested on 26 June 2023. 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 for sorghum (FRG, 2018). The highest weeds /m<sup>2</sup> (118 at 25 DAS and 167 at 45 DAS) was recorded in T<sub>9</sub> (No weeding). The lowest weed /m<sup>2</sup> (20 at 25 DAS and 32 at 45 DAS) was found in the treatment T<sub>5</sub>. The maximum weed dry weight of 90.45 g/m<sup>2</sup> and 145.25 g/m<sup>2</sup> were obtained in T<sub>9</sub> at 25 and 45 DAS, respectively, whereas, the minimum weed dry weight of 9.15g /m<sup>2</sup> and 15.23 g /m<sup>2</sup> were found in T<sub>5</sub> treatment, respectively. Among the herbicide treated plots the highest WCE of 90 % and 89 % was found at 25 and 45 DAS, respectively in T<sub>5</sub> treatment. The highest 1000- grain weight (33.45 g) and grain yield (3.12 t/ha) were observed in T<sub>5</sub> treatment. The lowest grain yield (1.50 t/ha) was recorded in control treatment (T<sub>9</sub>). The maximum cost of cultivation calculated in T<sub>1</sub> (Tk. 45100/ha) but the highest gross return (Tk.78000/ha) and BCR (1.80) observed in T<sub>5</sub> treatment. The lowest BCR (1.17) was obtained from T<sub>9</sub>. The result revealed that T<sub>5</sub> = Pendimethylene @ 3 L/ha at 3DAS + 1 HW at 25 DAS would be the best option for getting maximum yield of sorghum during *kharif*-1 season.

#### **Weed management of mukhikachu (*Colocasia esculenta*)**

S. Paul, M.H. Rahman, K.U. Ahmmad and M.A.H.S. Jahan

The experiment was conducted at the Regional Agricultural Research Station, Jashore during *kharif* Season, 2022 in randomized complete block



design with three replications. The study was undertaken to find out the effective weed management technique for *C. esculenta*. There were nine treatments viz.  $T_1$ = Mulching (wheat straw with 6 cm thickness),  $T_2$ = Pre-sowing herbicide (Pendimethalin @1.5 Lha<sup>-1</sup>) + Mulching (wheat straw)  $T_3$ = Pre-sowing herbicide +1 Hand weeding (HW) at 65 DAE,  $T_4$ = Post-emergence (Pendimethalin @1.5 Lha<sup>-1</sup>) herbicide spray at 20 DAE & 50 DAE,  $T_5$ = Post-emergence herbicide spray at 20 DAE & 50 DAE + HW at 95 DAE  $T_6$ = Intercropping (living mulch) + HW at 50 DAE and 70 DAE,  $T_7$ = HW (4 times) at 30 DAE, 60 DAE, 80 DAE & 100 DAE,  $T_8$ = weed free and  $T_9$ = Control (No weeding.) The mulch treatment was applied on the day of planting followed by earthing up. The Mukhikachu variety was BARI Mukhikachu-1 (Bilasi). The unit plot size was 4.0m x 2.0m where corm was planted with spacing 60 cm x 40 cm on 17 April 2022 and green amaranth was broadcasted on same day. Fertilizer was applied according to FRG 2018 in irrigated condition. Mukhikachu and green amaranth was harvested on 11 October 2022 and 1 June 2022 respectively. It was displayed exhibited better weed control efficiency in  $T_1$ ,  $T_2$  and  $T_6$  treatments and thus, the treatment  $T_1$  demonstrated the highest yield (21.78 t ha<sup>-1</sup>) and benefit-cost ratio (BCR) of 7.26 which was statistically similar to  $T_6$  (yield: 21.4 t ha<sup>-1</sup>, BCR: 5.19) and  $T_2$  (yield: 20.4 t ha<sup>-1</sup>, BCR: 6.52). Straw mulch or intercropping+ hand weeding can be recommended as the economically viable technique to manage crop-weed competition where yield was 21.78 t ha<sup>-1</sup> and 21.13 t ha<sup>-1</sup> respectively. This result also showed that, during mulching there is no need to use herbicide.

#### **Weed and nutrient management practice on yield of sweet gourd**

M.Z. Ali, J.A. Chowdhury, A.A. Begum, S.S. Kakon, M.R. Karim and M.A.H.S. Jahan

The experiment was conducted at Agronomy research field of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, during *rabi* season of 2022-2023 to find out the suitable fertilizer dose and weed management practice on sweet gourd for getting higher fruit yield and economic returns. The experiment was consisted of nine treatments viz. Note:  $T_1$  = STB + no weeding,  $T_2$  = 125% STB + 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 and  $T_9$  = Control (Native fertilizer and no weeding) were used in the study as treatment variable. Fertilizer was applied according to treatments. The test variety of BARI sweet gourd-2. The highest weed control efficiency (86.53% at 25 DAT and 90.36% at 50 DAT) and highest sweet gourd fruit yield 28.81 t/ha was found in  $T_2$  treatment. But higher marginal benefit cost ratio 2.75 was obtained from  $T_7$  treatment due to lower cost of production. From the result it might be concluded that the highest marginal benefit cost ratio (MBCR) 2.75 was obtained from  $T_7$  treatment (STB fertilizer dose, FRG, 2018 + herbicide spray Pendicare 33 EC (Pendimethalin 33%) @ 2 L/ ha at 4 DAT of sweet gourd seedling + one hand weeding at 50 DAT of sweet gourd seedling) due to lower cost of production which would be economically profitable for sweet gourd production at Gazipur region (AEZ 28).

#### **Efficacy of different herbicides for controlling weeds in onion field**

M.Z. Ali, S. Paul, A.A. Begum, M.R. Karim and M.A.H.S. Jahan

The present experiment has been undertaken to find out the efficacy of different herbicides for controlling weed in onion field and their weed control efficiency for getting maximum yield. The twelve treatments were as follows:  $T_1$  = Baitrione 27.5 SC @3 L/ha,  $T_2$  = Amcotrione 27.5 SC @ 3L/ha,  $T_3$ = Ecotrione 27.5 SC @3 L/ha,  $T_4$  = Mesozine 55 SC (Mesotrione 5% + Atrazine 50% SC) @ 1000 ml/ha,  $T_5$  = Yukon 55 WDG @ 1 kg/ha,  $T_6$  =Weedmar Super 30WP) @ 1.8 g/10 L,  $T_7$  = Cleanup 88 WG @ 1.35-1.8 kg/ha,  $T_8$  = Queenfop 5 EC @ 800 ml/ha,  $T_9$  = Trick 9 EC @ 500 ml/ha,  $T_{10}$  = Pen Pyr 32 EC @ 2.5-3 l/ha,  $T_{11}$ = Two hand weeding at 25 & 50 DAT and  $T_{12}$ = Control (No weeding and herbicide) were use in the experiment. All herbicides spraying at 2-4 leaf stage of weeds except  $T_{10}$  treatment (Pen Pyr 32 EC) spraying at 2-3 days after transplanting of onion seedling. The crop was fertilized according

to FRG, 2018. Seedlings of onion variety (BARI Piaj-4) were transplanted on 22 and 15 December 2022 and harvested on 23 and 28 March, 2023 at Gazipur and Jashore respectively. Result showed that the highest weed control efficiency was 87.63% and 83.21% at 25 DAT and 87.30% and 86.10% at 50 DAT of onion seedling, onion bulb yield 18.36 t/ha and 18.47-t/ha were obtained from T<sub>10</sub> treatment at Gazipur and Jashore respectively. So, the result revealed that all herbicides would be effective for weed control at Gazipur (AE 28) and Jashore (AEZ 11). The results revealed that all the herbicides were found effective for controlling weeds in onion field at Gazipur (AEZ-28) and Jashore (AEZ-11) region.

#### **Effect of herbicide 'stella 24 EC (oxyflurofen 24%)' on weed control in tomato**

S.T. Zannat, S.S. Kakon, A.A. Begum, J.A. Chowdhury, S. Kundu and M.A.H.S. Jahan

The experiment was conducted at Agronomy research field of BARI, Gazipur during *rabi* season of 2022-2023 to find optimum dose of herbicide for controlling weed in tomato (var. BARI tomato-21). Six treatments viz; T<sub>1</sub> = Stella 24 EC (Oxyflurofen 24%) @ 400 ml/ha spraying at 3 days before transplanting, T<sub>2</sub> = Stella 24 EC @ 400 ml/ha spraying at 15 days after transplanting, T<sub>3</sub> = Stella 24 EC @ 500 ml/ha spraying at 3 days before transplanting, T<sub>4</sub> = Stella 24 EC @ 500 ml/ha spraying at 15 days after transplanting, T<sub>5</sub> = Two hand weeding at 25 and 45 DAT and T<sub>6</sub> = Control (No weeding). The experiment was laid out in a randomized complete block design, with three replications and (3 × 3) m<sup>2</sup> plots. 25 days old seedlings of BARI tomato-21 were transplanted with (60 × 40) cm<sup>2</sup> spacing on 5 December, 2022 and finally harvested on 03 April, 2023. The crop was fertilized with 160-48-100-20-3-1.5 kg/ha of NPKSZnB, respectively (FRG, 2018); as Urea, TSP, MoP, Gypsum, Zinc sulphate and Boric acid. All P, S, Zn and B fertilizer applied as basal dose. Remaining N and K applied in two equal spits at 15 and 35 DAT as ring method under moist soil condition Highest WCE (87.86% and 86.73% at 25 and 45 DAT), fruit yield (67.74 t/ha) and BCR (4.52) found in T<sub>1</sub> treatment i. e; Stella 24 EC (Oxyflurofen 24%) 400 ml/ha spraying 3 days before transplanting found effective and profitable for tomato weed control. Results revealed that, herbicide Stella 24 EC (Oxyflurofen 24%) @ 400

ml/ha spraying 3 days before transplanting would be effective and profitable weed control for tomato.

#### **Effect of different herbicides for controlling weeds in potato field**

M.A.H. Khan, A.A. Begum, S.T. Jannat, J.A. Chowdhury, M.Z. Ali and M.A.H.S. Jahan

The experiment was conducted at agronomy research field of Bangladesh Agricultural Research Institute (BARI), Gazipur and Agricultural Research Station (ARS), Dinajpur during the period from November 2022 to March 2023 to find out the effectiveness of different herbicides for controlling weeds in potato field. The treatments were: T<sub>1</sub>=Vodvodi 20 SL (Glufosinate-ammonium 20%), T<sub>2</sub>=Nistaz 20 SL (Glufosinate-ammonium 20% SL), T<sub>3</sub>= Domon 26 OD (Quizalofop-P-Ethyl 10% EC + Rimsulfuron 1.5% + Metribuzin 19.5% OD), T<sub>4</sub>= Cina Supper 5EC (Quizalofop-P-Ethyl), T<sub>5</sub>= Dizola 5 EC (Quizalofop-P-Ethyl), T<sub>6</sub> = Niha 27.5 SC (Atrazine 25% + Mesotrione 2.5% SC), T<sub>7</sub> = Two hand weeding at 25 45 DAS, T<sub>8</sub>= Control (No weeding and herbicide). The highest weed control efficiency (WCE) was found 84.5% in T<sub>7</sub> (Two hand weeding at 25 and 45 DAS) at Gazipur, 87.9% in T<sub>1</sub> (Vodvodi 20 SL Glufosinate-ammonium 20%) at Dinajpur at 25 DAP. At 45 DAP the highest WCE was (88.45% at Gazipur, 86.49% at Dinajpur) in T<sub>5</sub> (Dizola 5 EC Quizalofop-P-Ethyl) at both locations. The highest tuber yield (27.59 t/ha at Gazipur and 29.14 t/ha at Dinajpur) was obtained from T<sub>6</sub> (Niha 27.5 SC (Atrazine 25% + Mesotrione 2.5% SC) and T<sub>7</sub> (Two hand weeding at 25 and 45 DAS) treatment. The results revealed that six herbicides would be effective for weed control for potato cultivation at Gazipur (AEZ 28) and Dinajpur (AEZ 1).

#### **Crop-weed association in oilseed and spice crops in gangachara upazila of Rangpur district**

M.M. Sheikh, A.I. Sarker and A.K. Saha

A survey was conducted at farmers' fields in Gangachara Upazilas of Rangpur district to assess the economic losses in oilseed and spice crops due to weed infestation and to develop management practices for controlling weeds in oilseed and spice crops during *Rabi* season 2022-23. Primary data were collected from the respondents through a well-oriented structural questionnaire. A total of 23 weed species under 13 families were identified from 2 oilseed and 2 spice crops. The

highest crop-weed association was found in groundnut (24:55) and the lowest in garlic (86:35). The maximum weed management cost was occurred in groundnut (37500 Tk. ha<sup>-1</sup>). Weed caused 12 to 33% yield loss in different oilseed and spice crops. Twenty-three different weeds under 13 families, were identified in association with two oilseed and two spice crops in the surveyed area. The highest weed abundance and maximum yield loss occurred in groundnut crops due to weed association. Among the weeds, Amrul, Bathua and Mutha were the most obnoxious weed and took disturbing in all investigated crops. The results revealed that Bathua emerged as the major noxious weed followed by Mutha and Amrul in oilseed and mustard crops of this district.

#### **Effect of weed control methods on groundnut at charland**

J. Rahman, M.R. Ali, M.A.H.S. Jahan and M.M. Kadir

The experiment was conducted at the charland area of Jamalpur during *rabi* season of 2022-2023 to find out the suitable weeding methods for controlling weeds in groundnut. Treatments included in the experiment were: T<sub>1</sub>=Spraying panida one day after sowing @ 2ml per liter T<sub>2</sub>=sonate at 30-35 DAE @ 2ml per liter T<sub>3</sub>=one weeding at 30-35 DAE and T<sub>4</sub>=control plot. One weeding at 30-35 DAE have given better results followed by the application of the herbicide sonate at 30-35 DAE. Fertilizers were applied at the rate of 25-160-85-300-10 kg/ha NPKSB (BARC, 2018) as urea, triple super phosphate (TSP), muriate of potash (M<sub>o</sub>P), gypsum, Boron. Seeds were sown on November 09, 2022 in rows. The highest yield (1.98 t ha<sup>-1</sup>) was registered under one hand weeding at 30-35 DAE which was significantly like spray sonate and while control was recorded the lowest (1.61 t ha<sup>-1</sup>). Crops were harvested on April 15, 2023. From an economic perspective, sonate treatment at 30-35 DAE was a successful and useful weed management method for groundnut production. For more precision, the experiment will be repeated in the next year.

#### **Effect of integrated weed management on sorghum in winter**

S.S. Kakon, S.S. Nasreen, A.A. Begum, S.T. Zannat and M.A.H.S. Jahan

The research experiment was conducted at Agronomy Research Field, BARI, Gazipur, during

*rabi* season of 2022-23 to study the appropriate weed controlling practice for sorghum. The experiment was conducted in RCBD with 3 replications consisting seven treatments viz., T<sub>1</sub>: Two hand weeding (HW) at 25 DAS and 45 DAS; T<sub>2</sub>: Atrazine @ 2 L/ha (pre-emergence) at 3-4 DAS + one HW at 25 DAS; T<sub>3</sub>: Atrazine @ 2 L/ha (pre-emergence) + BARI weeder at 25 DAS; T<sub>4</sub>: Atrazine @ 2 L/ha (post-emergence) at 25 DAS + one HW at 45 DAS; T<sub>5</sub>: Pendimethylene @ 3 L/ha (pre-emergence) at 3-4 DAS + one HW at 25 DAS; T<sub>6</sub>: Pendimethylene @ 3 L/ha (pre-emergence) at 3-4 DAS; T<sub>7</sub>: No weeding. The experiment was laid out in RCBD with three replications. The unit plot size was 3m × 3m. BARI sorghum-1 seeds were sown on 9 December 2022. The crop was fertilized with N<sub>120</sub> P<sub>60</sub> K<sub>50</sub> S<sub>27</sub> Zn<sub>2</sub> B<sub>2</sub> kg/ha based on FRG (2018). One third N and all other fertilizers were applied as basal. Rest of N was applied at 25 and 55 DAS. The crop was harvested on 30 April 2022. The highest WCE (90.2%) was found in T<sub>2</sub> treatment at 55 DAS. The highest grain yield (3.5 t/ha) was obtained from T<sub>5</sub> treatment (pre-emergence Pendimethylene with one HW at 25 DAS). Herbicide Pendimethylene @ 3 L/ha spraying as pre-emergence at 3-4 DAS with one hand weeding at 25 DAS produced higher seed yield of sorghum although herbicide Atrazine @ 2 L/ha spraying as pre-emergence at 3-4 DAS with one hand weeding at 25 DAS gave highest weed control efficiency.

#### **Maize- legume strip cropping for resource conservation**

J.A. Chowdhury, A.A. Begum, S.S. Kakon, M.R. Karim and M.A.H.S. Jahan

A field experiment was conducted under irrigated condition during *rabi* season, 2022-2023 at the Agronomy research field of Bangladesh Agricultural Research Institute. The experiment consisted of four treatments viz., T<sub>1</sub>= Maize (4 row) alternate with lentil (8 row), T<sub>2</sub>= Maize (4 row) alternate with pea (8 row), T<sub>3</sub>= Maize (4 row) alternate with grass pea (6 row) and T<sub>4</sub>= Sole Maize (8 row). Experiment was laid out in a RCB design with three replications and each gross plot of 9.6m × 7.0m. Maize (var. BARI Hybrid maize-9), lentil (var. BARI Masur-6, pea (var. BARI Motorsuti-3) and grass pea (var. BARI Khasari-1) were used as test crops. All crops were sown on 21 November 2022. Five t/ha of cowdung and



recommended dose of fertilizer was applied to all crops (FRG, 2018). For maize one third of N and all of other fertilizer was applied during final land preparation and rest N was applied in two equal splits at 30 days after sowing and 50 days after sowing. For other three crops all fertilizer was applied during final land preparation. The inclusion of pea as strip cropping ( $T_2$  treatment) resulted in higher content of all investigated nutrients in maize grain. The highest maize equivalent yield (9.65 t/ha) was observed in  $T_2$  treatment (maize + pea strip cropping). The grain yield of maize (7.30 t/ha) was higher in sole maize plot than all strip cropping plot. But maize equivalent yield (MEY), gross return, gross margin and benefit cost ratio (BCR) were higher in all strip plot than sole maize plot. The highest gross return (Tk. 193000/ha), gross margin (Tk. 113000/ha) and BCR (2.41) were also observed in  $T_2$  treatment. The result revealed that the farmers can be benefited by cultivating any one maize legume strip cropping with higher productivity. But among the three strip cropping, maize + pea strip cropping was more economically profitable.

#### **Barley- legume strip cropping for higher productivity and soil health**

J.A. Chowdhury, M.Z. Ali, S. Kundu and M.A.H.S. Jahan

The field experiment was conducted during *rabi* season, 2022-2023 at the Agronomy research field of Bangladesh Agricultural Research Institute. The experiment consisted of four treatments viz.,  $T_1$ = Barley (6 row) alternate with garden pea (4 row),  $T_2$ = Barley (6 row) alternate with lentil (4 row),  $T_3$ = Barley (6 row) alternate with grass pea (3 row) and  $T_4$ = Sole Barley (12 row). Experiment was laid out in a RCB design with three replications and each gross plot of 7.2 m x 24 m. Maize, lentil, garden pea and grasspea were used as test crop. All crops were sown on 22 November 2022. Five t/ha of cowdung and recommended dose of fertilizer was applied to all crops (FRG, 2018). For barley half of N and all other fertilizer was applied during final land preparation and rest N was applied in two equal splits at 30 days after sowing and 55 days after sowing. For other three crops all fertilizer were applied during final land preparation. In case of barley equivalent yield (BEY) all strip cropping system produced higher BEY than sole cropping (2.63-3.66 t/ha). Barley produced the 5.62-46.98%

higher BEY in strip cropping, as compared to sole cropping. The grain yield of barley (2.49 t/ha) was higher in sole barley plot than all strip cropping plot. But barley equivalent yield (BEY), gross return, gross margin and benefit cost ratio (BCR) were higher in all strip plot than sole barley plot. The highest barley equivalent yield (3.66 t/ha), gross return (Tk. 183000/ha), gross margin (Tk. 126000/ha) and BCR (3.21) were observed in  $T_1$  treatment. The result revealed that the farmers can be benefited by cultivating any one barley legume strip cropping with higher productivity. But among the three strip cropping, barley + pea strip cropping was more profitable.

#### **Long term effect of four crop based cropping pattern on soil health and crop productivity**

M.R. Karim, M.Z. Ali, S.T. Zannat and M.A.H.S. Jahan

The experiment was conducted at the Research Field of Agronomy Division BARI, Gazipur (AEZ 28), during *Rabi* season of 2017-18 to 2021-22 to find out the effect of intensive cropping on crop productivity and soil nutrients. Four treatments of cropping sequence were:  $CP_1$  = 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 x 4.2 m. Crops were sown as per growing season and followed by treatments. Fertilizer application and all other intercultural operations were done as per crop requirement. Intensive cropping has no or less effect on crop productivity. Soil nutrients are found to change over time. Nitrogen, phosphorus, potassium are increased over time in soil as a result of fertilizer and crop residue incorporated in soil. Sulfur, boron and zinc are found as limiting nutrients. Nitrogen level was found increased (30.3% to 100%) in all the patterns. Amount of phosphorus was increased (27% to 104.5%) in all the patterns. Amount of potassium was increased (87.14% to 169.39%) in all the patterns. Sulfur level was found decreased (5.53% to 40.18%) in all the patterns meaning more sulfur fertilization needed for those patterns. In all the patterns, boron levels were decreased about 4.17% to 28.13% meaning more boron fertilization needed for those patterns. In all the patterns, zinc levels

were decreased about 33.63% to 62.45% meaning more zinc fertilization needed for those patterns. In CP<sub>1</sub>, average yield of mustard, mungbean, T. *Aus* and T. *Aman* were found 1.42, 1.13, 3.41 and 4.49 t/ha respectively where the beginning yield of those crops were 1.40, 1.12, 3.41 and 4.45 t/ha respectively. In CP<sub>2</sub>, average yield of potato, mungbean, T. *Aus* and T. *Aman* were found 20.05, 1.12, 3.30 and 4.45 t/ha respectively where the beginning yield of those crops were 20.38, 1.25, 3.25 and 4.31 t/ha respectively. In CP<sub>3</sub>, average yield of garden pea, mungbean, T. *Aus* and T. *Aman* were found 4.99, 1.03, 3.24 and 4.52 t/ha respectively where the beginning yield of those crops were 4.97, 1.15, 3.18 and 4.43 t/ha respectively. In CP<sub>4</sub>, average yield of potato, red amaranth, maize and T. *Aman* were found 19.99, 15.15, 9.01 and 4.46 t/ha respectively where the beginning yield of those crops were 19.25, 15.38, 9.13 and 4.34 t/ha respectively. Yield of those crops shown consistency in spite of intensive cultivation.

#### Compatibility of minor cereals intercropping with groundnut

M.R. Karim, J.A. Chowdhury, A.A. Begum, S.S. Kakon, M.Z. Ali and M.H. Sarker

The experiment was conducted in agronomy research field, Bangladesh Agricultural Research Institute, Gazipur, during *rabi* season of 2022-23. The experiment was laid out in RCB design with seven treatments i.e. T<sub>1</sub> (Groundnut: Cheena = 4:1), T<sub>2</sub> (Groundnut: Cheena = 4:2), T<sub>3</sub> (Groundnut: Kaon = 4:1), T<sub>4</sub> (Groundnut: Kaon = 4:2), T<sub>5</sub> (Sole groundnut), T<sub>6</sub> (Sole cheena) and T<sub>7</sub> (Sole kaon). BARI Cheenabadam-9, BARI cheena-1 (Tushar) and BARI kaon-2 were respectively taken as groundnut, cheena and kaon varieties. The plot size was 3.0 m × 3.0 m. In case of 4:1 ratios, seeds are sown with 25 cm row to row distance. In 4:2 ratios, seeds are sown with 20 cm row to row distance. Groundnut was sown in line with 15 cm plant to plant spacing. Cereals were sown in continuous line. The plants were fertilized with 15 – 80 – 60 – 60 – 1.8 kg/ha of N-P-K-S-B respectively. Half N and all of other fertilizers were applied during final land preparation. Rest half N was applied at 40-45 DAS. Irrigation was done as and when necessary. Intercropping minor cereals with groundnut gave maximum productivity as well as economic return than monoculture of component crops. Considering equivalent yields, land equivalent ratio (LER),

competitive ratio (CR), relative crowding coefficient (RCC) and economic return, Groundnut: Kaon = 4:2 combinations was found superior i.e., two rows kaon in between four rows of groundnut could be accommodated for higher productivity with profitability for the farmers instead of sole crops.

#### Performance of intercropping bushbean with sorghum

M.Z. Ali, A.A. Begum, J.A. Chowdhury, M.R. Karim and M.A.H.S. Jahan

The experiment was conducted in agronomy research field, Bangladesh Agricultural Research Institute, Gazipur, during *rabi* season of 2022-23. This experiment was conducted to find out suitable planting systems of sorghum and bush bean (short duration crop) intercropping for higher productivity and economic return. The experiment consisted of six treatments viz., T<sub>1</sub>= Sorghum normal row 100% + 1 row bush bean in between two rows of sorghum 43.75%, T<sub>2</sub>= Sorghum normal row 100% + 2 row bush bean in between two rows of sorghum 87.50%, T<sub>3</sub>= Sorghum paired row 100% + 2 row bush bean in between two paired rows of sorghum 37.50%, T<sub>4</sub>= Sorghum paired row 100% + 3 row bush bean in between two paired rows of sorghum 56.25%, T<sub>5</sub>= Sole sorghum and T<sub>6</sub>= Sole bush bean were used in the experiment. Five t/ha of cowdung and recommended dose of fertilizer was applied to all crops (FRG, 2018). One third of N and all of other fertilizer was applied during final land preparation and rest N was applied in two equal splits at 30 days after sowing and 50 days after sowing. For other crop all fertilizer was applied during final land preparation. Among the intercropping situation the highest number of grains/panicle (1662) and 1000-grain weight (33.64 g) and the maximum grain yield 4.45 t/ha were obtained from T<sub>1</sub> treatment. The highest Sorghum equivalent yield (SEY) of 9.00 t/ha marginal benefit cost ratio (MBCR) of 3.91 and highest land equivalent ratio (LER) of 1.70 were obtained from T<sub>2</sub> treatment sorghum normal row 100% + 2 row bush bean in between two rows of sorghum. Among the intercrop situation the highest gross return (Tk. 1,79,900/ha), gross margin (Tk. 1,33,900/ha) and marginal benefit cost ratio 3.91 was obtained from T<sub>2</sub> treatment. The results revealed that sorghum normal row 100% + 2 rows bush bean 87.50% might be agronomically feasible and economically profitable.

### **Sorghum- legume strip cropping for resource conservation**

M.Z. Ali, J.A. Chowdhury, A.A. Begum, M.R. Karim and M.A.H.S. Jahan

The field experiment was conducted at the research field of Agronomy Division BARI, Gazipur during *rabi* season of 2021-22 and 2022-23 to find out the effect of strip cropping on maintain sustainable productivity and conserve soil health. Four treatments viz., T<sub>1</sub>= Sorghum 4 rows alternate with 8 rows garden pea, T<sub>2</sub>= Sorghum 4 rows alternate with 8 rows lentil, T<sub>3</sub>= Sorghum 4 rows alternate with 6 rows chickpea, T<sub>4</sub>= Sole Sorghum 8 rows were used. The experiment was under taken to evaluate the effect of strip cropping on maintain sustainable productivity and conserve soil health. The experiment was laid out in a RCB design with three replications. The unit plot size was 4.8 m × 12.0 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 27 November 2022 with maintaining spacing. Recommended dose of fertilizer was applied to all crops (FRG, 2018). All intercultural operation and plant protection were done as and when required. Sorghum was harvested on 10 April 2022 and 18 April 2023, Garden pea 01 February 2023 and 02 February 2023, Lentil 15 March 2022 and 13 March 2023 and Chickpea 15 March 2022 and 30 March 2023. The equivalent yield of sorghum was higher (79-159%) in all strips cropping, as compared to sole cropping of sorghum. The maximum sorghum equivalent yield (11.91 t/ha), gross return (Tk. 2,38,250 /ha), gross margin (Tk. 1,49,750/ha) and marginal benefit cost ratio (MBCR) 2.69 was obtained from T<sub>1</sub> treatment (Sorghum 4 rows alternate with 8 rows garden pea strip cropping) due to lower cost of production. The result revealed that the farmers can be benefited by cultivating any one sorghum legume strip cropping with higher productivity. But among the three strips cropping sorghum + garden pea strip cropping was economically profitable and agronomically feasible.

### **Sunflower- legume strip cropping for resource conservation**

A.A. Begum, M.Z. Ali, J.A. Chowdhury, S.S. Kakon M.R. Karim and M.A.H.S. Jahan

The field experiment was conducted at the research field of Agronomy Division BARI, Gazipur during *rabi* season of 2022-23 to find out the effect of strip

cropping on maintain sustainable productivity. Four treatments viz., T<sub>1</sub>= Sunflower 4 rows alternate with 7 rows lentil, T<sub>2</sub>= Sunflower 4 rows alternate with 7 rows garden pea, T<sub>3</sub>= Sunflower 4 rows alternate with 5 rows grass pea, T<sub>4</sub>= Sole sunflower 16 rows. The experiment was undertaken to evaluate the effect of strip cropping on maintain sustainable productivity. The experiment was laid out in a RCB design with three replications. The unit plot size was 8.0 m × 15.0 m. Seeds of sunflower (var. BARI Surjomuki-3), lentil (var. BARI Masur-8), garden pea (var. BARI Motorsuti-3) and grass pea (var. BARI Khesharri-3) were sown on 21 November 2022 with maintaining spacing. Recommended dose of fertilizer was applied to all crops (FRG, 2018). All intercultural operation and plant protection were done as and when required. Sunflower was harvested on 9 March 2023, Lentil 09 March 2023, Garden pea 30 January 2023, and grass pea 22 March 2023. The equivalent yield of sunflower was higher (13-267%) in all strips cropping, as compared to sole cropping of sorghum. The maximum sunflower equivalent yield (5.65t/ha), gross return (Tk. 2,25,800/ha), gross margin (Tk. 1,60,300/ha) and marginal benefit cost ratio 3.45 was obtained from T<sub>1</sub> treatment (Sunflower 4 rows alternate with 7 rows lentil strip cropping). The result revealed that the farmers can be benefited by cultivating any one sunflower legume strip cropping with higher productivity. But among the three strips cropping sunflower + lentil strip cropping was economically profitable and agronomically feasible.

### **Performance of cowpea intercropping with maize at Chottogram region**

S. Mahmud, M.M. Alam and M.S. Rahman

The experiment was conducted at Regional Agricultural Research Station, Hathazari, Chattogram during December 2022 to April 2023 to evaluate the performance of maize-cowpea intercrop as influence by planting arrangement for higher productivity. The treatments were T<sub>1</sub>= One row maize (60cm × 20cm) (100%) + one row cowpea (40cm× 10cm) in between two rows of maize, T<sub>2</sub>= One row maize (60cm × 20cm) + two row cowpea (40cm× 10cm) in between two rows of maize and T<sub>3</sub>= One row maize (60cm × 20cm) + cowpea broadcast in between two row maize T<sub>4</sub>= Sole maize (60cm × 20cm), T<sub>5</sub>=Sole cowpea (40cm× 10cm). The experiment design was completely randomized block design with three replications and individual



plot size was  $4\text{ m} \times 4.8\text{ m}$ . Maize seeds were sown on 23 December in 2022. Cowpea seeds were sown at two weeks after maize was sown. Sole Maize was fertilized by 250-55-120-50-5-1 N-P-K-S-Zn-B kg/ha, respectively. Sole cowpea was fertilized by 20-20-25 NPK kg/ha<sup>-1</sup>, respectively and intercrop was fertilized by 250-55-120-50-5-1 N-P-K-S-Zn-B kg/ha<sup>-1</sup>, respectively. The different intercrop combination is significantly different in terms of yield and yield attributes. Sole maize cropping produced highest maize grain yield (8.79t/ha) which was statistically similar to treatment T<sub>1</sub> (8.45 t/ha). Lowest maize grain yield (7.06 t/ha) was observed in treatment T<sub>3</sub> where the treatment combination was one row maize with cowpea broadcast. Cowpea equivalent yield of maize (2.45 t/ha), land equivalent yield ratio (1.84) was highest in T<sub>1</sub>. The highest gross return (218000 tk./ha) and BCR (1.79) was found in the intercrop combination of Maize with one row cowpea. The overall results indicated that cultivation of maize with one row cowpea was more effective than other intercrop combinations.

#### **Intercropping cowpea with sorghum under different planting system**

S. Mahmud, M.M. Alam and M.S. Rahman

The experiment was conducted at Regional Agricultural Research Station, Hathazari, Chattogram during December 2022 to April 2023 to evaluate the performance of sorghum cowpea intercrop as influence by planting arrangement for higher productivity. The treatments were T<sub>1</sub>= Sorghum normal row (100%) + 1 row cowpea in between two rows of sorghum. T<sub>2</sub>= Sorghum normal row (100%) + 2 rows cowpea in between two rows of sorghum. T<sub>3</sub>= Sorghum (100%) + cowpea broadcast (100%) in between sorghum lines T<sub>4</sub>= Sole sorghum and T<sub>5</sub>= Sole cowpea (40 cm  $\times$  10 cm). Sorghum cultivar BARI Sorghum-1 and cowpea cultivars BARI felon -2 were evaluated in this study. The experiment was laid out in a randomized complete block design with 3 replications with  $5\text{ m} \times 4.8\text{ m}$  individual plot size. Sorghum seeds were sown on 22 December in 2022. Three maize seeds were sown per hole and later thinned to one plant per stand at two weeks after planting. Cowpea seeds were sown at two weeks after sorghum was sown. Fertilizer application for sorghum, cowpea and sorghum + cowpea intercropping was done according to the FRG-2018. Cow pea was harvested during 3<sup>rd</sup> week of March to 2<sup>nd</sup> week of April 2023. Sorghum was harvested during 3<sup>rd</sup> week of April to 2<sup>nd</sup> week of May 2023. The

different intercrop combination is significantly different in terms of yield. The significantly highest sorghum grain yield (2.95 t/ha) and cowpea seed yield (1.55 t/ha) was obtained from treatment T<sub>4</sub> and T<sub>5</sub> where the practice as a sole crop. Highest sorghum equivalent yield and land equivalent ratio were observed in sorghum+ two row cowpea intercropping system. The highest MAI (42363.95) was obtained in the one row sorghum with two row cowpea intercropping, which implied that the planting pattern was highly economical and advantageous for this combination. From the above findings it may be concluded that optimum and sustainable productivity and profitability of sorghum cowpea intercrop combinations, a planting pattern comprising of one rows of sorghum to two rows of cowpea may be practiced in Chattogram region to increase land use efficiency.

#### **Productivity of chilli-onion intercropping system as influenced by fertilizer**

M. Rahman, M.A. Siddiky and M.O. Kaisar

An experiment was conducted at the research field of Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Cumilla during rabi 2022-23 to find out economic fertilizer dose for chilli-onion intercropping system for getting maximum yield and economic return. The treatments were: i) Recommended fertilizer dose of chilli + No additional fertilizer for onion ii) Recommended fertilizer dose of chilli + 25% Recommended fertilizer dose for onion iii) Recommended fertilizer dose of chilli + 50% Recommended fertilizer dose for onion iv) Farmers practice. The experiment was set up in a randomized complete block design with three replications. The unit plot size was  $2.5\text{ m} \times 2.0\text{ m}$ . The chilli and onion were planted at a spacing of 50 cm  $\times$  50 cm and 15 cm  $\times$  10 cm. chilli was planted on 08 December 2022. Onion seedling was transplanted on 10 December 2022. Fertilizers were applied according to the treatments. Irrigation and pesticide were applied as per necessary. The highest green chilli yield (8.45 t ha<sup>-1</sup>) was obtained from T<sub>2</sub> treatment and the highest onion bulb yield (14.67 t ha<sup>-1</sup>) was obtained from T<sub>2</sub> treatment. Among treatment T<sub>2</sub> was the most feasible intercropping system in respect of chilli equivalent yield (19.45 t ha<sup>-1</sup>), gross return (Tk. 7,78,000/ha), gross margin (Tk. 5,36,000/ha) and benefit cost ratio (3.21). Based on the present study, it may be

concluded that recommended fertilizer dose of chilli with 25% recommended fertilizer dose of onion could be used for chilli-onion intercropping system for getting higher yield and economic return.

#### **Intercropping of vegetables and spices with chilli in Chattogram region**

S. Mahmud, M.M. Alam and M.S. Rahman

The experiment was conducted at Regional Agricultural Research Station, Hathazari, Chattogram during December 2022 to April 2023 to assess the performance of the intercropping system of vegetables and spices with chilli for higher productivity and economic return. The treatments were  $T_1$ = Sole chilli (60cm  $\times$  50cm),  $T_2$ = Chilli (60cm  $\times$  50cm) + one row radish (30 cm  $\times$  10 cm) in between two row Chilli,  $T_3$ = Chilli (60cm  $\times$  50cm) + one row carrot (30 cm  $\times$  10 cm) in between two row chilli,  $T_4$ = Chilli (60cm  $\times$  50cm) + one row onion (30 cm  $\times$  10 cm) in between two row chilli and  $T_5$ = Chilli (60cm  $\times$  50cm) + one row garlic (30 cm  $\times$  10 cm) in between two row chilli. The experiment was laid out in RCB design with three replications. The unit plot size was 5m  $\times$  4m. Radish and carrot seeds; onion and garlic bulbs and 30 days old chilli seedlings were sown and transplanted respectively on 15 December, 2022. The land was fertilized at the rate of 97- 66-100-1 kg ha<sup>-1</sup> NPKS, respectively. Half of N and all other fertilizer was applied as basal. Rest N was applied at 30 DAS. All intercrop combinations performed better than sole chilli. Onion gave the highest equivalent yield (11.06 t/ha) with chilli. Maximum chilli equivalent yield (27.04 t/ha) was obtained from treatment  $T_4$ = Chilli (60cm  $\times$  50cm) + one row onion (30 cm  $\times$  10 cm) in between two row chilli. This might be cause of lower inter-specific competition for space and growth resources compared to the other intercrop. Highest net return (340850 Tk/ha) and benefit cost ratio (2.70) was obtained also obtained from  $T_4$ = Chilli (60cm  $\times$  50cm) + one row onion (30 cm  $\times$  10 cm) in between two row chilli intercropping system. From the results it may be concluded that cultivation of chilli with onion was more profitable than sole cropping of chilli. For further confirmation of the result, the experiment may be repeated in the next year.

#### **Performance of relay snake gourd in brinjal +onion intercropping at medium high land under AEZ-9 without trellis**

M.R. Ali, J. Rahman, M.A.H.S. Jahan and M.M. Kadir

An experiment was carried out at Regional Agricultural Research Station (RARS), Jamalpur during November 2020 to August 2021 and November 2021 to August 2022 to observe the performance of onion and snake gourd as intercropping and relay cropping with brinjal at medium high land under AEZ-9 for higher yield and economic return. The experiment consisted of five treatments, viz.,  $T_1$ = Sole brinjal (100cm $\times$ 60cm),  $T_2$ = Brinjal (100%) + 6 row onion + relay snake gourd (1m $\times$ 1.5m),  $T_3$ = Brinjal (100%) + 6 row onion + relay snake gourd (2m $\times$ 1.5m),  $T_4$ = Brinjal (100%) + 6 row onion + relay snake gourd (3m $\times$ 1.5m),  $T_5$ = Brinjal paired row+12 row onion + relay snake (1.75m $\times$ 1.5m). The treatments were tested in randomized complete block design with 3 dispersed replications. The unit plot size was 6.0 m  $\times$  3.0 m and spacing for brinjal was 100 cm  $\times$  60 cm. BARI Begun-8 for brinjal, BARI Pij 4 for onion and BARI Chichinga-1 for snake gourd were used as test materials. BARI Begun 8 was used in the study. Fertilizer 173-30-125-18-2 kg/ha NPKSB with cowdung 10 t/ha for brinjal (FRG' 2018) and Chichinga: 100-40-60-20-2 kg/ha NPKSB and cowdung 10 t/ha (BARC, 2018). For brinjal: all amount of cowdung, TSP, gypsum, borax and one-third of nitrogen, half of muriate of potash were applied during final land preparation. Remaining nitrogen fertilizer was applied in three equal splits at 15, 50 and 70 days after transplanting and remaining muriate of potash was applied in two equal splits at 15 and 50days after transplanting. The highest snake gourd yield (15.80 t/ha) was achieved from brinjal paired row+ 12 row onion + relay snake gourd (1.75m  $\times$  1.5m) treatment and the lowest (8.92 t/ha) was from brinjal (100%) + 6 row onion+ relay bitter gourd (1.0m  $\times$  1.5m) treatment. The highest brinjal equivalent yield (51.28 t/ha) was obtained from brinjal paired row+ 12 row onion + relay snake gourd (1.75m  $\times$  1.5m) treatment and the highest gross return (Tk. 12,82,000/ha), gross margin (Tk. 10,83,000/ha) and benefit cost ratio (6.44) was found from brinjal paired row+ 12 row onion + relay snake gourd (1.75m  $\times$  1.5m) treatment. However, in sole brinjal

treatment the highest yield was obtained might have the effect of number of brinjal per plant, single brinjal weight per plant. From two-year study (2020-21 and 2021-22) it may be concluded that brinjal paired row+12 row onion + relay snake (1.75m×1.5m) is the best treatment considering higher yield and good economic return.

#### **Performance of intercropping coriander with sunflower**

M. Rahman, M.A. Siddiky and M.O. Kaisar

An experiment was conducted at the research field of Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Cumilla during *rabi* season 2022-23 to find out the suitable intercrop combination of coriander with sunflower for increasing cropping intensity and productivity. The treatments were: i) Sunflower (100%) + 3 rows of coriander ii) Sunflower (100%) + 2 rows of coriander iii) Sunflower (100%) + coriander broadcast iv) Sole sunflower (100%). The experiment was set up in a randomized complete block design with three replications. The unit plot size was 3.0 m × 3.0 m. The Sunflower and coriander were sown at a spacing of 50 cm × 20 cm and 15 cm × 5 cm. Sunflower and coriander seeds were sown on 18 November, 2022. Fertilizers dose 200-175-135-145 of NPKS kg ha<sup>-1</sup> respectively. Half nitrogen and full number of other fertilizers was applied at basal. Rest amount of nitrogen was applied at flowering stage of sunflower. Among treatment T<sub>2</sub> was the most feasible intercropping system in respect of sunflower equivalent yield (2.98 t ha<sup>-1</sup>), gross return (Tk. 4,47,000), gross margin (Tk. 3,23,000) and benefit cost ratio (3.60). The result revealed that all intercropping treatments showed better performance as compared to sole treatments. Among the treatments, T<sub>2</sub>= Sunflower (100%) + 2 rows of coriander was more productive and profitable in respect of sunflower equivalent yield (SEY) and monetary return.

#### **Effects of management practices on growth and yield of pineapple under coconut orchard in Barishal region**

M.A. Rahman, M.M. Rahman, M. Ahmed and B.C. Kundu

The experiment was conducted during 2021-2022 and 2022-2023 under coconut orchard at RARS, Rahmatpur, Barishal to develop suitable management package for increasing the yield of

pineapple in Barishal region. Six management practices viz., T<sub>1</sub> = Recommended Fertilizer (RF: 180-75-180-21-3-3 kg/ha N-P-K- S-B-Zn + 5 t/ha organic manure) + Polythene mulch + Plant growth regulator (PGR), T<sub>2</sub> = RF + Mulch, T<sub>3</sub> = RF + PGR + Hand weeding, T<sub>4</sub> = PGR + Mulch + Hand weeding, T<sub>5</sub> = RF + Hand weeding and T<sub>6</sub> = Control were tested in this experiment. Days to flowering was higher in T<sub>2</sub>, T<sub>5</sub> and T<sub>6</sub> treatments due to no application PGR but spraying of PGR reduced the number of days to flowering remarkably in T<sub>1</sub>, T<sub>3</sub> and T<sub>4</sub> treatments. The experiment was laid out in randomized complete block design with three replications. Sucker of pineapple (variety: Giant kew) was transplanted on 1 July, 2021 with plant spacing 50 cm x 50 cm. Fertilizers and compost were applied in the experimental plots as per treatment specifications. Treatment T<sub>2</sub> produced the highest yield of fruit (48.67 t/ha), which was statistically similar to that of T<sub>1</sub> (44.86 t/ha). Net return was also the highest (Tk. 1177720/ha) in T<sub>2</sub> followed by T<sub>1</sub> (Tk. 983680/ha). Spraying of PGR produced early fruiting in plant. Improved management practices can enhance the yield and profitability of pineapple. Ripen pineapple was sweet and tasty (TSS/brix value 20.10%). Therefore, fallow land under fruit orchard can be utilized properly by cultivation of shade tolerant pineapple crop in Barishal region.

#### **Performances of different pulse crops under mango orchard in southern region of Bangladesh**

M.M. Rahman, M.R. Islam, M.A. Rahman and B.C. Kundu

The field experiment was conducted at Regional Agricultural Research Station, BARI, Rahmatpur, Barishal with the treatments: T<sub>1</sub>= Mango + Grass pea (BARI Khesari-3), T<sub>2</sub>= Mango + Black gram (BARI Mash-3), T<sub>3</sub>= Mango + Mung bean (BARI Mung-6), T<sub>4</sub>= Mango + Cowpea (BARI Felon-1), T<sub>5</sub>= Mango + Field pea (BARI Motor-3) and the trial was conducted to study the effect of intercropping on main crop mango and to select the most appropriate intercropping system. Seed rate for grass pea, black gram, mung bean, cowpea and field pea were 7, 30, 22, 40 and 90 kg/ha, respectively. The experiment was laid out in randomized complete block design with four replications. The experimental plots were fertilized



as per recommendation of Fertilizer Recommendation Guide (BARC, 2018) and applied following the recommended production technologies (BARI, 2020). The highest yield was recorded in T<sub>5</sub> treatment (1858.29kg/ha) and lowest obtained from T<sub>2</sub> (546.33kg/ha). The gross margin was found to be the highest (Tk. 37830/ha) treatment T<sub>5</sub> (BARI Motor-3) and lowest in treatment T<sub>2</sub> (BARI Mash-3) Tk. -3357/ha. The value of benefit cost ratio (BCR) revealed the highest (1.96) in treatment T<sub>5</sub> (BARI Motor-3) and treatment T<sub>2</sub> (BARI Mash-3) was found lowest (0.87). BARI Motor-3 might be cultivated as most appropriate component crops under mango orchard in southern region of Bangladesh. From the economic point of view treatment T<sub>5</sub> that means BARI Motor-3 might be cultivated as most appropriate component crops under mango orchard in southern region of Bangladesh.

#### **Integrated nutrient management on garlic-maize -T. Aman rice cropping pattern in Rangpur region**

S. Hasan, A.I. Sarker, M.M. Sheikh, M.N. Sarker and A.K. Saha

A field experiment was conducted at RARS, BARI, Burirhat, Rangpur with five treatments to find out the best fertilizer dose and economic return for Garlic – Maize-T. Aman rice cropping pattern in Rangpur region during *rabi* season 2020-2021 and 2021-2022. The experiment was laid out in RCBD with three replications. Five different fertilizer doses i.e., T<sub>1</sub>=(FRG), BARC-2018, T<sub>2</sub>=FRG, BARC-2018+5t/ha CD, T<sub>3</sub>= FRG, BARC-2018+2t/ha VC, T<sub>4</sub>= FRG, BARC-2018+3t/ha PM and T<sub>5</sub> = Control. Organic fertilizer such as vermicompost, cowdung, poultry manure had produced better yield than inorganic fertilizer. The size of the unit plot was 3m×4 m. Considering the price of organic fertilizer, organic fertilizers gave the more yield and economic return. The highest rice equivalent yield (32.78 t/ha in 2020-21 and 32.98t/ha in 2021-22) from T<sub>3</sub> and gross return (819500 Tk./ha in 2020-2021 and 824523 Tk./ha in 2021-22) were recorded from T<sub>3</sub> also. From two years' field experiment, it was observed that T<sub>3</sub> (FRG, BRAC, 2018 + 2 t/ha vermicompost) gave the highest gross return among the five treatments. So it was the most profitable fertilizer dose for Garlic- Maize -T. Aman rice cropping pattern in Rangpur region. Organic fertilizer such as

vermicompost, cowdung, poultry manure has produced better yield than inorganic fertilizer

#### **Integrated nutrient management on garlic- T. Aus rice -T. Aman rice cropping pattern in Rangpur region**

S. Hasan, A.I. Sarker, M.M. Sheikh, M.N. Sarker and A.K. Saha

A field experiment was conducted at RARS, BARI, Burirhat, Rangpur with five treatments to find out the best fertilizer dose and economic return for Garlic- T. Aus rice -T. Aman rice cropping pattern in Rangpur region during *rabi* season 2020-21 and 2021-2022. The experiment was laid out in RCBD with three replications. Five different fertilizer doses i.e., T<sub>1</sub>=Fertilizer Recommended Guide (FRG), BARC-2018, T<sub>2</sub>= FRG, BARC-2018+5t/ha cowdung, T<sub>3</sub>= FRG, BARC-2018 + 2 t/ha vermicompost, T<sub>4</sub>= FRG, BARC-2018+3 t/ha poultry manure and T<sub>5</sub> = Control. The size of the unit plot was 3 m × 4 m. The highest rice equivalent yield and gross return were recorded from T<sub>3</sub> in 2020-21 and 2021-2022 which was identical to T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub>. The highest equivalent rice yield was 27.98 t ha<sup>-1</sup> in 2020-21 & 27.99tha<sup>-1</sup> in 2021-22 from T<sub>3</sub> and the highest gross return (699500 Tk./ha in 2020-21 and 699000Tk./ha in 2021-22) and were recorded from T<sub>3</sub> due to vermicompost use. But the maximum benefit cost ratio was recorded from T<sub>1</sub> in both years. The lowest rice equivalent yield and gross return were recorded from T<sub>5</sub> Control treatments. From two years' field experiment, we observed that T<sub>3</sub>(FRG, BARC-2018 + 2ton ha<sup>-1</sup>vermicompost) gave the highest rice equivalent yield, gross return among the five treatments. So, it was the most profitable fertilizer dose for Garlic- T. Aus -T. Aman rice cropping pattern in Rangpur region. Organic fertilizer such as vermicompost, cowdung, poultry manure has produced better yield than organic fertilizer.

#### **Integrated nutrient management on onion seed production- T. Aus -T. Aman rice cropping pattern in Rangpur region**

S Hasan, A.I. Sarker, M.M. Sheikh, M.N Sarker and A.K. Saha

A field experiment was conducted at RARS, BARI, Burirhat, Rangpur with five treatments to find out the best fertilizer dose and economic return for Onion-T. Aus-T. Aman cropping pattern of

Rangpur areas during Rabi season 2020-21 and 2021-22. The experiment was laid out in RCBD with three replications. Five different fertilizer doses i.e., T<sub>1</sub>=FRG, BARC-2018, T<sub>2</sub>=FRG, BARC-2018+5t/ha cowdung, T<sub>3</sub>=FRG, BARC-2018+2t/ha vermicompost, T<sub>4</sub>= FRG, BARC-2018+3 t/ha poultry manure and T<sub>5</sub> = Control. Organic fertilizer such as vermicompost, cowdung, poultry manure has produced better yield than inorganic fertilizer. Considering the price of organic fertilizer, these fertilizers gave the more yield and economic return. The highest rice equivalent yield (108.58 t/ha in 2020-21 & 108.60 t/ha in 2021-22), gross return (2714500 Tk./ha in 2020-21 & 2715000 Tk./ha in 2021-22) and gross margin (189509Tk./ha in 2020-21 & 1895095Tk./ha in 2021-22) were recorded from T<sub>3</sub>. From two years' field experiment, we observed that T<sub>3</sub> (FRG, BARC-2018+2t/ha vermicompost) gave the highest gross return among the five treatments. So, it was the most profitable fertilizer dose for Onion seed-T. Aus-T. Aman cropping pattern in Rangpur region. Organic fertilizer such as vermicompost, cowdung, poultry manure has produced better yield than organic fertilizer.

#### **Performance of different agro-forestry crops as intercrop with arecanut (*Areca catechu*)**

M.M. Sheikh, A.I. Sarker and A.K. Saha

The experiment was conducted at Farmer's field in Bhurungamari, Kurigram during cropping season 2022-23 with the objectives to introduce and determine economic performance of different crops as intercrop along with Arecanut and to motivate farmers to cultivate inter crops in Arecanut orchards. There were three intercrop combinations; T<sub>1</sub>: Arecanut, T<sub>2</sub>: Arecanut-Banana, T<sub>3</sub>: Arecanut-Pumpkin-Ladies finger, T<sub>4</sub>: Arecanut-Spices (Turmeric). The maximum net return was observed in T<sub>2</sub> treatment followed by T<sub>3</sub> treatment. The experimental site (Arecanut orchard) is of eight years old. 200 m<sup>2</sup> area was selected from Acecanut orchard (purposely selected) for each intercropping system. The seeds/saplings of each intercrop were sown in the Arecaut orchard. The experiment was initiated on 06 June 2022. Spacing followed for arecanut and banana was 3 x 3 m, turmeric 60 x 25 cm, pumpkin 3 x 2 m and sown in line sowing method. The varieties used in this experiment were: arecanut (Local), BARI Banana-1, BARI Turmeric-4, BARI Pumpkin-2, BARI

Ladies finger-1. Fertilizer dose for each crop was arecanut: 275-255-280-48-NPKS (g/tree/year)-7 OF (kg/tree/year) Banana: 230-80-300-36-1.2-2 NPKSZnB (g/plant)-5 OF (kg/pit), Turmeric: 100-25-130-40-2-6 NPKSZnB (kg/ha)-6 OF (t/ha), Pumpkin: 50-24-40-14-1-7 NPKSZnB (kg/ha)-4 OF (t/ha), Ladies finger: 60-20-40-10-1.7 NPKSZnB (kg/ha)-3 OF (t/ha). All OF (Organic fertilizer), P, K, S, Zn, B and half of N should be applied as basal during final land preparation except Banana. The maximum BCR (3.6:1) was calculated in T<sub>3</sub> treatment where, pumpkin and ladies' finger were grown as intercrops with arecanut. While minimum BCR (2.4:1) found in case of T<sub>4</sub> treatment where turmeric grown along with arecanut as main crop. The arecanut-Pumpkin-Ladies finger combination was found most profitable intercropping.

#### **Estimation of temperature co-efficient of wheat for adjusting optimum sowing time**

A.A. Begum, S. Kundu and M.A.H.S. Jahan

The field experiment was conducted at Agronomy Research Field, Gazipur, BARI during *rabi* season of 2022-2023 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<sub>1</sub> = 10 November, D<sub>2</sub> = 20 November, D<sub>3</sub> = 30 November, D<sub>4</sub> = 10 December and D<sub>5</sub> = 20 December. The experiment was laid out in a RCB design with three replications and the unit plot size was 5m x 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. Two third of urea and full doses of other fertilizers were applied at the time of final land preparation. The remaining one third of urea was top dressed at CRI stage followed by irrigation. 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 (LI3100 c, LICOR, USA). Daily air temperatures were recorded for computing the growing degree days (GDD). The harvested spikes were oven dried at 70°C for 72 hours. Twenty grains of each spike were separated from the middle of each spike and then weight was taken. Yield data were recorded by harvesting ten square

meters' area excluding border. Collected data was analyzed statistically following MSTAT-C software package and means were compared using LSD test at 5% level of significance. The 30 November sowing produced the maximum TDM and LAI followed by 10 December and 20 November sowing. The 30 November sowing took the longest period (105 days for physiological maturity) due to prevailing lowest temperature (21.6°C) with highest GDD (1743) produced the highest grain yield and 20 December sowing took the shortest period (95 days for physiological maturity) due to prevailing highest temperature (22.5°C) with lowest GDD (1662) produced the lowest grain yield of wheat. It was also found that 30 November sowing produced the higher grain yield (4.89 t/ha). 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.

#### **Effects of different production systems on the performance of vegetables in low-lying areas of Barishal region**

M.A. Rahman, M.M. Rahman, M.A. Rahman and M. Ahmed

The experiment was conducted at RARS, Rahmatpur, Barishal during late *kharif* season of 2022-23 to evaluate the effects of different production systems on the performance of vegetables in low-lying areas of Barishal region. There were five production systems of vegetables viz., T<sub>1</sub> = Pyramid (soil made cone shaped structure, 1.0 m high), T<sub>2</sub> = Dyke cropping (embankment of pond, canal or river), T<sub>3</sub> = Sorjan (alternate deep sinks and raised beds, bed height 1.3 m), T<sub>4</sub> = Plastic sac (plastic bag filled with fertilized soil) and T<sub>5</sub> = Plain land (control) systems. The experiment was laid out in randomized complete block design with three replications. Seedlings of bottle gourd (var. BARI Lau-4) were transplanted through pyramid, dyke, sorjan, plastic bag and plain land systems on 15 September 2022. The crop was fertilized as per recommended dose of fertilizer at the rate of 65-36-20-7-1-1 kg/ha N-P-K-S-Zn-B, respectively + 5 t/ha compost in the forms of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid (BARC, 2018). Irrigation was applied for three times and other intercultural operations were done as and when necessary,

following the recommended production technologies of the crop (BARI, 2020). Data were collected on relevant parameters of the production systems. Data were analyzed statistically using windows-based computer software of Statistics 10 version and then the mean differences were adjudged with Duncan's Multiple Range Test (DMRT). Sorjan system showed the highest yield of fruit (40.53 t/ha), which was statistically at par to that of pyramid and dyke systems (38.33 and 35.00 t/ha, respectively). Plastic sac gave the lowest yield (26.14 t/ha) and it was statistically identical to plain land system (27.12 t/ha). The low-lying fallow lands could be utilized by cultivating creeper vegetables through sorjan, pyramid and dyke systems for increasing the crop productivity in Barishal region.

#### **Performance of mustard varieties in the hilly area of Khagrachari**

J.A. Chowdhury M.A.A. Malek, A.A. Begum, S.S. Kakon, M.Z. Ali, M.R. Karim and M.A.H.S. Jahan

This experiment was conducted at the hill valley of Hill Agricultural Research Station, Khagrachari during *rabi* season 2022-2023 to evaluate the mustard variety for maximum yield in the hilly area of Khagrachari. Three mustard varieties viz: V<sub>1</sub>= BARI Sarisha- 14, V<sub>2</sub>= BARI Sarisha- 15 V<sub>3</sub>= BARI Sarisha- 17 was used for this experiment. The experiment was carried out following RCB design with three replications and unit plot size was 11.0 × 25.0 m. Seeds were sown on the hill valley following continuous line sowing method (20cm x continuous). 120-35-90-30kg NPKS/ha fertilizer were applied in three spilt. Half of urea and all other fertilizer were applied at the time of land preparation. and remain half doses urea was applied at vegetative and flowering stage. Ten plants were randomly selected from each row for data collection. Yield and yield contributing components data were recorded and statistically analyzed. BARI Sharisha-17 showed the longest days to 50% flowering (39.61), and maturity (83.17 days) followed by BARI Sharisha- 15 and while BARI Sharisha- 14 showed the lowest value in both cases.

Significantly the highest number of siliqua /plant (128.57) was recorded in BARI Sharisha-17 and the lowest (105.33) in BARI Sharisha-15. The highest thousand seed weight (4.99g) was in BARI Sharisha -17 and the lowest thousand seed weight



was in (3.95g) BARI Sharisha -14. Seed yields also differed significantly among mustard varieties. Significantly the highest yield (1602.3 kg/ha) was observed in BARI Sharisha-17 followed by BARI Sharisha-15 (1416.7 kg/ha). From the result it may be concluded that BARI Sharisha-17 produced higher yield than other variety and it could be easily accommodated for cropping pattern. Farmers can cultivate BARI Sharisha-17 in the hill valley along with BARI Sharisha-14.

#### **Performance of BARI realized minor cereal crops in acidic soil at Moulvibazar**

M. Shaheenuzzamn, M.S. Alam, M.A.M. Miah, M. Rasheduzzaman and M.H. Hossain

An experiment was conducted at RARS, BARI, Akbarpur, Moulvibazar during *rabi* season of 2021-22 ( $Y_1$ ) and 2022-23 ( $Y_2$ ) to evaluate the performances of minor cereal crops at acidic soil condition. The soil of the experimental field was analyzed before and after the experiment conducted. There were eight treatments viz.  $T_1$ =BARI Barley- 6,  $T_2$ =BARI Barley- 7,  $T_3$ =BARI Barley- 8,  $T_4$ =BARI Barley- 9,  $T_5$ =BARI Kaon- 2,  $T_6$ =BARI Kaon- 4,  $T_7$ =BARI Sorghum- 1 and  $T_8$ =BARI Cheena- 1. The experiment was laid out in RCBD with three replications. The unit plot size was 3 m  $\times$  3 m. The seed of minor cereal crops were sown on 11 November, 2021 and 15 November, 2022 at the rate of 120 kg/ha, 10 kg/ha, 20 kg/ha and 10 kg/ha for Barley, Kaon, Cheena and Sorghum respectively. Row to row distance 20, 25, 25, 50 cm for barley, kaon, chena and sorghum. The plant-to-plant distance was 10 cm for all the crops. Before seed sowing, the liming material used in the experiment was called *Dolo Chun* @ 2 ton/ha. Fertilizer was applied in the plots as per their respective recommended doses and methods (FRG, BARC, 2018). Irrigation was applied for two times and other intercultural operations were done as, when necessary, by following the production technologies (BARI, BARC, 2020). Yield attributes and yield related data were collected and analyzed statistically. The study reported that spike length, plant height, 1000-seed weight and yield were significantly differed ( $P < 0.05$ ) for Barley; plant height and yield were differed significantly ( $P < 0.05$ ) for Kaon. Furthermore, the highest yield and BCR was recorded from BARI Barley-7 (1.45 t/ha, 2.53), BARI kaon-2 (0.78 t/ha, 2.01), BARI Sorghum-1 (2.81 t/ha, 3.18) and BARI Cheena-1

(1.38 t/ha, 3.47), respectively. The study recommended cultivating BARI Cheena-1, BARI Sorghum-1, BARI Barley-7 and BARI Kaon-2.

#### **Performance of BARI released groundnut varieties in acidic soil at Moulvibazar**

M. Shaheenuzzamn, M.S. Alam, M.A.M. Miah, M. Rasheduzzaman and M.H. Hossain

The experiment was conducted at RARS, BARI, Akbarpur, Moulvibazar during *rabi* season of 2021-22 ( $Y_1$ ) and 2022-23 ( $Y_2$ ) to evaluate the performances of groundnut varieties at acidic soil condition. Ten groundnut varieties viz.  $T_1$ =BARICHinabadam-5,  $T_2$ =BARICHinabadam-6,  $T_3$ =BARICHinabadam-7,  $T_4$ =BARICHinabadam-8,  $T_5$ =BARI Chinabadam-9,  $T_6$ =BARI Chinabadam-10,  $T_7$ =Dhaka-1,  $T_8$ =Basanti (DG-2),  $T_9$ =Tridana and  $T_{10}$ =Zhingabadam were tested using a RCBD with three replications. The unit plot size was 2.25 m  $\times$  2.25 m. The seed of ground nut varieties were sown on 14 November, 2021 and 15 November, 2022 and harvested on 5-7 April in both years with maintaining 90-100 kg seed/ha. Before sowing, seeds were treated with Provex @ 0.2% to prevent seed and soil borne diseases. Weeding followed by irrigations was done twice at 15-20 and 45-50 days after sowing of seed and earthing up was followed as per package. The crop was fertilized with 25-160-85-300-10 kg urea-TSP-MoP-Gypsum-Boric acid ha<sup>-1</sup>. The intercultural operations were performed as necessary. The mean value of branches per plant, fresh stover yield per plant, pod yield per plant, 1000-seeds weight, pod yield per hectare, shelling percentage and harvest index showed significant ( $P < 0.05$ ) differences among the groundnut varieties during 2021-22 and 2022-23 season. The study reported that  $T_2$  (BARI Chinabadam-6) showed most promising groundnut variety at acidic soil. Apart from  $T_2$ ,  $T_1$  (BARI Chinabadam-5),  $T_4$  (BARI Chinabadam-8) and  $T_7$  (Dhaka-1) might be selected to cultivate at acidic soil of Moulvibazar as well as Sylhet region.

#### **Strip cultivation of tomato in tomato and lalsak along with bitter gourd in intercropping system at acidic soil at Moulvibazar**

M. Shaheenuzzamn, M.S. Alam, M.A.M. Miah, M. Rasheduzzaman and M.H. Hossain

The experiment was conducted at RARS, BARI, Akbarpur, Moulvibazar during *rabi* season of 2022-

23 to at acidic soil condition to find out the suitable crop combination of tomato along with red amaranth (lalshak) and bitter gourd for increasing total productivity, economic return and maximize land utilization through strip intercropping. The five treatments of the experiment were as follow: T<sub>1</sub>= Sole Tomato (60 cm×60 cm) (control), T<sub>2</sub>=Sole bitter gourd (60 cm X 150 cm), T<sub>3</sub>= Tomato strip (100%) +2 row lalshak/bitter gourd (60 cm×150 cm), T<sub>4</sub>= Tomato strip (100%) + 4 row lalshak/bitter gourd (120 cm×150 cm) and T<sub>5</sub>= Tomato strip (100%) + 6 row lalshak/ bitter gourd (180cm×150cm). The experiment was laid out in RCBD with three replications. Half of the organic fertilizer and P with whole K, zinc and boron were applied during land preparation. The remaining half organic fertilizer was applied during pit preparation. The rest of K and entire N were applied at two equal installments at 15 days and 30 days after transplanting under moist condition and mixed thoroughly with soil as soon as possible. Fertilizer dose were calculated based on average value of low fertility level of soil (FRG, BARC, 2018). Intercultural operations were done as when necessary, following the recommended production technologies of the Tomato crops. Tomato equivalent yield (BEY) and economic analysis was performed in this study. Tomato equivalent yields were recorded the highest in the intercrops T<sub>4</sub> (39.44 t/ha). The highest land equivalent ratio (1.93) was recorded in T<sub>4</sub> and T<sub>5</sub> treatment in intercropping system. Among the intercropping system the highest gross return (Tk.394400.00/ha) was recorded from T<sub>4</sub> treatment. This intercropping combination also gave the highest gross margin (Tk. 214400.00/ha) and benefit cost ratio (2.19) followed by T<sub>5</sub> treatment (2.14) and T<sub>3</sub> treatment (1.70). So, T<sub>4</sub> and T<sub>5</sub> intercropped combination might be found agronomically feasible and economically profitable. The unit plot size was 2 m × 4 m. Variety used were, BARI Tomato-21, BARI Korola-1 and BARI Lalshak-1. Tomato seedlings transplanted on 18 November, 2022 where, bitter gourd and lalshak sown on same date.

#### **Effect of management practices on mustard yield in Chalanbeel area**

S.S. Kakon, A.A. Begum, J.A. Chowdhury, S.T. Jannat and M.A.H.S. Jahan

The experiment was conducted at Dobila, Tarash of Shirajgonj in Chalanbeel during the *rabi* season of

2021-2022 and 2022-23 to find out suitable management practices in mustard in Chalanbeel area. The treatments were T<sub>1</sub> = 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<sub>2</sub>= 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<sub>3</sub>= 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)}. The experiment was conducted at Dobila, Tarash of Shirajgonj in Chalanbeel during the *rabi* season of 2021-2022 and 2022-23to find out suitable management practices in mustard in Chalanbeel area. The treatments were T<sub>1</sub> = 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<sub>2</sub>= 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<sub>3</sub>= 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)}. The results revealed that maximum response in yield (1672.5 kg ha<sup>-1</sup>) was observed with timely sowing (November 10) with complete package. The highest gross return (Tk. 1,06,020 ha<sup>-1</sup>), gross margin (Tk. 42360 ha<sup>-1</sup>) and benefit cost ratio (2.50) were observed in T<sub>1</sub> treatment, i.e., the high management practice. The results revealed that maximum response in yield (1672.5 kg ha<sup>-1</sup>) was observed with timely sowing (November 10) with complete package. The highest gross return (Tk. 1,06,020 ha<sup>-1</sup>), gross margin (Tk. 42360 ha<sup>-1</sup>) and benefit cost ratio (2.50) were observed in T<sub>1</sub> treatment, i.e., the high management practice.

#### **Effect of management practices on potato at Chalan beel area**

S.S. Kakon, M.A.K. Mian, A.A. Begum and M.A.H.S. Jahan

The experiment was conducted at Dobila, Tarash of Shirajgonj in Chalanbeel during the *rabi* season of

2021-2022 to determine optimum management for potato production in chalanbeel area. The treatments were: T<sub>1</sub>=Recommended fertilizer dose (180-40-180-20-4-1 kg/ha of NPKSZnB) + earthing up at 20-25 DAE, T<sub>2</sub>=RFD + pre-emergence herbicide (pandimethylene @ 3L/ha) spraying at 5 DAP, T<sub>3</sub>=120% RFD + earthing up at 20-25 DAE and T<sub>4</sub> =Farmers' practice (local variety + no earthingup+RFD). Unit plot size was 20 decimals. Potato (BARI Alu-7 and *Deshalalu*) were planted on 28 November 2021. Crop was harvested on 28 February 2022. The collected data were analyzed statistically using MSTAT-C package and means were adjudged by LSD test at 5% level of probability. The results revealed that maximum response in yield (25.22 /ha) was observed with 120% RFD + earthing up at 20-25 DAE. The highest gross return (Tk. 252233/ha), gross margin (Tk. 92569/ha) were observed in T<sub>3</sub> (120% RFD + earthing up at 20-25 DAE) treatment but the highest benefit cost ratio (1.86) was observed in T<sub>2</sub> (180-40-180-20-4-1kg/ha of NPKSZnB + pre-emergence herbicide (Pandimethylene @ 3L/ha) spraying at 5 DAP) treatment. From the result it could be concluded that RFD 180-40-180-20-4-1 kg/ha of NPKSZnB + pre-emergence herbicide (Pandimethylene @ 3L/ha) spraying at 5 DAP might be suitable for getting maximum yield of potato at chalanbeel area.

#### **Performance of sweet potato varieties at Chalanbeel area**

S.S. Kakon, A.A. Begum, J.A. Chowdhury, M.R. Karim, S.T. Zannat and M.A.H.S. Jahan

The experiment was conducted at chalan beel of Sirajgong during the rabi season of 2022-2023. It belongs to the Lower Atrai Basin (AEZ-5). The four varieties of sweet potato were as BARI SP-12, BARI SP-15, BARI SP-16 and BARI SP-17 were evaluated. The design was followed with RCB with three replications. The unit plot size was 12 m × 10 m. The spacing was maintained 60 cm × 30 cm in BARI released varieties and 50 cm × 20 cm in local cultivar. The experiment was started 17 November, 2022. Fertilizers were applied at the rate of 280-170-260-80-12-8 Kg/ha of Urea-TSP-MP-Gypsum-Zinc Sulphate-Boric acid (BARI Krishi Projukti Hand Book, 2017), respectively. Half of Urea, whole amount of TSP, MoP, Gypsum, Zinc and Boron were applied as basal. Remaining rest urea was top dressed at 35 days and mixed thoroughly

with the soil as soon as possible for better utilization. Data on yield contributing characters of sweet potato were taken from randomly selected 5 plants from each plot. Yields of the crops were taken from whole plot area. Sweet potato was harvested at 25 March, 2023. The data were compiled and analyzed with STAR version 2.0.1 (Statistical Tool for Agricultural Research; 2014) package program and mean separation was done with the help of Least Significant Difference (LSD) Test.

Higher yield (24.70-27.77 t/ha) was observed in BARI SP-12, BARI SP -16 and BARI SP-17. Cumulative effect of yield components contributed to higher tuber yield in BARI SP -12, BARI SP -16 and BARI SP -17. The highest foliage yield (29.41 t/ha) was recorded in BARI SP -17 which was statistically identical with V<sub>3</sub> (BARI SP -16) and V<sub>1</sub> (BARI SP -12) treatment and the lowest (24.72 t/ha) was in V<sub>2</sub> (BARI SP -15). There was no Weevil infestation in the experimental field. Farmers have moderate interest to grow sweet potato in chalan beel area.

#### **Performance of water melon as relay with garlic in Chalanbeel area**

S.S. Kakon, J.A. Chowdhury, A.A. Begum and M.A.H.S. Jahan

A field experiment was conducted to evaluate the economic benefits of water melon relay with garlic under farmers field condition at Gurudaspur of Sirajganj chalan beel area during 2022-2023. The treatments were T<sub>1</sub>= garlic/water melon (local), T<sub>2</sub>= garlic/water melon (BARI tarmuj-1), T<sub>3</sub>= Water melon (local), T<sub>4</sub>= water melon (BARI tarmuj-1) and T<sub>5</sub>= garlic (BARI Rasun-3). Relaying of water melon with garlic at 45 days after garlic sowing (DAGS). The experiment was laid out in randomized complete block design with three dispersed replications. Proper spacing for garlic (25 cm × 15 cm) and watermelon as relay (2 m × 2 m) were maintained cautiously. The unit plot size was 10 m × 2 m. The clove of garlic was planted (15 Nov., 2022) on the muddy soil like rice seedling transplanting with 15 cm × 10 cm spacing followed by covering with rice straw. Garlic was fertilized with the rate of 114-48-90-30-2-1 kg N-P-K-S-Zn-B/ha. Half of nitrogen and K and all other fertilizers were applied on the muddy soil as basal before planting and two third nitrogen and K were top dressed in two equal installments at 25 (first



mulching) and 50 days after planting. Water melon was fertilized with 105-36-81-15-2-1 kg N-P-K-S-Zn-B/ha. All of other fertilizers were applied in pit 5-7 days prior to seedling plantings as basal and nitrogen was top dressed in three equal installments at 25, 35 and 65 days after planting. Twice mulching: first light mulching then mulching after 15-20 days after planting is suitable. Low weed infestation occurred due to mulching. Garlic was harvested from 21 March to 7 April and watermelon was also harvested on 5 to 12 April. Five plants were collected randomly from each plot for yield component and yield data at maturity of the crop. Collected data were analyzed statistically with the help of MSTAT-C program and mean separation was done by LSD at 5% level of significance. Economic performance of the study was also evaluated. The result revealed that the higher fruit yield (34.34 t/ha) of water melon was recorded in garlic/water melon (local) and the lowest (31.51 t/ha) in sole water melon (BARI Tarmuj-1) and the higher yield of garlic (12.56t/ha) was found from the treatment sole garlic. The result revealed that the highest GEY (28.62t/ha), Gross return (Tk. 1431000 /ha) and BCR (4.94) were recorded in garlic/water melon (local). So, water melon relayed with garlic could be an economically viable technology, instead of sole garlic for best utilization of fallow land.

#### **Nutrient management of BARI Sarisha-18 in Char land ecosystem under AEZ -11**

M.R. Islam, A.A.M.M. Mustakim and M.M. Uddin

A field experiment was conducted at charland, Koikunda, Lakkikunda, Ishurdi, Pabna during *rabi* season of 2022-23 to find out suitable nutrient management for higher yield of BARI Sarisha-18. Seven treatments viz; T<sub>1</sub>= Fertilizer used as FRG; T<sub>2</sub>= Fertilizer used as FRG for INMS i.e., 50% Manure + 50% fertilizer; T<sub>3</sub>= Fertilizer used as 25% higher than FRG; T<sub>4</sub>= Fertilizer used as STB; T<sub>5</sub>= Fertilizer used as BARI recommendation; T<sub>6</sub>= Fertilizer used as 25% higher than BARI recommendation; T<sub>7</sub>= Fertilizer used as farmers practice were included in the experiment. The experiment was laid out in a RCB design with three replications. Unit plot size was 4m x 3 m. The crop was fertilized as per treatment. The ½ N, and all other nutrients were applied during final land preparation. The rest N was applied as top dress during flowering stage (35 DAS) followed by

irrigation. The crop was sown on 02 November 2022 and harvested on 22 February 2023. Weeding cum thinning was done at 20 DAS. Two irrigations were applied at 25 DAS and 35 DAS, respectively. Collected data were analyzed statistically with the help of 'R' program and mean separation was done by LSD at 5% level of significance. The experimental soil was analyzed before sowing of the crop. As the level of fertilizer increased in different recommended dose had significantly influenced the seed yield of BARI Sarisha-18. Fertilizer used as 25% higher than FRG and BARI recommendation (T<sub>3</sub> and T<sub>6</sub>) produced the highest seed yield, which were 49% and 47% higher than the farmer's practice. In contrast of economic performance, the same treatments (T<sub>3</sub> and T<sub>6</sub>) also gave the higher gross margin (Tk. 79450 and 79842 ha<sup>-1</sup>) and BCR (2.51 and 2.44).

#### **Performance of sweet potato varieties at char land area in Rangpur**

M.A.I. Sarker, A.K. Saha and M.A.H.S. Jahan

A field trial was conducted at Mohipur char, Gangachara, Rangpur with different varieties of sweet potato to find out the yield performance of different sweet potato varieties in char land during *rabi* season 2022-23. Five varieties of sweet potato along with local were used viz. BARI Misti alu-8, BARI Misti alu -12, BARI Misti alu -16, BARI Misti alu-17 and local. The experiment was laid out in RCB design with three replications. The unit plot was 4.8m × 4.8m. Weeding, irrigation and spraying were done as required. Fertilizers were applied at the rate of 280-170-260-80-12-8 Kg/ha of Urea-TSP-MoP-Gypsum-Zinc Sulphate-Boric acid (BARI Krishi Projukti Hand Book, 2017) as respectively. Half of Urea, whole amount of TSP, MoP, Gypsum, Zinc and Boron were applied as basal. Remaining rest urea was top dressed at 35 days and mixed thoroughly with the soil as soon as possible for better utilization. Data on yield contributing characters of sweet potato were taken from randomly selected 5 plants from each plot. Yields of the crops were taken from whole plot area. Sweet potato was harvested at 16 April, 2023. Gathered data were compiled and analyzed with STAR version 2.0.1 (Statistical Tool for Agricultural Research; 2014) package program and mean separation was done with the help of Least Significant Difference (LSD) Test. The result revealed that all the developed BARI Sweet potato

varieties showed better performance and gave 19-39% higher yield than local in char land area. Among the varieties, the highest yield (29.65 t/ha) was observed in BARI Misti alu-17.

#### **Effects of companion crops of seed rate on yield of onion at Tista Char land area of Rangpur region**

M.N. Sarkar, S. Hasan, M.A.I. Sarker, M.M. Sheikh and A.K. Saha

An experiment was conducted at farmer's field at Shibdav Char, Pirgachha, Rangpur, during the year of 2022-23. Four treatments viz.  $T_1$ =Recommended Seed Rate (RSR) of onion (Sole Onion),  $T_2$ =RSR of onion+10% RSR of black cumin+5%RSR of coriander,  $T_3$ =RSR of onion+15% RSR of black cumin+10%RSR of coriander,  $T_4$ =RSR of onion+20% RSR of black cumin+15%RSR of coriander was used in the experiment, which was carried out using a randomized complete block design (RCBD) with three replications. Plots were fertilized with cowdung @ 3  $\text{tha}^{-1}$  and  $N_{58}$ ,  $P_{43}$ ,  $K_{46}$   $S_{20}$   $\text{kg ha}^{-1}$ . The entire quantity of cowdung, P, K, S and  $\frac{1}{2}$  N was applied during final land preparation and the rest of N was applied in two equal splits at 25 DAS & 45DAS. Seeds of Onion, black cumin and coriander was soaked overnight and treated with provax @ 2.5g  $\text{kg}^{-1}$  before sowing. Seeds were broadcasted on Decembar 05, 2022. Autostin @ 2g  $\text{L}^{-1}$  and Amistertop @ 2g  $\text{L}^{-1}$  were applied at 25, 65 and 75 days after sowing. Among three crops firstly the coriander was harvested on 20th March 2023, Onion and black cumin were harvested on April 12, 2023. Data were statistically analyzed by using open-source software 'R' and the mean differences were tested by the Least Significant Difference (Gomez and Gomez, 1984). Onion Equivalent Yield (OEY) was estimated using the formula by Willey (1979) for assessing yield advantages derived from an intercropping practice. Treatment  $T_1$  gave the highest bulb yield (12.90  $\text{tha}^{-1}$ ), whereas  $T_4$  treatment gave the lowest yield (6.75  $\text{tha}^{-1}$ ). The average highest onion equivalent yield (16.56 t/ha), gross return (Tk. 414000  $\text{ha}^{-1}$ ), gross margin (Tk. 209500  $\text{ha}^{-1}$ ) and BCR (2.02) was obtained from the treatment  $T_3$  and the lowest onion equivalent yield (12.9 t  $\text{ha}^{-1}$ ), gross return (Tk. 322500  $\text{ha}^{-1}$ ), gross margin (Tk. 132300  $\text{ha}^{-1}$ ) and BCR (1.70) was obtained from treatment  $T_1$ .

#### **Performance of early vegetable production in Charland area**

J. Rahman, M.R. Ali, M.A.H.S. Jahan and M.M. Kadir

This experiment was carried out at Nawvanger char, sadar, Jamalpur 2022-2023 to find out the suitable early sowing and early market of vegetable for increase productivity and economic development of charland farmers. Vegetable cultivation is a promising economic activity and vegetable consumption is important for human health due to the high nutritional content of vegetables. Vegetables are rich in vitamins, minerals, dietary fiber and several phytochemical compounds. The production of vegetables is insufficient to meet the demand of the ever-increasing population. Treatments included in the experiment were radish (leaf), jute (leaf), bottle gourd (leaf), amaranth (leaf), cabbage and cauliflower. Variety used in the experiment were BARI Badhacopi-2/Hybrid, BARI Phulcopi-2/Hybrid, BARI Mula-4, Binapatshak-1, BARI Lau-1 and BARI Danta-1. The design of the experiment was RCBD with 03 (three) replications having the unit of plot 2m  $\times$  2m. Seeds were sown on 25 September 2022 and harvested on November 01, 2022, to December 17, 2022. Fertilizer was applied in accordance with the fertilizer recommendation guide BARC, 2018. 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. 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 growth regulator on groundnut at Charland**

J. Rahman, M.R. Ali, M.A.H.S. Jahan and M.M. Kadir

The experiment was conducted at the charland area of Jamalpur during *Rabi* 2022-2023 to find out the effect of growth regulator. Treatments included in the experiment were: Flora (Nitrobenzene, ACI), Nafa (Entefa), Miraculan (Triacentalol, Auto crop), Potozim (Syngenta co.) and Control. The experiment was laid out in RCBD design with three replications. Groundnuts in the Charland region respond well to the growth regulators Flora, Nafa, Miraculan, and Potozim. Miraculan, and Potozim g

Miraculan, and Potozim gave the highest (2.05 t/ha) yield. The experiment was laid out in RCB design with 3 replications and unit plot size was 3m × 3m. BARI Badam-8 was used as a variety in the experiment. 11 PGRs were applied at 65 DAE in a single spray @ 2ml per liter. Fertilizers were applied at the rate of 25-160-85-300-10 kg/ha NPKSB (BARC, 2018) as urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, boron. Seeds were sown on November 09, 2022 in rows. Weeding was done 20 days after emergence of the crop. Crops were harvested on April 15, 2023. Grain yield was calculated from the whole plot. Yield contributing characters were taken from 05 randomly selected plants from the middle rows of each plot. Data were analyzed with the help of a computer package program STAR and means were separated following LSD test at 5% level of significance. Groundnuts in the Charland region respond well to the growth regulators Flora, Nafa, Miraculan, and Potozim. Miraculan, and Potozim g Miraculan, and among them Potozim gave the highest (2.05 t/ha) yield.

#### **Performance of sunflower varieties in charland area of Cumilla**

M. Rahman, M.A.H. Khan, M.A. Siddiky and M.O. Kaisar

The experiment was conducted at farmer's field of charland area of Roghunathpur village under Meghna upazila in Cumilla district during *rabi* season of 2022-23 to compare the yield performance of BARI released sunflower varieties against local variety with the aim to replace it by the best one. The sunflower varieties used in the experiment were, BARI sunflower -2 and BARI sunflower -3 and local variety (Hysan-33). The experiment was laid out in randomized complete block design with three replications. Seed was sown on 06 December 2022 and harvested on 10 March 2023. The unit plot size was 3.0 m x 1.8 m having a spacing of 50 cm x 30 cm. The fertilizer was applied in the form of urea, triple super phosphate, muriate of potash, gypsum @ N<sub>25</sub>, P<sub>35</sub>, K<sub>55</sub>, S<sub>18</sub> Kg ha<sup>-1</sup> along with 3 t ha<sup>-1</sup> cow-dung. Half nitrogen and full amount of other fertilizers was applied at basal. Rest amount of nitrogen was applied at flowering stage. Data on plant height (cm), head diameter (cm), number of seed per head, yield per plot (kg), yield (t/ha) were collected. The recorded data were statically analyzed by using statistics10 software. The highest number of

seed/head (762.67) and yield (1.61 t ha<sup>-1</sup>) were recorded in BARI sunflower -3 which was statistically similar to BARI sunflower -2. Therefore, Hysan-33 variety might be replaced by high yielding BARI sunflower -2 and BARI sunflower -3.

#### **Performance of different onion varieties in charland area of Cumilla**

M. Rahman, M.A.H. Khan, M.A. Siddiky and M.O. Kaisar

The experiment was conducted at farmer's field of charland of under Roghunathpur village under Meghna upazila in Cumilla district during *Rabi* season of 2022-23 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 used were, BARI Piaz-4, BARI Piaz-6 and local variety. The experiment was laid out in randomized complete block design with three replications. Bulbs were planted on 15 December 2022 and harvested on 13 March 2023. The unit plot size was 3.0 m x 2.25 m with spacing of 15 cm x 10 cm. The fertilizer was applied in the form of urea, triple super phosphate, muriate of potash, gypsum @ N<sub>120</sub>, P<sub>54</sub>, K<sub>75</sub>, S<sub>20</sub> Kg ha<sup>-1</sup> along with 5 t ha<sup>-1</sup> cow-dung. The whole of cow-dung, P, S, Zn, B and one third of K were applied at the time of final land preparation and the rest of K and urea were applied at 25, 50, and 75 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/plants, bulb length (cm), bulb diameter (cm), individual bulb weight (g) were collected. The recorded data were statically analyzed by using statistics10 software. The highest bulb length (5.90 cm), bulb diameter (3.98 cm), individual bulb weight (37.90 g) and yield (15.40 t ha<sup>-1</sup>) were recorded in BARI Piaz-4 which was statistically similar to BARI piaz-6. BARI Piaz-6 and BARI Piaz-4 were given 35-70% higher yielder than the check local variety. The local variety might be replaced by high yielding BARI Piaz-4 and BARI Piaz-6 variety.

#### **Improvement of Sorjan based cropping systems for increasing crop productivity in southern Bangladesh**

M.A. Rahman, M.M. Rahman and M. Ahmed

The experiment was conducted at farmers' field of Atghar, Nesarabad, Pirojpur and Gava,



Banaripara, Barishal during 2021-23 under sorjan system to develop sorjan based cropping systems in southern Bangladesh. As treatment, eight cropping patterns on sorjan bed (CPSB) viz., viz., CPSB-1 (Chili - Brinjal + Cabbage), CPSB-2 (Brinjal - Chili + Knolkhol), CPSB-3 (Chili + Indian spinach + Red amaranth - Chili + Coriander leaf + Cauliflower), CPSB-4 (Chili - Brinjal), CPSB-5 (Chili - Stem amaranth - Knolkhol), CPSB-6 (Okra + Indian spinach - Cabbage), CPSB-7 (Indian spinach + Red amaranth - Cauliflower), and CPSB-8 (Red amaranth - Red amaranth - Knolkhol) and six cropping pattern on sorjan trellis (CPST) viz., CPST-1 (Bottle gourd - Bottle gourd - Sweet gourd), CPST-2 (Bottle gourd - Ash gourd - Sweet gourd), CPST-3 (Bitter gourd - Sponge gourd - Sweet gourd), CPST-4 (Ribbed gourd - Bottle gourd - Sweet gourd), CPST-5 (Ribbed gourd - Ash gourd - Bottle gourd), and CPST-6 (Bitter gourd - Bottle gourd - Bottle gourd) were tested. The experiment was laid out in randomized complete block design with three replications. Data were collected on different yield parameters of the cultivated vegetable and spice crops. The chili or bottle gourd equivalent yield was calculated using the formula:  $CEY = Y_x (P_x/P_r)$ , where  $Y_x$  is the yield of crops (other than chili or bottle gourd) (kg/ha),  $P_x$  is the price of crops (other than chili or bottle gourd) (Tk/kg), and  $P_r$  is the price of chili or bottle gourd (Lal *et al.*, 2017). Data were analyzed statistically using windows-based computer software of Statistics 10 version and then the mean differences were adjudged with DMRT. Statistically significant variation was observed among the non-creeper cropping patterns on sorjan bed. Chili + Indian spinach - red amaranth + red amaranth - Chili + Coriander leaf + Cauliflower cropping pattern gave the highest Chili Equivalent Yield (CEY) (67.05 t/ha) and net return (Tk. 2326203/ha). Slightly reduced amount of CEY (63.63 t/ha) and net return (Tk. 1885145/ha) were recorded in Chili - Brinjal + Cabbage cropping pattern. In case of creeper cropping pattern on sorjan trellis (CPST), Bottle gourd - Bottle gourd - Sweet gourd produced the highest (165.50 t/ha) Bottle gourd Equivalent Yield (BEY) and net return (Tk. 2058164/ha).

### **Intercropping of vegetables with new guava orchard (BARI Peyara-2) under Sorjan system in Barishal region**

M.A. Rahman, M.M. Rahman, M. Ahmed and B.C. Kundu

The experiment was conducted at Gava village under Banaripara upazila of Barishal district for all the year round to develop suitable intercropping system(s) of vegetables with new guava orchard (BARI Peyara-2) for sorjan agriculture system in Barishal region. Four Guava based intercropping on sorjan bed (GICSB) viz., GICSB-1 (Guava - Okra + Indian spinach - Cabbage), GICSB-2 (Guava - Indian spinach + Red amaranth - Knolkhol), GICSB-3 (Guava - Red amaranth - Red amaranth - Radish), and GICSB-4 (Guava - Stem amaranth - Radish) and five Guava based intercropping on sorjan trellis (GICST) viz., GICST-1 (Ash gourd - Bottle gourd), GICST-2 (Ribbed gourd - Bottle gourd), GICST-3 (Bitter gourd - Bottle gourd), GICST-4 (Ribbed gourd - Sweet gourd), GICST-5 (Bitter gourd - Sweet gourd) were tested under this experiment. The experiment was laid out in randomized complete block design with three replications. The seedlings of creeper vegetables were transplanted as intercrops on the edge of the sorjan beds. Fertilizers were applied as per recommended dose of the respective crops (BARC, 2018). The Guava equivalent yield (GEY) was calculated using the formula:  $GEY = Y_x (P_x/P_r)$ , where  $Y_x$  is the yield of crops (other than guava) (kg/ha),  $P_x$  is the price of crops (other than guava) (Tk/kg), and  $P_r$  is the price of guava (Lal *et al.*, 2017). Data were analyzed statistically using windows-based computer software of Statistix 10 version and then the mean differences were adjudged with DMRT. Grafted guava seedlings were produced with BARI developed variety (BARI Peyara-2). Among the GICSBs, Guava Equivalent Yield (GEY) differed significantly. The highest GEY (49.21 t/ha) was found in GICSB-1, where GICSB-2 and GICSB-3 gave the GYE of 35.54 and 31.49 t/ha, respectively. However, the highest net return (Tk. 503734/ha) was obtained from GICSB-4. Of the GICSTs, GEY differed significantly. Besides, GYE in GICST-1 and GICST-4 were 35.70 and 30.36/ha, respectively. Treatment GICST-2 gave the highest net return (Tk. 872617/ha) as compared to GICST-1 (Tk. 564337/ha) and GICST-4 (Tk. 506600/ha). Intercropping of both non-creeper and creeper

vegetables with new guava orchard might be suitable for sorjan system.

#### **Effects of USG and NPK briquette on the yield and economic return of bottle gourd under Sorjan system in Barishal region**

M.A. Rahman, M.M. Rahman and M. Ahmed

The experiment was conducted at Gava village under Banaripara upazila of Barishal district during *Kharif* season of 2022 on sorjan bed to find out the optimum fertilizer dose for getting higher yield and economic return from bottle gourd. The treatments of the experiment were: T<sub>1</sub> = Recommended dose of fertilizer (RDF: 150-175-150-100-12-10 kg/ha urea-TSP-MP-Gypsum-Zinc-Boron, respectively.) as granular form, T<sub>2</sub> = USG + PKS as granular form, T<sub>3</sub> = NPK briquette (weight of single briquette 1.8g) + Sulphur as granular form and T<sub>4</sub> = Farmers' practice (170-190-160-110-14-12 kg/ha Urea-TSP-MP-Gypsum-Zinc-Boron, respectively). The experiment was laid out in randomized complete block design with three replications. Seedlings of bottle gourd (variety: BARI Lau-4) of 12-day old were transplanted on the edge of sorjan bed. Before setting up the experiment, the initial soil sample was collected and analyzed in the Regional Laboratory of SRDI, Barishal. Treatment T<sub>3</sub> produced the highest yield of fruit (91.71 t/ha), which was statistically identical to that of T<sub>2</sub> and T<sub>1</sub> treatments (77.82 and 66.32 t/ha, respectively). The results further revealed that treatments T<sub>3</sub>, T<sub>2</sub> and T<sub>1</sub> increased the fruit yield of 51.98%, 28.96% and 19.06%, respectively over the farmers' practice (T<sub>4</sub>). The gross return showed the highest value (Tk. 1375667/ha). Treatment T<sub>3</sub> gave the highest net return (Tk. 908767/ha). Benefit cost ratio (BCR) showed the highest value (2.95) in T<sub>3</sub> treatment. The results further indicated that treatment T<sub>3</sub> (NPK briquette + Sulphur as granular form) could be applied for increasing yield and economic return of bottle gourd under sorjan system.

#### **Effects of USG and NPK briquette on the yield and economic return of ribbed gourd under Sorjan system in Barishal region**

M.A. Rahman, M.M. Rahman and M. Ahmed

The experiment was conducted at Gava village under Banaripara upazila of Barishal district (Farmer's name: Md. Ibrahim Kazi) during *kharif* season of 2022 on sorjan bed to examine the effects

of USG and NPK briquette on the yield and economic returns of ribbed gourd on sorjan bed. The treatments were: T<sub>1</sub> = USG (4 briquette/plant) + PK as granular form, T<sub>2</sub> = NPK briquette (4 briquette/plant, weight of single briquette 1.8g), T<sub>3</sub> = NPK briquette (6 briquette/plant) and T<sub>4</sub> = Farmers' practice (170-170-145-75-14-12 kg/ha urea-TSP-MP-gypsum-zinc-boron, respectively). The Recommended dose of fertilizer (RDF) was 160-160-140-70-12-10 kg/ha urea-TSP-MP-gypsum-zinc-boron, respectively (BARC, 2018). Seedlings of ribbed gourd (variety: BARI Jhinga-1) were transplanted with spacing pit to pit distance 1m on the edge of sorjan bed. The experiment was laid out in randomized complete block design with three replications. Data were collected on yield attributes and yield. Data were analyzed statistically using windows-based computer software of Statistix 10 version and then the mean differences were adjudged with DMRT. Treatment T<sub>3</sub> gave the highest yield of fruit (21.85 t/ha). Treatment T<sub>1</sub> and T<sub>2</sub> produced the yields of 17.47 and 16.85 t/ha, respectively. The results further showed that treatments T<sub>3</sub>, T<sub>1</sub> and T<sub>2</sub> increased the fruit yield of 65.54%, 49.33% and 27.63%, respectively over the farmers' practice (T<sub>4</sub>). The highest gross return (Tk. 546322/ha) was obtained from T<sub>3</sub> treatment. The highest net return (Tk. 285972/ha) was observed in treatment T<sub>3</sub>. Besides, treatments T<sub>1</sub> and T<sub>2</sub> gave the net returns of Tk. 188883 and 162872/ha, respectively. Benefit cost ratio (BCR) showed the highest value (2.10) in T<sub>3</sub> treatment.

#### **Performances of ginger varieties under existing fruit orchard on Sorjan bed**

M.A. Rahman, M.M. Rahman, M. Ahmed and M.A. Rahman

The experiment was conducted at Bermahal village under Jhalakati Sadar upazila of Jhalakati district (Farmer's name: Md. Al Amin Howlader) all the year round to introduce ginger crop in the existing fruit orchard and increasing the profitability of the sorjan system. Three varieties of ginger viz., V<sub>1</sub> = BARI Ada-1, V<sub>2</sub> = BARI Ada-2 and V<sub>3</sub> = BARI Ada-3 were tested. The experiment was laid out in randomized complete block design with three replications. Seeds (sprouted rhizome) of ginger varieties were sown on sorjan bed under existing golden apple orchard. Plant spacing was row to row distance 30 cm and hill to hill distance 25 cm. The

fertilizer dose was 304-267-233-110-12-12 kg/ha urea, TSP, MoP, gypsum, zinc sulphate and boron acid, respectively + 5 t/ha cow dung. Data were collected on different plant characters of ginger. Photosynthetically active radiation (PAR) ( $\mu\text{mol m}^{-2}\text{s}^{-1}$ ) was measured by using the device Sunflex Ceptometer (Model: LP-80, Decagon Device Inc., USA) at the maximum vegetative growth stage of the crop. Data were analyzed statistically using windows-based computer software of Statistix 10 version. BARI Ada-3 produced the highest yield of rhizome (21.58 t/ha), which was statistically similar to that of BARI Ada-2 (16.30 t/ha) and the lowest yield was obtained from BARI Ada-1 (14.96 t/ha). The gross return obtained from BARI Ada-3 was the highest (Tk. 1726778/ha). On the other hand, BARI Ada-2 and BARI Ada-1 gave the gross returns of Tk. 1303667 and 1196889/ha, respectively. The highest net return (Tk. 912431/ha) was found in BARI Ada-3 but net returns obtained from BARI Ada-2 and BARI Ada-1 were Tk. 488820 and 385042/ha, respectively. Cultivation of BARI Ada-3 on sorjan bed showed the highest BCR (2.12). Cultivation of BARI Ada-3 on sorjan bed under existing golden apple orchard could be more suitable for getting higher yield and economic return because Photosynthetically Active Radiation (PAR) value under golden apple orchard was 58.80% than that of the open space. Only 41.20% less PAR was existed in the ginger experimental plot due to shadow effect of the plant canopy.

#### **Performances of turmeric varieties under existing fruit orchard on Sorjan bed**

M.A. Rahman, M.M. Rahman, M. Ahmed and M.A. Rahman

The experiment was conducted at Bermahal village under Jhalakati Sadar upazila of Jhalakati district during 2022-23 to find out the suitable variety(ies) of turmeric for introduction under sorjan system. Five varieties of turmeric viz.,  $V_1$  = BARI Halud-1,  $V_2$  = BARI Halud-2,  $V_3$  = BARI Halud-3,  $V_4$  = BARI Halud-4 and  $V_5$  = BARI Halud-5 were tested. The experiment was laid out in randomized complete block design with three replications. Seeds (sprouted rhizome) of turmeric varieties were sown on 4 April, 2022 on sorjan bed under existing golden apple orchard. Plant spacing was row to row distance 30 cm and hill to hill distance 25 cm. The fertilizer dose was 220-125-260-110-12-12 kg/ha

urea, TSP, MoP, gypsum, zinc sulphate and boric acid, respectively + 5 t/ha cow dung. Photosynthetically active radiation (PAR) ( $\mu\text{mol m}^{-2}\text{s}^{-1}$ ) was measured by using the device Sunflex Ceptometer (Model: LP-80, Decagon Device Inc., USA) at the maximum vegetative growth stage of the crop. Data were analyzed statistically using computer software of Statistix 10 version. Experimental results revealed that Photosynthetically Active Radiation at open space was  $704 \mu\text{mol m}^{-2}\text{s}^{-1}$  and the value under golden apple orchard was  $313 \mu\text{mol m}^{-2}\text{s}^{-1}$  at experiment plot (40% of open place). Among the turmeric varieties, BARI Halud-4 exhibited the highest yield of rhizome (31.24 t/ha), which was statistically identical to that of BARI Halud-5 (28.16 t/ha), BARI Halud-1 (23.06 t/ha) and BARI Halud-2 (22.81 t/ha). BARI Halud-4 gave the highest gross return (Tk. 1562077/ha) followed by BARI Halud-5 (Tk. 1407965/ha). Net return was also the highest (Tk. 1077727/ha) in BARI Halud-4, while BARI Halud-5 showed the net return of Tk. 923615/ha. The highest benefit cost ratio (3.23) was obtained from BARI Halud-4 followed by BARI Halud-5 (2.91). Therefore, cultivation of BARI Halud-4 and BARI Halud-5 under existing golden apple orchard on sorjan bed could be more suitable for their higher yields and economic returns.

#### **Performances of fodder crop species with different planting position on bed slope under Sorjan farming systems**

M. Ahmed, M.A. Rahman and M.M. Rahman

The experiment was conducted at Gava village under Banaripara upazila of Barishal district to find out the suitable fodder species and transplanting position on sorjan slope under sorjan base integrated farming systems. Treatments were two factors viz., Factor A: Three fodder species viz.,  $S_1$  = Napier,  $S_2$  = Pakchong and  $S_3$  = German grass) and Factor B: Three positions on sorjan slope viz.,  $P_1$  = Top of the slope,  $P_2$  = Middle of the slope and  $P_3$  = Bottom the slope, i.e., close to canal water level). Seedlings (cutting) of fodder species were transplanted on sorjan slope as per treatment specifications. The fodder crop was harvested in five times after attaining at desirable vegetative stage. Data were analyzed statistically using windows-based computer software of Statistix 10 version.



Total fodder yield varied significantly due to the effect of fodder species. Fodder species S<sub>2</sub> (Pakchong) showed the highest yield (77.13 t/ha), which was statistically at par to that of S<sub>1</sub> (Napier) (72.48 t/ha). Fodder crop planted on the top of the sorjan slope produced the highest yield of fodder (80.68 t/ha). However, comparatively lower yield (75.51 t/ha) was found when it was planted on the middle of sorjan slope (P<sub>2</sub>). Pakchong planted on top of sorjan slope (S<sub>2</sub>P<sub>2</sub>) gave the highest yield of fodder (101.66 t/ha), which was statistically similar to that of Napier x Middle (92.22 t/ha), Pakchong x Middle (90.35 t/ha), Napier x Top (86.83 t/ha) and German grass x Top position (53.54 t/ha). Results further revealed that Napier and Pakchong grass were found to be suitable for planting on the top and middle positions of sorjan slope.

#### **Performances of different fish species in canal water under sorjan farming systems**

M.A. Rahman, M. Ahmed and M.M. Rahman

The experiment was conducted in sorjan canal water at Gava village under Banaripara upazila of Barishal district during *kharif* season of 2022 to find out the suitable fish species for increasing farmers' income under sorjan based farming systems. Treatments of the experiment were four types of short duration fish species viz., F<sub>1</sub> = Climbing fish (Koi fish), F<sub>2</sub> = Stinging catfish (Shing Fish), F<sub>3</sub> = Olive barb (Sorputi) and F<sub>4</sub> = Tilapia. The experiment was laid out in randomized complete block design with three replications (disperse). The number of released fingerlings of Koi, Sing, Sorputi and Tilapia were 500, 500, 120 and 500/decimal, respectively. Data were collected on different characters of the fish species. The Tilapia equivalent yield (TEY) was calculated using the formula:  $TEY = Y_x (P_x/P_r)$ , where  $Y_x$  is the yield of Koi, Sing or Sorputi (kg/decimal),  $P_x$  is the price of Koi, Sing or Sorputi (Tk/kg), and  $P_r$  is the price of Tilapia (Lal *et al.*, 2017). Data were analyzed statistically using windows-based computer software of Statistix 10 version. Fish yields of Koi, Sing, Sorputi and Tilapia were 5.19, 2.79, 27.21 and 77.22 kg/ decimal, respectively. The Tilapia equivalent yield (TEY) differed significantly due to various fish species. The highest TEY (77.22 kg/decimal) was obtained from Tilapia. However, slightly reduced amount of TEY (47.88 kg/decimal) was found in Sorputi. The highest gross return and net return (Tk. 9652 and 3579/decimal, respectively) was found in Tilapia.

Net return achieved from Sorputi was Tk. Tk. 3007/decimal. Rearing of Tilapia and Sorputi fishes in sorjan canal water was found to be suitable for increasing farmers' income under sorjan based farming systems.

#### **Pilot production programme of grafted BARI Peyara-2 replacing local Swarupkati guava variety on Sorjan bed**

M.A. Rahman, M.M. Rahman, M. Ahmed, M.A. Rahman and B.C. Kundu

The pilot production programme has been conducting at Gava village under Banaripara upazila of Barishal district (Farmer's name: Md. Rashedul Islam) for all the year round to examine the performance of grafted BARI Peyara-2 over the existing local Swarupkati variety under sorjan system in Barishal region. BARI developed guava variety (BARI Peyara-2) was used as grafted planting material. The whole plot size was 0.26 ha (64 decimal). Previously, scion of BARI Peyara-2 was placed on the root stock of Swarupkati variety for seedlings production. Seedlings were planted on sorjan bed with row-to-row distance 3m and plant to plant distance 2m through zigzag method on 22 February 2022. Before planting of guava seedling, pits of about 60 cm x 60 cm x 45 cm were dug in zigzag system. The pits were exposed for 15 days before it is filled with soil, manure and fertilizer. The pits were filled with 15 kg well rotten cowdung or compost, 250g TSP, 250g MP, 100g gypsum and 25g zinc sulphate (BARI, 2020). Total plant population at 0.26 ha of land was 330. Date of first flowering was 22 November 2022. Average height of guava plant 1.25 m. Number of branch/plant was 8. Number of immature fruit/plants was 24. The fruit will attain at ripening stage after one month. Growth of grafted BARI Peyara-2 variety is satisfactory and fruit remain at growth stage. However, it will take at least three years to evaluate the yield performance and economic return of BARI Peyara-2 over the existing Swarupkati variety. As this was the results of initial stage of fruit bearing, therefore, final recommendation will be made after three years of experiment on BARI Peyara-2.

#### **Effect of folic acid as seed treating chemical on growth and yield of sunflower**

M.R. Karim, J.A. Chowdhury, A.A. Begum, S.S. Kakon, M.Z. Ali and A.H.S. Jahan

The experiment was conducted at ARS, Benerpota, Satkhira during 2022-23 with three factors, i.e.,

Factor A: Sowing date (D1-15 November, D2-30 November, D3-15 December, D4- 30 December), Factor B: Folic acid level (F0- No folic acid, F1- 50  $\mu$ M folic acid) and Factor C: Potassium level (K0- No potassium, K1- 2.5% KCl, K2- 2.5% K<sub>2</sub>SO<sub>4</sub>) to find out the effect of seed treatment with folic acid and potassium foliar spray on phenotype and yield of sunflower under saline condition. Unit plot size was 2 m  $\times$  3 m. Fertilizer application and all other intercultural operations were done as per crop requirement. Data on phenotypic and yield contributing characters were collected and statistically analyzed with R. Seed treatment with 50  $\mu$ M folic acid potassium (2.5%) foliar spray has significant influence on seed per head and seed yield of sunflower and might be effective for obtaining higher yield of sunflower at saline region.

### Survey of multiple cropping in farmers' field

S.S. Kakon, J.A. Chowdhury, A.A. Begum, M.Z. Ali, S.S. Nasreen, M.A.H. Khan, M.R. Karim. S.T. Zannat, J. Rahman, D.A. Choudhury and M.A.S. Jahan

The survey was carried out at Modhupur and Dhonbari upazila of Tangail district, respectively to know the existing multiple cropping system in the farmers' field for refinement of those technologies. Different multiple cropping systems were practiced in different region due to differences in agro-ecological conditions and farmers' desire. Two main groups of multiple cropping practiced in Bangladesh: i) sequential cropping pattern ii) intercropping system. Potato and pineapple based inter/relay cropping were found at Dhonbari upazila under Tangail district. Fifty percent of total MC farmers practiced potato based, 27% did pineapple based, 8% cauliflower based and 15% practiced onion based intercropping system. Gourd were the companion crops in pineapple-based intercropping. The MC farmers of this area also applied lower doses of fertilizers. Moreover, they did not apply gypsum, zinc sulphate or boric acid. Maximum farmers practiced the sequences of Potato - Boro - T. Aman, Mustard- Boro- jute, Fallow- Banana-fallow and Mustard- Boro- T. Aman at Dhonbari upazila under Tangail district. Out of 5 sequences farmers gave importance in cultivation 3 sequences. The sequences of Fallow-Banana-fallow (30%), Mustard- Boro- jute and Potato - Boro - T. Aman (25%) were found most dominant in cultivation. Farmers of Madhupur practiced 8 cropping sequences. These systems were categorized into pineapple and banana based.

Majority of MC farmers (13%) practiced banana based intercropping systems. In banana-based systems, chilli and taro were the companion crops. Only 10% MC farmers practiced pineapple based multiple cropping. Maximum farmers practiced the Pineapple+ taro, Pineapple+ banana and Yard long bean+ red amaranth+ radish. Only 10% MC farmers practiced jujube based mixed cropping. MC farmers of this area also used lower doses of fertilizers. They applied urea, TSP and MP only. In banana-based systems, they have been using urea 100-170kg, TSP 60-120kg and MP 100-150 kg/ha. In pineapple based intercropping system, farmers applied 100-130 kg urea, 50-90 kg TSP and 50-90 kg MP/ha, respectively. Moreover, they did not apply gypsum, zinc sulphate or boric acid. Banana is a long duration crop. Different kinds of rabi crops like zinger, taro, papaya, turmeric and chilli may be grown as intercrop in between two rows of banana. On the other hand, large number of fruits garden like mango, jujube, litchi is established at Modhupur region. Different crops (like yard long bean, red amaranth, and radish, onion) may be grown in those fruit garden. Besides, growing of different crops in multiple cropping systems may supply nutrition to the rural people. Different multiple cropping systems were practiced in different locations. In all the regions, the farmers applied lower fertilizer doses. The results of the survey revealed that there would be a vast scope of improving the multiple cropping system practiced in the farmers field of different region.

### RARS Jashore

#### Development of fertilizer packages for five crop based cropping pattern in rice based cropping system

M H Rahman, S Paul, K U Ahammad and M A H S Jahan

An experiment was conducted at the RARS, Jashore during 2022-23 to develop the fertilizer packages and to estimate economic return of T. Aman-broccoli- spinach- yard long bean- T. Aus cropping pattern. The fertilizer treatments were: T<sub>1</sub> = 100% NPKSZnB, T<sub>2</sub> = T<sub>1</sub> + 25% N, T<sub>3</sub> = T<sub>1</sub> + 25% NP, T<sub>4</sub> = T<sub>1</sub> + 25% NK, T<sub>5</sub> = T<sub>1</sub> + 25% PK, T<sub>6</sub> = T<sub>1</sub> + 25% NPK, T<sub>7</sub> = 75% of T<sub>1</sub> and T<sub>8</sub> = control. The highest total REY 24.72 t ha<sup>-1</sup> was recorded from T<sub>6</sub> treatment and the lowest was from control treatment. The highest gross margin (Tk. 92920 ha<sup>-1</sup>) was recorded from treatment T<sub>6</sub>. The highest marginal

benefit cost ratio (MBCR) was obtained from treatment T<sub>6</sub>. The income was increased by (T<sub>6</sub>) 19% and 239% compared to the STB (100%) nutrient treatment (T<sub>1</sub>) and control (T<sub>8</sub>), respectively. The 25% additional NPK with STB Treatment produces higher yield of the cropping pattern.

#### **Weed management of mukhikachu (*Colocasia esculenta*)**

S Paul, MH Rahman, KU Ahammad and M A H S Jahan

The experiment was conducted at the RARS, Jashore during *Kharif* Season, 2022 in randomized complete block design with three replications and nine treatments viz. T<sub>1</sub> = mulching (wheat straw with 6 cm thickness), T<sub>2</sub> = pre- sowing herbicide (Pendimethalin @ 1.5 L ha<sup>-1</sup>) + mulching (wheat straw) T<sub>3</sub>= pre- sowing herbicide +1 hand weeding (HW) at 65 DAE, T<sub>4</sub> = post- emergence (Pendimethalin @ 1.5 L ha<sup>-1</sup>) herbicide spray at 20 & 50 DAE, T<sub>5</sub> = post- emergence herbicide spray at 20 & 50 DAE + HW at 95 DAE T<sub>6</sub> = intercropping (living mulch) + HW at 50 and 70 DAE , T<sub>7</sub> = HW (4 times) at 30, 60, 80 & 100 DAE, T<sub>8</sub> = weed free and T<sub>9</sub>= control (no weeding) displayed exhibited better weed control efficiency in T<sub>1</sub>, T<sub>2</sub> and T<sub>6</sub> treatments and thus, the treatment T<sub>1</sub> demonstrated the highest yield and BCR which was statistically similar to T<sub>6</sub> and T<sub>2</sub>. Straw mulch or intercropping + hand weeding can be recommended as the economically viable technique to manage crop-weed competition where yield was 21.78 t ha<sup>-1</sup> and 21.13 t ha<sup>-1</sup> respectively. This result also showed that, during mulching there is no need to use herbicide.

#### **Determination of crop weeds competition of lentil**

S Paul, MH Rahman, MS Kobir, M A H S Jahan and KU Ahmmad

The critical period of weed control (CPWC) for the lentil variety BARI Masur-9 was studied using two sets of treatments as one set of treatments was weed free for periods of 15, 30, 45, 60, and 75 days after sowing (DAS) and then weeds were allowed to grow, while the other set was weedy, where weeds were permitted to grow for periods of 15, 30, 45, 60, and 75 DAS and then weeds were removed up to harvest, with a weedy check and a season-long weed-free plot. The critical period of weed control (CPWC) of BARI Masur-9 was between 7 to 43 days after sowing (DAS) based on a 5% yield loss threshold with the highest yield 966.25 kg ha<sup>-1</sup>.

#### **RARS Ishurdi, Pabna**

##### **Improvement of lentil productivity through increasing potassium (k) fertilizer**

M. R. Islam

Terminal heat stress is occurred due to deficiency of extreme soil moisture and high temperature in late sown lentil which responsible for decreases the plant water status, chlorophyll content as well as pollen viability resulted considerable yield loss. Potassium is the third macronutrient obligatory for plant growth, physiology and sustainable crop production by stress adaptations. Under water stress condition, it play an important role in osmotic-regulation of plant cell and water uptake along a soil-plant gradient, stimulate root growth resulting higher absorption of nutrient elements and increasing the retention of water in plants, Hence, an experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during 2022-2023 to know the effect of K on productivity of lentil under late and optimum sown condition. BARI Masur-8 were grown with five potassium fertilization levels viz., 1) Recommended fertilizer dose (RFD) , 2) RFD + 25% additional K, 3) RFD + 50% additional K, 4) RFD + 75% additional K and 5) RFD + 100% additional K. The design was split-plot with three replications, where two sowing time viz. i) Nov 15, ii) Dec 15 were allotted in the main plots, and potassium fertilization levels were assigned randomly in the sub-plots. As increase the level of K fertilizer with recommended dose (RFD) had improve the relative water content, chlorophyll content, and alleviates the terminal heat stress through accumulation of proline content. However, increase of K at 25, 50, 75 and 100% more with RFD treatment positively influenced the seed yield of lentil, and is also noted that the seed yield increased to 5, 8, 10, 11% in optimum sown condition and 3, 8, 9, 11% in late sown condition, respectively. Results exhibited K fertilizer improves the productivity of lentil both under late and optimum sown condition.

##### **Nutrient management of BARI Sarisha-18 in char land ecosystem under AEZ -11**

M. R. Islam and A.A.M. M. Mustakim

Bangladesh is running with acute shortage of edible oil since long time. As a result, a huge amount of foreign exchange is being spent every year for importing edible oil. BARI Sarisha-18 (Canola) is newly released oilseed crops in Bangladesh. It is a long dratted mustered variety,



not fit well the existing cropping pattern. There are great scopes of increasing of this long dratted mustered production with choosing proper area. Charland is one of them. In our country more than 1000000 ha of land remain under Charland. But the soil physical and chemical properties are different than the normal land. So, nutrient management study should be undertaken of that area for higher yield of BARI Sarisha-18 (Canola). Therefore, the experiment was conducted at charland, Koikunda, Lakkikunda, Ishurdi, Pabna during 2022-2023 to find out suitable nutrient management for higher yield of BARI Sarisha-18. Seven treatment viz; T<sub>1</sub>= Fertilizer used as FRG (260-180-180-150-8-6 kg ha<sup>-1</sup> of Urea-TSP-MOP-Zypsum-Zinc Sulphate-Boric acid); T<sub>2</sub>= Fertilizer used as FRG for INMS i.e., 50% Manure + 50% fertilizer (4 t cow dung + 130-90-90-75-4-3 kg ha<sup>-1</sup> of Urea-TSP-MOP-Zypsum-Zinc Sulphate-Boric acid); T<sub>3</sub>= Fertilizer used as 25% higher than FRG (325-225-225-188-10-7.5 kg ha<sup>-1</sup> of Urea-TSP-MOP-Zypsum-Zinc Sulphate-Boric acid); T<sub>4</sub>= Fertilizer used as STB (206-100-26-78-5.56-5.88 kg ha<sup>-1</sup> of Urea-TSP-MOP-Zypsum-Zinc Sulphate-Boric acid); T<sub>5</sub>= Fertilizer used as BARI recommendation (250-170-85-150-5-10 kg ha<sup>-1</sup> of Urea-TSP-MOP-Zypsum-Zinc Sulphate-Boric acid); T<sub>6</sub>= Fertilizer used as 25% higher than BARI recommendation (313-213-106-188-6-13 kg ha<sup>-1</sup> of Urea-TSP-MOP-Zypsum-Zinc Sulphate-Boric acid) ; T<sub>7</sub>= Fertilizer used as farmers practice (150-100-50-100-0-0 kg ha<sup>-1</sup> of Urea-TSP-MOP-Zypsum-Zinc Sulphate-Boric acid) were included in the experiment. The experiment was laid out in a RCB design with three replications. Result obtained that as increase the level of fertilizer in different recommended dose had significantly influenced the seed yield of BARI Sarisha-18. The treatment T<sub>3</sub> produced the highest seed yield (1.71 t ha<sup>-1</sup>) followed by T<sub>6</sub> (1.69 t ha<sup>-1</sup>), which were 49% and 47% higher than the farmers practice (1.15 t ha<sup>-1</sup>). In contrast of economic performance, the same treatments (T<sub>3</sub> and T<sub>6</sub>) also gave the higher gross margin (Tk. 79450 and 79842 ha<sup>-1</sup>) and BCR (2.51 and 2.44).

#### Effect of integrated weed management on sunflower

M. R. Islam and A.A.M. M. Mustakim

Weed competition in different crops is a major economic treat to farmers. However, sunflowers (*Helianthus annuus* L.) have been considered good competitors with weeds in its early growth stages. Hence, the trail was conducted at the Regional

Agricultural Research Station, Ishurdi, Pabna during 2022-2023 to find out suitable weed management method for sunflower. Five treatments viz; T<sub>1</sub>: Post sowing application of Pandamithalin; T<sub>2</sub>: Post sowing application of Pandamithalin + one hand weeding at 20 DAE; T<sub>3</sub>: Post sowing application of Pandamithalin + one hand weeding at 40 DAE; T<sub>4</sub>: Two hand weeding at 20 and 40 DAE; T<sub>5</sub>: Control (no weeding); were tested in the experiment. The design of the experiment was RCB and replicated thrice. Result exhibited that different weed management methods numerically varied the yield and yield contributing traits of sunflower. However, the treatment T<sub>2</sub> produced the highest seed yield (2.16 t ha<sup>-1</sup>) followed by T<sub>4</sub> (2.11 t ha<sup>-1</sup>), which were 29% and 26% higher than the control. Likewise, treatment T<sub>1</sub> and T<sub>3</sub> gave 9% and 19% higher seed yield compared to control. In economic point of view, T<sub>2</sub> treatment produced the higher gross margin (79981 Tk ha<sup>-1</sup>) and BCR (2.61) than the others treatments.

#### Intercropping of ginger with pigeon pea

M. R. Islam, A.A.M. M. Mustakim and J. Hossain

Pigeon pea [*Cajanuscajan* (L.) Millsp.] is an important grain legume that originated in the Indian sub-continent. It is a wide spaced long durational crop. There is a great scope to cultivate another partial shade loving crop as intercrop with it. Therefore, the trail was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna during 2022-2023 to find out the suitable combination for higher productivity and economic return of ginger + pigeon pea intercropping system. Six treatments combination viz; T<sub>1</sub>= Four line of ginger in between two line of pigeon pea; T<sub>2</sub>=Three line of ginger in between two line of pigeon pea; T<sub>3</sub>=Two line of ginger in between two line of pigeon pea; T<sub>4</sub>=One line of ginger in between two line of pigeon pea; T<sub>5</sub>=Sole ginger; T<sub>6</sub>=Sole pigeon pea were evaluated in the experiment. The design of the experiment was RCB and replicated thrice. Results had showed that all the intercropping system gave superior performance in respect of economic return as compared to sole stand. The combination four line of ginger in between two line of pigeon pea was found as the best intercrop combination in terms of higher gross margin (Tk. 1089800 ha<sup>-1</sup>) along with pigeonpea equivalent yield (30.88 t ha<sup>-1</sup>). Farmers could be benefited by adoption this technology.

# IRRIGATION AND WATER MANAGEMENT

10

## Background

Irrigation and Water Management Division (IWM) is one of the research divisions of Bangladesh Agricultural Research Institute (BARI) that conducts research on advanced irrigation methods, irrigation scheduling, and on-farm water management of BARI mandated crops. It also conducts research on water quality, agricultural meteorology, drainage, salinity management, groundwater and surface water management through field observations, and applying simulation models and machine learning tools. Till date, IWM Division already developed 53 irrigation and water management technologies and most of them are being used at the farm level. The following sections contain the titles and abstracts of the research conducted during 2022-23.

### Response of barley to different irrigation regimes

K.F.I. Murad, M.P. Haque, M.A. Hossain, F. Akhter, S.K. Biswas

This study aimed to examine the effects of irrigation level and stage on barley growth, yield, and water productivity for the first time in Bangladesh. Nine irrigation regimes with varying levels and stages were considered as treatments. Full irrigation ( $L_1$ ) resulted in the best figures for both growth and yield attributes, while reduced irrigation decreased these figures ( $L_1 > L_2 > L_3$ ). Likewise, irrigation stages also significantly influenced the growth and yield attributes of barley with irrigation at three growth stages ( $S_1$ ) producing the highest values. Between the two 2-irrigation treatments,  $S_2$  showed better results for the growth attributes, whereas the yield parameters were higher in  $S_3$ . Irrigation water use was significantly lower in deficit irrigation treatments, thereby they showed higher WP. The highest significant WP and second lowest irrigation water

use figures in  $L_3S_3$  suggest 50%-irrigation at vegetative and booting stages is effective for barley cultivation under water-scarce conditions.

### Modelling potato-maize-aman cropping system as influenced by sowing dates and climate change

K.F.I. Murad, M.B. Hossain, D.K. Roy, K.K. Sarker, M.H. Rashid, S.K. Biswas

The aman-potato-maize system offers improved water productivity, especially in the water-scarce northwestern region of Bangladesh. This study calibrates and validates a crop simulation model for the system, estimating crop yields and water usage across different sowing dates. Results reveal significant effects of sowing dates on potato growth, yield, and water use. Delayed sowing leads to shorter growth duration, accelerated tuber formation, and reduced tuber weight per plant. The calibrated model demonstrates good agreement with observed data for BARI Alu-7, indicating accurate simulation of tuber yield and irrigation water productivity. The model will be further validated using additional data and extended to other crops to develop resilient and sustainable agricultural practices in Bangladesh.

### Response of mungbean to different levels of irrigation

F. Akter, S. S. A. Kamar, S. K. Biswas, M. A. Hossain, and M. A. Rahman

This research study investigated the impact of different irrigation treatments on BARI mug-8, a stress-tolerant crop variety. Treatments included no irrigation (control), early vegetative stage irrigation, early vegetative stage + flowering stage irrigation, and early vegetative stage + pod formation stage irrigation. The study indicated that irrigation during the early vegetative stage and flowering stage led to the highest plant height,

number of pod/plant, number of seed/pod, 1000 seed weight, and yield in the first and second years, respectively, at both locations. On the other hand, the control treatment (T1) resulted in the lowest values for these parameters in both years. In conclusion, the study established that irrigation, especially during the early vegetative stage and flowering stage, had a positive impact on mungbean yield. These findings hold practical implications for farmers aiming to enhance crop productivity and water management in mungbean cultivation.

#### **Automated model selection using bayesian optimization and asynchronous successive halving algorithm (ASHA) for predicting daily minimum and maximum temperatures**

D. K. Roy, S. K. Biswas and M. A. Hossain

State-of-the-art machine learning (ML) algorithms were employed to provide multi-step ahead daily maximum ( $T_{max}$ ) and minimum ( $T_{min}$ ) temperatures forecasts at three weather stations in Bangladesh. The top-performing ML algorithms were selected automatically through tuning of the relevant hyperparameters using the Bayesian optimization and Asynchronous Successive Halving Algorithm (ASHA). Although both Bayesian and ASHA optimizations produced satisfactory performance, they differ with respect to computational time requirements, with ASHA algorithm took less time to converge to finding the best model. The forecasting accuracy of the models decreased with the increase in the forecasting horizon. This study shows the promise of the automated model selection using the Bayesian and ASHA optimization algorithms for multi-step ahead forecasting of daily  $T_{max}$  and  $T_{min}$ . This work has potential applications to other geographic locations.

#### **Optimum water and urea management of dwarf sunflower using APSIM (field experiment)**

A. J. Mila, R. W. Bell, D. Gaydon, E. B. Lennard, S. K. Biswas, M. A. Hossain

Proper sowing along with appropriate use of irrigation urea at actual crop growth stages can minimise misuse of these costly inputs and can increase water productivity. Dwarf sunflower (BARI Surjamukhi 3) was grown at three sowing dates (Factor A) using four irrigation combinations with full and 70% of full irrigation urea at 3 crop growth stages (Factor B). 19 Nov sowing gave the

significantly highest seed yield. Three irrigation at vegetative, pre-flowering, and flowering with full urea produced the highest yield. Higher water productivity was found by mid-Nov sowing, and 70% of full irrigation urea at vegetative, pre-flowering, and flowering. Therefore, it can be concluded that dwarf sunflower can be irrigated at 70% of full irrigation urea at three growth stages to get higher water productivity in central Bangladesh.

#### **Validation of BARI irrigation advisory for sunflower at Gazipur**

A. J. Mila, S. K. Biswas, N. A. Shawn, I. Ahmed, A. F. M. T. Islam, T. Munmun

BARI irrigation advisory is a tool that will operate through mobile and give information to farmers or irrigation managers. It was validated for the first time with BARI released dwarf sunflower variety (BARI Surjomukhi 3). Here the test crop was validated with the existing irrigation practice-commonly known as crop growth stage-based irrigation. There were two irrigation treatments, replicated thrice in the research field of IWM Division, BARI, Gazipur during the Rabi season in 2022-23. BARI irrigation advisory produced a 13% lower yield using a 60% lower amount of irrigation water and gave a 62% higher water productivity than the crop growth stage-based irrigation.

#### **Feasibility of surface drainage for winter crop for greater resilience of smallholder farm income and food security in southern Bangladesh**

A. J. Mila, P. L. C. Paul, A. K. Chaki, R. W. Bell, D. S. Gaydon

Waterlogging at the end of the Kharif 2 season makes early Rabi crop establishment delay and faces plant other abiotic stresses that decreased yield. Therefore, surface drainage before early crop establishment would be a potential option. This study was conducted at the farmer's field at Dacope, Khulna at two locations with three drainage depths and replicated thrice. 30 cm surface drain gave the significantly highest yield for both locations followed by 15 cm drainage depth. It released comparatively more water in lesser time than the 15 cm drainage depth. The  $SEW_{30}$  was higher at no drain and gradually decreased with the increase of drainage depth. Farmers of Bangladesh can increase smallholder farm income using this surface drainage technique,



consequently increasing food security in Southern Bangladesh.

#### **Growth and yield of chilli as influenced by different levels and intervals of drip irrigation**

A.J. Mila, K. F. I Murad, S. Brahma, F. Akhter

Irrigation at the proper time and amount is important to get a good yield of shallow-rooted plants like chilli. There were two factors RCBD: irrigation intervals (every alternate day and 3 days) and irrigation amounts (100%, 75% and 50% of  $ET_c$ ) replicated thrice. 3 days irrigation interval gave ~37% higher chilli yield than every alternate day irrigation. It gave ~116% and 50% higher irrigation water productivity using 50% of crop  $ET_c$  than 100% and 75% of crop  $ET_c$ . It also gave ~37%, 176% and 37% higher gross return, net return and benefit-cost ratio than every alternate day irrigation. Therefore, it is recommended to irrigate chilli at similar agro-climatic conditions at 3 days intervals with 50% of crop  $ET$  to get higher irrigation water productivity and net return.

#### **Effect of irrigation interval and mulching on growth, flower and corm production of gladiolus in winter season**

F. Akter, S.K. Biswas, M. A. Hossain, K.F.I. Murad, and F.N. Khan

This research aimed to evaluate the influence of different irrigation intervals and mulching on the growth and yield of gladiolus (BARI Gladiolus-4). Nine treatments were tested, varying irrigation intervals (5, 10, 15, and 20 days) and mulching practices. The study found that the combination of irrigation at every 10 days with mulching resulted in the highest plant height, spike length, and floret count. However, for corm production, the best results were obtained with a 15-day irrigation interval and no mulching. More frequent irrigation (every five days) led to excessive water use and reduced yield, while longer intervals (15 and 20 days) resulted in higher yields despite consuming lower water consumption. Farmers' practice showed comparable results to the FTDII (5 days irrigation interval) with mulching treatment in terms of spike yield, but its water usage resembled the more frequent irrigation approach.

#### **Effect of irrigation on mango fruit cracking in Chattogram region**

M.P. Haque, M. F. Zaman, S.K. Biswas, and M. S. Rahman

The study was conducted at the existing HRC Mango Orchard of Regional Agricultural Research Station, Hathazari, Chattogram during the Rabi season of 2019-20, 2020-21, 2021-22, and 2022-23 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 intervals). The highest yield was found at higher frequency irrigation ( $T_5$ ). The maximum irrigation (average 1865 liters plant<sup>-1</sup>) was applied at two weeks interval irrigation ( $T_5$ ). In rain-fed condition ( $T_1$ ), yield was lowest. The lowest number of fruits dropping (average 18 no. fruits) had 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 through irrigation at fruit setting ( $T_3$ ) and the benefit-cost ratio was also higher in this treatment.

#### **Evaluation of alternate furrow irrigation and irrigation interval with supplemental every-furrow irrigation for eggplant cultivation**

K. K. Sarker, M. A. Rahman, M. A. Quddus, S. K. Biswas, A. K. M. Quamrurazaman

The study was conducted to evaluate the alternate furrow irrigation (AFI) with 10 and 15-days interval with supplement one every furrow irrigation (EFI) on eggplant yield, water saving, water productivity and benefit cost ratio as compared with AFI without supplement EFI, and EFI with 10 and 15 days interval. The field experiment was laid out in randomized block design with six treatment replicated thrice. The results showed that plant height and SPAD were not significantly different. The yield had significantly different but the yield was not differ between the treatments of AFI with or without supplement one EFI at 10 days interval. AFI saved water by 35% and improved WP by 50%. Benefit-cost ratio of AFI was nearly similar to EFI. AFI with 10-days interval could be an alternative irrigation option.

### **Feasibility study of the IoT based precision agriculture for sustainable crop production in Bangladesh**

K.K. Sarker, M.N. Uddin, I. Ahmed, A.F.M. Tareq, N.N. Karim, M.R. Islam, M.S. Hasan, M. T. Ali, S.K. Biswas

Sensor-based precision agriculture (PA) is not in general practice in Bangladesh and its potential is yet to be adequately investigated at crop field conditions. Therefore, this study has been taken to test the feasibility of the Internet of Things (IoT) based PA for predicting water and fertilizer use at field conditions. The field experiment was set up at BARI, Gazipur and the reference database is being created from experiment for testing the IoT-based eggplant production. The IoT based PA software system has been designed developed and is being tested. Initial machine learning models-irrigation and fertilizer requirement and pest attack have been developed and will be evaluated the performance. A Mobile app has been developed and is being improved for representing the possible interfaces and relative features for the end user.

### **Evaluation of sprinkler irrigation for improving water productivity of watermelon/ sunflower in coastal zone of Bangladesh**

K.K. Sarker, S.K. Biswas; M.A. Rahman, M.A. Quddus, M.M. Islam

Sprinkler irrigation is becoming popular for increasing water productivity in the regions where the fresh water availability and resources are scarce. Therefore, the objectives of this study were to evaluate the hydraulic performance of sprinkler irrigation, find out the effect of sprinkler irrigation on yield, water use and water productivity of watermelon/sunflower, and introduce/disseminate the water saving technique of sprinkler irrigation. A portable sprinkler irrigation system was developed, installed and evaluated. The results showed that the performance was good and indicated the acceptable for application. Sunflower yield was greater by 6.3% than traditional practice. Sprinkler irrigation saved water by 10.6-19.7% compared to traditional practice. Water productivity was improved by sprinkler irrigation compared to traditional irrigation. Sprinkler irrigation technique could be an option for better irrigation in the coastal zones.

### **Yield and water productivity indices of garlic varieties under sprinkler irrigation**

S.K. Biswas, M.A. Hossain, D.K. Roy

A field study was conducted to develop water – yield relationship for two garlic varieties with different irrigation regimes (0.6, 0.8, 1.0, 1.2 and 1.4 ETo) under sprinkler irrigation to quantify crop water productivity functions (CWPF) for optimum use of irrigation water. Marginal water productivity (MWP) and elasticity of water productivity (EWP) were calculated using the relationship between bulb yield and seasonal evapotranspiration (SET). A continuous increasing trend in yield was recorded with the increase in SET up to 1.0 ETo. The critical levels of SET ranged from 183 – 237 mm for BARI Rashun-1 and from 186 – 243 mm for BARI Rashun-3 for obtaining maximum WP and yield, respectively, indicating almost same irrigation practices is needed for cultivation of these two garlic varieties.

### **Effect of fertilizer and irrigation frequency on the yield and quality of export and processing potato**

S.K. Biswas, M.A. Anower, D.K. Roy, K.F.I. Murad, Farzana, K.K. Sarker

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) were evaluated. SOP with vermicompost and SOP alone with recommended fertilizer dose were tried under three levels of irrigation to increase the dry matter content and tuber yield of potato. The treatment of recommended dose with 75% MOP + 25% SOP + Vermicompost @2t/ha produced slightly higher tuber yield, tuber dry matter content and water productivity under the irrigation treatment where four irrigations at 30, 45, 60 and 75 days after planting (DAP) were applied with last irrigation up to 50% of field capacity (FC). These results are of considerable importance to the growers of potato and may be preferred for growing export and processing potato in Bangladesh.

### **Effect of saline water irrigation with different doses of potassium on crop growth and yield of mungbean**

F. Akter, S.K. Biswas, M.A. Hossain, K.K. Sarker and K.F.I. Murad

The experiment was conducted 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 and 12 dS/m) with four potassium levels (0%, 100%, 125% and 150% of recommended dose). Results indicate that increasing salinity levels negatively impacted plant growth and yield parameters, including the number of pods per plant, pod length, number of seeds per pod, weight of seeds per pod, hundred seed weight, and seed yield. High salinity adversely affected the plant's physiological processes and nutrient uptake. Similarly, higher levels of potassium application showed negative effects on plant growth and yield.

#### **Adaptation of raised bed furrow irrigation technique for increasing yield and water productivity of sunflower in saline zone**

K. K. Sarker, S. K. Biswas, M. S.I.Khan, M. Mainuddin

Water saving technique is now essential in the coastal areas where fresh water resources are limited. Therefore, this study was taken to conduct the field experiment at the salt affected area of Patuakhali. The specific objectives were to (i) find out the effect of planting (top center and side slope of the furrow) and furrow (Skip fixed, alternate and every) irrigation method on yield, water use and water productivity (WP) of sunflower. The results indicated that the yield was found significantly greater in the side slope planting of the skip, alternate and every furrow irrigation (EFI) than top center of the raised bed. The water saving technique of skip fixed and alternate furrow irrigation saved water use by 25-28% and significantly improved WP in AFI compared to EFI.

#### **Effect of cyclic use of non-saline and saline water irrigation on yield, water productivity and solute potential of zero-tilled potato**

K. K. Sarker, S. K. Biswas, K.F.I. Murad, M.S.I.Khan, M. H. Rashid, M. Mainuddin

Cyclic use of non-saline (NS) and saline water (SW) is a technique to irrigate crops in the salt affected where fresh water is not available. The objectives were to find out the response of tuber yield, water productivity and solute potential to the cyclic use of NS and SW at different growth stages of potato. Two field experiments were laid out in Dacope and Kalapara. Results showed that the

cyclic use of NS and SW irrigation treatment had significant ( $P<0.01$ ) difference on potato tuber yield and WP ( $P<0.001$ ). The greater solute potential was found in mid-February to March. The response of potato tuber yield to the cyclic use of NS ( $EC<2$  dS/m) and SW ( $2<EC<5$  dS/m) irrigation could be an alternative irrigation optioned in the coastal zones.

#### **Response of zero-tilled garlic with and without mulch to saline water irrigation in coastal saline soil**

K. K. Sarker, S. K. Biswas, M. S.I.Khan, M. H. Rashid, M. Mainuddin

Straw mulch and irrigation plays a crucial role in enhancing yield and water productivity of zero-tilled garlic in the salt affected coastal zones. The specific objectives of this study were to find out the response of garlic yield under mulch and irrigation interval and the interaction effect of mulch and irrigation interval on yield and water productivity. A factorial field experiment was laid out in eight treatments. The results indicate that plant height and bulb yield of garlic were significantly different among the treatments. The straw mulch with 10 days irrigation intervals produced greater bulb yield relative to non-mulch with other irrigation interval. The interaction effect of straw and irrigation interval had no significant differences. WP significantly varied among the treatments. Solute potential (-kPa) negatively increased as yield decreased.

#### **Effect of mulch and irrigation interval on yield and water productivity of watermelon in coastal saline soil**

K. K. Sarker, S. K. Biswas, A. Mila, M. H. Rashid, M. Kamal, M. Mainuddin

Mulch and irrigation is necessary to sustain coastal agriculture in southern Bangladesh. Therefore, a field experiment was carried out to investigate the response of watermelon at mulch and irrigation interval on yield and water productivity in the salt-affected coastal zone. A field experiment was conducted in Dacope. The experiment was laid out in a randomized complete block design with six treatments and replicated thrice. The treatments were as follows: factor a: mulch: (i) plastic mulch, (ii) no mulch; factor b: irrigation interval:  $I_1$ : 5 days interval,  $I_2$ : 10 days interval and  $I_3$ : 15 days interval. The cultivar (Sweet dragon) was tested.



The better fruit yield and water productivity of watermelon was found at 5 days irrigation interval with plastic mulch in the salt-affected saline soils of Dacope in Bangladesh.

#### **Deep learning emulators for saltwater intrusion management modelling in coastal aquifers**

D. K. Roy, S. K. Biswas and B. Datta

Deep learning (DL) emulators were developed to replace the simulation model in a coupled simulation-optimization (S-O) approach to develop a saltwater intrusion management model, which provided optimal groundwater pumping to control saltwater intrusion. Among six DL emulators developed at 16 monitoring locations (ML), the Deep Feed Forward Neural Network (DFFNN) provided the superior performance at 13 MLs as indicated by the Shannon's Entropy based decision theory. The simple FFNN for DL was found to be the top-performing model at locations M3, M7, and M12. Consequently, the DFFNN and FFNN appeared to be the best candidate for the S-O approach to develop the management model. The experiment will be continued for the next year to externally link DFFNN and FFNN models with the optimization algorithms to develop the management model.

#### **Interpretable and explainable machine learning algorithms for predicting saltwater intrusion in coastal aquifers**

D. K. Roy, S. K. Biswas, M. A. Hossain and B. Datta

While some models are inherently interpretable, most of them are black-box in nature which cannot provide relative predictor importance in producing the output. Interpretable and explainable machine learning models were developed, for the first time, to predict saltwater intrusion in coastal aquifers. The Gaussian Process Regression (GPR) model outperformed the Artificial Neural Network (ANN) and Support Vector Regression (SVR) models at the monitoring locations ML2, ML4, and ML5. On the other hand, the ANN model outperformed the GPR and SVR models at the other monitoring locations (ML1 and ML3). Once evaluated, the interpretability of the developed models was assessed through Partial Dependence Plot (PDP), Local Interpretable Model-Agnostic Explanations (LIME), and Shapely plots. Results revealed that the proposed approaches can adequately provide

the model-predictor relationships in producing the desired output.

#### **Accuracy and computational time of ga and pso based multi-objective optimization algorithms for saltwater intrusion management model in coastal aquifers**

D. K. Roy, S.K. Biswas, B. Datta

A heterogeneous ensemble of several surrogate models (emulators) was created using the Dempster-Shafer theory (DST) of evidence based weighting scheme to develop a multi-objective saltwater intrusion management model. Results revealed the acceptable performance of the ensemble candidates consisting of 11 different machine learning algorithms developed at each of the five monitoring locations (ML). The first five top-performing models were selected using Shannon's Entropy, which incorporated a set of different performance evaluation indices. The performance sequence of the top five models at ML1, for instance, was ANFIS>ANN>GPR>FIS>PLR. The top five models thus obtained were integrated using the DST computed model weights. The performance of the DST ensemble was compared with the Random Forest (RF)-based ensemble approach. Results indicated the superior performance of the DST ensemble over the RF ensemble.

#### **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. 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 STWs, DTWs and HTWs that used for irrigation and domestic uses. Besides, the composite influence of different water quality parameters on the overall quality of water was also assessed using water quality index (WQI). 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.

**Project: Conservation of groundwater and raising its use efficiency and productivity in irrigated agriculture in Bangladesh**

S.K. Biswas, G.W. Sarker, M. Asaduzzaman

Baseline survey of 2500 farm households in BADC, BMDA and privately owned DTWs and STWs irrigation schemes was conducted electronically using TAB to collect information on various aspects of irrigation water use in Boro rice production, such as AWD technology, water user associations, use of smart cards, irrigation water distribution system, production cost of Boro rice, irrigation cost, irrigation water pricing method, etc. Data analysis shows that about 30% farmers have educated experience/guess on AWD technology and they follow the AWD technique without using the plastic pipe. In irrigation schemes of BMDA and BADC, the buried pipe covers only 60-80% as compared to the requirement. Earthen canals are mainly used for privately owned DTWs and STWs to distribute irrigation water. About 53% farmers of BMDA DTWs scheme have their own smart card while in BADC schemes it is totally absent. Irrigation costs are the lowest for volumetric pricing with own controlled smart card. However, in BADC and BMDA areas, irrigation charges are determined mainly on volume basis. In private DTWs and STWs, irrigation charges are almost entirely based on land area. Water user association (WUA) exists only 23.1% in BADC DTW schemes, 31.4% in BMDA irrigation schemes,

28.5% in privately owned DTW irrigation schemes and only 0.6% in STW irrigation schemes. Total production costs and cost patterns are broadly similar across management group. Labor costs account for 45-50%, fertilizer and manures and irrigation account for similar levels and proportion of costs, broadly 12-14%.

**Dissemination of solar-powered drip irrigation system for watermelon cultivation in saline prone areas of Bangladesh (Kuakata and Noakhali)**

S. K. Biswas, D. K. Roy, M. A. Hossain, K. F. I. Murad and M. P. Haque

Traditionally farmers irrigate watermelon by carrying water in a container from a small pond which is laborious work and labor-intensive. Therefore, field demonstrations were conducted with solar-powered drip irrigation system to mitigate the laborious work of water application, save water and energy for irrigation. There were two treatments with four replications: solar-powered drip irrigation system ( $T_1$ ) and farmer's practice as a control treatment ( $T_2$ ). The demonstrations were conducted from 2019-20 to 2022-23 growing seasons. The results revealed that treatment  $T_1$  was highly responsive to yield and more profitable than  $T_2$ . The solar powered drip irrigation treatments provided the highest BCR for the consecutive growing seasons. The farmers were benefited and interested in using this promising water and energy saving irrigation technology.

# FMP ENGINEERING

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## **Development and evaluation of four-wheel tractor operated seeder**

M. A. Hoque, M. S. Miah, M. R. Karim and M. A. Hossain

Four wheel tractor (4WT) are being introduced in recent day's in farming works. They are also a suitable option to resolve the issues described herein. Therefore, this research has been under taken to develop four-wheel tractor operated seeder (4WTOS). It was re-designed and fabricated at FMPE Division, BARI, Gazipur during 2022-23. The power of the seeder was taken from the tractor wheel shaft. With this seeder, maximum of 09-line seed can be sown, and the tilling width was 180 cm. The effective field capacity and efficiency of the seeder without and with rotator were found to be 0.24 and 0.25 ha/h and 77.50 and 78.73%, respectively. Yield and yield contributing characters of wheat and sunflower sown by different methods were also not varied. Yield of sunflower planted by four wheel tractor operated seeder without rotavator in plough land and four wheel tractor operated seeder with rotavator in strip tillage were statistically similar to conventional planting despite of numerically higher yield in strip tillage. The experiment will be conducted in the coming year in order to improve and evaluate the performance of the seeder for different crops.

## **Design and development of a tractor operated vegetable seedling transplanter**

M. S. Miah, M. J. Hasan, M. Asaduzzaman and M. A. Hossain

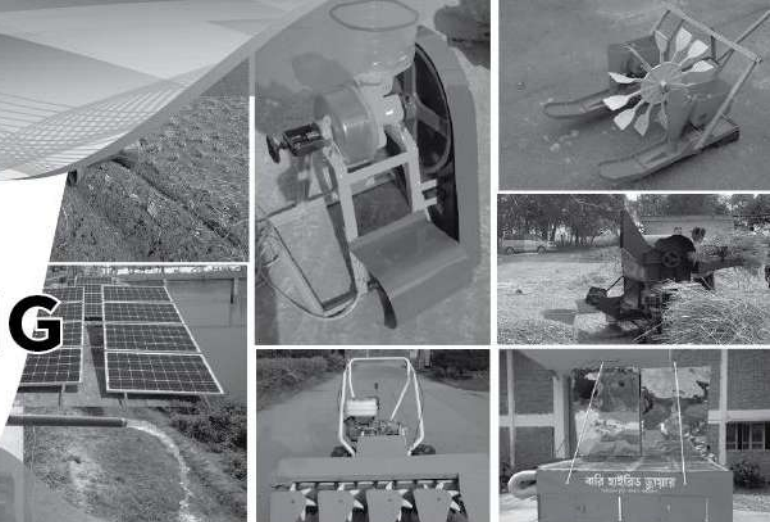
The traditional method for transplanting vegetable seedlings is required making a hole in the soil, placing the seedling at the proper depth and finally filling the hole with press. All activities are time consuming labour intensive and expensive. A four wheel tractor operated furrow opener type vegetable seedling transplanter was designed and

fabricated. The transplanter can transplant seedlings in two rows at a time. Overall dimension of the transplanter was 2550×2000×1200 mm. The study was conducted at the FMPE Divisional research field during the rabi season (winter) of 2022-23. The machine was tested at the brinjal crop (BARI Begon-8). The spacing between seedling to seedling could be adjusted 20-80 cm. During the laboratory test, there was no missing placement of seedlings in the soil. Seedlings showed a lower degree of vertical axis inclination after transplantation. At a forward speed of 1.2 km/h, the field performance of the transplanter was assessed in the brinjal field during 2022-23. The depth of placement of seedling can be maintained at 3.25 cm. Following the placement of the seedling in the hole, the root of seedling must be completely covered with soil. Otherwise, the seedling might be death due to high water loss. The results revealed that there was no problem associated with the vegetative development and found the higher yield productivity as transplanted by hand. The field capacity of the transplanters was found to be 0.10 ha/h. The experiment will be carried out next year in order to improve the machine.

## **Energy use analysis of conservation agriculture tillage systems for rice-soybean cropping pattern**

M. A. Hoque, M. S. Miah and M. A. Hossain

System-based evaluation of the conservation tillage in terms of energy and economic is important. Therefore, this experiment was undertaken for Rice-Soybean-Fallow cropping pattern to assess the system productivity, and quantify energy flow of conservation tillage methods. The experiment was conducted at the research field of FMPE Division, BARI during 2022-23 with eight treatments. Treatments were conventional tillage (CT) T. Aman-CT Soybean, CT machine transplanted T. Aman-CT Soybean, CT T. Aman-Strip tillage (ST) Soybean,





CT T. Aman-Zero tillage (ZT) Soybean, STMT T. Aman-ST Soybean, Strip till followed by manual transplanting (STMT) T. Aman-ZT Soybean, Unpuddled tillage (UPT) T. Aman-ST Soybean and UPT T. Aman-ZT Soybean. Yield of rice and soybean for different treatments were not significantly varied. When the treatments were merged to basic three treatments (CT, ST and ZT) significant variation were found. The highest soybean grain yield was found in strip tillage which was similar with zero tillage. The lower soybean yield was found in conventional tillage. The highest energy output-input ratio was found for strip tillage followed by manual planted T.aman-ST soybean cropping systems. Therefore, the conservation tillage based cropping systems could be recommended for the farmers due its energy efficiency.

#### **Design and development of onion and garlic detopper**

M. A. Hoque, M. A. Hossain, M. A. Mottalib and S. Brahma

Onion and garlic are important spice crops in Bangladesh. After harvesting onion and garlic, the edible bulb portion is separated from the inedible stem by cutting or detopping (leaving only 15–30 mm stem with the bulb). This cutting 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 at the Farm Machinery and Postharvest Process Engineering Division of Bangladesh Agricultural Research Institute during 2022–23. It was consisted of a feeding hopper, conveyer belt feeding mechanism, screw conveyer, cutter blade and delivery chute and made of locally available materials and operated by a 0.37 kW electric motor. A cutter blade was developed with 10 upper blades and 10 lower blades. A fan type delivery accelerator was settled on the delivery end of the rollers to ensure the delivery to the chute. The detopper was evaluated with both the onion and garlic. The capacities of the detopper for onion and garlic was 175 and 90 kg/h whereas only 65 and 40kg/h could be trimmed by manually. Capacities of the detopper for onion and garlic was 2.7 and 2.4 times higher than that of the manual method. Stem length of garlic was maintained using the detopper like manual method. The total loss due to machine and operational parameters was less than 2 percent. The capacity of the machine should be further verified with different size of onion and garlic in

both green and dried condition. Thus the experiment will be continued in the next year.

#### **Establishment of ca park at BARI and adaptive trial of conservation machinery and water management systems in the southern delta of Bangladesh**

M. A. Hoque, M. A. Hossain, T. Jahan, M. J. Alam, M. M. Alam and C. K. Saha

This was undertaken to evaluate the long term effect of conservation agriculture and conventional tillage on crop yield and soil properties for different cropping systems and tillage methods. The long term conservation agriculture trials were conducted at CA park established at BARI, Gazipur. The maize and mungbean experiments were conducted with four tillage methods such as conventional, strip tillage, zero tillage and bed planting. Rice experiment was conducted with the tillage methods as manual transplanted in conventional tilled soil, mechanical transplanted in conventional tilled soil manual transplanted in unpuddled soil and mechanical transplanted in unpuddled soil. The variety of rice was BRRI dhan 48. The individual plot size was  $28 \times 3.25$  m. Soils of research plots were analyzed before and after conducting experiments. In the Rabi season 2022-23, 1.05 ha of mungbean was planted by BARI seeder at Mundopasha, Wazipur, Barishal, 3.70 ha mungbean was planted at Holdibaria, Kolapara, Patuakhali. In the Kharif-1 season, jute was planted in Dumuria, Khulna by CA machine. System rice equivalent yield (SREY) in maize-rice pattern was not varied for residue level since the experiment in the second year. The highest SREY was found in bed planting and that was similar among the others treatments in maize-rice pattern. The highest SREY was found in strip tillage in mungbean-rice pattern. The similar SREY was found among the treatments in rice-rice-rice based cropping pattern. The soil health improvement was observed due to residue retention and minimum tillage in CA tillage practices. The experiments will be continued in the next year to observe the real impact of CA in the long run.

#### **Design and development of tractor operated potato harvester**

M. S. Miah, M. A. Hoque and M. N. Amin

A four-wheel tractor driven potato harvester was developed and fabricated with locally available materials to facilitate the farmers to harvest their

potatoes at low cost. The developed potato harvester is a semi-automatic digging machine, and it consisted 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 performed digging, separating potato from soil, bagging at a time. In order to relieve the farmer's labor and save time, money, and potato losses. During laboratory test, potato missing, damage, field capacity, field efficiency, etc. data were taken followed standard method. Overall dimension of potato harvester was 1890 mm x 1200 mm x 750 mm. The field capacity and width of harvesting of the tractor operated potato harvester was 0.10 ha/h and 1200 mm respectively. The missing of harvesting and damage of potato were 5.92% and 5.52% respectively. The forward speed of the machine was 1.25 km/h. Due to the tractor's application of force in push mode, it was very challenging to maintain a consistent depth of cut. A U-skidder or wheel should be placed on the harvester's front side to solve the problem. Another essential component that can ensure a consistent depth of soil cut is the harvester's shovel. Again, the harvester's shovel needs to be redesigned. The experiment, which is in its second year, will be repeated in 2023-24 to make a precision potato harvester.

#### **Development of a four wheel tractor operated onion and garlic planter**

M. A. Hoque, M. A. Mottalib and M. N. Amin

Four-wheel tractors are became popular in farming works in recent day's since they have suitable alternative use option. Therefore, this research work has been taken to design, develop and evaluate a suitable four-wheel tractor operated onion and garlic planter. A four-wheel tractor operated onion and garlic planter were designed and fabricated accordingly in FMP Engineering Division, BARI, Gazipur during 2022-23. The working principle of the planter is tilling operation, planting in line and seed covering simultaneously in a single operation. Two cups were developed and two cups were collected. Maximum 12 lines of seed can be sown with this planter and the tilling width was 180 cm. CSISA-MEA developed cups were picking 46.5% double or more garlic cloves, 48.5% single and 5% missing. BARI-1 Cups were taking 39.5% double and 52.5% single garlic cloves but

8% missing was found. BARI-2 cups were picking only 12% double and 77.5% single garlic cloves but 10.5% missing was found. The average effective field capacity and efficiency of the 4WT operated planter was found to be 0.25 ha/h and 78.73%, respectively. The experiment will be conducted in the coming year in order to improve and evaluate the performance of four-wheel tractor operated seeder for different crops.

#### **Development of a boom sprayer for coconut tree**

M. Z. Hossain, M. S. Miah, M. M. Hasan, M. Z. Hasan, M. N. Amin, M. A. Hoque, and M. A. Hossain

Spraying chemical is an important intercultural operation to control coconut insect, mites, disease etc. However, coconut trees in Bangladesh can be taller than 10 meters. Therefore, with the existing method, an excessive amount of pesticide was used because of the height of the coconut and an extra amount of chemicals are exposed to the environment. The experiment was taken to develop a coconut climber. The device was designed and fabricated at FMPE Division, BARI, Gazipur during 2022-2023. This climber consisted of an electric motor (0.5 hp), gear box, belt and pulley, SS box, wheel, tension spring etc. The climbing part was fabricated using locally available stainless steel (SS) hollow square box, SS sheet, etc. The diameter at the bottom of the coconut tree was 43±4.3 cm. The middle (3 feet above the ground) and upper part of the tree was almost similar 29±2.6 and 29±2.1 cm, respectively. Thus the machine was designed over a tree diameter of 29 cm. Field test will be conducted in the next year.

#### **Improvement and validation of automatic irrigation device**

M. Z. Hossain, M. S. Miah, M. Z. Hasan, M. A. Hoque and M. N. Amin

A sensor based automatic drip irrigation system was developed and installed at the roof top of FMPE Division, BARI, Gazipur during 2022-23. The system composed of soil moisture sensor, solenoid valve, water tank with drip irrigation set and control panel (ESP32, relay, battery, voltage stepper, etc.). About six numbers of ornamental plant was planted at six different pot (300×300×300 mm). About three (3) soil moisture sensor was inserted into the soil of three different bucket. The drip irrigation device was set through a

tube where one side was attached to the water tank (1000 L) outlet and other side to the drip nozzle pipe. A solenoid valve was set in between the pipe of water tank outlet and drip inlet. The circuit board consisted of an ESP32 microcontroller, a pocket router, an LCD display, a 4-channel relay (12V), a buck converter (24V to 12V), an inverter (300W, DC 12V to AC 230V), a battery (12V 10A), a solar panel (50 W) and a solenoid valve (gravity flow, 1 inch diameter). The minimum and maximum sensor threshold was 250 to 650. However, we set the value between 400 and 350, representing 63% and 75% soil moisture, respectively. This value was written into computer code of Arduino IDE platform. The sensor drip irrigation system worked well to water pot plants. The device will be set in farmer's field in the next Roby season for testing its efficacy.

#### **Improvement and validation of barley thresher**

M. Hossain and M. A. Rahman

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 was laborious. Therefore, there was a need for a thresher which could accomplish the task in a single pass. In this endeavor, development of a new barley thresher was started during 2021-2022. The new model consisted of a conveyor part, threshing part and dehulling part. In the new model a threshing part and a dehulling part were combined to effectively separate grains from the spikes. There was a conveyor chain to feed the heads of crop bundles into the threshing cylinder. In 2022-23 the thresher was assembled and tested with harvested bundles of hulled barley (grain-straw ratio= 1:0.3). In the initial stage the thresher did not perform satisfactorily as threshing recovery (45.72%) and threshing efficiency (49.31%) were below 50%. However, blown grain was found to be 3.6% which was satisfactory. Therefore, further improvement and validation of the thresher will be done in the next year.

#### **Development of a power operated coconut tree climber**

M. Hasan, M. N. Amin, M. A. Haque, S. Miah, M. Z. Hossain and N. Jahan

Coconut tree climbing is a labor-intensive task that poses numerous challenges to workers due to its

height, slippery trunk, and sharp leaves. This research report focuses on the development of a power-operated coconut tree climber as an innovative solution to enhance productivity and reduce the risks associated with manual climbing. Thus, there is a huge demand for developing a power-operated coconut tree climber. So, a power-operated coconut tree climber was fabricated at FMPE Division, BARI, Gazipur in 2022-2023 with the climbing mechanism components include a stainless-steel frame, durable rubber, and specialized climbing pads, which are employed to provide secure traction against the coconut tree's surface a reliable 65cc petrol engine from Honda of a powerful 3.8 hp output. Adjustable strong straps are used to secure the climber to the user's body, while a safety harness is included to prevent accidental falls during tree climbing. An intuitive control panel with user-friendly buttons and safety features is integrated to operate the climber smoothly. Its automatic transmission and automation grade ensure seamless operation. The experiment will be conducted in the next year for improving the safe measure.

#### **Testing and evaluation of combine harvester for harvesting mungbean and soybean in coastal areas**

M. S. Miah, M. A. Hoque, M. N. Amin and M. A. Hossain

The aim of the research to evaluate the performance of the combine harvester for harvesting mungbean and soybean as well as to modify and improve combine harvester. The machine was tested at undarchor, Noakhali sodor for combine harvesting of soybean and at Amkhola, Golacipa, Patuakhali for combine harvesting of mungbean during the year. The soybean pod spreads across the entire plant. Soybean pods often grow 2 inches above the soil's surface. It became very difficult to maintain uniform height below two inches during harvesting. The average forward speed and field capacity of combine harvester for soybean and mungbean were 2.03 km/h, 0.34 ha/h and 2.21km/h, 0.39 ha/h respectively. It was found that the percentage of unthreshed grain pad in soybean and mungbean were 39.20% and 35.67% respectively. In order to improve the efficiency of mungbean and soybean harvesting, threshing, and cleaning, some problems with combine harvesters have already been identified. Thus the experiment



will continue for the following next years with the necessary modifications to be made to improve the efficiency of the harvester.

#### **Development of an oat dehulling machine**

N. Jahan, M. N. Amin, M. M. Hossain, S. Akter and A. H. Akhi

The demand of the oat dehulling machine has been propelled by the increasing demand for plant-based diets. The outer layer of the groat is an important source of protein, neutral lipids,  $\beta$ -glucan, phenolics and niacin. The Plant Breeding Division of BARI has been researching on oat. But there is no machine available in the country to remove the hull from oat grains. Therefore, the aims of the present study were to develop a small scale oat dehulling machine and to evaluate performance of the developed oat dehulling machine. A roller type dehulling machine was tested with oats at 11% of moisture (wb) and multiple trials were conducted in different arrangement of roller such as keeping one roller fixed and moving both roller at opposite direction and moving both roller at opposite direction. When keeping one roller fixed and moving another roller at opposite direction, unhusked and broken grains were found 37.78% and 20% of oat samples. For modification and improvement concepts coffee grinding machine and Kaon dehulling machine were considered and tested them with oat samples. Among these three machines, coffee grinding machine gave better result (dehusking of 40%) at 10% moisture content of the oat sample. This experiment will be continued next year for improvement of the machine.

#### **Design and development of a mungbean dehuller**

M. Hasan, M. N. Amin and M. A. Rahman

Mungbeans (*Vigna radiata*) are highly nutritious legumes with considerable health benefits, but their tough hulls containing mucilage and gums pose challenges for dehulling. To address this, an experiment was conducted at FMPE Division, BARI, Gazipur during 2022-2023 to create a mungbean dehuller using locally available materials powered by a 3.0 hp electric motor. The dehuller weighed 50kg. The experiment assessed a pulse dehuller's performance with various motor and shaft pulley sizes. Different tests were conducted, varying pulley sizes, pulse weights,

dehulled pulse weights, and other parameters. In trials, a 3-inch motor pulley and 3-inch shaft pulley achieved pulse recovery percentages of 76.75% and 74.22% with respective feeding capacities and moisture content. Alternatively, using a 3-inch motor pulley and 5-inch shaft pulley increased recovery rates to 86.4% but at the cost of reduced throughput. While the initial testing yielded unsatisfactory results, modifications will be made to enhance the machine's performance. In the following year, the dehuller will undergo retesting to ensure an efficient solution for mungbean processing.

#### **Design and development of a jute fiber extraction machine**

M. A. Hoque, M. S. Miah, M. R. Karim and M. A. Hossain

Jute fiber extraction accounts higher cost and involves lots of drudgery. With the aim to reduce the drudgery and fiber extraction cost, a small-scale jute fiber extraction machine was redesigned and tested at the FMPE division, BARI, Gazipur during 2022-23. For field performance evaluation, three jute plant's samples were collected randomly from three representative area of 20 square meter. For measuring the extraction capacity of the machine, jute plants of 20 square meter area were fed into the machine. The machine was tested feeding the plants increasing the number gradually from 1 to 6 plants at a time per batch and observe the condition. Capacity of the jute fiber extraction machine was 2300 Nos. plants/h (0.08 Bigha/h) for retaining jute stick and 3500 Nos. plants/h (0.12 Bigha/h) for breaking sticks. Whole stick retaining reduces 40-50% capacity compared to stick breaking system. The developed jute fiber extraction machine can retain 71% jute sticks without damage. Gross return, net return, BCR and the payback period of the jute fiber extraction machine were 383 Tk/h, 102 Tk/h, 1.36 and 3.83 year, respectively. The fiber extraction machine must be fine-tuned and thoroughly tested in the ongoing season. Developed jute fiber extraction machine can be recommended for the farmers of Bangladesh.

#### **Improvement of power tiller operated potato harvester**

M. A. Hoque and M. N. Amin

Potato is the third largest crop of Bangladesh in terms of area and production, is grown in about

0.46 million hectares and has production of 21.86 million ton per hector (BBS, 2021). The average annual growth of potato in the last 10 years in Bangladesh is steady due to the availability of quality seed, standardization of agronomic practices and suitable potato cultivators. A two-wheel tractor driven potato harvester was developed with locally available materials at Farm Machinery and Postharvest Process Engineering Division of BARI, Gazipur to facilitate small farmers to harvest potatoes. There is a demand for matching the row width as farmers practiced (20-22 inch). Therefore, an attempt was undertaken to improve the potato harvester and to test its harvesting performance. Potato harvester was improved during 2022-23 reducing the effective width from 600 to 530 mm and modified the wheel rim for the Sifeng power tiller to operate within narrow bed (530mm width) practiced by the farmer. Field capacity of it was 0.12 ha/h. Capacity of the traditional harvesting was 0.04ha/h. Tuber exposure were >95 and >50% for mechanical and traditional harvesting system. Tuber damage was ≤1 and >6%, respectively in mechanical and traditional harvesting system. Tuber damage was minimum (1%) in mechanical harvesting. Minimum amount (around 1%) of potato tubers were found during second harvest in mechanically harvested fields but around 10% potato tubers were found in manually harvested fields.

#### **Improvement of tomato seed separator cum pulper**

T. N. Barna, N. Jahan, M. A. Hossain, S. Miah, M. N. Amin and M. A. Hoque

BARI Tomato- 14, 16, and 17 have weighty fruits with a very low seed quantity. To safely extract these varieties' seeds, special care and specialized techniques need to be followed. This study was dedicated to address the problems of manual extraction developing a machine to extract tomato seed and pulping the remaining flesh. A power operated tomato seed separator was designed and fabricated at Farm Machinery and Postharvest Process Engineering Division, BARI during 2022-23. BARI tomato-14 and BARI tomato-15 were used for the experimental purpose. Ripe tomatoes of 78.4-92.7% moisture content were used for performance testing. Two treatments each replicated three times were done with 10 kg of BARI tomato-14, BARI tomato-15 and mixed varieties.

Traditional method was compared with the mechanical method. The throughput capacity, extractor productivity, extractor efficiency, seed purity and seed loss were found to be 161.94 kg/h, 9.37 kg/h, 98.62%, 65.44% and 2.82% for BARI tomato-14 and 214 kg/h, 16.53 kg/h, 99.12%, 83.78%, and 0.89% for BARI tomato-15. The pulping capacity, cylinder loss and cleaning efficiency were found to be 82.54 kg/h, 29.35% and 70.65% for BARI tomato-14 and 103.13kg/h, 22.41% and 76.92% for BARI tomato-15. The machine showed a 38 times greater throughput capacity than traditional method as well as saved seed separation time at the rate of 17 times than that of traditional method.

#### **Development of a four blades automatic cashew shelling machine**

M. N. Amin and M. Hasan

Cashew (*Anacardium occidentale L.*) is one of the high value crops in Bangladesh. It is cultivated in limited areas of Chittagong and Chittagong hill tracts. The cashew fruit is unusual in comparison with other tree nuts since the nut is outside the fruit. Removal of cashew kernel from its shell is a labour intensive operation. 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 and fabricated at FMPE Division, BARI, Gazipur. The main parts of the semi auto cashew nut sheller are mainframe, hopper, crank shaft, cutting unit, scraper, blades, spring, picking bar, and adjusting levers etc. It was operated by 2hp electrical motor. The performance test was conducted with steam boiled raw cashew nut. Ninety five kg of raw cashew nut were boiled at 40 minutes at 120°C and 0.1 Mpa. The boiled cashew nut was kept at 24 hour for cooling. The boiled cashew nut were dried by cabinet dryer 75°C for 12 hours. Whole recovery was 60%, half recovery was 30% and broken was 10%. The capacity and whole recovery percentage were not satisfied. It was not economically viable for users. So, adjustment of the cutting blades will be done more precision according to cashew nut sizes.

#### **Improvement of mechanical coconut dehusker**

M. N. Amin and M. Hasan

Coconut (*Cocos nucifera*) is a very popular and common fruit in Bangladesh. It is usually grown in

coastal areas. The fruit is abundant all over the country. The nut is more or less oval in shape and varies in size depending on the variety. Normally husking is done manually but it is a very difficult and time-consuming operation. To avoid this problem a mechanical high capacity and efficient husking machine has developed for commercial purpose. An improved coconut dehulling machine was designed and fabricated with locally available materials at Farm Machinery and postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Gazipur. The main parts of the machine are i) main frame; ii) dehulling unit; iii) power transmission unit; iv) Input and delivery tray. The capacity of the improved coconut dehuller was higher than that of previous one. The breakage percentage of coconut was found to be reduced to 0-2%. The capacity of the machine was 380 nuts/h and price of the machine was Tk.60000.00. The dehulling cost of the dehuller was found to be reduced to 0.21 from 0.27 Tk./nut. 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 a machine involve process because it is a very labor intensive job. It was fabricated with local materials with some modification. The main parts of it are-i) Main Frame ii) Rubber pad roller; iii) MS concave net; iv) Fluted type roller; v) Hopper; vi) Blower; vii) Sieve; viii) Power transmission. It was tested with dried parchment coffee. The capacity of dehuller was higher with less breakage percentage than previous one. The capacity of the machine was 350kg/h. Price of the machine was Tk. 50,000.00. Whole coffee bean was found to be higher (98%) than that of previous dehuller (75%). The dehuller should be disseminated among the users and coffee company by contacting adaptive trials in the hilly areas.

#### **Design and development of a sesame seed dehuller**

T. N. Barna, N. Jahan, S. Miah, M. N. Amin and M. A. Hossain

Sesame seeds are manually dehulled all over the country using mortar-pestle or grinding stone and sack cloth which has a very low capacity, high labor engagement and very time consuming. A mechanical approach can solve the problem and save time and money. In order to reduce the cost and drudgery, an attempt has been made to design and develop a sesame seed dehuller at the FMPE Division, BARI, Gazipur during 2022-23. Some existing mechanical approaches were investigated for this purpose. The experimental approaches were investigated to dehull sesame seeds. BARI til-3 and BARI til-4 were used as experimental sample. The sesame was dehulled using a) BARI millet dehuller, b) Grinding stone and c) 1000 Watt Panasonic mixer grinder. The existing BARI millet dehuller was tested to check for competence. Another test was done with a very high-capacity mixer grinder. Due to high oil percentage in sesame seeds, for the same amount of feed, tests with time laps i.e. pulse showed better results than that of continuous run. Among all treatments and factors, BARI til-3 showed better performance than BARI til-4 due to its physical and mechanical properties. Among all the feed rates, 100 gram feed rate showed suitable performance in all cases. The mixer grinder method showed the most promising result with highest throughput capacity (25.71 g/h), dehulling capacity (91.47%) and the highest head grain recovery (97.47%). The least breakage of grain was also found in this method (2.3%). Thus, the design parameters for sesame seed dehuller were calculated through the conducted test results. Fabrication has not yet been done. The fabrication and performance evaluation will be done next year.

#### **Development of a suitable fruit bagging tool**

M. Hasan, M. N. Amin and M. Hossain

Several good agricultural practices (GAP) gaining popularity worldwide aim to produce high-quality fruit with reduced reliance on synthetic chemicals. One such practice is pre-harvest fruit bagging, which has proven effective. However, the manual bagging method commonly used for fruit bagging in trees faces challenges when dealing with fruits at different heights, hindering its efficiency. To address this, a study examined fruit bagging tools



and found that the average bagging time for a mango was 42.4 seconds and 44.5 seconds using two different fabricated tools. The fabrication work of a fruit bagging tools was completed at the workshop of the Farm Machinery and Postharvest Process Engineering Division of Bangladesh Agricultural Research Institute (BARI), Gazipur during 2022-2023. The materials used for the previous model were plastic pipe, MS sheet, nut-bolts, bamboo, nylon rope, elastic garter, fruit covering bag etc. and the new model were with MS sheet, MS wire bamboo, nylon rope, nut-bolts etc. However, issues were noted with the previous tool, particularly with the tightness of the elastic rubber band on brown fruit bags, prompting the development of an improved model. The new tool was lighter (0.8kg) and more affordable (Tk.500) compared to the previous one (1kg, Tk.1000). Ongoing experiments are planned for the following year to further enhance its effectiveness.

#### **Improvement of BARI oil expeller for higher oil recovery**

M. Z. Hossain, M. N. Amin and M. Hasan

An oil expeller was developed at the workshop of the Farm Machinery and Postharvest Process Engineering Division of Bangladesh Agricultural Research Institute, Gazipur during 2022-2023. The main aim of this study is to design and fabricate a multi seed oil pressing machine. Other specific objectives are to evaluate the performance of the machine in terms of oil yield, extraction rate, extraction efficiency and machine throughput capacity. Overall dimension of the expeller 1900×1500×1500 mm. It can be operated by diesel engine or electric motor. The expeller can easily move from one place (set on a wheeler) to another so that the service provider of rural areas can use it as custom hire basis. The machine was made of mild steel angle bar, flat bar, square bar, etc. About 8 kg of mustard seed (BARI Sharisha-14) was fed into the feeding hopper. The moisture content of the seed was 12.50% (wb). The average engine and machine speeds were 1496 and 49 rpm, respectively. Average oil recovery was 37% for BARI Sharisha-14. The machine became sometimes stuck during operation. The machine will be tested with different type of oil seeds in the next year. Further improvement will also be done to increase the expelling recovery efficiency of the machine.

#### **Development of an iot based seed storage for high value spices and vegetable seeds**

M. Z. Hossain, T. N. Barna, M. S. Miah, M. A. Hoque, M. H. H. Khan, R Ara and M. N. Amin

Design and selection of appropriate storage structure for vegetable seed preservation is important for all seed processing areas in Bangladesh. Recent development of sensor and microcontroller can help to build up an internet of things (IoT) system with a relatively low cost and easy handling. Besides there are increasing demand of using IoT and smart technology in the field of agriculture to tackle the challenges of fourth industrial revolution (4IR). Thus the overall objectives of the research is development of a smart storage system for small scale high value vegetable and spices growers. An automated (IoT based) seed storage (50,000 cm<sup>3</sup> and 100,000 cm<sup>3</sup>) was developed for storing high value vegetable and spice seeds at FMPE division, BARI, Gazipur during 2022-2023. The systems run by refrigerant cooling system. The control panel consist of an ESP 8266 microcontroller, DHT 22 temperature and humidity sensor, etc. The computer programming code to communicate between hardwares were written in Arduino IDE 1.8.16. A mobile App (Android) was developed to monitor and develop real time temperature and humidity. The sensor reading was saved and downloaded in the custom made software. The device was tested both load and no-load condition, found an energy consumption of 1.9 and 3.25 kWh, billing 11 and 18.2 Tk/day, respectively. The sensor value inside the cooling chamber was between 3 and 6°C, represents a better cooling performance by the device. A smart cooling storage has been developed throughout this study. The fabrication was done using locally available materials. It is expected that once this technology is adopted by the farmers, it will have substantial positive impacts on the agriculture and the socio-economics of the farmers. The fabrication process is still ongoing. Further development will continue in the next year.

#### **Development of cost-effective, intensified and sustainable recirculating aquaculture system (RAS) in Bangladesh**

M. A. Hoque, m. A. Hossain and a. M. Shahabuddin

Recirculating Aquaculture System (RAS), as a healthy and safe fish production system and can be

located virtually anywhere. In this method, fishes are grown at high density under controlled environmental conditions. The most of all Recirculating Aquaculture System (RAS) used in Bangladesh, have been imported from abroad. 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 materials. Three tanks were designed with three different models. The designed tanks were fabricated with different materials. Three types of fish tanks were designed and fabricated at FMP Engineering divisional workshop during 2022-23. The fish tank was designed with easily available materials. The capacity of the U-shaped, V-shaped and Food-graded fish tank were 3000, 3500 and 3000 liters, respectively. The major source of RAS energy consumption is the water pump or air blower which drives the circulation loop. The capacity of the drum filter was 70.66 liter per minute. A submersible water pump was installed to lift the water from the underground biomedica tank to the fish tanks. The discharge of the pump was 78 l/m which could be operate with solar electricity during day time and with grid electricity during night time. A solar and grid powered aerator was developed to inject air bubble through nano bubble tube in the fish tanks of the RAS. The experiment will be conducted in the next year. It is a KGF funded sub-project.

#### **Development of a fertilizer sensor using fluorescence technology and field mapping**

M. S. Miah, M. Z. Hasan and M. R. Karim

Fertilizer is important for crop production; it has various function in plant body. There are three forms of fertilizer application method namely inorganic, organic and mix (organic plus inorganic). Fluorescence is the emission of light by a substance that has absorbed light or other electromagnetic radiation. The purpose of this research is to monitor the fluorescence properties of soil, organic matter, and fertilizer in order to create a soil sensor for determining the soil's current fertility level and, ultimately, for prescribing fertilizer for a particular crop. At the FMPE division workshop, materials that were readily available in the area were used to create a portable image acquisition system. Halogen and UV light are the two types of lighting used in this system.

Two UV lights and four halogen lights are used as lighting sources. The system uses a Cannon Kiss 7i camera mounted with an 18-55 mm lens. Six circular filters were placed in front of the camera and the light source to cut down on reflections and glare. Without eliminating halation, it is challenging to obtain accurate data from the sample surface. 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 the following year in an effort to enhance the soil sensor and its field performance.

#### **Development of an automated squirrel repellent**

M. Z. Hossain, M. S. Miah, M. S. Alam and A. T. M. Hasanuzzaman

Squirrels are considered to be an agricultural pest because they destroy a significant quantities of fruits, grain seeds and vegetables. With the development of science and technology, we can now use sensors, deep learning techniques to develop animal repellents. A deep learning technique is being used to develop an automated squirrel repellent at FMPE Division, BARI, Gazipur in 2022-23. A YOLO V5 algorithm was used to run into raspberry pi 4 microcontroller. The physical structure of the repellent was fabricated by locally available materials such as MS angle bar, MS flat bar, MS sheet, wheel, GI pipe etc. The functional parts of the machine are stand wheeler, supporting pool, solar panel unit. This machine was set on wheeler stand (3 wheels) so that it can easily move from one place another. The system consisted of a camera and ultrasound speaker to detect squirrel presence and scare the squirrel respectively. The test result reveals a promising accuracy of 91.4% in squirrel detection. The device will be tested in the farmers' field in the next year.

#### **Improvement of BARI solar cabinet dryer**

T. N. Barna, N. Jahan, M. N. Amin and M. A. Hossain

There is strong positive effect of quality seed production on increased agricultural productivity. Seed is the vital factor of profitable crop cultivation. Proper drying and storage can reduce the demand gap to a notable succession. Keeping the above scenario in mind, the solar assisted cabinet dryer was designed and fabricated. So, a study to improve the performance of the dryer was undertaken this year. Farm Machinery and

Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Gazipur has developed a solar cabinet dryer to dry moist vegetable seeds under desirable temperature ( $<43^{\circ}\text{C}$ ) by 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 during 2022-23 year and for sensitive seeds, the germination percentage was not satisfactory. So, a critical investigation was done for the inner temperature and humidity condition of the cabinet dryer while in test run. A suitable management data was generated to allow the inner temperature to remain in a safe level. The management practices are done manually till this year. The laboratory test to access the best suited drying condition at any weather parameters is determined. It was seen that a panel temperature set at  $38^{\circ}\text{C}$  is the safest for both the solar drying as well as solely electric heater drying. The collector should be covered half way through while the solar irradiation is above  $750 \text{ W/m}^2$  to lower the dryer inlet airflow temperature. A précised embedded system based automatic system will be fabricated in 2023-24 for ease of management.

#### **Development of a fruit grader using machine learning technique**

M. Z. Hossain, M. S. Miah, M. A. Haque, S. Akter and M. N. Amin

Fruit produced in farm can be graded based on size, shape, color, texture, and defects or disease of fruit. In present scenario, grading of fruit is performed manually before export of fruits. This manual grading and sorting by visual inspection is needed extra man power and is also time consuming. Thus this research was taken to develop a fruit grader using machine learning technique. This experiment has two objectives: (a) to design and fabricate a sensor and machine learning technique based fruit grader, (b) to test and evaluate the performance of the grader. A sensor and machine learning technique based mango grader was designed at Farm Machinery and Postharvest Process Engineering (FMPE) Division of Bangladesh Agricultural Research Institute (BARI) in 2022-2023. The design was prepared using SolidWorks 2021. The overall dimension of the grader is  $350 \times 100 \times 100 \text{ cm}$ . There is three part of the grader: 1. Approach conveyer, 2. Processing chamber

(camera, sensor, etc) and exit chamber. The grades would be in terms of quality and weight. These weight grades are small ( $< 100 \text{ gm}$ ), medium ( $\geq 100$  to  $\leq 200 \text{ gm}$ ), medium large ( $\geq 200$  to  $\leq 300 \text{ gm}$ ) and large  $\geq 300 \text{ gm}$ . The average capacity of the grader is designed for 1 t/h. The fabrication and field experiment will continue to the next year for its better performance.

#### **Adaptive trial of BARI developed agricultural machinery for crop production in the coastal areas of Bangladesh**

M. S. Miah, M. N. Amin and P. C. Sarker

Farm mechanization part of Smallholder Agricultural Competitiveness Project (SACP) was implemented in three different coastal districts (Patuakhali, Barguna, and Noakhali) by Farm Machinery and Postharvest Process Engineering Division of BARI during 2022-23. BARI developed six types of agriculture machinery (BARI Seeder, BARI Bed Planter, BARI Weeder, BARI Axial Flow Pump, BARI Sunflower Thresher, BARI Compost Separator) were disseminated to farmers and local service providers through 8 adaptive trials with the help of OFRD, BARI. The machine was used for various agricultural operations like tilling, seeding, weeding, irrigation, threshing, etc. The machines used for planting, weeding, irrigation and threshing of 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. Under the SACP project, awareness was built up among 400 farmers on BARI developed machinery through demonstration as well as adaptive trials this year. Seven local service providers (LSPs) in the working areas were developed and totally 0.97 ha of area was covered under trials and 150 ha of area was covered by LSPs. This program will be continued next year to build up the skillness of the farmers/service providers/operators to disseminate the machinery, get feedback from farmers' fields and improve the machinery.



### **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 different districts by Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Gazipur during 2022-23. BARI developed eighteen types of different agriculture machinery were disseminated to farmers and local service providers were developed through adaptive trial and training with the help of OFRD, BARI and Department of Agricultural Extension (DAE). These trials have been conducted under the GoB funded FMDP (Farm machinery technology development for profitable crop production project). FMDP project aims to increase income and livelihood of smallholder farmers (2,50,000) in the 10 district of Bangladesh. The project locations were 21 different upazila under 11 districts of Bangladesh. The selected districts were Gazipur, Kishorganj, Jamalpur, Dinajpur, Rajshahi, Bogura, Patuakhali, Jashore, Sunamganj, Noakhali and Bandarban. The selected farm machinery was BARI Seeder, BARI Bed Planter, BARI Axial Flow Pump, BARI Dry Land Weeder, BARI Power Weeder, BARI Compost Separator, etc. based on cropping diversity and local farmers' demand. This year 400 batches of farmers training and 453 adaptive trials were done in the project areas. Under the FMDP project, awareness was built up among 18120 farmers on BARI developed machinery through demonstration as well as adaptive trials up to this year. Farmers opined that the machine reduced their drudgery and cost significantly and often obtained higher yields compared to hand sowing. About 8000 participants were trained by two days long training of farmer, machine operator and mechanic on BARI developed machinery. They are setting up the machine, operating, running, solving trouble shooting and other different work under close supervised of trained engineer and mechanic. One hundred twenty local service providers (LSPs) in the working areas were developed. Three manufacturer in house training were done in Kishoreganj and Jashore.

### **Adaptive trial of BARI orchard weeder cum mini tiller**

M. A. Hoque, M. S. Miah and M. N. Amin

Number of fruit orchard have been increasing in Bangladesh and farmers are searching suitable power weeder for tilling inter row space for weeding and cultivating vegetables and spices in this row space. A diesel engine operated power weeder was developed during 2021-2022 which was capable to use in the orchard. This research programme was undertaken to evaluate the orchard weeder cum mini tiller in orchard and crop field. An adaptive trial of BARI orchard weeder cum mini tiller was done in crop field (sunflower dibbling in wet soil) for weeding at Khulna, in poly tunnel for tilling at Jashore and in fruit garden for weeding Jamalpur during 2022-23. The effective field capacity of the weeder in Khulna was 0.06 ha/h, the field efficiency was 73.71% and the weeding index (WI) was 0.80. The effective field capacity and field efficiency of the weeder in Jashore as mini tiller was 0.07 ha/h and 77.84%, respectively. The effective field capacity and field efficiency of the weeder in Jamalpur was 0.06 ha/h and 70%, respectively. The orchard weeder cum mini tiller can be used in high density orchard since the width is less than the power tiller. The weeder can also use in interrow space of wide row crops and in kitchen yard. Thus, this orchard weeder cum mini tiller could recommended for the farmers.

### **Development and adoption of suitable technology for hygienic potato chips production**

M. A. Hoque, M. Hasan, T. N. Barna, M. M. Alam, M. G. F. Choudhury and M. A. Hossain

Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute has taken ample effort to successfully utilize the surplus yield of potato and other fruits-vegetables in valuable by products. The excess moisture in fresh produce causes spoilage and reduced the shelf-life of the product. A study was conducted during 2022-23 to improve and adopt BARI machinery for rural region to enhance healthy and quality dried food, to design and develop a low cost solar tunnel dryer for efficient and hygienic drying of dried food product. Adaptive trial of BARI power slicer and BARI solar tunnel dryer were done at Madhupur, Tangail during 2022-23. Another field day on use of solar tunnel dryer for safe food production was

conducted at Edilpur, Madhupur, Tangail on 24 May 2023 Capacity of the power slicer for potato slicing at Gazipur and Tangail were 120 and 117kg/h. Capacity of the power slicer for lengthwise banana slicing at Tangail was 150kg/h. The dryer took 6.5 hours to dry the potato sliced from moisture content 85%(wb) to final moisture content 5% (wb). The farmers of Tangail express their satisfaction. The price of the solar tunnel dryer is Tk. 15,000. The slicer could be recommended for slicing and then solar tunnel dryer could be used for drying after blanching in automatic blanching machine for producing hygienic dried food products like potato chips by the farmers.

### **Securing the food systems for climate and livelihood resilience through appropriate scale farm mechanization**

M. A. Hoque and M. N. Amin

The long area in the coastal region is cultivating with polder support. Salinity, drought, flash flood, etc. are the major problems in the region. Crop production in the region will be vulnerable under this condition. As a result, food security of the country will be at risk. Food security of Bangladesh could be achieved if this region could be intensified. The experiment was conducted with IRRI funded Asian-Mega delta project to evaluate and select suitable BARI developed machinery for crop production in the southern and northern areas of Bangladesh and to disseminate the selected farm machinery in the southern areas of Bangladesh. A dibler was developed for coastal polder region. Different machines were demonstrated in polder 34/2P during 2022-23. Two adaptive trials and two training on BARI developed machinery was done at Khulna. Area under the trials of BARI orchard weeder cum mini tiller and BARI seeder at Khulna, were 25 bigha and 2.5 bigha, respectively. A field experiment of sunflower planting was conducted at Polder 34/2P, Batiaghata, Khulna with five treatment T<sub>1</sub>= Dibbler tilled with seeder, T<sub>2</sub>= BARI Seeder, T<sub>3</sub>= Dibbling without tillage, T<sub>4</sub>=conventionally tilled with 2WT and manual planting, T<sub>5</sub>= Strip Tillage planting. Farmers express their happiness on the use of BARI mini tiller and BARI seeder. The sunflower yield planted with BARI seeder was the highest than the others planting methods. Thus, the experiment will be continued to evaluate those machinery and other

BARI machinery in the coastal polder regions of Khulna and Patuakhali.

### **RARS Jashore**

#### **Prediction of major crop production applying machine learning algorithm**

Rokon Uz Zaman and K U Ahammad

Machine learning techniques can help farmers and government organizations to agricultural planning and prediction and to make better decisions and policies, which lead to increased production. In this research, we concentrate on the use of a machine learning techniques named Radial Basis Function (RBF) and Multi-layer Perceptron (MLP) to gain information from agricultural data to forecast the production of significant crops annually. For this purpose, we used the data from Agricultural year book since 2008-2021 provided by Bangladesh Bureau of Statistics. At the beginning, the models were trained to correlate past environmental trends with crop production. Then the simulations are assembled with uncertain climate variables for calculation of their effectiveness and findings suggest that crop production for a specific area of land is cost effective for cultivation.

#### **Potato leaf disease detection using image processing**

Rokon Uz Zaman and K U Ahammad

This project aims to build a web application to predict the diseases of Potato plants that will help farmers to identify the diseases so that they can use appropriate fungicide to get more yields. The purpose of this project is to assist and provide efficient support to the monoculture farmers. In this project, we propose a system that will use the techniques of image process to both analyze and detect the plant diseases using machine learning Conventional Neural Networks (CNN) and Tensorflow. The results of the implementation show that the designed system could give a successful result by detecting and classifying the potato leaf diseases and focusing on two common diseases: Late blight caused by fungus *Phytophthora infestans* and early blight caused by the fungus *Alternaria solani*.

### **Adaptive trial of BARI developed farm machinery in Jashore region**

Rokonuz Zaman And K U Ahammad

The experiment was conducted during Rabi season 2022-23 at farmers field of Bagarpara and sadar, Jashore. The treatments were consisted: T<sub>1</sub>= crops sowing/planted by traditional method; T<sub>2</sub>= crops sowing/planted by mechanical method. The treatment T<sub>2</sub> gave more yield than T<sub>1</sub>. The results clearly revealed that mechanical seeding method was saved about 52.91% of time and increased 20-30% yield respectively than that of crops sowing/planted by traditional method. For Seeder, there was no need post sowing irrigation if seed was showing with in one week just after T. Aman harvest having enough residual soil moisture. While, post sowing irrigation maybe applied for ensure seed germination at maize cultivation by using Bed planter. Besides, bed planting seeding system supplies extra facilities for irrigation and drainage system for irrigated crops.

### **RARS Ishurdi, Pabna**

#### **Effects of irrigation scheduling and water use of dragon fruit production**

M M Rahman, M M Morshed, S K Biswas, M R Islam, M A Hossain and M M Uddin

Dragon fruit tree is a drought-tolerant plant that does not require frequent watering, but sufficient soil moisture is needed for good growth and yield productivity. Adequate optimum irrigation is known as an important part of precision agriculture now a days, where well-scheduled and well-dosed irrigation is essential, as by applying the right amount of water at the right time. Thus, a field study was conducted at Pulses Research Center and Regional Agricultural Research Station, Ishurdi, Pabna during 2021-22 to develop irrigation scheduling and water uses for dragon fruit farming in the semi-arid region of Bangladesh. Five different irrigation treatments consisting of no irrigation (T<sub>0</sub>), irrigation at 10 days intervals (T<sub>1</sub>), irrigation at 15 days intervals (T<sub>2</sub>), irrigation at 20 days intervals (T<sub>3</sub>) and irrigation at 25 days interval (T<sub>4</sub>) were introduced. The design of the experiment was the RCBD method having three replications. The unit of plot size was 1.25 m × 1 m with

maintaining 3.0 m x 3.0 m pillar-to-pillar distance. The land was fertilized according to the fertilizer recommendation guide 2018. The results show that all the parameters under plant and fruit characteristics varied significantly among the treatments. However, treatment T<sub>4</sub> produced the tallest plant (2.82 m) and the shortest plant was found in treatment T<sub>1</sub> (2.56 m). No. of fruits/pillar was observed maximum (12.0) in treatment T<sub>4</sub> followed by treatment T<sub>5</sub> (11.67) and minimum from T<sub>1</sub> (6.67). The longest fruit (10.04 cm) was obtained from treatment T<sub>4</sub>, closely followed by treatment T<sub>5</sub> (9.96 cm), and the most miniature fruit was produced by treatment T<sub>1</sub> (8.76 cm). The fruit diameter was highest in T<sub>4</sub> (8.27 cm) and lowest in T<sub>1</sub> (7.32 cm). The highest yield (25.7 t/ha) was obtained from the treatment T<sub>4</sub> which was followed by the treatment T<sub>4</sub> (23.53 t/ha) and on the other hand, the lowest yield was found in the treatment T<sub>1</sub> (17.07 t/ha). This experiment will be continued in the next year to evaluate more details.

#### **Seed sowing for breeder seed production by power tiller operated inclined seeder (PTOS)**

M M Rahman and M M Uddin

Seeding crops under minimum tillage can be achieved by using modern agricultural machinery. Planting pulses, wheat and other oilseed crops using the minimum tillage seeding machinery such as a power tiller operated seeder (PTOS) is an alternate way to ensure timely planting, alleviate labour shortage, enhance cropping intensity, and achieve profitable crop production. Thus, the field experiment was conducted at Pulses Research Center (PRC) and Regional Agricultural Research Station (RARS), BARI, Ishurdi, Pabna, during Kharif-I season of the year 2022-23. Power tiller operated inclined seeder (PTOS) was used for minimum tilling, line seeding, seed covering and land leveling for Mungbean and Sunflower cultivation, all in one operation simultaneously. The row-to-row distance was 30 and 60 cm following the continuous sowing of the seeds for Mungbean and sunflower, respectively. Furthermore, the area covered by the PTOS sowing was 12 acres, where this minimum tillage saved planting time and costs by 67% compared to the conventional method with regard to the fuel and laborer saved during the planting operation.



# IRRIGATION AND WATER MANAGEMENT

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## Cost and returns analysis of selected spices crops in Bangladesh

The study was undertaken to estimate the financial and economic returns and competitiveness of some selected spices crops in Bangladesh. A total of 450 spices growers were randomly selected for the study. The study revealed that the gross margins of producing selected spices crops were found positive. The highest benefit cost ratio was for ginger (2.87) followed by turmeric (2.65) and blackcumin (2.38). The estimates of DRC showed that Bangladesh had comparative advantage in ginger, turmeric and blackcumin production for import substitution. Low market price and market syndicate, infestation of insect and diseases infection and labour crisis were the major constraints for spices production. Government should take initiatives for reasonable price, insect-pest resistance varieties should be developed and mechanization should be introduced.

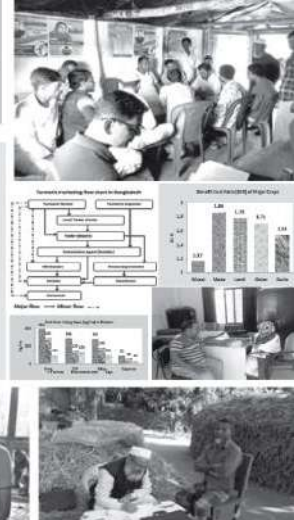
## Financial profitability and ex-post economic impact assessment of investment of BARI mango-4 in Bangladesh

This study has been undertaken to conduct the financial profitability and economic impact of BARI Mango-4 to the society, the most popular mega variety of BARI. This is a two years study. Data were collected from BARI Mango-4 farmers of Chapainawabganj and Rajshahi districts this year. Sample size of the respondent farmers selected randomly was 60, 34 from Chapainawabganj district and 26 from Rajshahi district. Owing to time constraints, analysis was done only for Chapainawabganj district. As many as 32 types of mango varieties were cultivated by the responded farmers in Chapainawabganj district. Per hectare average number of BARI Mango-4 trees of the respondent farmers was found 519.

Average yield was found 16113 kg/ha from which farmers got return of Tk. 1,029,743 and the average price of BARI Mango-4 stood Tk. 63.91 per kg. Total variable cost and total cost were calculated Tk. 219,312 and Tk. 353,516. Gross margin and net return were estimated Tk. 810,431 and 676,227 with BCR 4.7 and 2.91 respectively. Respondent farmers cultivated BARI Mango-4 in place of 6 crops, namely rice, turmeric, guti Aam, aati Aam, fozly Aam, guava. They also grew BARI Mango-4 in fallow land (21% respondent farmers). Most replaced crop is rice (56% farmers). Among these six crops, guti AAM was the best alternative of BARI Mango-4 giving highest net return of Tk. 391,832 followed by Guava (net return Tk. 149,697), fozly Aam (net return Tk. 148,200), rice (net return Tk. 97,083). Farmers received an additional net benefit of Tk. 579,144 for cultivating BARI Mango-4 over rice and received an additional net benefit of Tk. 284,395 for cultivating BARI Mango-4 over Gutu Aam. Because of being late variety and sweetness the price of BARI Mango-4 was higher than that of many varieties, which would encourage the farmers to grow more BARI Mango-4 in future despite having some difficulties of cultivation such as disease prone than other varieties, stolen problem, inclination of tree towards soil etc.

## Adoption status of BARI developed tuber crops varieties at farm level in Bangladesh

The study was conducted to identify the adoption of improved potato and sweet potato varieties in major growing areas namely Dinajpur, Naogaon, Rajshahi, Munshigonj, Thakurgoan, Gainbandha, Jamalpur, Barishal, Noakhali, Cumilla, Tangail, Bhola, Kishoregonj and Bagura districts. Data were collected through expert elicitation panels by using questionnaire. Descriptive statistics were used for



data analysis. The results indicated that the highest 88% of the area covered by improved varieties and 12% area covered by local varieties. Most of the farmers were cultivating improved varieties of potato due to the higher yield and export potentiality. About 61% of the sweet potato area was covered by improved varieties and 39% by local varieties. Most of the farmers opined that improved varieties of sweet potato were cultivated because the yield was very high and good taste. In order to increase the linkage between research and extension, non-governmental organizations (BRAC, Supreme, ACI, etc.), agricultural universities and NARS institute might use the study's empirical feedback. If it is possible to give the improved vine of sweet potato to the respondent in due time, the respondent will cultivate more amount of improved sweet potato.

#### **Determinants of crop diversification for sustainable livelihood in haor areas of Kishoreganj district, Bangladesh**

The haor areas of Bangladesh have traditionally been dominated by boro rice production, which is frequently destroyed by extreme climate event such as early flash flood, drought, hailstorm and embankment breakdown. However, crop diversification has a great potential to reduce crop loss from natural disasters. The research was conducted in three haor Upazillas of the Kishoreganj district to investigate the extent, determinants, and limitation of crop diversification in haor areas. The data were collected from 240 sample respondents by applying proportionate random sampling technique. Simpson's diversity index, censored Tobit and Poisson regression were used to calculate crop diversification index and determinants of crop diversification in the haor areas. It was revealed from the study that farmers diversified the range of potential food crops such mustard, green chilli, maize, bitter gourd, jute, potato, snake gourd, pumpkin, black gram, cucumber, and groundnut along with rice dominated farming system in the study areas. The mean crop diversification index was 0.20 which indicates crop diversification in haor areas is poor. The Tobit model results revealed that the intensity of crop diversification were positively and significantly influenced by education, farm size, agricultural marketing training, societal

membership, agricultural credit facilities, flood protection training, agro-ecological settings and medium and high land typology whereas extension linkage and no of dam breached in the last 10 years negatively and significantly influenced the crop diversification. Poisson regression results revealed that own irrigation facilities and medium and high land typology positive and significantly influenced. On the other hand, a month of waterlogged and no of dam breached negatively and significantly influences the counts of crop diversification. The study also identified some constraints crop diversification, such as labor crisis during harvesting, hill pitch and flash floods, dam breaches, reluctance to adopt new technology, waterlogging and inundation, high labor costs, unsuitable land for crop diversification, and a lack of irrigation facilities, which require policy recommendations.

#### **Adoption status of BARI developed onion varieties at farm level in Bangladesh**

The study assessed the adoption of BARI released onion varieties analyzing 560 household's data collected from BARI onion variety adopters and non-adopters spread in the seven onion growing districts namely Faridpur, Magura, Pabna, Rajshahi, Jhenaidah, Bogura and Kurigram districts. Along with descriptive statistics, the study used probit model for analyzing the data. Approximately 48% farmers cultivated BARI onion variety (BARI piaz-1, BARI piaz-3 and BARI piaz-4). 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 benefit-cost ratio of BARI Piaz-4 was highest 2.32 followed by BARI Piaz-3 (2.18), lalteer king (2.01), red king (2.01), super king (1.88), BARI Piaz-1 (1.86), local (1.57). 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. Total post-harvest loss at farm level was estimated about 21.08% where, highest 16.58% loss was occurred during storage. If the farmers followed only scientific method of storage post-harvest loss can be reduced and supply of onion will be increased to meet the domestic demand.

### **Effect of covid-19 pandemic on agricultural production, income and nutrition of farm households in selected areas of Bangladesh**

The study was conducted in the Comilla, Rajshahi, and Jashore districts of Bangladesh to assess the effect of COVID-19 pandemic on agricultural production, income-generating activities and the nutritional status of farm households. A combination of purposive and random sampling techniques was followed. The total sample size was 240 out of which 80 from each district. Household Dietary Diversity Score (HDDS), Crop Diversity Score (CDS) and Probit model was used. Majority of the farmers informed that COVID-19 affected their income generating activities to a greater extent. Both HDDS and CDS were low during COVID-19 period as compared to the normal period which indicates that the pandemic affected agricultural production and nutrition of farm households. Lower market price, unable to sell crop due to travel restrictions and business loss/business closer were the main factors which affected agricultural production and income of the farmers. The government needs to implement structural changes in social security schemes considering members' needs to aid in stabilizing incomes, access to food, and livelihood recovery after a pandemic like COVID-19.

### **Assessment of safe vegetable cultivation in some selected areas of Jashore region**

The study was designed to assess the present status and methods of safe vegetable production at farm level in selected areas of Jashore region during January-May, 2023. Average farm size was 0.79 ha. Farmer doing different agronomic management such as weeding, irrigation, spraying, de topping, staking, earthing up etc. Farmer used different methods for insect pest control combinely at a time. About sixty four percent farmer sprayed synthetic pesticide and rest of the farmer used bio control method such as bio-pesticide, sex pheromone trap, yellow trap and hand picking for control insect pest in their fields. About fifty eight percent farmer used bio-fertilizer and seventy eight percent farmer was chemical fertilizer for vegetable cultivation. Total production cost of country bean was Tk.3,36,579 ha-1, cucumber was Tk.3,25,915 ha-1 and pointed gourd was Tk.4,40,106 ha-1. Among the cost item labor cost was highest. Average yield of country

bean was 30.60 tonha-1, cucumber was 30.08 tonha-1 and pointed gourd was 41.60 tonha-1. Highest benefit cost ratio was cucumber (2.13) followed by pointed gourd (2.07) and country bean (1.50). Farmer awareness and havoc attack of pest and insect were the main problem for safe vegetable cultivation.

### **Adoption status and profitability analysis of BARI aam-3 and BARI aam-4 cultivation in Rajshahi region**

The study was conducted in three mango growing districts namely Naogaon, Natore, and Chapainawabganj during 2023 to assess the adoption status of BARI Aam-3 and -4 varieties, its farm level profitability, and constraints to cultivation at the farm level. A total of 60 farmers taking 20 from each district were randomly selected for interviews. The study revealed that BARI Aam-3 is highly adopted in Naogaon district which is covered 61% of the total mango production in that area. Besides 32% of the mango orchards are occupied by BARI Aam-3 variety in Natore district. Whereas, BARI Aam-4 is highly adopted in Naogaon district which shared 7.5% of the total mango production in that area. The highest yield of BARI Aam-3 was found at 12.56tonha-1 from a more than 8 years old orchard. Gross return and net return was Tk. 7,26,474 ha-1 and Tk. 5,58,474ha-1, respectively from 8 years above old mango orchard. Regular bearings, higher yield, higher profit, sweetness, and less insect-pest infestation were the prime reasons for choosing BARI Aam-3 and BARI Aam-4 at the farmers' level. Farmers opined very low bearing after 15 years, scarcity of quality saplings, unattractive color, and short shelf life were the major constraints to BARI Aam-3 cultivation. Market controlled by a business syndicate, lack of credit facilities, lack of knowledge about modern cultivation, and lack of storage facilities were common problems opined by the sample farmers.

### **Adoption status of BARI developed pulses varieties at farm level in Bangladesh**

The study assessed the adoption of BARI released pulses varieties in major growing areas namely Chuadanga, Faridpur, Kushtia, Jamalpur, Mymensingh, Manikganj and Rajshahi, Bhola, Gopalganj and Naokhali. Both descriptive and



inferential statistics were used. About 33% of area covered by improved chickpea varieties and 67% by local varieties. Among improved varieties, BARI Chola-5 was mostly popular variety in Rajshahi (68%), it also cultivated in Chuadanga (4%), Faridpur (8%) and Kushtia (13%) as well. Approximately 59% of the area covered by improved varieties and 41% by local varieties. BARI black gram occupied by 51% of the total area, with only 49% occupied by other varieties. The present study also provides some problems such as unavailability of improved seed, owing to a lack of knowledge quality seed. About 63% of the area covered by improved varieties and 37% by local varieties. BARI khesari occupied by 56% of the total area, with only 44% occupied by other varieties. . If it is possible to give the improved seed of pulses to the respondent in due time, the respondent will cultivate more amount of improved variety. In order to increase the link between research and farmers' extension, non-governmental organizations (Brac, Supreme, ACI etc), agricultural universities and NARS institute (BARI, BINA) might use the study's empirical feedback.

#### **Adoption status of BARI developed selected vegetable varieties at farm level in Bangladesh**

The study assessed the adoption and identified the causes of the adoption of BARI-released vegetable varieties in major growing areas in Bangladesh. Among the vegetables brinjal, country bean, bottle gourd and tomato were taken for the study. Descriptive statistics were used. The study found that the rate of adoption of tomato, brinjal, bottle gourd and country bean, in the study area was 39%, 27%, 22% and 16%, respectively. The major causes of cultivating improved varieties of vegetables were high yielding, more profitable, less disease infections and pest infestation, high market demand, attractive shape and color etc. This study also revealed that BARI-developed vegetable varieties were not significant due to some limitations. Unavailability of seeds and low media campaign and knowledge gap of the farmers were reasons for low adoption status for BARI-developed varieties. The rate of adoption of BARI vegetable varieties in the areas may be accelerated by enhancing training on BARI vegetable production technology, ensuring the supply of

BARI vegetable seed, and conducting media campaigns on the variety.

#### **Adoption status of BARI developed oilseed varieties at farm level in Bangladesh**

The study assessed the adoption of BARI released oilseed varieties in major growing areas. Both descriptive and tabular analysis was used. About 90% of area covered by improved mustard varieties where 76% of total area occupied by BARI mustard variety (54% area cover by BARI mustrad-14) and only 14% occupied by others. Regarding to 88% of area covered by improved soybean varieties where 80% of total area occupied by BARI soybean varieties (41% area cover by BARI soybean-5) and only 8% occupied by others. Revealing 79% of the area covered by improved varieties where BARI Chinabadam occupied by 75% of the total area, with only 4% occupied by other varieties. The present study also highlights some problems, such as the lack of improved seed due to a lack of knowledge about quality seed, increased disease infection and insect infestation, the existence of some new varieties that the respondents were unfamiliar with and some varieties with a long lifespan that hindered the cultivation of the oilseed variety for the subsequent growing season. Improved oilseeds should be delivered directly in time to the respondent for increased cultivation. Government should increase BARI seed supply, strengthen linkages, cooperate with BADC and DAE; collaborate with non-governmental organizations, agricultural universities and NARS institute (BARI, BINA) in order to improve the link between research and farmers' extension.

#### **Adoption status of BARI developed fruits varieties at farm level in Bangladesh**

The study assessed the adoption of BARI-released fruit varieties in major fruit growing areas of Bangladesh. Five fruits were considered, namely mango, litchi, banana, guava and dragon fruit. Both descriptive and tabular analyses were used. The finding was that about 51% of the area is covered by improved mango varieties, of which 50% of the total area was occupied by BARI mango varieties (31% of the area was covered by BARI Aam-3). Considering that improved litchi varieties occupied roughly 64.5% of the whole area, BARI litchi varieties only occupy 4.5% of the total area (2.5%

of the area that was occupied by BARI litchu-3). Regarding bananas, 48% of the area was occupied by improved banana varieties, of which 47% were BARI banana varieties (22% of the area was occupied by BARI-Kola-1). About 71% of the land was occupied by improved guava varieties, with BARI guava varieties occupying roughly 30% of the total area (23% of the area being covered by BARI Payera-2). In the case of dragons, 100% of the area was occupied by improved dragon varieties, of which 48% was taken up by BARI Dragonfal-1, the sole dragon variety produced by BARI. The causes of cultivating improved varieties of fruits were high yielding, more profitable, high market demand, sweetness, taste, availability of saplings, less disease infection and insect infestation, low fiber, attractive shape and color, year-round production, late variety, export potential, etc. There are still ample opportunities for spreading BARI varieties among fruit farmers. By boosting training in BARI mango production technologies, ensuring the availability of BARI mango saplings, and running media campaigns on the varieties, the rate of adoption of BARI mango varieties in the areas may be accelerated. Fruit cultivation is encouraged by the government of Bangladesh, which raises output, profitability, and export potential while improving quality of life and stimulating economic growth.

## **RARS Jashore**

### **Assessment of safe vegetable cultivation in some selected areas of Jashore region**

P Hajong and K U Ahammad

The study was designed to assess the present status and methods of safe vegetable production at farm level in selected areas of Jashore region. About 64% farmer sprayed synthetic pesticide and other farmer used bio-pesticide, sex pheromone trap, yellow trap and hand picking for control insect pest in their fields. About 58% farmers used bio-fertilizer and 78% farmers was chemical fertilizer for vegetable cultivation. Total production cost of country bean was Tk. 3,36,579 ha<sup>-1</sup>, cucumber was Tk. 3,25,915 ha<sup>-1</sup> and pointed gourd was Tk. 4,40,106 ha<sup>-1</sup>. Average yield of country bean was

30.60 t ha<sup>-1</sup>, cucumber was 30.08 t ha<sup>-1</sup> and pointed gourd was 41.60 t ha<sup>-1</sup>. Farmer awareness and havoc attack of pest and insect were the main problem for safe vegetable cultivation. Though farmer practices some organic methods of vegetable cultivation but fully did not follow safe vegetable cultivation. Farmer spray pesticide along with IPM practices. Farmer required motivating for safe vegetable cultivation.

## **RARS Ishurdi, Pabna**

### **Adoption status of BARI Aam-3 and BARI Aam-4 in Rajshahi region**

M. I. Kaysar, M. S. Rahman & M. M. Uddin

A study was conducted in three mango growing districts namely Naogaon, Natore and Chapainawabganj during 2023. An attempt was made to assess the adoption status of BARI Aam-3 and BARI Aam-4 variety, its farm level profitability and constraints of cultivation at farmers level. A total of 20 farmers were randomly selected for this study in each district. The study revealed that BARI Aam-3 is highly adopted in Naogaon district which is covered 61% of the total mango production in that area. Beside this 32% of the mango orchards are occupied by BARI Aam-3 variety in Natore. In case of BARI Aam-4, highly adopted in Naogaon district which occupied 7.5% of the total mango production in that area? Highest yield of BARI Aam-3 was found 12560 kg ha<sup>-1</sup> from more than 8 years old orchard. Gross return and net return was Tk. 726474 ha<sup>-1</sup> and Tk. 558474 ha<sup>-1</sup>, respectively from 8 years above old mango orchard. Regular bearings, higher yield, profitability, sweetness, and less insect-pest infestations were the prime reasons for choosing BARI Aam-3 and BARI Aam-4 at farmers level. Farmers opined very low bearing after 15 years, scarcity of quality saplings, unattractive color, and short shelf life were the major constraints to BARI Aam-3 cultivation. market controlled by a business syndicate, no credit facilities of mango cultivation, lack of knowledge about modern cultivation, lack of storage facilities were common problem found to cultivation of mango.

# PLANT GENETIC RESOURCES

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## Exploration and collection of PGR diversity

M M Ali, R Afroz, N Pervin, S Rahman, M G Hossain, I Ahmed, N Jahan, M F Khatun, Q M Ahmed and N Jahan

Multi-crop exploration and collection program of different crop was undertaken in 28 upazilas of 11 districts in Bangladesh and some materials were collected from 3 foreign countries during 2022-2023. Five hundred and eleven (511) germplasm of 40 crops were collected from Bogura, Bhola, Chattogram, Chuadanga, Gazipur, Jashore, Khagrachari, Narsingdi, Noakhali, Pabna, Rangamati as well as three foreign countries such as Australia, Thailand, and Malaysia. The germplasm were cereal, pulses, oilseeds, vegetables, spices, fruits, and other crops. The sample information was collected according to the passport data sheet and locations were recorded during germplasm collection. The samples were registered in the germplasm collection register of PGRC and conserved in active collection following appropriate procedures.

## Characterization of pumpkin germplasm

R Afroz, M G Hossain, N Jahan and M M Ali

Ninety-four germplasm of pumpkin (*Cucurbita moschata*) were studied at the Plant Genetic Resources Centre of BARI, Gazipur during winter season 2022-23 to identify the variations in pumpkin germplasm. Among the qualitative character the maximum variation was found on fruit shape and immature fruit skin colour. Globular 60.64%, flattened 19.15%, oblong blocky 11.70%, elliptical 7.45% and pyriform 1.06% fruit shape with light green 1.06%, green 11.70%, dark green 39.36%, mosaic 46.81% and cream 1.06% immature fruit skin colour were observed among the 94 germplasm. Among the germplasm the range TSS (Brix) 3-8% was recorded. The maximum coefficient of variation was obtained for number of

fruits per plant 66.99% followed by fruit weight in kg 35.31% and days to germination 28.90%. The promising germplasm was selected based on sweetness of fruit on brix % like SNQ-47 (8% TSS) and SNQ-59 (8% TSS). The species *Cucurbita moschata* and *Cucurbita maxima* were identified among the 94 germplasm.

## Characterization of amaranth germplasm

Q M Ahmed, N Jahan, R Afroz, S Rahman, N Jahan and M M Ali

Sixty-three germplasm of amaranth was studied in augmented block design at PGRC, BARI, Gazipur during winter 2022-23. Qualitative variation was found in different parameters as early plant vigor, growth habit, compactness, shape, and spininess of inflorescence. Six types of leaf, five types of inflorescence, and four types of stem color variations were observed. The range of plant height is 73.6 cm (SNQR-47) to 213.6 cm (NQ-18). The maximum CV was found in fresh weight per plant (FWP). The highest FWP was recorded in 290g (AH-13) followed by IAH-114 (283g). Germplasm was grouped into three clusters and contained members 9, 27, and 27 respectively.

## Characterization of brinjal germplasm

S Rahman, N Pervin and M M Ali

The experiment was conducted with 64 germplasm of brinjal (*Solanum melongena*) in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI during winter 2022-23 to find out the variability in the germplasm. The maximum variation observed in overall leaf prickles, fruit calyx prickles, fruit colour and fruit flesh density. The highest variation was observed in 100 seed weight (CV-69.02%) of quantitative character. Based on yield parameters the germplasm MRI-107 (808.33 g), SU-196 (810.00 g), SU-198 (825.17 g)



and SU-232 (907.75 g) might be considered as the best yielder.

### Characterization of coriander germplasm

N Pervin

Eighty-five coriander (*Coriandrum sativum* L.) germplasm were studied at the Plant Genetic Resources Centre of BARI, Gazipur during rabi season of 2022-23 to identify the genetic diversity among the germplasm. Variations were observed in different qualitative and quantitative characters. Most of the germplasm (91.76%) showed green leaf colour. Leaf margin colour were exhibited as dark green (82.35%) and reddish tinge (17.65%). Small (14.12%), medium (47.06%) and large (38.82%) leaf size were observed. Petiole colour such as light green (20%), green (76.47%) and reddish tinge (23.53%) were exhibited. Petiole length was identified as short (7.06%), medium (37.65%) and long (55.29%). Green (24.71%), green with streaks (51.76%) and red (23.53%) stem colour were observed. Most of the germplasm (95.29%) showed light pink inflorescence colour. Foliation of the plant like very many leaves (44.71%), middle (44.71%) and very few leaves (10.59%) were occurred. The maximum germplasm (94.12%) showed brown seed colour. The germplasm NRI-197 (6.30 g) and KMR-70 (6.33 g) showed the high yielding for green leaf yield per plant. RAI-226 (6.90 g), NQR-28 (7.27 g), RNF-122 (7.29 g) and MRI-65 (7.33 g) exhibited high yielding for seed yield per plant. The maximum coefficient of variation (45.06%) was estimated in green leaf yield per plant followed by seed yield per plant (38.31%).

### Characterization of hyacinth bean germplasm

Q M Ahmed, I Ahmed, M F Khatun, and M M Ali

The experiment was conducted on hyacinth bean at PGRC of BARI, Gazipur, during October 2022 to May 2023 to study the variability in the germplasm. The germplasm was grown in augmented RCBD design including 54 germplasm with three check varieties. 15 qualitative and 14 quantitative traits were characterized. Variations were found in qualitative traits. The highest differentiation was observed in flower bud, pod, and dry seed colors. The maximum number of pods per plant was recorded in 1792.33 (TT-28) whereas the minimum was 48.67 (SRS-01). The highest edible pod weight was found in SS-154 (141.67 g) followed by SS-92

and RNF-89. Hundreds of dry seed weight were obtained from 73.58 g (RNF-37) to 23.92 g (AMA-338). The highest yield per plant was recorded in TT-28 (138.32 kg) followed by RNF-30 (79.89 kg) and SS-92 (73.86 kg). The maximum CV was found in pods/rachis (22.54%).

### Characterization of Indian spinach germplasm

Q M Ahmed, R Afoz, M F Khatun and M M Ali

The study was conducted in the field at PGRC of BARI, Gazipur, during the Kharif season 2022-23. Forty-nine germplasm of Indian spinach where 8 qualitative and 7 quantitative data were recorded. The variations were found in leaf, leaf vein, petiole, and stem colors. Plant growth habit was observed in three types such as twining (2.04%), procumbent (85.71%), and bushy (12.24%). The stem color showed light red (28.57%), dark red (2.04%), green (65.31%), and greenish red (4.08%). Leaf length ranged from 14.33 cm to 25.33 cm and leaf width ranged from 12.16 cm to 24.33 cm. The maximum number of leaves per meter vine was recorded in 23. Leaf weight per meter vine ranged from 37 g to 286 g and stalk weight from 2.33 g to 5.66 g. The highest yield per meter vine was 268 g. The highest coefficient of variation 63.62% was found in leaves weight per meter vine. The experiment still exists in the field.

### Characterization of muskmelon germplasm

N Jahan, M R Molla, N Pervin and M M Ali.

Thirty-five (35) muskmelon (*Cucumis melo*) germplasm were studied at the Plant Genetic Resources Centre of BARI, Gazipur during January-May 2023 to characterize the germplasm and to identify the variations among the germplasm. Twenty-nine (29) agro morphological characters were recorded, twenty-three (23) were visually assessed and six (6) were measured. Variation was found on different qualitative and quantitative characters. In case of qualitative characters, maximum variation was found in fruit shape and secondary fruit skin colour. Maximum coefficient of variation 109.57 % was estimated in fruit weight followed by flesh thickness for quantitative characters. Considering fruit characters, germplasm IAH-124, SR-97, NRI-39, IAH-244, SSR-46 were selected for future breeding program

**Characterization of snake gourd germplasm**

M G Hossain, N Jahan, I Ahmed and M M. Ali

Characterization of collected germplasm helps to estimate diversity among the germplasm. Thirty-four germplasm of Snake gourd (*Trichosanthes anguina* L) were characterized at PGRC research field, BARI, Gazipur during kharif 2022-23 season following augmented RCB experimental design to identify the important traits. Variation both for qualitative and quantitative characters were observed in most of the characters where, flower color, sex type, leaf pattern, leaf margin, tendril and stem shape have no variation. Variations in stem pubescence was observed. Different leaf size viz. small for 15 germplasm (44.12%), medium for 13 germplasm (38.23%), and large for 6 germplasm (17.65%) were recorded. Dissimilarity in leaf shape viz. ovate, cordate and lobed palmate were identified. Huge variations were observed in days to 50% flowering, days to 1<sup>st</sup> fruit harvest, number of primary branches, Petiole length and node number on which first female flower appears among the tested germplasm. The germplasm MRI-145 and MRI-150 were the earliest (47 days) and MRI-136 and MRI-137 were the late yielding germplasm regarding days to 1<sup>st</sup> fruit harvest.

**Characterization of ash gourd germplasm**

M F Khatun, N Jahan, Q M Ahmed and M M Ali

The experiment was conducted with sixty-one germplasm of ash gourd to assess the desirable morphological variations and identify salient features of different traits following the non-replicated augmented design. Germplasm was varied for different qualitative and quantitative characters. Qualitative variation was observed in early plant vigor, plant growth habit, leaf size, leaf pubescence density, leaf pubescence nature, fruit shape, fruit skin color, fruit pubescence density, stem end fruit shape, and blossom end fruit shape. The highest co-efficient of variation was found in no. of fruit per plant (45.34%) which was followed by the nodal position of 1<sup>st</sup> male flower (34.24%) while the minimum co-efficient of variation was found in days to 1<sup>st</sup> female flower (13%) which was followed by fruit breadth (14.18%) and petiole length (14.82%).

**DNA fingerprinting of sonamugh germplasm in Bangladesh**

M R Molla, I Ahmed and M M Ali

Characterization of sonamung 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 twenty-one previously developed mungbean microsatellite markers for the identification and discrimination of 43 local sonamung cultivars. Nineteen microsatellite markers were found to be polymorphic. Variation was found in number of alleles, allele frequency, observed and expected heterozygosity. Using nineteen primers across 43 genotypes a total of 42 alleles with an average number of 2.143 alleles per locus were found of which MB-23 showed highest number of alleles (4) and allele size profiling ranging from 126 bp to 378 bp. The narrow genetic base could be one of the reasons for the low yield of polymorphic markers in the study. The primer MB-23 motif [(AG)<sup>34</sup>(GA)<sup>14</sup>] also yielded highest number of PIC value (0.786). Genetic differentiation (*F<sub>st</sub>*) values were an average 0.871 and gene flow (*N<sub>m</sub>*) with an average of 0.037. Our data indicated that a narrow genetic base among the mung bean accessions in this study. Over all Nei's genetic distance value (*D*) from 0.05 to 1.03 among 903 accessions pair resulting as a means of permutation combination of 43 sonamung genotypes. The UPGMA dendrogram based on Nei's genetic distance separated the genotypes.

**DNA fingerprinting of popular rapeseed-mustard varieties of Bangladesh**

M R Molla, I Ahmed and M M Ali

*Brassica* mustard species is the most important oilseed crops in Bangladesh. A better understanding on their molecular diversity essential for the identifying the genotypes released from different organizations. In this study 27 released varieties of different organizations were characterized with the help of SSR markers to reveal the genetic diversity among genotypes of oilseed *Brassica* species. These species include *Brassica campestris*, *B. juncea* and *B. napus*. All 28 microsatellite markers were found to be polymorphic and they produced 77 alleles with an average 2.63 allele per locus. Variation of allele sizes ranged from 83 to 450 bp for the primer BR-16 and BR-03, respectively. The locus BR-16 had

the smallest (83-110 bp) and BR-03 had the largest fragments (315-450 bp). Average observed heterozygosity of SSR markers was 0.205, ranging between 0.000 and 0.556. PIC values ranged from 0.358 (BR-32) to 0.830 (BR-16 and BR-31) with an average 0.563. Genetic differentiation ( $F_{st}$ ) values were found in the ranges 0.438 to 1.000 with an average of 0.808 and gene flow ( $N_m$ ) values ranged from 0.000 to 0.321 with an average of 0.078. Higher level of genetic differentiation and low level of gene flow values are indicative of diverse genotypes used in this study. Over all Nei's genetic distance and Similarity coefficient values from 0.034 to 1.00 among 351 pair resulting as a means of permutation combination of 27 mustard genotypes. In the UPGMA dendrogram, the total genotypes were distributed into two main clusters (I and II). Cluster I mainly comprised of the *B. napus* genotypes, while most *B. rapa* and *B. juncea* genotypes grouped in Cluster II.

#### Conservation of germplasm in active and base collection

S Rahman, N Jahan and M 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, medicinal plants, cash crops and other crops etc., since 1987. The accessions were conserved in medium-term storage (at 4 to 6°C) and long-term storage (at -18°C to -22°C). Viability (germination %), quantity and moisture were checked before conservation. Accessions having less than 80% viability and/or less quantity of seeds were regenerated. Generally, the seeds were dried at 6-8% moisture content before storing. Till now, the centre has conserved 12873 (twelve thousand eight hundred seventy-three) accessions of 152 different crops in its genebank. In seed genebank 1792 accessions were cereals, 3720 pulses, 822 oilseeds, 523 spices, 5341 vegetables, 283 fruits, 54 cash crops and 8 other crops. In field genebank 31 accessions were spices, 165 vegetables, 124 fruits, 9 medicinal plants and 1 cash crops. In 2022-23, a total of 379 germplasm was assigned as new accession and were conserved in seed genebank of PGRC.

#### Monitoring of germplasm in active and base collection

S Rahman, N Jahan and M M Ali

The monitoring of 1682 accessions from different year (batch references) among 20 important crops

viz. cow pea (84), faba bean (13), vetch (6), sweet gourd (889), chili (588), pearl millet (4), lia shak (35), sword bean (19), triticale (8), chinese cabbage (7), winged bean (5), cauliflower (5), cabbage (3), china shak (4) oat (2), teff (2), finger millet (2), butter fly pea (2), halim shak (2) and velvet bean (2) were tested in 2022-23 by germination test. Among the monitored germplasm 923 accession from active collection and 759 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, N. Jahan, and M M Ali

Germplasm distribution is one of the important activities of Plant Genetic Resources Centre (PGRC). The centre distributed 1044 accessions of 26 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, biotic and abiotic stress, salt and draught tolerant, and molecular diversity analysis during 2022-23. Among the germplasm, 107 accessions were cereals (buck wheat, maize, sorghum, and barley), 150 oil seeds (linseed, soybean and mustard), 453 pulses (grass pea, black gram, field pea and mung bean), 5 spices (black cumin), 319 vegetables (ridge gourd, brinjal, tomato, sweet gourd, french bean, faba bean, country bean, cucumber, ash gourd, rice bean, snake gourd, brinjal and bitter gourd) and 10 fruits (muskmelon). Ten to hundred seeds or 5-10 g per accession were distributed to the ultimate users.

#### Regeneration of conserved accession of mustard

R Afroz and N Jahan

The experiment was conducted with 253 accessions of mustard at PGRC, BARI, Gazipur during the winter season 2022-23. Among the 253 germplasm *Brassica rapa* 107, *Brassica juncea*, 64 *Brassica*



*napus* 75 and *Brassica juncea* var. *rugosa* 7 were identified. Overall diversity was observed within the collection and seed quantity and seed viability has been increased. Finally, the seeds were preserved in genebank for future utilization.

#### **Regeneration of conserved accession of jute and sunhemp**

N Pervin

The experiment was conducted at the experimental field of Plant Genetic Resources Centre, BARI, Gazipur, during kharif 2022-23 to regenerate the conserved accession of jute (5) and sunhemp (1). All the germplasm were sown on 06 April, 2023 with recommended practices to get adequate quantity of seed for future use. Now the plants are in vegetative stage except BD-9963 and the experiment is going on. Some qualitative data were recorded up to vegetative stage.

#### **Regeneration of conserved accession of horse gram**

M G Hossain, N Jahan, I Ahmed, N Pervin and M M Ali

The experiment was conducted at the research field of Plant Genetic Resources Centre, BARI, Gazipur during rabi season of 2022-23 to regenerate the 23 conserved horse gram germplasm. Some of the qualitative and quantitative characters were recorded for using as reference data. In general, all the accessions were bushy and twining with greenish yellow flowers having green immature pods with straw colored pedicels. However, variations were also observed among the germplasm in both qualitative and quantitative traits. Adequate amount of seeds was harvested. After completing all the post-harvest operations such as; drying, cleaning, curing etc. the seeds were conserved properly for future use.

#### **Regeneration of conserved accession of cucumber**

I Ahmed

The regeneration of nineteen cucumber (*Cucumis sativus* L.) germplasm was conducted in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI, Gazipur, during February, 2023 to June, 2023. Variation was found among the characters viz, stem end fruit shape, fruit shape, fruit colour at table maturity stage and fruit colour at harvesting stage. There were some

quantitative characters also recorded and also observed differences in days to male and female flowering, fruit length, fruit width and fruit weight among the cucumber germplasm. Collected seeds from field was properly dried and conserved in the gene bank for future use.

#### **Regeneration of conserved accession of barley**

N Jahan, N Jahan and S Rahman

The regeneration of thirty-two (32) barley (*Hordeum vulgare*) germplasm was conducted in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI, Gazipur, during November' 22 to April' 23. 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 23.15 kg seeds were conserved properly for future study.

#### **Regeneration of conserved accession of yard long bean**

N Jahan and M F Khatun

The regeneration of One hundred and twenty-one (121) yard long bean (*Vigna sesquipedalis* L. Vercourt) germplasm was conducted in the experimental field at Plant Genetic Resources Centre (PGRC) of BARI, Gazipur, during February–June, 2023. Germplasm regeneration leads to get the sufficient seed quantity with increase viability for future use. Six (6) observations on qualitative (3) and quantitative (3) characters were recorded. After completing all the post-harvest operations, the seeds were conserved properly for future study. After completing all the post-harvest operations, the 12.73 kg seeds were conserved properly for future use.

#### **Regeneration of conserved accession of foxtail millet**

M F Khatun

The regeneration experiment was conducted at the research field of the Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur during the rabi season of 2022-23. One hundred fifty-three foxtail millet germplasm was taken for regeneration to increase sufficient seeds for the gene bank. Remarkable variations were observed in both

qualitative and quantitative traits among the germplasm. Some qualitative and quantitative data were recorded and an adequate amount of seeds have been harvested for conservation and future utilization.

#### **Regeneration of conserved accession of buckwheat and radish**

Q M Ahmed and N Jahan

The regeneration of two buckwheat and twenty-three radish germplasm were conducted at the experimental field of Plant Genetic Resources Centre, BARI, Gazipur during rabi season 2022-23. Germplasm regeneration leads to getting a sufficient seed quantity with increased viability for future use. The most important qualitative and quantitative characteristics were recorded to know the variations in the germplasm. After completing all the post-harvest operations, the seeds were conserved properly for future study.

#### **Regeneration of conserved accession of chickpea**

M I Riad and M M Kadir

Chickpea is the third most important pulse crop as a source of dietary protein. The regeneration of 80 germplasm of chickpea (*Cicer arietinum* L.) was carried out at the Plant Genetic Resources Centre (PGRC), RARS, Jamalpur during 2022-2023. Variation were found in both qualitative and quantitative characters among the germplasm. Some of the qualitative and quantitative data were recorded and adequate amount of seeds were harvested for conservation and future use.

#### **Regeneration of conserved accession of foxtail millet**

M. M. Hossain

The experiment was conducted at Regional Agricultural Research Station, Burirhat, Rangpur during the rabi season of 2022-23 with a view to regenerate the conserved accession of foxtail millet. All the germplasm were planted on 30 November, 2023 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. After completing all the post-harvest operations, the seeds were conserved properly for future study.

#### **Regeneration of conserved accession of chickpea**

K U Ahamed and M M Uddin

The study was conducted at Regional Agricultural Research Station, Ishurdi, Pabna during rabi season of 2022-2023 to regenerate the seeds for conservation. The experiment involved 206 chickpea accessions. Variations were observed in respect of days to first flowering, days to 50% flowering, days to maturity, plant canopy height, number of seeds per pod, 100-seed weight and yield per plant among chickpea accessions. Collected seeds from field was properly dried and conserved in the gene bank for future use.

#### **Regeneration of conserved accession of foxtail millet**

M A A Malek, S Rahman, I Ahmed, N Jahan, M M Ali and M A Hossain

This experiment was conducted at the hill valley of Hill Agricultural Research Station, Khagrachari during 2022-2023. Maximum number of tiller was found in BD-1260 (9.6) on the other hand minimum tiller was found in BD- 1220. Quantitative characters showed variation in days to 50% heading formed ranged from 73 to 105 days, Head weight ranged from 4.4-26g and harvesting ranged from 106-133 days. Accession BD-1241 showed maximum plant height 96.8 cm. The seed of all accessions will store in cold storage of PGRC at Gazipur for further utilization.

#### **Regeneration of conserved accession grass pea**

M S Kobir, M M Ali, S Rahman, N Jahan and K U Ahammad

The experiment was involved 214 grass pea accessions. Variations among grasspea accessions were observed in qualitative characteristics like plant growth rate stage-I, plant growth rate stage-II, plant growth habit, flower size and in flower colour. The highest seed yield plot<sup>-1</sup> was observed in BD-5439 (1.096 kg) which is followed by BD-4945 (1.021 kg). The highest standard deviation (13.41) was observed in the plant height and the lowest (0.12) standard deviation was observed in pod width. The highest co-efficient of variation (41.78%) was observed for seed yield per plot whereas the lowest (0.93 %) was found in maturation period.

### **Maintenance and development of field gene bank**

I Ahmed 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 genebank. In 2022-23, new 09 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 germplasm are taro, yam, elephant foot, drumstick etc. The exotic germplasm are rambhutan, pear, tamarind, coffee, passion fruit, dragon fruit and gynura etc. The intercultural practices were done as and when necessary. The field gene bank has been maintained since 1985 and continued for the following years.

### **Data base development and data entry for germplasm documentation**

R Afroz, Q M Maruf, M G Hossain and M M Ali

During 2022-23 five hundred and eleven (511) passport information of newly collected germplasm was documented. The 710 germplasm characterization data have been documented under excel format.

### **RARS Ishurdi, Pabna**

#### **Regeneration of chickpea germplasm**

K .U. Ahamed and M .M. Uddin

Chickpea (*Cicer arietinum* L.) is the third most important pulse crop in Bangladesh. Major constraints of chickpea production are due to lack of early suitable and diseases resistant varieties. This program are included with the objective to develop high yielding, which will be responsive to high management and to ensure long/medium term conservation of the genetic diversity represented chickpea germplasm regeneration for food safety.

This study was conducted at Regional Plant Genetic Resources Center, Regional Agricultural Research Station, BARI, Ishurdi, Pabna during Rabi season of 2022-2023. The experiment involved 206 chickpea accessions. Variations in different qualitative and quantitative were observed among the accessions. The first female flower initiation was noticed in BD-6517 (44 days) and days to 50% flowering was earlier in BD-6569 (57 days). The more earlier maturity was observed in BD-6489, BD-6490, BD-6497, BD-6498, BD-6507, BD-6509, BD-6514, BD-6558, BD-6569, BD-6576, BD-6633, BD-6682, BD-6692, BD-6704, BD-6721, BD-6543, BD-6762, BD-6641, BD-6731, BD-6771 and 10117 (87-108 days) than the other accessions. Five types of growth habit were observed as erect, semi-erect, semi-spreading, spreading and prostrate. Semi-spreading type growth habit showed highest 70 accessions for 33.98% found among the genotypes. Three types of leaf type were found normal, simple and multipinnate, among them, normal type of leaf type showed highest 103 accessions for 50.00%. Flower colour was dark pink for 1.46%, light blue for 0.97%, dark pink for 56.80%, pink for 20.39%, light pink for 18.45%, white for 1.46% and rest lines were observed white-pink striped for 0.49% variations. Seed shape showed variations as angular, rams head, irregular roundedowl's head and pea-shaped, smooth round. Highest 57 accessions for 57.28% found irregular roundedowl's head type seed shape. Fifteen types of seed colour were observed among the accessions as black, brown, light brown, darkbrown, reddish brown, greyishbrown, salmon brown, grey, brown beige, yellow, light yellow, yellowbrown, ivorywhite, green and black brown mosaic. Among them, highest 53 accessions for 25.73% showed reddish brown type seed colour. Biotic stress susceptibility showed highest 145 accessions for 70.79% observed as very low or no visible sign of susceptibility. The number of pods per plant range varied from 18.33 to 193.67. Hundred seed weight range varied from 6.30 to 50.90g. The highest seed yield (53.84g per plant) was found from BD-6525 chickpea accession and the lowest yield (2.93g per plant) from BD-6633 chickpea accession. Yield varied from 2.93 to 53.84g per plant, where BD-6684, BD-6615, BD-6594, BD-6646 and BD-6525 showed high yielding (41.41 to 53.84 g per plant) with quality and resistant for



pests and diseases, it may be considered as better accessions.

### **Morphological characterization of custard apple germplasm**

K .U. Ahamed and M .M. Uddin

Custard apple (*Annonasquamosa* L.) is a delicious and important minor fruit crop which is wild and cultivated throughout Bangladesh and commercially important fruit with pleasant flavor, mild aroma, sweet taste, good nutritional and medicinal values. Fruit contains significant quantities of vitamin C, thiamin, potassium, magnesium and dietary fiber. It gives 104 kcal per 100gm of edible portion. This program is included with the objective to characterize the germplasm and regenerate seeds for conservation for food security. The experiment was conducted at Regional Plant Genetic Resources Centre, RARS, BARI, Ishurdi, Pabna during the Rabi season of 2022-2023. The experiment involved 15 custard apple accessions. Variations were observed in different qualitative, quantitative characteristics and TSS% were observed in stems, leaves, flowers, fruits and seeds. The early fruit harvesting was observed within 334.45-340.50 days. The earlier maturity was found in AS-Isd-013 (334.45 days) than the other accessions. Three types of colour of young branches were found as light green, green, dark green and highest 9 accessions for 60.00% showed dark green. Leaf blade shape was observed ovate for 33.33%, elliptic for 13.33%, obovate for 20.00% and lanceolate for 33.33%. Shape of leaf apex showed acute for 53.33%, rounded for 6.67% and acuminate type for 46.67%. Location of fructification was recorded as base of the crown 6.67%, middle of the crown for 46.67% and top of the crown for 46.67%. Four types of fruit shape were found as round, oblate, cordate and broadly cordate, among them, cordate showed highest 12 accessions for 80.00%. Exocarpcolour was found five categories like light green for 33.33%, green for 6.67%, dark green for 40.00%, brownish green for 13.33% and brown for 6.67%. Pulp colour was white for 86.67% and cream for 13.13% among 15 germplasm. Pulp taste was tasted and observed three categories as bad taste for 6.67%, average taste for 33.33% where good tasted for 60.00%. Seed coat colour found three types as grey, dark brown and black where dark brown showed highest 9 accessions for

60.00%. AS-Isd-002 produced significantly the highest number of fruits per plant (44.33). Total soluble solids (TSS %) range varied from 18.70 to 25.20, the maximum TSS% (25.20) found in AS-Isd-002 and minimum TSS% was recorded in genotype AS-Isd-007 (18.70). Biotic stress susceptibility observed highest 11 accessions for 73.33% in very low or no visible sign of susceptibility, low for 13.33% and very high for 13.33% showed among the germplasm. The highest fruit yield (5.76 kg per plant) was recorded from AS-Isd-002 and the lowest yield (1.30 kg per plant) from AS-Isd-009 custard apple accession. Fruit yield per plant range varied from 1.30 to 5.76 kg, where AS-Isd-001, AS-Isd-002, AS-Isd-004, AS-Isd-005, AS-Isd-011 and AS-Isd-012 showed high yielding (4.26–5.76 kg per plant) with quality and resistant for pests and diseases, it may be considered as better accessions.

### **Morphological characterization of bael germplasm**

K .U. Ahamed and M .M. Uddin

Bael (*Aegle marmelos* Correa.), commonly known as bael wild form in Bangladesh and India used as minor fruit belongs to the family Rutaceae. The fruit is rich source of carbohydrates, vitamins and minerals. Ripe fruits are generally used for fresh consumption, preparation of squash, nectar and value added products. Bael fruits are gaining popularity due to its medicinal and nutritional properties and regarded as “Amrit Phal” in cure of diarrhoea and dysentery, malaria, fever, jaundice, cancer, ulcers, urticaria and eczema. This programme was undertaken to characterize the germplasm and regenerate seeds for conservation for food security and to identify suitable type/ types in Bangladesh. The experiment was conducted at Regional Plant Genetic Resources Centre, RARS, BARI, Ishurdi, Pabna during the Rabi season of 2022-2023. The experiment involved 10 wood apple accessions. Variations were observed qualitative and quantitative characteristics. The early flower bud period was noticed in AM-004 (39 days). The earlier maturity was found in AM-001 (351 days) than the other accessions. Variations in different qualitative characteristics like plant pigmentation were observed in stems, leaves and flowers. Growth habit was observed four categories that were in drooping for 10.00%, spreading for 40.00%, semi spreading for 40.00% and rest lines were upright for 10.00%. Leaf shape

was recorded as broadly lanceolate to ovate for 90.00% and Ovate for 10.00%. Fruit Shape showed as globose for 10.00% and round for 90.00%. Total soluble solids (TSS %) range varied from 31.00 to 37.00, among the 10 accessions, 5 accessions showed maximum TSS% (36.00-37.00) and 5 accessions observed minimum TSS% (31.00-32.00). Biotic stress susceptibility were observed as very low or no visible sign of susceptibility for 30.00%, low for 50.00% and rest lines observed intermediate susceptibility for 10.00%. The highest total soluble solids (TSS %) were recorded (37) in AM-009 and lowest (31) was found in AM-002, AM-004, AM-005 and AM-008. The highest fruit yield per plant (136.62 kg per plant) was recorded from AM-005 and the lowest yield (6.30 kg per plant) from AM-010. Fruit yield per plant range varied from 6.30 kg to 136.62 kg, among them, AM-002, AM-004, AM-005, AM-008 and AM-009 showed high yielding (33.80–136.62 kg per plant) and high TSS% with quality and resistant for pests and diseases, it may be considered as better accessions.

### **Morphological characterization of jackfruit germplasm**

K .U. Ahamed and M .M. Uddin

Jackfruit (*Artocarpus heterophyllus* Lam.) belongs to the family Moraceae called as Kathal grown throughout in Bangladesh. The jackfruit has extensive used in food industries and fruit is used as vegetable, mature fruit for preparation of value added products such as chips, papad, dried and dehydrated flakes/flake powder and the flakes of ripe fruits are high in nutritive value; every 100 g of ripe flakes contains 191-407 mg potassium, 20-37 mg calcium, 38-41 mg phosphorus, 0.5-1.1 mg iron and 11-19g carbohydrates. This programme was undertaken to characterize the germplasm and regenerate seeds for conservation for food security and to identify suitable type/ types in Bangladesh. The experiment was conducted at Regional Plant Genetic Resources Centre, RARS, BARI, Ishurdi,

Pabna during the Rabi season of 2022-2023. The experiment involved 47 jackfruit accessions. Variations were observed in qualitative and quantitative traits. Tree growth habit observed as erect for 25.53%, semi-erect for 51.06% and spreading for 23.40%. Five types of fruit shape showed as spheroid 8.51%, ellipsoid for 51.06%, clavate for 12.77%, oblong for 4.26% and irregular type for 23.40%. Four types of pulp taste was recorded as insipid for 23.40%, acid for 10.64%, bitter for 12.77% and sweet for 53.19%. Five types of flake shape was found such as spheroid for 17.02%, twisted for 10.64%, rectangular or 27.66, oblong with curved tip for 8.51% and irregular for 36.17%. Seed shape was observed as spheroid for 2.13%, ellipsoid for 8.51%, elongate for 10.64%, oblong for 12.77%, reniform for 29.79% and irregular for 36.17%. Biotic stress susceptibility was observed three categories such as very low or no visible sign of susceptibility for 80.85%. The early maturity was observed (143 days) from AH-021 accession and late maturity was found (209 days) from AH-044 jackfruit accession. Fruit weight range varied from 1.67 kg to 13.40 kg, the highest fruit weight (13.40 kg) was found in AH-033. Number of fruits per tree range varied from 8.00 to 154.00, the highest number of fruits per tree was recorded (154.00) from AH-021 and lowest (8.00) from AH-042. Number of flakes (bulbs) per kg fruit range varied from 6.80 to 54.22. The highest fruit yield per tree (937 kg per tree) was recorded from AH-032 accession and the lowest yield (30.60 kg per tree) from AH-022 jackfruit accession. The highest TSS% (28-30) was found in AH-040, AH-035, AH-038, while the minimum (15.00) was found in AH-007. Fruit yield per tree varied from 30.60 kg to 937.20 kg, AH-001, AH-010, AH-017, AH-019, AH-021 and AH-032 accessions showed maximum fruit yield per tree (622.50-937.20 kg) and high TSS% with quality and resistant for pests and diseases, it may be considered as better accessions.

# ON-FARM STUDIES

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## Project I: On-Farm Soil Fertility Management

### Effect of potassium fertilizer on groundnut in charland

M.U.S. Khatun, M.Z. Ferdous, M.A.A.H. Talukder and N. Sultana

Potassium fertilizers can play a significant role in yield of groundnut under char land area. A study was designed and executed to evaluate the effect of potassium on groundnut production and also to find out a suitable dose of potassium for yield maximization of groundnut. The study was initiated with the potassium fertilizer application viz: T<sub>1</sub>: Recommended dose of chemical fertilizer, T<sub>2</sub>:T<sub>1</sub>+125% of recommended MoP, T<sub>3</sub>:T<sub>1</sub>+150% of recommended MoP and T<sub>4</sub>: Farmer's practice. Significantly higher yield (1.72 t ha<sup>-1</sup> and 1.57 t ha<sup>-1</sup>) were produced when potassium was applied 150% more with recommended dose of chemical fertilizers and 125% more with RDCF, respectively. The treatment with 150% more potassium along with RDCF gave the maximum gross margin (Tk 117600 ha<sup>-1</sup>). Application of higher level of Potassium fertilizers (150% more potassium with RDCF provided the highest yield in groundnut production in char land of Kurigram.

### Development of fertilizer recommendation for foxtail millet at charland of bogura

M.R.A. Mollah, M.S. Alam, M.T. Hasan and N. Sultana

A trial was conducted on Foxtail millet to find out a fertilizer recommendation in the Horirumpur char, Sariaakandi, Bogura during Rabi 2022-2023. The study was designed and executed with the treatment combinations of T<sub>1</sub>: recommended dose of FRG' 2018 (28-20-37-0.5-0.5 kg NPKZnB ha<sup>-1</sup>); T<sub>2</sub>:T<sub>1</sub> + 25% NPKSZn, T<sub>3</sub>:T<sub>1</sub> + 50% NK, T<sub>4</sub>: T<sub>1</sub> + 1 kg B

ha<sup>-1</sup> and T<sub>5</sub>:Farmers practice (46-15-20-14-1.5-1.3 kg NPKSZnB ha<sup>-1</sup>). Significantly the higher yield (2.18 and 2.10 t ha<sup>-1</sup>) were produced with the application of FRG recommended fertilizer dose with an extra 1 kg B ha<sup>-1</sup> and also in farmers' practiced fertilizer doses. The treatment with FRG fertilizer dose plus extra 1 kg B ha<sup>-1</sup> also gave the highest gross return (Tk 152600 ha<sup>-1</sup>). The results expressed that the micronutrient boron enhanced the higher yield in foxtail millet in char areas. Application of FRG recommended fertilizer with 1 kg B ha<sup>-1</sup>(28-20-37-0.5-0.5 kg NPKZnB ha<sup>-1</sup> + 1 kg B ha<sup>-1</sup>) offered highest yield (2.18 t ha<sup>-1</sup>) for foxtail millet in char area of Bogura.

### Development of fertilizer recommendation for lentil-maize-t. Aman rice cropping pattern

M.S. Rahman, M.N.A. Siddique, M.J. Islam, M.M.I. Chowdhury and N. Sultana

The experiment was conducted in the farmer's field of Paba, Rajshahi during 2020-21 and 2021-22 to find out a suitable fertilizers packages for Lentil-Maize-T.Aman rice cropping pattern. The study was executed with the treatment combinations were T<sub>1</sub>: Fertilizer dose (FRG, 2018), T<sub>2</sub>: 75% recommendation base dose of T<sub>1</sub>, T<sub>3</sub>:125% recommendation base dose of T<sub>1</sub> and T<sub>4</sub>: Farmers practice. The effects of different fertilizers were significant in total yield. The significant highest yield of lentil (2.34 and 2.30 t ha<sup>-1</sup>), maize (7.94 and 5.19 t ha<sup>-1</sup>) and T.Aman (5.5 and 5.13 t ha<sup>-1</sup>) were produced when the soil were treated with 125% more fertilizer. The benefit cost ratio for lentil (3.61 and 2.95), maize (2.36 and 1.68) and T.Aman (2.64 and 2.18) were highest in both the year when the fertilizers were applied with extra 125% of FRG. The application of 125% FRG gave the highest yield and gross return and gross margin in all crops of the cropping pattern.



### Development of fertilizer recommendation for garlic/ brinjal-T.aman rice cropping pattern

M.S. Rahman, M.N.A. Siddique, M.J. Islam, M.M.I. Chowdhury and N. Sultana

The experiment was conducted in the farmer's field of Shibpur, Rajshahi during 2020-21 and 2021-22 to evaluate the nutrient element on the crops and to find out a suitable combination of fertilizers for Garlic/Brinjal-T.Aman rice cropping pattern. The experiment was designed with the treatment combinations viz: T<sub>1</sub>: Fertilizer dose (FRG, 2018), T<sub>2</sub>: 75% recommended dose of T<sub>1</sub>, T<sub>3</sub>: 125% recommended dose of T<sub>1</sub> and T<sub>4</sub>: Farmers dose. The fertilizer dose were significant in yield of all crops and the significant highest bulb yield in garlic (10.29 and 10.39 t ha<sup>-1</sup>), brinjal (27.56 and 27.55 t ha<sup>-1</sup>) and T.Aman (5.43 and 4.33 t ha<sup>-1</sup>) were produced when the soil were treated with 125% FRG fertilizers. The highest gross return in garlic (Tk 515777 ha<sup>-1</sup>), brinjal (Tk 757750 ha<sup>-1</sup>) and T.Aman (Tk 137772 ha<sup>-1</sup>) were recorded when the fertilizers were applied with extra 25% of FRG.

### Effect of boron on seed yield of sunflower in acidic soil of Sylhet region

M.I. Nazrul and N. Sultana

Basal application of boron plays an important role on yield of sunflower in acidic soil of haor soil system. Sunflower productivity is mainly affected by balance fertilizer and water availability. The study was undertaken in Hakaluki haor during rabi season of 2022-23 to determine yield response of sunflower (*Helianthus annuus* L.) on boron fertilizers. The study was executed with the treatment combinations viz: T<sub>1</sub>: 0 kg boron ha<sup>-1</sup>, T<sub>2</sub>: 1.0 kg boron ha<sup>-1</sup>, T<sub>3</sub>: 1.5 kg boron ha<sup>-1</sup>, T<sub>4</sub>: 2.0 kg boron ha<sup>-1</sup> and T<sub>5</sub>: 2.5 kg boron ha<sup>-1</sup>. The effect of boron were significant in yield and contributing characters. However, the significant higher yield (1.81 and 1.91 t ha<sup>-1</sup>) were produced when the soil received recommended fertilizers (150-110-90-120 kg NPKS ha<sup>-1</sup>) with 2 kg boron ha<sup>-1</sup> and 2.5 kg boron ha<sup>-1</sup>, respectively. Boron supplied to soil boosted the yield, gross return and gross margin. The application of recommended dose with 2.5 kg boron ha<sup>-1</sup> offered the highest yield (1.91 t ha<sup>-1</sup>) and gross margin (Tk 35400 ha<sup>-1</sup>) of sunflower in acidic soil of haor in Sylhet.

### Effect of lime on seed yield of sunflower in acidic soil of Sylhet region

M.I. Nazrul and N. Sultana

A field experiment was conducted at Hakaluki haor, Moulvibazar during the rabi season of 2022-2023 to quantify the proper dose of lime for cultivation of *Helianthus annuus* L. Six lime treatments were evaluated viz. T<sub>1</sub>: 0 t lime ha<sup>-1</sup>, T<sub>2</sub>: 0.5 t lime ha<sup>-1</sup>, T<sub>3</sub>: 1.0 t lime ha<sup>-1</sup>, T<sub>4</sub>: 1.5 t lime ha<sup>-1</sup>, T<sub>5</sub>: 2.0 t lime ha<sup>-1</sup> and T<sub>6</sub>: 2.5 t lime ha<sup>-1</sup>. The study was designed with the application of lime as dolomite. The significant higher yield (1.70, 1.71 and 1.76 t ha<sup>-1</sup>) were obtained when the lime was applied at 1.5, 2.0 and 2.5 ton ha<sup>-1</sup>, respectively with 150-110-90 and 120 kg NPKS ha<sup>-1</sup>. The highest yield (1.76 t ha<sup>-1</sup>) was found with the application of 2.5 ton lime ha<sup>-1</sup>. Higher doses of lime enhanced the yield and gross return (Tk 114400 ha<sup>-1</sup>) but the cost of lime is maximum (Tk 107500 ha<sup>-1</sup>) in higher dose. However, the highest gross margin (Tk 11000 ha<sup>-1</sup>) was obtained from the application of 1.5 t lime ha<sup>-1</sup>. Thus, the application of 1.5 t lime ha<sup>-1</sup> is enough for satisfactory yield of sunflower with higher economic profit.

### Effect of rice straw burn ash on yield of mustard

M.I. Nazrul and N. Sultana

The experiment was conducted at Madhobpur, Habigonj district during rabi season of two consecutive years of 2020-21 and 2021-2023 to select a profitable practice for maximizing the yield of mustard. The study was initiated with five cultivation practices viz. T<sub>1</sub>: Rice straw burn + no tilth, T<sub>2</sub>: Rice straw burn + no tilth + water spray, T<sub>3</sub>: Rice straw burn + one tilth dose, T<sub>4</sub>: Rice straw burn + two tilth doses and T<sub>5</sub>: Conventional method were evaluated in the farmer's field. The popular broadcast aman rice (viz. Gota, Lucky, Kasha) following mustard var. BARI Sarisha-14 were considered in this trial. The cultivation practice significantly effect on the yield of mustard. However, significantly highest yield (1.73 t ha<sup>-1</sup>) was produced when the cultivation technique was rice straw burn with two tilths. The maximum gross return (Tk 140000 ha<sup>-1</sup>) and benefit cost ratio was 3.31 offered by the practice rice straw burn with two tilths.

### Effect of spacing and fertilizer on yield of sunflower in Bhola

G.N. Hasan, R.H. Anik, M. Islam and N. Sultana

The spacing and suitable fertilizers application can play a significant role in sunflower yield in coastal soil. The study was designed and executed to the spacing and fertilizers dose for maximizing the yield of sunflower in Bhola during the rabi season of 2022-23. The study was initiated with the treatment combinations viz: three spacing  $S_1$ : 50cm  $\times$  25cm (recommended),  $S_2$ : 40cm  $\times$  30cm,  $S_3$ : 40cm  $\times$  40cm and three doses of fertilizers ( $F_1$ : Recommended Dose of Fertilizer,  $F_2$ : 125% of RDF and  $F_3$ : 150% of RDF). The higher yield (1.67 t ha<sup>-1</sup> and 1.48 t ha<sup>-1</sup>) were generated when the spacing followed 40cm  $\times$  30cm and 50cm  $\times$  25cm. Significantly the higher seed yield (1.64 t ha<sup>-1</sup> and 1.60 t ha<sup>-1</sup>) was obtained from 125% of RDF and 150% RDF dose, respectively. The application of 125% RDF with 40cm  $\times$  30cm spacing combination offered the highest seed yield (1.74 t ha<sup>-1</sup>) and gross return (Tk 162160 ha<sup>-1</sup>).

### Fertilizer dose for stolon producing bari panikachu-2

M.M. Rahman, A.K.M.Z.U. Noor, M.A. Rahman and N. Sultana

The experiment was carried out at Nakla, Sherpur during December 2021 to August 2022 to develop a suitable fertilizer package in combination of organic manure and chemical fertilizers for sustainable aquatic taro production. There were three treatments  $T_1$ : Cow dung 15 t ha<sup>-1</sup> +  $N_{170}P_{40}K_{160}S_{15}$  kg ha<sup>-1</sup> (proposed);  $T_2$ : Farmers' practice (Cow dung 10 t ha<sup>-1</sup> +  $N_{225}P_{70}K_{200}S_{18}$  kg ha<sup>-1</sup>) and  $T_3$ : Control, respectively. Significantly highest stolon (29.8 t ha<sup>-1</sup>) was produced when the nutrient element was highest with organic fertilizer and minimum stolon yielded from  $T_3$  treatment. Highest rhizome yield obtained from  $T_2$  (32.5 t ha<sup>-1</sup>). Lowest rhizome yielded from  $T_3$  (22.3 t ha<sup>-1</sup>). Highest gross return (914500 Tk ha<sup>-1</sup>) and gross margin (Tk 649200 ha<sup>-1</sup>) resulted from  $T_2$  treatment where the lowest gross return (Tk 365440 ha<sup>-1</sup>) and gross margin (Tk 143240 ha<sup>-1</sup>) resulted from  $T_3$  treatment.

### Performance of water hyacinth residue as an organic manure for cauliflower production

M.M. Howlader and N. Sultana

Management of water hyacinth residue as an organic fertilizer can play a significant role in

yield improvement of cauliflower under Gopalganj district. The study was executed to determine the suitability and amount of water hyacinth residue on the yield performance of cauliflower in Gopalganj sadar of Gopalganj and Nazirpur of Pirojpur (AEZ-14) during three consecutive year of 2020-21, 2021-22 and 2022-23. The study was designed with three doses of water hyacinth with cow dung viz:  $T_1$ : 5 t ha<sup>-1</sup> cow dung (control),  $T_2$ : 5 t ha<sup>-1</sup> water hyacinth residue,  $T_3$ : 8 t ha<sup>-1</sup> water hyacinth residue,  $T_4$ : 11 t ha<sup>-1</sup> water hyacinth residue. Significantly the higher yield of cauliflower (46.51 and 45.02 t ha<sup>-1</sup>) were produced when 5 ton cow dung and 11 ton water hyacinth residue per hectare were applied, respectively. The higher gross return (Tk 1162750 and Tk 1125500 ha<sup>-1</sup>) and benefit cost ratio 4.70 and 4.55 were observed from 5 ton cow dung and 11 ton water hyacinth residue per hectare, respectively. However, considering the cost effectiveness of cow dung and availability of water hyacinth residue, 11 ton water hyacinth residue per hectare might be the alternate source of organic fertilizer for cauliflower production in Gopalganj region.

### Nutrient management for oat production in Faridpur

S. Ahmed, M.Z.H. Sohel and N. Sultana

The fertilizer management on the yield of oat production were conducted at the FSRD Site, Sholakundu, Faridpur during the rabi 2022-23. The study was designed with five treatments ie.  $T_1$ : (Recommended dose for Barley): 80-30-30-10-3-1 kg NPKSZnB ha<sup>-1</sup>,  $T_2$ : (FRG'2018): 50-7-15-0-1.25-0 kg NPKSZnB ha<sup>-1</sup>,  $T_3$ : ( $T_2$  + 25%): 63-9-20-0-1.25-0 kg NPKSZnB ha<sup>-1</sup>,  $T_4$ : ( $T_2$  + 50%): 75-11-23-0-1.25-1 kg NPKSZnB ha<sup>-1</sup> and  $T_5$  (Farmer's practice): 90-25-25 kg NPK ha<sup>-1</sup>. The effect of fertilizers were significant on the yield of oat. However, the significant higher grain yield (1.65 and 1.57 t ha<sup>-1</sup>) were produced when the soil received FRG recommended fertilizer with extra 25% of all element and FRG plus 50% of all element, respectively. Application of ( $T_2$  + 25%) ie. 63-9-20-0-1.25-0 kg NPKSZnB ha<sup>-1</sup> offered the highest oat yield (1.65 t ha<sup>-1</sup>), gross margin (Tk 64108 ha<sup>-1</sup>) and benefit cost ratio (2.07) at Faridpur region.

### Validation of biofertilizer on legume crop

S. Ahmed, M.Z.H. Sohel, K.N. Islam, M.M. Islam, M.S.I. Khan, M.S. Islam M.M. Bashir, M.M. Rahman, A.K.M.Z.U. Noor, M.A. Rahman and N. Sultana

The biofertilizer in the form of BARI RLc-105, BARI RCa-59, BARI RVr-402 and RGm-902 were applied in the soil to see the effect of biofertilizer on the yield of lentil, chickpea, mungbean, soybean and groundnut. A field trial was conducted at Faridpur, Patuakhali, Sherpur and Noakhali during the year 2022-23. The yield of legume crops were significant and the higher yield (lentil: 1.77 ton, chickpea: 2.03 ton, mungbean: 1.72 and 1.25 ton, soybean: 1.63 ton and groundnut: 2.05 t ha<sup>-1</sup>) were produced when the soil were treated with biofertilizer plus PKSZn or PKSZNb. Higher gross return of lentil (Tk 132750 ha<sup>-1</sup>), Chickpea (Tk 137025 ha<sup>-1</sup>), mungbean (Tk 120400; 112500 ha<sup>-1</sup>), soybean (Tk 101875 ha<sup>-1</sup>) and groundnut (Tk 164000 ha<sup>-1</sup>) and benefit cost ratio (lentil: 2.25; chickpea: 2.73; mungbean Patuakhali: 2.55; mungbean Noakhali: 3.51; soybean: 2.37 and groundnut: 2.12) were also higher with the application of rhizobium fertilizer plus PKSZn or PKSZNb.

### Effect of organic fertilizer to mitigate soil salinity and maximize yield of potato in coastal saline soil

M.M. Islam, K.N. Islam, M.S.I. Khan and N. Sultana

The effect of basal application of organic fertilizers in the form of cow dung, compost and vermicompost was studied on the yield of potato. The experiment was conducted at Kuakata, Patuakhali in Rabi season of 2022-23 in coastal area. The study was executed with four fertilizers combinations viz: T<sub>1</sub>: FRG'2018 + 3 t cow dung ha<sup>-1</sup>, T<sub>2</sub>: FRG'2018 + 1.5 t compost ha<sup>-1</sup>, T<sub>3</sub>: FRG'2018 + 2 t vermicompost ha<sup>-1</sup> and T<sub>4</sub>: Farmers' practice (130-44-45-30 kg NPKS ha<sup>-1</sup>). Significantly the higher yield of potato (23.33, 22.48 and 26.13 t ha<sup>-1</sup>) were produced when the soil was treated with FRG recommended fertilizer and cow dung, compost and vermicompost. Application of FRG recommended fertilizer (118-30-60-23 kg NPKS ha<sup>-1</sup>) plus 2 ton vermicompost per hectare offered the highest yield (26.13 t ha<sup>-1</sup>) and the yield increased (29.60%) over chemically fertilized treatment. Soil electrical conductivity was found

lower in organic fertilizer treated plots. Vermicompost reduced salinity more than compost and cow dung. The highest gross return (Tk 522600 ha<sup>-1</sup>), gross margin (Tk 314900 ha<sup>-1</sup>) and BCR (2.52) was recorded highest in the treatment of vermicompost with FRG recommended fertilizers in coastal saline soil of Patuakhali.

### Response of vermicompost on yield and fruit quality of watermelon in coastal saline soil

M.M. Islam, K.N. Islam, M.S.I. Khan and N. Sultana

Vermicompost can play a significant role in yield improvement of watermelon in coastal soil. The study was executed to see the effect and amount of vermicompost on the yield and quality of watermelon in Kuakata, Patuakhali during Rabi season of 2022-23. The experiment was designed with four combinations of fertilizers viz: T<sub>1</sub>: Vermicompost 1 t ha<sup>-1</sup> + 150-50-125-40-5-4 kg NPKSZnB ha<sup>-1</sup>, T<sub>2</sub>: Vermicompost 2 t ha<sup>-1</sup> + 150-50-125-40-5-4 kg NPKSZnB ha<sup>-1</sup>; T<sub>3</sub>: Vermicompost 3 t ha<sup>-1</sup> + 150-50-125-40-5-4 kg NPKSZnB ha<sup>-1</sup> and T<sub>4</sub>: Farmers practice (150-50-125-40-5-4 kg NPKSZnB ha<sup>-1</sup>). Significantly the higher yield (36.11, 34.26 and 32.16 t ha<sup>-1</sup>) were produced when different doses of vermicompost were applied. The application of recommended fertilizer (150-50-125-40-5-4 kg NPKSZnB ha<sup>-1</sup>) plus 3 ton vermicompost ha<sup>-1</sup> produced the highest yield (32.16 t ha<sup>-1</sup>). The highest (10.10%) Total Soluble Solids, gross return (Tk 577760 ha<sup>-1</sup>) and BCR (3.06) was recorded with 3 t vermicompost ha<sup>-1</sup> along with recommended fertilizer. Vermicompost in coastal soil of Patuakhali.

### Development of fertilizer management on fruit yield of Bt-brinjal

Md. R. Amin, Md. E. Haque and N. Sultana

A field trial was conducted on Bt brinjal to see the effect of fertilizers on the yield under Manikganj district. The study was initiated with three fertilizers packages viz: (131-9-78-10-0.14-0.33 kg NPKSZnB ha<sup>-1</sup> (FRG Recommended dose); (165-11-98-10-0.14-0.33) kg NPKSZnB ha<sup>-1</sup> (T<sub>1</sub>+25% of NPK) and (197-14-117-10-0.14-0.33 kg NPKSZnB ha<sup>-1</sup> (T<sub>1</sub>+50%NPK) at farmers' field of Shibaloya upazila in Manikganj district during Rabi season of 2022-23. Higher yield (58.31 and 53.18 t ha<sup>-1</sup>) were produced when higher doses of fertilizers were applied (FRG plus 25% and 50% of extra amount



of fertilizer). However, extra NPK applied to the soil boosted the yield and the highest yield (58.31 t ha<sup>-1</sup>) was obtained from the application of (197-14-117-10-0.14-0.33 kg NPKSZnB ha<sup>-1</sup> (T<sub>1</sub>+50%NPK), gross margin (Tk 1570640 ha<sup>-1</sup>) and benefit cost ratio (9.80).

#### **Integrated nutrient management for cabbage under agroforestry system**

M. Maniruzzaman, M.A. Isalm, M.Z. Hasan, M.A. Suborna, M.S.H. Molla, M.R. Alam and N. Sultana

An experiment was carried out at the FSRD site, Ganggarampur, Pabna during the rabi season of 2022-23 to evaluate the performance of different nutrient management in mango-based agroforestry system. Four nutrient management practices viz. recommended dose (FRG'18), Integrated Plant Nutrient System (IPNS) + 5 t cow dung ha<sup>-1</sup> and IPNS + 3 t vermicompost ha<sup>-1</sup> along with farmers practice were combined in this study. Significantly the higher yield (72.5 t and 67.1 t ha<sup>-1</sup>) were obtained with the soil application of IPNS plus 5 ton cow dung ha<sup>-1</sup> and IPNS with 3 ton vermicompost ha<sup>-1</sup> in mango based agroforestry system in Pabna. The yield contributing characters and increased yield were 32% and 22%, respectively with the same treatment.

#### **Effect of nitrogen on crop productivity and soil health under different rice-based cropping systems**

M. A. Islam, M. Maniruzzaman, M.Z. Hasan, M.A. Suborna, A.K.M. M. Alam, M. S. H. Molla, M.R. Alam

An on-station field experiment was conducted to assess crop productivity, nutrient use efficiency and economic return in diversified rice-based cropping systems at Agriculture Research Station, Pabna, Bangladesh. Three cropping systems: wheat-pre-monsoon rice-monsoon rice (cereal-dominated rice-based system - CBS), mustard-sesame-monsoon rice (oilseed-dominated rice-based system - OSB), lentil-mung bean – monsoon rice (legume-dominated rice-based system - LBS) in main plots and four levels of nitrogenous fertilizer – 0 % N of recommended N dose – control - RND (N<sub>0</sub>), 50 % of RND, 100 % of RND and 150 % of RND in a split-plot design with three replications. The rice yields of N150 (5.2 t/ha) were higher while the lowest in N<sub>0</sub> (3.0 t/ha). The REY of crop 2 in CP1 (5.0 t/ha) were higher than the REY in CP2 and

CP3 while the lowest REY of crop 2 was recorded in CP2 (2.2 t/ha). The REY of crop 2, the highest REY was recorded from CP1 along with N150 (6.8 t/ha) while the lowest REY recorded from CP2 with N<sub>0</sub> treatments (0.8 t/ha). For the REY of crop 3, the highest REY was recorded from CP3 along with N50 (6.7 t/ha) while the lowest REY recorded from CP2 with N<sub>0</sub> treatments (1.1 t/ha). The system REY of CP3 (13.4 t/ha) were higher than CP1 (11.7 t/ha) and CP2 (8.8 t/ha), and the lowest REY was recorded from CP2 (8.8 t/ha). The system REY of crop 3 in N150 (13.6 t/ha) were higher followed by N100 (12.6 t/ha) and N50 (10.9 t/ha), but the lowest REY was recorded from N<sub>0</sub> (8.1 t/ha). The highest system REY was recorded from CP1 along with N150 (15.6 t/ha) while the lowest REY recorded from CP2 with N<sub>0</sub> treatments (4.7 t/ha). The B:C ratio was highest in LBS, intermediate in CBS, and lowest in OSB. Regarding N levels, the gross return, net return and the B:C ratio increased with increasing N amount up to 150 kg/ha while the production cost reduced with decreasing the N levels.

#### **Effect of nitrogen fertilizer and weed management on weed and yield of T. Aman rice-wheat-mungbean cropping pattern under conservation agriculture systems**

Taslina Zahan, Apurbo K Chaki, Md. Faruque Hossain, Md. Akhtar Hossain, Qumrun-Nahar and N. Sultana

Management of nitrogen and weed can play a significant role in yield improvement of T. aman rice-wheat-mungbean cropping pattern under conservation agriculture (CA) systems. A study was designed and executed to evaluate the effect of nitrogen and weed management on weed and crop yield of strip-tilled non-puddled T. aman rice and strip-planted wheat and also to optimize nitrogen and weed management for achieving maximum yields of rice and wheat under CA systems. The study was initiated with strip-tilled non-puddled T. aman rice in 2022 at the on-station field of On-Farm Research Division, BARI, Gazipur. In rice, three nitrogen (N) rates viz. no nitrogen fertilizer (0 kg N ha<sup>-1</sup>), the recommended rate of nitrogen fertilizer (85 kg N ha<sup>-1</sup>), and double recommended nitrogen fertilizer rates (170 kg N ha<sup>-1</sup>); and four weed management treatments viz. no weeding control, weed-free control, application of one pre-emergence herbicide (pendimethalin) and application of one pre-emergence herbicide

(pendimethalin) followed by one post-emergence herbicide (bispiribac-sodium) were tested. In wheat, three N rates viz. 0 kg N ha<sup>-1</sup>, 92 kg N ha<sup>-1</sup> (recommended rate), and 184 kg N ha<sup>-1</sup> (double recommended rates); and four weed management treatments viz. no weeding control, weed-free control, application of one pre-emergence herbicide (PRE: pendimethalin) and application of one pre-emergence herbicide (PRE: pendimethalin) followed by one post-emergence herbicide (POST: carfentrazone-ethyl) were evaluated. Mungbean was generally grown in the same field after harvest of wheat without receiving any N and weed management treatment. The experiment was laid out in a factorial randomized complete block design with three replications. The study identified eleven (11) weed species in strip-tilled non-puddled T. aman rice and fourteen (14) species in strip-tilled wheat fields. The most infested weed species of T. aman rice was *Echinochloa crus-galli* and *Digitaria sanguinalis* in wheat. The effects of nitrogen rate and weed management were significant on total weed density, total weed biomass, and grain yields of rice and wheat. N<sub>2</sub>O gas flux was also measured in wheat. In rice, the highest weed density and biomass were recorded from the application of 170 kg N ha<sup>-1</sup>, and the spray of PRE followed by (fb) POST herbicides offered the most effective control of weeds. The highest weed density of strip-planted wheat was recorded from weedy plots with 92 kg N ha<sup>-1</sup> and the highest weed biomass and N<sub>2</sub>O flux were found in weedy plots with 184 kg N ha<sup>-1</sup>. The best weed management was obtained from the application of PRE fb POST herbicides with 92 kg N ha<sup>-1</sup> and the highest wheat yield was recorded from PRE fb POST herbicide plots with 184 kg N ha<sup>-1</sup> and similarly from weed-free control plots with 184 kg N ha<sup>-1</sup>. Application of the recommended dose (85 kg ha<sup>-1</sup>) and double recommended dose (170 kg ha<sup>-1</sup>) of N fertilizer offered higher aman rice yield under CA systems.

#### **Effects of tillage, residue retention and phosphorus management on the performance of lentil in rice-based system**

M. A. Islam, D. Sarker, J. Hossain, F. Hossain, A.K.M. M. Alam, R. Alam, M.S.H. Mollah, M. Maniruzzaman, M.Z. Hasan, M.A. Suborna

Performance of mustard under three tillage treatments such as conventional tillage (CT), notillage (NT) and strip planting (SP), two levels of residue retention – high residue (HR) and low

residue retention (LR) and three levels of phosphorus (50 % of recommended dose of P, 100 % of recommended dose of P and 150 % of recommended dose of P) were evaluated in rice-based system of Bangladesh. The field experiment was initiated in November 2015 and continuing for a longer term period at Pulses Research Centre Ishurdi, Pabna. The cropping sequence mustard-mung bean-t.aman is practicing since November 2018 at Ishurdi, Pabna. The cropping sequence of lentil-sesame-T.aman has practiced in 2021-22. In the present report, only the Crop number 22 (lentil) grown in rabi season (cool dry season) of 2022-23 are presenting. The results showed that the application of SP resulted in increasing number of plant populations/m<sup>2</sup>, plant height, pods/plant which may lead to increase seed yield by 11 %, however, NT decreased the yield of lentil by 5.0 % as compared to CT. In case of P levels, the increased dose of P (150 % of recommended P) increased plant height, branches/plant, pods/plant and consequently, the seed yield of lentil increased. However, this study will be continued for a long-term period to concrete conclusion.

## **Project II: Improvement of Cropping Systems**

### **Development of lentil-millet-t. Aman rice cropping pattern against lentil-fallow-t. Aman rice in barind area**

M. S. Hossain and J. C. Barman

The experiment was made at farmers' field of FSRD site, Basantapur, Rajshahi during 2021-22 to study productivity, production efficiency, land use efficiency and economic return of some cropping patterns in High Barind Tract. Two improved cropping patterns i.e., Lentil-Proso millet-T. Aman rice and Lentil-Foxtail millet-T. Aman rice was developed against existing Lentil-Fallow-T. Aman rice cropping pattern. The experiment was conducted with randomized complete block design with three dispersed replications. The maximum rice equivalent yield was obtained from Lentil-Proso millet-T. Aman rice pattern (11.19 t ha<sup>-1</sup>) which gave 24.61% higher rice equivalent yield (REY) compared to the existing Lentil-Fallow-T. Aman rice pattern. However, Lentil-Proso millet-T. Aman rice cropping pattern resulted in higher variable cost; nevertheless, it gave the highest

values of gross return, gross margin and marginal benefit-cost ratio.

#### **Development of four crops based cropping pattern potato-mungbean-T. Aus-T. Aman against potato-d. Aush-T. Aman rice cropping pattern in Bhola**

G N Hasan, R H Anik & M Islam

The study was performed at MLT site Daulatkhan and Bhola sadar under Bhola district during 2022-23 cropping season. The experimental design was RCB with four dispersed replications. In alternate pattern, the yield of T. Aus, T. Aman, Potato and Mungbean was 4.28, 4.72, 22.76 and 1.20 t ha<sup>-1</sup> respectively where as in existing pattern, the yield of D. Aus, T. Aman and Potato was 3.86, 4.65 and 19.32 t ha<sup>-1</sup> respectively. The alternate cropping pattern gave higher Rice Equivalent Yield (30.14 t ha<sup>-1</sup>) while existing one recorded 23.50 t ha<sup>-1</sup>. The gross margin of the alternate cropping pattern was 44.36 % higher than that of the existing pattern. The MBCR calculated 3.10 indicating that alternate cropping pattern could produce more returns than the existing farmers' pattern.

#### **Development of alternate cropping pattern potato-maize + coriander-t. Aman rice against potato-maize-t. Aman rice cropping pattern in cumilla region**

M. Jamal Uddin, M. M. Bashir & S. K. Bhowal

A field experiment was conducted at the farmers' field of Bashra, Daudkandi under AEZ 19 of Cumilla during 2021-22 to fit coriander in the existing cropping pattern and also to increase cropping intensity and productivity. Two treatments i.e., T<sub>1</sub>: Existing cropping pattern (Potato-Maize-T. Aman) and T<sub>2</sub>: 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 is 37.89t ha<sup>-1</sup>, which is almost 117.59% higher over existing pattern (17.416 t ha<sup>-1</sup>). Higher gross return (Tk. 1167790.00 ha<sup>-1</sup>) and gross margin (Tk. 892372.00 ha<sup>-1</sup>) as well as higher MBCR (4.24) were also obtained from alternate cropping pattern over existing cropping pattern due to additional yield of HYV Coriander leaves and HYV potato.

#### **Development of improved cropping pattern**

#### **potato/aroid-T. Aman rice against potato-fallow-t. Aman rice**

M. Jamal Uddin, S. K. Bhowal & M. M. Bashir

A field experiment was conducted at the farmers' field of Amratoli, Barura, Cumilla under AEZ 19 during 2021-22 in order to fit Aroid in the Potato-Fallow-T. Aman cropping pattern for increasing cropping intensity and farmer's income. Two treatments i.e, T<sub>1</sub>: Existing cropping pattern (Potato -Fallow-T. Aman) and T<sub>2</sub>: Alternate cropping pattern (Potato/Aroid - T. Aman) were studied. From the cropping pattern research findings documented that Rice equivalent yield (REY) in alternate cropping pattern was to be found 34.07 t ha<sup>-1</sup>, which is almost 89.28% higher over existing pattern (18.0 t ha<sup>-1</sup>). Higher gross return (Tk. 709565.00 ha<sup>-1</sup>) and gross margin (Tk.494310.00 ha<sup>-1</sup>) as well as higher MBCR (3.33) were also obtained from alternate cropping pattern over existing cropping pattern.

#### **Development of improved cropping pattern mustard-sesame-b. Aman rice in cummilla region**

M. Jamal Uddin, M. M. Bashir & S. K. Bhowal

A field experiment was conducted at the farmers' field of Kesobpur, Titas under AEZ 19 during 2021-22 in order to fit sesame in the existing cropping pattern for increasing cropping intensity and farm income. Two treatments i.e, T<sub>1</sub>: Existing cropping pattern i.e., Mustard (Tori-7) -Fallow-B. Aman (Local) and T<sub>2</sub>: Alternate cropping pattern i.e Mustard (var. BARI Sarisha-18)- Sesame (var. BARI Til-4)- B. Aman (var. BRRI dhan-91) was experimented. Rice Equivalent Yield (REY) in alternate cropping pattern was 8.69 t ha<sup>-1</sup>, which is higher over existing pattern (2.60 t ha<sup>-1</sup>). Higher gross return (Tk. 357040.00 ha<sup>-1</sup>) and gross margin (Tk. 236176.00 ha<sup>-1</sup>) as well as higher MBCR (2.95) were also obtained from alternate cropping pattern over existing cropping pattern due to additional yield of sesame and higher yield of modern var. BARI Sarisha-18 and BRRI dhan91.

#### **Development of improved cropping pattern potato-mungbean-T. Aus-yard long bean against potato-yard longbean-T. aus-T. Aman rice**

M. Jamal Uddin, S. K. Bhowal & M. M. Bashir

A field experiment was conducted at the farmers' field of Sayedpur Cumilla Sadar under AEZ 19 with the following rice based cropping pattern



during 2021-22 to fit Mungbean in the existing cropping pattern for increasing cropping intensity. Two treatments i.e., T<sub>1</sub>: Existing cropping pattern (Potato-Yard long bean-T. aus-T. Aman) and T<sub>2</sub>: Alternate cropping pattern (Potato- Mungbean-T. Aus-Yard long bean) was studied. Research findings revealed that Rice equivalent yield (REY) in alternate cropping pattern is 50.65t ha<sup>-1</sup>, which is almost 69.85% higher over existing pattern (29.82 t ha<sup>-1</sup>). Higher gross return (Tk. 1515870.00 ha<sup>-1</sup>) and gross margin (Tk. 1270334.00 ha<sup>-1</sup>) as well as higher MBCR (6.17) were also obtained from alternate cropping pattern over existing cropping pattern implies that the improved cropping pattern is profitable.

**Development of alternate cropping pattern potato-maize + leafy vegetable-t. Aman rice against potato-maize-t. Aman rice cropping pattern**

M S Huda

A field experiment was conducted at the farmers' field of Raniganj, Sadar Upazila under AEZ 1 of Dinajpur district during 2021-22 to fit vegetable in the existing cropping pattern and also to increase cropping intensity and productivity. Two treatments i.e., T<sub>1</sub>: Existing cropping pattern (Potato-Maize-T. Aman) and T<sub>2</sub>: Alternate cropping pattern (Potato-Maize + Palong Sak -T. Aman) were evaluated in the farmer's field. From the research findings, it is documented that Rice equivalent yield (REY) in the alternate cropping pattern is 51.42 t ha<sup>-1</sup>, which is almost 60% higher than the existing pattern (32.22 t ha<sup>-1</sup>). Higher gross return (Tk. 1285400 ha<sup>-1</sup>) and gross margin (Tk. 1050020 ha<sup>-1</sup>), as well as higher MBCR (1.75), were also obtained from alternate cropping pattern over the existing cropping pattern.

**Development of improved cropping pattern wheat-mungbean-t. Aman against wheat-fallow-t.aman rice in medium highland of aez-1**

Md.Nuruzzaman and Muhammad Shamsul Huda

An experiment was executed at multi-location testing (MLT) site Pirgonj, Thakurgaon during 2019-20 2020-21 and 2021-22 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 BARIGom-31, BARI Mung-8 and BRRIdhan87, respectively. The whole pattern rice equivalent yield in alternate cropping pattern was 16.46 t ha<sup>-1</sup> while 10.53 t ha<sup>-1</sup> in existing pattern. The higher gross return and gross margin were substantially higher in the alternate pattern than the farmer's existing pattern. The marginal benefit cost ratio (MBCR) was found 3.96 which indicated the superiority of alternate pattern over the farmer existing pattern.

**Development of improved cropping pattern maize-mungbean-T. Aman against maize-fallow-T. Aman rice in medium highland of dinajpur region**

Md.Nuruzzaman and Muhammad Shamsul Huda

The field experiment was conducted at MLT site Raniganj, Dinajpur for two consecutive years 2019-20, 2020-21 and 2021-22 to improve the existing cropping pattern for increasing cropping intensity and productivity by inclusion of mungbean. The alternate cropping pattern was Maize-Mungbean-T. Aman rice against the existing Maize-Fallow-T. Aman rice pattern. The experiment was laid out in RCB design with four dispersed replications. Three years mean data showed that the improve management practice for the pattern provided significantly higher yield. The rice equivalent yield in alternate cropping pattern was 22.90 while 15.75 t ha<sup>-1</sup> in existing pattern. The higher gross return of the alternate pattern was Tk.458000 ha<sup>-1</sup> which was 45% higher than farmers pattern (Tk.315000 ha<sup>-1</sup>) and gross margin were substantially higher in the alternate pattern than that of the farmer's existing pattern.

**Development of improved cropping pattern wheat-summer onion-t. Aman against wheat-fallow-t.aman rice in medium highland of aez-1**

Md.Nuruzzaman and Muhammad Shamsul Huda

A trial was conducted at multi-location testing (MLT) site Raniganj, Dinajpur during 2020-21 and 2021-22 increase cropping intensity and productivity by inclusion of summer onion. 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 was BARI Gom-31, BARI Piaz-5 and BRRIdhan87, respectively. The whole pattern rice equivalent yield in alternate

cropping pattern was 32.46 while 10.38 t ha<sup>-1</sup> in existing pattern. The higher gross return and gross margin were found higher in the alternate pattern than the farmer's existing pattern.

#### **Development of alternate cropping pattern boro-t. Aman rice-mustard against boro-t. Aman-fallow in Faridpur**

Selim Ahmed and Md Zahid Hasan Sohel

The trial was conducted at FSRD site, Faridpur during *rabi* 2022 with alternate cropping pattern Boro-T. Aman rice-Mustard against existing cropping pattern Boro-T. Aman- Fallow to increase yield and economic return. The trial belongs to AEZ 12. The yield of Boro, T. Aman and Mustard in alternate cropping pattern was 6.92, 4.53 and 1.09 t ha<sup>-1</sup> while Boro and T. Aman in existing pattern was 5.43 and 4.21 t ha<sup>-1</sup>, respectively. The alternate cropping pattern gave higher rice equivalent yield (14.80) against existing cropping pattern (9.83) which 50% higher than existing cropping sequence. The production efficiency was higher (50%) in existing cropping pattern. The higher gross return (Tk. 518390 ha<sup>-1</sup>) and gross margin (Tk.252780 ha<sup>-1</sup>) were obtained in alternate cropping pattern. The MBCR (3.3) of alternative pattern over existing cropping pattern was also profitable.

#### **Development of existing cropping pattern mustard-sesame-t. Aman in Faridpur**

Selim Ahmed, Md Zahid Hasan Sohel and Ferdousi Begum

A trial was conducted at FSRD site, Faridpur started during Kharif I, 2021-22 and continued in 2022-23 to improve the existing cropping pattern Mustard-Sesame-T. Aman and increase yield & economic return through rice-based cropping system. The yield of sesame, T. Aman and mustard in improved cropping pattern were 1.57, 4.75 and 1.7 t ha<sup>-1</sup> while in existing pattern 1.38, 4.42, 1.44 t ha<sup>-1</sup>, respectively. REY was found to increase 6.7% over existing cropping sequence. The production efficiency was increased near about 9.26 % over existing cropping sequence. The higher gross return (Tk. 448030 ha<sup>-1</sup>) and gross margin (Tk. 234868 ha<sup>-1</sup>) were obtained in improved Mustard-Sesame-T. Aman cropping pattern and lower gross return (Tk 391560 ha<sup>-1</sup>) and gross margin (Tk. 190470 ha<sup>-1</sup>) were found in existing cropping pattern. The average MBCR (4.72) of two years' study of

alternative pattern over existing cropping pattern was also promising.

#### **Development of alternate cropping pattern sunflower-jute-t. Aman rice against existing cropping pattern lentil-jute-t. Aman in Faridpur (epoc project)**

Selim Ahmed, Md Zahid Hasan Sohel and Ferdousi Begum

A trial was conducted under "Expanded Production of Oilseed Crop (EPOC)" project at FSRD site, Faridpur started with 2021-22 and continued in 2022-23 with alternate cropping pattern Sunflower-Jute-T. Aman against existing cropping pattern Lentil-Jute-T. Aman to increase productivity and economic return through rice-based cropping system. The yield of jute, T. Aman and sunflower in alternate cropping pattern was 3.12, 5.28, 2.33 t ha<sup>-1</sup> while in existing pattern the yield of Lentil-Jute-T. Aman was 2.77, 4.82, 1.93 t ha<sup>-1</sup>, respectively. REY was increased 20% over existing cropping sequence. The production efficiency was increased 9.5% over existing cropping pattern. The higher gross return (Tk. 695690 ha<sup>-1</sup>) and gross margin (Tk. 381206 ha<sup>-1</sup>) were obtained in alternate cropping pattern and lower gross return (Tk 578785 ha<sup>-1</sup>) and gross margin (Tk. 292631 ha<sup>-1</sup>) were found in existing cropping pattern.

#### **Development of alternate cropping pattern mustard-boro-t. Aman rice against fallow-boro-t. Aman rice in active Brahmaputra Jamuna floodplain of Gaibandha**

Md Jahangir Alam, Abdullah-Al-Mahmud and Md Shohel Rana

The experiment was conducted at Kalpani, Saghata, Gaibandha during 2022-23 to intensify cropping system from double to triple as well as to increase the productivity and profitability. The system productivity based on rice equivalent yield (REY) in the alternate cropping pattern was 15.99 t ha<sup>-1</sup>, which was 41% higher than that of the existing cropping pattern (11.35 t ha<sup>-1</sup>). The gross return from the alternate cropping pattern was Tk. 399850 ha<sup>-1</sup>, 41% more compared to the existing cropping pattern with a value of Tk. 283850 ha<sup>-1</sup>. Similarly, the higher gross margin was recorded from the alternate cropping pattern (Tk. 151850 ha<sup>-1</sup>) or 76% higher than the existing cropping pattern (Tk. 86350 ha<sup>-1</sup>). Finally, the marginal benefit-cost ratio (MBCR) of the whole cropping pattern was 2.30 over the existing cropping pattern.

**Development of mustard-sesame-t. Aman cropping pattern against boro-fallow-t. Aman in active Brahmaputra Jamuna floodplain of Gaibandha**

Md Jahangir Alam, Abdullah-Al-Mahmud, and Md Shohel Rana

The experiment was conducted at Kamolpur, Saghata, Gaibandha under On-Farm Research Division during 2022-23 to increase the cropping intensity and productivity by integrating short-term mustard in rice-based cropping patterns. The system productivity based on rice equivalent yield (REY) in the alternate cropping pattern was 14.69 t ha<sup>-1</sup>, which was 34% higher than that of the existing cropping pattern (10.99 t ha<sup>-1</sup>). The gross return from the alternate cropping pattern was Tk. 403920 ha<sup>-1</sup>, 34% more compared to the existing cropping pattern with a value of Tk. 302335 ha<sup>-1</sup>. Similarly, a higher gross margin was recorded from the alternate cropping pattern (Tk. 153920 ha<sup>-1</sup>) or 14% higher than the existing cropping pattern (Tk. 134835 ha<sup>-1</sup>). Finally, the marginal benefit-cost ratio (MBCR) of the whole cropping pattern was 1.23 over the existing cropping pattern.

**Development of alternate cropping pattern wheat-jute-t. Aman against farmers existing fallow-jute-t. Aman pattern in gopalganj region**

M M Howlader

The experiment was conducted at the MLT site, Tungipara, Sader and Moksedpur under Gopalganj district and Najirpur Pirojpur during 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 (REY) (22.01 t ha<sup>-1</sup>) where farmers practice gave (17.04 t ha<sup>-1</sup>). At the same time improved cropping, Wheat-Jute-T. Aman gave highest gross return (Tk. 550270 ha<sup>-1</sup>) and gross margin (Tk. 195670 ha<sup>-1</sup>). The MBCR of 1.73 in improved pattern meaning superiority of improved pattern over existing pattern.

**Development of alternate cropping pattern fieldpea-boro-t. Aman against mustard-boro-t. Aman cropping pattern**

M H Rahman and K U Ahammad

The trial was conducted at the farmers' field of Multilocation testing (MLT) site, Jhikargacha,

Jashore during 2022-23 to develop Fieldpea (BARI Motor-3)-Boro (BRRI dhan63)- T. Aman (BRRI dhan75) rice cropping pattern. There were two treatments i.e, T<sub>1</sub>: Existing Cropping pattern: Mustard (var. BARI Sarisha-14)-Boro (var. BRRI dhan28)-T. Aman (var. Binadhan-7) and T<sub>2</sub>: Alternate Cropping pattern: Fieldpea (var. BARI Motor-3)-Boro (var. BRRI dhan63)-T. Aman (var. BRRI dhan75). Higher Rice Equivalent yield and gross margin were obtained from alternate cropping pattern over existing cropping pattern due to inclusion of new crops and marginal benefit cost ratio was 1.81.

**Development of alternate cropping pattern mustard-jute-t. Aman against lentil-jute-t. Aman cropping pattern**

M H Rahman and K U Ahammad

A trial was conducted at the farmers' field of Multilocation testing (MLT) site, Shalikha, Magura during 2022-23 to develop Mustard (var. BARI Sarisha-18)-Jute (var. BJRI Tosha pat -8)-T. Aman (var. BRRI dhan87) cropping pattern. There were two treatments i.e, T<sub>1</sub>: Existing Cropping pattern: Lentil (var. BARI Masur-7)-Jute (var. O-9897)-T. Aman (var. Binadhan-7) and T<sub>2</sub>: Alternate Cropping pattern: Mustard (var. BARI Sarisha-18)-Jute (var. BJRI Tosha pat -8)-T. Aman (var. BRRI dhan87). Higher Rice Equivalent yield and gross margin were obtained from alternate cropping pattern over existing cropping pattern due to inclusion of new crops and marginal benefit cost ratio was 1.35.

**Development of alternate cropping pattern t. Aus -cauliflower + knolkhol - relay pointed gourd against t. Aman – cauliflower - fallow**

M. K. Shahadat, M. H. Rashid, M. K. Islam, M. M. Rahman, and T. S. Munmun

An on-farm trial was conducted during two consecutive years 2021-22 and 2022-23 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. Improved pattern produced the higher REY (63.04 and 56.82 t ha<sup>-1</sup>) than farmers practice (18.03 and 12.40 t ha<sup>-1</sup>) in each year, respectively. Production efficiency was also higher in IP (200.77 and 245.95 kg ha<sup>-1</sup>day<sup>-1</sup>) than farmers practice (71.78 and 70.45



kg ha<sup>-1</sup>day<sup>-1</sup>). The IP produced the higher gross return (Tk. 1260840 and 1136310) and gross margin (Tk.932340 and 248500) in 2021-22 and 2022-23, respectively with MBCR of 7.93 and 10.44 in 2021-22 and 2022-23, respectively.

#### **Development of alternate cropping pattern through t. Aman –mustard–jute against t. Aman–fallow–fallow**

M.K. Islam, M.H. Rashid, T.S. Munmun, M. Rahman and M. K. Shahadat

The experiment was conducted at the MLT site, Satkhira during 2022-2023 for improving the productivity and profitability of an existing cropping pattern T. Aman–Fallow–Fallow by introducing BARI Sharisha-18 variety after T. Aman harvest. Results revealed that improved cropping pattern T. Aman–Mustard–Jute produced the highest total rice equivalent yield (10.74 t ha<sup>-1</sup>) than farmers practice (4.75 t ha<sup>-1</sup>). As a result, an improved cropping pattern brought the highest gross return (Tk. 322200) and gross margin (Tk. 192740). The overall MBCR of 2.49 from an improved pattern over existing cropping pattern.

#### **Development of potato-groundnut-fallow cropping pattern against existing fallow-boro-fallow**

M. Mohiuddin and M. Y. H. Rayhan

An experiment was executed at the MLT site Nikli during 2022-2023 under AEZ # 9 to introduce two crops based Potato-Groundnut-Fallow cropping patterns as well as to increase crop production and economic return of the farmers. It was laid out in RCBD design with four dispersed replications. The improved cropping pattern gave the highest rice equivalent yield (19.3 tha<sup>-1</sup>) against existing cropping pattern (7.45 tha<sup>-1</sup>). The improved cropping pattern gave the higher gross margin (288703 Tkha<sup>-1</sup>) compared to existing pattern (105796 Tkha<sup>-1</sup>). The MBCR was 2.73 over the existing cropping pattern.

#### **Development of potato-jute leaf-cucumber-t. Aman rice cropping pattern against existing maize-fallow-t. Aman rice**

M. Mohiuddin and M. Y. H. Rayhan

An experiment was executed at the MLT site Hossainpur during 2021-2022 under AEZ # 9 to introduce four crops-based Potato-Jute leaf-

Cucumber-T. Aman cropping patterns as well as to increase crop production and economic return of the farmers. It was laid out in RCB design with four dispersed replications. The improved cropping pattern gave the highest yield (52.68 tha<sup>-1</sup>) against existing cropping pattern (15.08 tha<sup>-1</sup>). The improved cropping pattern gave the higher gross margin (486554Tkha<sup>-1</sup>) compared to existing pattern (123825 Tkha<sup>-1</sup>) with MBCR of 3.93 over existing cropping pattern.

#### **Development of potato-jute-t. Aman rice cropping pattern against wheat-jute-t. Aman rice cropping pattern**

M.Mohiuddin and M.Y.H. Rayhan

An experiment was executed at the MLT site Hossainpur during 2021-2022 under AEZ # 9 to introduce four crops based Potato-Jute-T. Aman cropping patterns as well as to increase crop production and economic return of the farmers. It was laid out in RCB design with four dispersed replications. The improved cropping pattern gave the highest yield (33.78 t ha<sup>-1</sup>) against existing cropping pattern (15.98 t ha<sup>-1</sup>). The improved cropping pattern gave the higher gross margin (258510 Tk. ha<sup>-1</sup>) compared to existing pattern (81555 Tk.ha<sup>-1</sup>). The MBCR was 3.17 over existing cropping pattern.

#### **Improvement of sweet gourd-kenaf-fallow cropping pattern against existing cropping pattern in haor areas of Kishoreganj**

M. Mohiuddin and M. Y. H. Rayhan

The experiment was conducted in Old Meghna Estuarine Floodplain soils under the Agro-Ecological Zone (AEZ) 19 at MLT site, Nunir haor, Nikli, Kishoreganj, 2021-22. Results showed that the highest rice equivalent yield (14.75 tha<sup>-1</sup>) was obtained from two crops pattern. The highest average gross return and gross margin of the two crops pattern were obtained Tk.295010 and Tk. 150190 ha<sup>-1</sup> which were 98 and 138 % higher over farmers' pattern. The marginal benefit cost ratio (MBCR) was found 2.47 which indicated the superiority of two crops pattern over the farmers' existing pattern. The marginal benefit cost ratio (MBCR) analysis also showed that inclusion of sweet gourd and kenaf rice in the existing pattern might be profitable and acceptable to the farmers.

### **Improvement of mustard-boro-t. Aman cropping pattern in Kushtia**

J. A. Mahmud, M. M. Morshed, M. M. Hossain

An experiment was conducted at Kushtia sadar upazila during 2022-2023 to improve cropping pattern Mustard-Boro-T. Aman with latest varieties. The varieties Fallow-Boro (var. BRRI dhan-28)-T. Aman (Bina dhan-7) were replaced by Mustard (BARI Sarisha-14)-Boro (Rod mini)-T. Aman (BRRI dhan-75). Gross return and gross margin (Tk. 439588 ha<sup>-1</sup> and Tk. 219238 ha<sup>-1</sup>) were higher in ICS where existing cropping pattern were Tk. 279163 ha<sup>-1</sup> and Tk. 113913 ha<sup>-1</sup>. The marginal benefit and cost ratio 2.91 was much higher over farmer's practice

### **Development of alternate cropping pattern vegetable-vegetable-t. Aman against vegetable-fallow-t. Aman rice**

M Asaduzzaman

The experiment was conducted at OFRD, BARI, Shibpur, Narsingdi during the years 2020-21 and 2021-2022 to improve the existing cropping pattern by inclusion of vegetables and to increase crop yield and farmers' income. The experiment was laid out in 3600 m<sup>2</sup> of land under 6 farmers. Alternate cropping pattern Potato (var. BARI Alu40)-Ladies finger (var. BARI Derosh-2)-T. Aman (var. BRRI dhan72) gave higher gross margin (Tk. 434814 ha<sup>-1</sup>) against the existing pattern Cabbage (var. Atlas 70)- Fallow-T. Aman (var. BRRI dhan49) with gross margin of Tk. 245484 ha<sup>-1</sup>.

### **Development of alternate cropping pattern vegetable-jute-t. Aman rice against wheat-jute - t. Aman rice**

M Asaduzzaman

The experiment was conducted at OFRD, BARI, Shibpur, Narsingdi during the year of 2021-22 to improve the existing cropping pattern by inclusion of vegetables and to increase crop yield and farmers income. The experiment was laid out in RCB design in an area of 4800 m<sup>2</sup> of land under 6 farmers. Alternate cropping pattern Potato (var. BARI Alu-40) - Jute (var. Deshi Pat-5) - T. Aman (var. BRRI dhan49) gave higher whole pattern gross margin (Tk. 607060 ha<sup>-1</sup>) against the existing pattern Wheat (var. BARI Gom-21)- Jute (var. CVL1)-T. Aman (var. BRRI dhan-87) with (Tk. 190920 ha<sup>-1</sup>).

### **Improvement of t. Aman rice-mustard-boro rice cropping pattern**

M. Maniruzzaman, M. A. Isalm, M. Z. Hasan, M. A. Suborna, M. S. H. Molla and M.R. Alam

The program was carried out at the farmers' field during 2022-23 to improve T. Aman-Mustard-Sesame rice cropping pattern comparing with T. Aman-Mustard-Boro rice at FSRD site, Ganggarampur, Pabna. The program was implemented in five farmer's fields. Crop yield of T. Aman, Mustard and Boro rice were recorded as 5.30, 1.71 and 5.56 t ha<sup>-1</sup>, respectively with rice equivalent yield (REY) 18.6 t ha<sup>-1</sup> in the improved cropping pattern whereas REY 16.47 t ha<sup>-1</sup> were recorded in the existing cropping pattern. The gross margin was higher in improved cropping pattern than existing pattern due to addition of Mustard.

### **Improvement of t. Aman-mustard-sesame cropping pattern**

M. Maniruzzaman, M. A. Isalm, M. Z. Hasan, M. A. Suborna, M. S. H. Molla and M.R. Alam

The program was carried out at the farmers' field during 2022-23 to improve T. Aman-Mustard-Sesame rice cropping pattern at FSRD site, Ganggarampur, Pabna. The program was implemented in five farmer's fields. Yield of T. Aman, Mustard and Sesame rice were recorded as 4.63, 1.81 and 1.38 t ha<sup>-1</sup>, respectively with rice equivalent yield (REY) 15.54 t ha<sup>-1</sup> in the improved cropping pattern whereas REY 13.73 t ha<sup>-1</sup> were recorded in the existing cropping pattern. The gross margin was higher in improved cropping pattern than existing pattern due to inclusion of modern high yielding varieties.

### **Development of alternate cropping pattern relaying maize with potato -fallow- t. Aman rice against farmers existing potato-fallow-t. Aman rice pattern in coastal region**

M. M. Islam, K. N. Islam and M. S. I. Khan

The experiment was conducted at MLT site Kuakata, Kalapara, Patuakhali during the year of 2022-23 to determine the profitability of the developing cropping pattern, Maize (var. Hybrid NK-40) relaying Potato (var. BARI Alu-72)-Fallow - T. Aman rice (var. BRRI dhan 49) against the farmers' existing pattern Potato (var. BARI Alu-7) - Fallow - T. Aman rice (Sarnogota). The developed cropping pattern was found

Agronomically and economically more profitable than the existing pattern. Fertilizer was applied in potato at early vegetative stage in relay maize. The highest gross return (Tk. 830720/ha), gross margin (Tk. 530320 ha<sup>-1</sup>) and MBCR (1.76) were obtained from developed cropping pattern over existing pattern. The similar results were found during last two years. So, Potato/Maize - Fallow - T. Aman rice could be recommended as a new pattern in coastal regions.

**Development of alternate cropping pattern onion/ groundnut-t. Aman instead of groundnut-t. Aman in charland area**

Md. Zannatul Ferdous, Md. Al-Amin Hossain Talukder and Eakramul Haque

A rice-based improved cropping pattern was tested at Char land areas against farmers traditional practice at Ulipur site, Rangpur under during 2021-22 to develop a new cropping pattern. The yields of onion, groundnut and T. Aman grain seed were recorded as 13.17, 1.56 and 4.46 t ha<sup>-1</sup>, respectively with rice equivalent yield (REY) 25.73 t ha<sup>-1</sup> in the improved cropping pattern, whereas 1.37 and 5.61 t ha<sup>-1</sup> grain, or seed yield of Groundnut and T. Aman with REY 13.32 t ha<sup>-1</sup> were recorded in the existing cropping pattern. The whole pattern gross margin was higher in alternate pattern (Tk. 382748 ha<sup>-1</sup>) than existing pattern (Tk. 178320 ha<sup>-1</sup>). The MBCR was 1.73 in alternate pattern over existing pattern.

**Development of four crops based cropping pattern potato-potato-jute-t. Aman rice instead of tobacco-maize-t. Aman rice**

S. M. A. H. M. Kamal, Ummay Kulsum Laily and M. A. H. Talukder

A observation trial was conducted at Magura, Kisorganj, Nilphamari, OFRD with compare to farmer existing cropping pattern to increase cropping intensity, find out the suitability of the cropping pattern in the region and the productivity to increase the production per unit area per unit time during Rabi season 2021-22. The total potato equivalent tuber yield was recorded 86.18 t ha<sup>-1</sup> from developed cropping pattern against 39.33 t ha<sup>-1</sup> from FP. The gross margin of developed cropping pattern and farmers cropping pattern were Tk. 898016 and 351320 ha<sup>-1</sup>, respectively. The benefit of developed cropping pattern was 546696 Tk. ha<sup>-1</sup> over the farmers cropping pattern.

**Increase cropping intensity and productivity by adoption of short duration mustard varieties in rice based cropping system (sherpur region)**

M.A. Rahman, M. M. Rahaman and A.K.M.Z. Noor

The experiment was conducted at FSRD, Tarakandi, Sherpur of On-Farm Research Division, BARI, Sherpur during 2022-2023 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 (var. BARI Sarisha-14) after T. Aman rice harvest. The higher rice equivalent yield (16.54 t/ha) was obtained from improved cropping pattern which was 62.15% higher over farmers existing pattern. At the same time, improved cropping pattern Mustard- Boro-T. Aman rice gave higher gross return (Tk. 441207 ha<sup>-1</sup>) and gross margin (Tk. 181747 ha<sup>-1</sup>) which was (56.34%) higher over farmers' pattern. Farmers practice gave the lower gross return (Tk. 282200ha<sup>-1</sup>) and gross margin (Tk. 100665 ha<sup>-1</sup>).

**Increase cropping intensity and productivity by adoption of short duration mustard varieties in rice based cropping system (jamalpur region)**

M.A. Rahman, M. M. Rahaman and A.K.M.Z. Noor

The experiment was conducted at Multilocation Testing site (MLT), Baoushi, Sarishabari, Jamalpur under On-Farm Research Division, BARI, Sherpur during 2022-2023 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) was obtained from improved cropping pattern which was 48.5% higher over farmers existing pattern. At the same time, the improved cropping pattern Mustard- Boro-T. Aman rice gave higher gross return (Tk. 4,13,400 ha<sup>-1</sup>) and gross margin (Tk. 1,36,018 ha<sup>-1</sup>). Farmers practice gave the lower gross return (Tk. 2,49,400 ha<sup>-1</sup>) and gross margin (Tk. 44,326ha<sup>-1</sup>).



### **Development of onion-based cropping patterns against onion-jute- t aman rice cropping pattern**

M. N. A Siddique, M. J. Islam, M. M. I. Chowdhury

The experiment was conducted at the experimental field of on-farm research division, Shyampur, Rajshahi, 2021-22 to see the performance of AP1: Onion (Leaf +Bulb)-Onion (Bulb)-T. Aus rice-T. Aman rice, AP2: Potato (Early harvest)-Onion (Bulb)- Jute- T. Aman, and AP3: Mustard- Onion (Bulb)-T. Aus rice-T. Aman rice) over the existing (EP): Onion (Bulb)-Jute- T Aman rice. The experiment was conducted in a RCB design with three dispersed replications. The higher REY (55.41 t ha<sup>-1</sup>) was recorded from AP1; over the REY of EP (26.37 t ha<sup>-1</sup>). The higher production efficiency (170.5 kg<sup>-1</sup> ha<sup>-1</sup> day<sup>-1</sup>), gross return (Tk. 1697170ha<sup>-1</sup>) and gross margin (Tk. 1020333 ha<sup>-1</sup>) was obtained from AP1.

### **Improvement of cropping patterns with summer vegetables and t. Aus rice**

M. S. Rahman, M. N. A.

The experiment was conducted at experimental field of on-farm research division, Shyampur, Rajshahi, 2021-22 to see the performance of alternate cropping patterns AP1: Potato-sweet gourd- T. Aus- T. Aman, AP2: Potato-Stem amaranth- T. Aus- T. Aman and existing pattern (EP): Potato- Boro rice-T. Aman in AEZ 11. The experiment was conducted by following RCB design with three replications. The higher rice equivalent yield (39.1 t ha<sup>-1</sup>) was recorded from AP2 over EP. The higher PE was observed in AP2 (126.1 kg<sup>-1</sup> ha<sup>-1</sup> day<sup>-1</sup>) but EP provided lower PE (75.3 kg<sup>-1</sup> ha<sup>-1</sup> day<sup>-1</sup>). The higher LUE (94 %) was recorded in AP1, whereas (85%) was in AP2. The higher gross margin (Tk. 654694 ha<sup>-1</sup>) was recorded in AP2 than EP (Potato-Boro rice-T. Aman rice).

### **Improvement fallow-t. Aus-t. Aman rice against mustard-t. Aus -t. Aman rice under aez 20 of sylhet region**

M. I. Nazrul

An experiment was executed at multilocation testing (MLT) sites, Moulvibazar during 2021-2022 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 pattern (EP): Fallow-T. aus-T. Aman rice and improved cropping pattern (IP): Mustard-T. aus-T. Aman rice, respectively tested under this experimentation. The variety BARI Sarisha-14 for mustard, BRRI dhan48 of T. aus rice and BRRI dhan75 of T. Aman rice were used in this trial. The improved pattern (IP) provided 16.32 t ha<sup>-1</sup> of T. Aman rice equivalent yield which was almost 75 % higher than that of existing pattern EP. Similarly, the highest total gross margin (Tk. 178360 ha<sup>-1</sup>) with marginal benefit cost ratio (2.65) was obtained over the existing pattern.

### **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**

M. I. Nazrul and F. Begum

The study was conducted at the farmer's field in Sylhet under AEZ 20 during two consecutive years 2020-21 and 2021-2022. Two cropping patterns viz. improved pattern (IP): Mustard (BARI Sarisha-18-T. Aus (BRRI dhan48)-T. Aman ric (BRRI dhan75) and existing pattern (EP): Mustard (var. BARI Sarisha-14-T. Aus(var. BRRI dhan48)-T. Aman rice (var. Binadhan-7) were tested. The experiment was laid out in RCB design with six dispersed replications. Results showed that the IP with high management practices provided 24.95 % higher REY than EP. Similarly, the highest gross margin (Tk. 231790 ha<sup>-1</sup>) with MBCR (1.51) was obtained over the EP. Results revealed that 4.41 % extra cost provides ample scope for considerable improvement of the productivity with the inclusion of modern mustard and T. Aman rice in improved pattern.

### **Developmentof alternative cropping pattern mustard - sesame - t. Aman rice against mustard – fallow - t. Aman cropping pattern in hibiganj**

M. I. Nazrul and F. Begum

A field trial was conducted at the farmers' field of Baniachang, Hobiganj during 2022-2023 to develop Mustard-Sesame-T. Aman rice cropping pattern. There were two treatments viz. EP (Existing Cropping pattern): Mustard (var. BARI Sarisha-18)-Fallow-T. Aman (var. BRRI dhan75) and AP (Alternate Cropping pattern): Mustard (var. BARI Sarisha-18)-Sesame var. (BARI Til-4/5)-T. Aman (var. Binadhan-16/17). In AP, yield of

mustard, sesame and T. Aman rice were 8.13, 6.56, and 7.67 t ha<sup>-1</sup>, respectively while in EP, yields of mustard and T. Aman rice were 8.15 and 5.58 t ha<sup>-1</sup>, respectively. The AP gave higher REY (22.36 t ha<sup>-1</sup>) than EP (13.73 t ha<sup>-1</sup>); which was 62.85 % higher. The total gross margin of AP was Tk. 327230 ha<sup>-1</sup> whereas in EP those value was Tk. 178190 ha<sup>-1</sup>, respectively and MBCR was 1.84.

#### **Intercropping of sweet gourd with cabbage**

Quamrun-Naher, M. Akhtar Hossain, M. Faruque Hossain, Apurba Chaki, Taslima Zahan, M Mazharul Anwar, M Robiul Alam

The experiment was conducted at MLT site, Dhirashram, Gazipur sadar during rabi of 2022-23 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<sub>1</sub>= Sole Sweet gourd (2 m × 2 m), T<sub>2</sub>=Sole Cabbage (60 cm × 45 cm), T<sub>3</sub>= Sweet gourd (2m × 2m) + Cabbage (60 cm × 45 cm), T<sub>4</sub>= Sweet gourd (2m × 2m) + Cabbage (65 cm × 50cm) and T<sub>5</sub>=Sweet gourd (2m × 2m) + Cabbage (70 cm × 55 cm) were tested. The variety BARI Mistikumra-2 and cabbage var. Autumn queen were tested with three dispersed replications. CEY (74.65t ha<sup>-1</sup>) in sweet gourd (2 m × 2 m) + Cabbage (65 cm × 50 cm) combination was higher than sole cabbage (60 cm×40 cm) (64.8 t ha<sup>-1</sup>). Maximum gross margin was also achieved in T<sub>4</sub> (Tk.451500ha<sup>-1</sup>) followed by T<sub>3</sub> (Tk. 438500 ha<sup>-1</sup>).

#### **Performance of bush bean intercropped with groundnut in haor areas of Sylhet region**

M. I. Nazrul

An experiment was conducted at farmers' field of Hakaluki Haor under MLT site, Moulvibazer during 2022-23. Five intercrop combinations, T<sub>1</sub>: sole groundnut, T<sub>2</sub>: sole bush bean, T<sub>3</sub>: alternate row of groundnut and bush bean, T<sub>4</sub>: Two rows of groundnut in between paired rows of bush bean and T<sub>5</sub>: Two rows of bush bean in between paired rows of groundnut were considered. The experiment was set up in RCB design with six dispersed replications. The higher ground nut equivalent yield (4.97 t ha<sup>-1</sup>) was obtained from T<sub>3</sub>, the lowest yield (3.30 t ha<sup>-1</sup>) was found from T<sub>1</sub>. The highest gross return (Tk. 447300 ha<sup>-1</sup>) and gross margin (Tk. 283950 ha<sup>-1</sup>) was also recorded from T<sub>3</sub>, which was more than 55 percent higher over sole ground nut.

#### **Intercropping of cabbage and cauliflower with sugarcane**

S. Roy, M. A. Rahaman, T. Tasmima, G. Paul, and K. Roy

An experiment was conducted at the FSRD site, Atia, Delduar, Tangail during 2021-22 to find out the suitable crop for intercropping with sugarcane under farmers' field condition for increasing cropping intensity, increase productivity and economic returns. Four treatments viz., T<sub>1</sub> = sole sugarcane (100%), T<sub>2</sub>= Sugarcane (100%) + Two rows of cabbage (80%), T<sub>3</sub> = Sugarcane (100%) + Two rows of Cauliflower (80%), T<sub>4</sub> = Farmers' practice (Sugarcane 100% + Cauliflower 80%). Analysis of intercropping treatments revealed that two rows of cauliflower in between two rows of sugarcane resulted in the highest sugarcane equivalent yield (177.80 t ha<sup>-1</sup>) as well as gross margin (Tk. 932822 ha<sup>-1</sup>) and the lowest sugarcane equivalent yield (107.33 t ha<sup>-1</sup>) as well as gross margin (Tk. 499057 ha<sup>-1</sup>) were obtained from T<sub>1</sub> treatment (Sole sugarcane).

#### **Intercropping of onion and potato with sugarcane**

S. Roy, M. A. Rahaman, T. Tasmima, G. Paul, and K. Roy

An experiment was conducted at the FSRD site, Atia, Delduar, Tangail during 2021-22 to find out the suitable crop for intercropping with sugarcane under farmers' field condition for increasing cropping intensity and increase productivity and economic returns. Four treatments viz., T<sub>1</sub> = sole sugarcane (100%), T<sub>2</sub>= Sugarcane (100%) + Five rows of onion (83%), T<sub>3</sub> = Sugarcane (100%) + Two rows of potato (67%), T<sub>4</sub> = Farmers' practice (Sugarcane 100% + Cauliflower 80%). Analysis of intercropping treatments revealed that T<sub>2</sub> treatment (five rows of onion in between two rows of sugarcane) resulted in the highest sugarcane equivalent yield (167.30 t ha<sup>-1</sup>) but the highest gross margin (Tk. 678811 ha<sup>-1</sup>) was obtained from T<sub>3</sub> treatment (Sugarcane 100% + Two rows of potato 67%) and the lowest sugarcane equivalent yield (129.33 t ha<sup>-1</sup>) as well as gross margin (Tk. 545727 ha<sup>-1</sup>) was recorded in sole sugarcane.

#### **Intercropping of potato with brinjal**

S. Roy, M. A. Rahaman, T. Tasmima, G. Paul and K. Roy

An experiment was conducted at the FSRD site, Atia, Delduar, Tangail during 2021-22 to find out the

most suitable intercropping system. Five treatments viz.,  $T_1$  = sole brinjal (100 cm x 75 cm),  $T_2$  = sole potato (50 cm x 20 cm),  $T_3$  = potato (50 cm x 20 cm) + brinjal (100 cm x 60 cm),  $T_4$  = brinjal (100 cm x 75 cm) + potato (50 cm x 20 cm),  $T_5$  (Farmers' practice) = brinjal (100 cm x 100 cm) + potato (50 cm x 20 cm). The results revealed that potato+brinjal gave the highest potato equivalent yield (82.53 t ha<sup>-1</sup>) and gross margin (Tk. 917725 ha<sup>-1</sup>).

#### **Utilization of inter space of watermelon through spices production in saline area**

M.S. Islam and M.M. Bashir

The experiment was conducted in the farmer's field of Char Wapda, Sadar upazilla in Noakhali district during Rabi season of 2022-23 to select suitable intercrop for utilizing the inter space of watermelon. Onion, garlic, and coriander leaf were tested. The yield of onion, garlic and coriander leaf were 7.06, 2.54 and 1.18 t ha<sup>-1</sup>, respectively. Among them the highest gross return (Tk.176500 ka<sup>-1</sup>) and gross margin (Tk.115400 ka<sup>-1</sup>) were obtained from onion. Coriander leaf stood the second position in terms of gross margin (Tk. 804000 ka<sup>-1</sup>). The lowest gross margin was from garlic (Tk. 71000 ka<sup>-1</sup>).

#### **Effect of intercropping onion with okra at charland of Mymensingh**

N. Sultana and M.M. Zaman

The experiment was carried out at the farmers' field of Mymensingh region to find out a suitable intercrop system in increasing of onion and okra during Rabi 2022-2023. For this instance, the treatments were consisted of  $T_1$ =Sole okra (45cm x 30cm),  $T_2$ = Sole onion (15cm x 10cm),  $T_3$ =One row onion in between two rows of okra,  $T_4$ =Two rows of onion in between two rows of okra,  $T_5$ =Three rows of onion inbetween two rows of okra. Between the intercropped treatments,  $T_5$  okra showed higher onion equivalent yield (44.3 t ha<sup>-1</sup>) and land equivalent ratio 1.74 as compared to other treatments. While, higher economic return (Tk. 749300 ha<sup>-1</sup>) was obtained from  $T_5$ .

#### **Performance of intercrops with panikachu in charland of sherpur**

M. M. Rahman, A.K.M.Z.U. Noor Andm. A. Rahman

The field experiment was conducted at FSRD site Tarakandi under Sherpur district during the

cropping season of 2022-23 at the farmer's field to investigate growth and yield of vegetable and spices and taro grown alone as sole crop and in various combinations (intercropping). Five treatments combination viz.,  $T_1$ = Sole taro,  $T_2$ =taro+ spinach,  $T_3$ =taro+ coriander leaf,  $T_4$ =taro+ radish and  $T_5$ =taro+ stem amaranth were tested. The highest taro equivalent yield was resulted from  $T_3$  (87.95 t/ha) which was 23% higher than sole crop, while lowest taro equivalent yield was obtain from  $T_1$  (71.5 t/ha.). The gross margin and return was also maximum in  $T_3$  14,11,503/- Tk/ha and 9,55,970/-Tk/ha, respectively.

#### **Performance of intercropping garlic, onion, fenugreek, black cumin with groundnut in charland areas**

An experiment was conducted at the MLT site, Bhuapur, Tangail during the rabi season of 2021-22 and 2022-23 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 two rows of groundnut resulted in the highest groundnut equivalent yield (5.80 t ha<sup>-1</sup>) as well as gross margin (Tk. 388270 ha<sup>-1</sup>) and the lowest groundnut equivalent yield (1.74 t ha<sup>-1</sup>) as well as gross margin (Tk. 67795 ha<sup>-1</sup>) were obtained from  $T_3$  treatment.

#### **Performance on mixed cropping system of lentil, mustard and linseed under aez-11**

M. Maniruzzaman, M. A. Isalm, M. Z. Hasan, M. A. Suborna, M. S. H. Molla and M.R. Alam

The field experiment was carried out at MLT site, Atghoria during rabi season of 2022-23 to verify the performance of mustard and linseed as mixed cropping with lentil. The treatments  $T_1$ = Lentil (80%) + Linseed (20%),  $T_2$ = Lentil (80%) + Mustard (20%),  $T_3$ = Lentil (75%) + Mustard (15%) + Linseed (10%),  $T_4$ = Lentil (100%),  $T_5$ = Mustard (100%) and  $T_6$ = Linseed (100%) were used. Maximum lentil equivalent yield (LER) (1.52 t ha<sup>-1</sup>) was obtained from Lentil (80%) + Mustard



(20%), which is identical to Lentil (80%) + Linseed (20%). Two crop mixed cropping systems produced the higher economic return and LER than sole crop and three crop based mixed crop cultivation.

#### **Mixed cropping of mustard with lentil at a different seed ratios**

M. S. Rahman, M. N. A. Siddique, M. J. Islam and M. M. I. Chowdhury

The experiment was undertaken to study the effect of lentil (BARI Masur-8) and mustard (BARI Sharisa-14) mixed cropping in different plant populations at Shibpur and Paba, Rajshahi during 2022-2023 cropping season. The mixed cropping ratios were  $T_1=100\%$  lentil + 5% mustard,  $T_2=100\%$  lentil + 10% mustard,  $T_3=100\%$  lentil + 15% mustard and as two sole crops  $T_4=$ mustard and  $T_5=$ lentil. The highest LEY (3532 kg ha<sup>-1</sup>) was recorded from  $T_1$  (100% lentil + 5% Mustard) followed by  $T_3$  (100% lentil + 15% mustard). The maximum gross return and gross margin was recorded in  $T_1$ , followed by  $T_3$  and lowest from  $T_4$ .

#### **Mixed cropping of black cumin with lentil at different seed ratios**

M. S. Rahman, M. N. A. Siddique, M. J. Islam and M. M. I. Chowdhury

The experiment was undertaken to study the effect of lentil (BARI Masur-8) and black cumin (BARI kalojira-1) mixed cropping in different plant populations at Paba and Rajshahi during 2022-2023. In this study, the main plots were pure stand of two crops as well as two mixed cropping ratios ( $T_1=95\%$  lentil + 5% black cumin,  $T_2=90\%$  lentil + 10% black cumin,  $T_3=85\%$  lentil+15% black cumin,  $T_4=80\%$  Lentil + 20% black cumin,  $T_5=$  Sole lentil and  $T_6=$  Sole black cumin). Mixed cropping of lentil and black cumin ( $T_3= 85\%$  lentil + 15% black cumin) contributed higher LEY (2153 kg ha<sup>-1</sup>) in compared to sole lentil and other mixed cropping. The maximum gross return and gross margin was recorded in the  $T_3$  (85% lentil + 15% black cumin) and lowest from  $T_6$  (100% black cumin).

#### **Performance of mixed lentil and linseed under the stripand conventional tillage method**

M. S. Rahman, M. N. A. Siddique, M. J. Islam and M. M. I. Chowdhury

The experiment was undertaken to see the performance of lentil (var. BARI Masur-8) and

linseed (BARI Tisi-3) mixed cropping in different plant populations at Shibpur and Rajshahi during 2022-2023. In this study, the main plots were pure stand of two crops as well as three mixed cropping ratios (100% lentil + 50% linseed, 100% linseed + 50% lentil, 80% lentil + 20% linseed). Mixed cropping of lentil and linseed ( $T_5= 100\%$  lentil + 50% linseed) gave the superior yield (1840 kg ha<sup>-1</sup>) in compared to sole and other mixed cropped treatments. The maximum gross return and gross margin was recorded in the  $T_5$  (100% lentil + 50% linseed) that was followed by  $T_3$  (sole lentil by strip planting) and lowest was in  $T_2$  and  $T_4$  (sole linseed).

#### **Effect of sowing time of mustard variety in eastern surma-kushiyara floodplain soil of Sylhet**

M. I. Nazrul

The present study was conducted at farming system research and development (FSRD) site under Sylhet district to determine the effect of sowing date on flowering and seed yield of mustard. Five different sowing dates viz.  $S_1$ : 15 November,  $S_2$ : 30 November,  $S_3$ : 15 December,  $S_4$ : 30 December,  $S_5$ : 15 January were studied on BARI Sarisha-18. Delay in sowing caused a significant reduction in the length of flowering period. The crop sown on  $S_1$  had the longest flowering duration (40.67 days) followed by the crop sown on  $S_2$  (39.00 days) and  $S_3$  (34.33 days). Delaying sowing time resulted in a significant reduction in the seed yield.

#### **Planting date influence phenology, growth and yield of lentil in high barind tract**

M. Shakhawat Hossain<sup>1\*</sup>, J.C. Barman<sup>1</sup>, T. Zahan<sup>2</sup>, A. K. Chaki<sup>2</sup>, F. Ahmed<sup>3</sup> and M. Mazharul Anwar<sup>2</sup>

A study was made to evaluate the effect of planting date on phenology, growth and yield of two lentil varieties. The experiment comprised of four planting dates viz., 10 November, 20 November, 30 November and 10 December. The planting dates was tested on two lentil varieties viz., BARI Masur-3 and BARI Masur-8 in two trials separately. The experiment was laid out in a randomized complete block design with three replications. It was observed that both two varieties emerged withing 6-7 days while early planting (10 November) took 6 days. The BARI Masur-3 took 48-53, and 82-100 days for its 1<sup>st</sup> flower and physiological maturity, respectively. Delayed planting took less time for its maturity. BARI

Masur-8, took 48-54 and 86-102 days for 1<sup>st</sup> flower and pod maturity, respectively while delay planting took less days for its maturity. The BARI Masur-8 (1.37-1.68 t ha<sup>-1</sup>) gave comparative higher seed yield than that of BARI Masur-3 (1.40-1.55 t ha<sup>-1</sup>). Both the two varieties gave the maximum seed yield from 20-30 November while planting on 20 November recorded the highest seed yield and the BARI Masur-8 has late yield potentiality.

#### **Effect of planting time on sweet potato in char land condition**

Abdullah Al Mahmud, Md. Jahangir Alam, Md Shohel Rana and Md Mazharul Anwar

The experiment was conducted at Chinirpotol char of Saghata, Gaibandha under the supervision of OFRD, Gaibandha during the *rabi* season of 2021-22 and 2022-23 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 following the RCBD (two factors) design. The significantly highest tuberous root yield was recorded from BARI Mistialu-8 (37.6 t ha<sup>-1</sup> in 2021-22 and 38.2 t ha<sup>-1</sup> in 2022-23) when the vines were planted on 15 October, similar to BARI Mistialu-12 (35.6 t ha<sup>-1</sup> in 2021-22 and 36.3 t ha<sup>-1</sup> in 2022-23) with the same date of vine plantation. The tuberous root yield of sweet potato significantly decreased with late plantation from the date of 15 October. The tuberous root yield has decreased by 17-28 % in BARI Mistialu-8 and by 20-26 % in BARI Mistialu-12 for every 15 days of late vine plantation from 15th October in both the year. Considering the variety, BARI Mistialu-8 and BARI Mistialu-12 produced 60-62% and 51-53% more yield compared to the local sweet potato variety in both crop years.

#### **Effect of sowing dates and varieties on early planted potato**

S. M. A. H. M. Kamal, Ummay Kulsum Laily and M. A. H. Talukder

A field trail was conducted at Magura, Kishoreganj, Nilphamari, under AEZ-3 during Rabi season 2022-23 to find out the BARI devolved suitable early potato varieties yield under different sowing dates. Three (03) sowing dates and eight (08)

potato varieties were used in this experiment. The highest tubers yield 41.50 t ha<sup>-1</sup> was obtained from the combination of sowing date 22 October and the variety BARI Alu-79 along with highest gross return (910404 Tk. ha<sup>-1</sup>), gross margin (745404 Tk. ha<sup>-1</sup>) and benefit cost ratio (5.51) than the other treatment combinations.

#### **Effect of selective herbicide in black cumin in Faridpur**

Selim Ahmed and Md Zahid Hasan Sohel

A field trial was conducted at the FSRD site, Faridpur during the *rabi* 2022-23 to find out the suitable herbicidal optimum dose of Oxadiazon and to reduce cost of production and increase yield in black cumin. The experiment was laid out in a randomized complete block design with four dispersed replications. Activar was used as trade name of Oxadiazon group. Five treatments were considered as T<sub>1</sub>: Activar @ 0.25 ml 1 Lt<sup>-1</sup> of water, T<sub>2</sub>: Activar @ 0.50 ml 1 Lt<sup>-1</sup> of water, T<sub>3</sub>: Activar @ 0.75 ml 1 Lt<sup>-1</sup> of water, T<sub>4</sub>: Activar @ 1 ml 1 Lt<sup>-1</sup> of water, T<sub>5</sub>: No weeding. BARI Kalozira-1 was used as planting material. The highest number of weed density (50.73 m<sup>-2</sup>) were recorded from T<sub>1</sub> (378.6 m<sup>-2</sup>) followed by T<sub>5</sub> (139.24 m<sup>-2</sup>) and the lowest (40.78 m<sup>-2</sup>) from T<sub>4</sub> where Activar @ 1 ml 1 Lt<sup>-1</sup> of water was applied. The dry weight of the entire weeds ranged between 13.8 g m<sup>-2</sup> (T<sub>4</sub>) to 139.2 g m<sup>-2</sup> (control). Weed persistence index (WPI) was varied from 0.02 (T<sub>4</sub>) to 0.2 (T<sub>1</sub>). The acceptable WPI was found in treatment, T<sub>3</sub> (0.058). The lowest WPI value from T<sub>4</sub> (0.02) stated that, weed was effectively controlled. The significantly highest seed yield (1029 kg ha<sup>-1</sup>) was recorded in T<sub>3</sub> treatment (0.75 ml 1L<sup>-1</sup>). The lowest seed yield (787.5 kg ha<sup>-1</sup>) was calculated from T<sub>5</sub> due to lower number of crop plants, number of capsules per plant, number of seeds per capsule. Seed yield was increased 30.70% in T<sub>3</sub> over control (no weeding) which was followed by T<sub>2</sub> (25 %). The highest gross margin (Tk 123094 ha<sup>-1</sup>) and BCR (3.16) were obtained from T<sub>3</sub> and the lowest from T<sub>5</sub> (Tk 81729 ha<sup>-1</sup> and 2.46, respectively).

#### **Effect of fungicide to control foot and root rot disease of lentil in Faridpur**

Selim Ahmed and Md Zahid Hasan Sohel

An experiment was conducted at the FSRD site, Faridpur during the *rabi* season of 2022-23 to measure the effectiveness of several fungicides

controlling foot and root disease of lentil. The variety of lentil was BARI Masur-8. Four (4) replications were established with five (5) treatments each e.g.  $T_1$  = Trichoderma @62.5 kg ha<sup>-1</sup>,  $T_2$  = Provax 200WP @3g kg<sup>-1</sup> seed,  $T_3$  = Trichoderma + Provax,  $T_4$  = Topzim super 75WDG @3g kg<sup>-1</sup> seed and  $T_5$  = control. The treatment,  $T_3$  had the lowest mortality rate (4.46%) and  $T_5$  control had the highest (21.5%).  $T_4$  (5.09%) showed close value to  $T_3$ .  $T_4$  had the highest no of pod plant<sup>-1</sup> (57.6).  $T_4$  (Topzim super 75WDG @3g kg<sup>-1</sup> seed) was the best treatment in term of yield. Topzim super holds combination of insecticide (Imidacloprid) and fungicide (Thiram and Carbendazim). The second most effective treatment was  $T_3$  (Trichoderma + Provax), which controlled better than  $T_1$  (Trichoderma) and  $T_2$  (provax) separately. However, Topzim super ( $T_4$ ) showed the best result in terms of mortality rate (5.09%), yield (2.11 tha<sup>-1</sup>) and BCR (3.35) for controlling of foot and root rot disease of lentil.

#### **Effect of post harvest stacking on the quality of sesame seed**

Selim Ahmed and Md Zahid Hasan Sohel

A trial was conducted at the FSRD site, Faridpur during Kharif I, 2022 to evaluate the effect of post-harvest stacking on the yield, quality of sesame seed and oil at the farmer's field. The experiment was laid out in a randomized complete block design (RCBD) with three compact replications and three treatments like siliqua bundle inside the stack, siliqua bundle outside the stack and siliqua bundle stacked upright. The highest seed yield (1.62 t ha<sup>-1</sup>) was obtained from bundle inside the stack due to might be the highest number of filled seed (92) and highest weight of 1000-seed (2.8g). The lowest seed yield (1.52 t ha<sup>-1</sup>) was calculated from bundle stack upright. Chemical analysis depicts that, bundle inside the stack had the most desirable characters like maximum oil content (42%) and minimum free fatty acid content (1.4%).

#### **Effect of growth regulator on late sowing lentil in Faridpur**

Selim Ahmed, Md Zahid Hasan Sohel and Md Saleh Uddin

An experiment was set up at the FSRD site, Faridpur under Pulse project during *rabi* season, 2022-23 to find out the optimum dose and spraying number of different plant growth regulator to

increase sustainable yield of late sowing lentil. Four (4) dispersed replications with five (5) treatments e.g.  $T_1$  = 20% Nitrobenzene @2ml L<sup>-1</sup> two times (25 and 50 DAS),  $T_2$  = 20% Nitrobenzene @2ml L<sup>-1</sup> one time (50 DAS),  $T_3$  = GA<sub>3</sub> @0.2g L<sup>-1</sup> two times (25 and 50 DAS),  $T_4$  = GA<sub>3</sub> @0.2g L<sup>-1</sup> one time (50 DAS) and  $T_5$  = control were used. The highest yield (1.76 t ha<sup>-1</sup>) was obtained from  $T_1$  due to its highest number of pod plant<sup>-1</sup> (42.6) which was 38% higher compared to  $T_5$ . This study revealed that, nitrobenzene was better than gibberellin in late sowing lentil. Maximum profit (GM 102990 Tk ha<sup>-1</sup>) and BCR (2.8) was recorded from  $T_1$ .

#### **Effect of sunflower rows for onion seed production in Faridpur**

Selim Ahmed and Md Zahid Hasan Sohel

An experiment was conducted at the FSRD site, Sholakundu, Faridpur during *rabi* 2022-23 to find out the optimum number of sunflower rows in onion field for maximum onion seed production. BARI Piaz-4 and BARI Surjamukhi-3 variety were selected for this experiment and design was followed RCBD. Three (3) dispersed replications with four (4) treatments i.e.  $T_1$  = one row of sunflower after ten rows of onion,  $T_2$  = two rows of sunflower after ten rows of onion,  $T_3$  = three rows of sunflower after ten rows of onion and  $T_4$  = control (sole onion) were used in this experiment. Onion seed yield was recorded higher in  $T_1$  (347 kgha<sup>-1</sup>) which was identical to  $T_2$  and  $T_3$ .  $T_4$  produced the minimum yield (291 tha<sup>-1</sup>). Although,  $T_1$  produced maximum onion seed,  $T_2$  was more profitable (BCR 10.2) and  $T_4$  was less profitable (BCR 8.3).

#### **Performance of country bean varieties to pod borer infestation at farmers field**

S. Akhtar and M. M Zaman

The experiment was conducted at Trishal, Mymensingh during the *rabi* season of 2022-2023 to observe the pod borer infestation and to popularize the country bean varieties at farmers' field. The country bean variety BARI sheem-1, BARI sheem-8, BARI sheem-9 and local Khishamoti were used in this experiment. The experiment was laid out in randomized complete block design with three replications. Out of four varieties, BARI Sheem-8 showed the lowest (11.42%) pod borer infestation and highest



(9.15tha<sup>-1</sup>) pod yield. The maximum gross return (274748 Tk ha<sup>-1</sup>) and gross margin (169,408 Tk. ha<sup>-1</sup>) were also recorded from BARI sheem-8.

#### **Effect of different sowing dates on the yield of mungbean in coastal area**

Kn Islam, Mm Islam and Msi Khan

The experiment was conducted at Badodpur, Patuakhali Sadar during late rabiseason of 2022-23. Mungbean (BARI Mung-6) was sown three times at 10 day intervals starting from 20 January to 10 February to find out suitable sowing date for increasing yield in coastal area. 30 January sowing provided maximum number of pods/plant (18.8), pod length (10.4 cm), seeds/pod (10.9), 1000-seed weight (52.7 g) and yield (1.87 t ha<sup>-1</sup>). The seed yield decreased 28% when seed sown early (20 January) or late (10 February) due to production of lower yield components. The maximum gross margin (Tk. 96400/ha) and BCR (2.81) was recorded from 30 January treatment.

#### **Performance of different mustard varieties under late sowing condition**

M M Howlader

The experiment was conducted at three locations under Gopalganj and Pirojpur district during rabi season in 2022-23. The objective of the study was to identify suitable mustard variety (ies) for late sowing at Gopalganj and Pirojpur district. The experiment was laid out in two factors RCB design allocating four sowing dates (S<sub>1</sub>=03 December, S<sub>2</sub>=10 December, S<sub>3</sub>=17 December, S<sub>4</sub>=24 December) and three mustard varieties (V<sub>1</sub>=BARI Sarisha-16, V<sub>2</sub>=BARI Sarisha-17 and V<sub>3</sub>=BARI Sarisha-18). The highest seed yield 1.68 t ha<sup>-1</sup> was found from S<sub>1</sub>V<sub>1</sub> (3 December×BARI Sarisha-16) followed by S<sub>2</sub>V<sub>1</sub>, S<sub>1</sub>V<sub>3</sub> and S<sub>2</sub>V<sub>3</sub>. The lowest seed yield and 0.22 t ha<sup>-1</sup> was found from S<sub>4</sub>V<sub>2</sub> (24 December×BARI Sarisha-17).

#### **Maximizing the yield of existing cashewnut garden through improved management practices in chittagong hill tracts**

M. T. Islam, F. Arshad, I. Hossain and A. Hossain

A trial was conducted at farmer's field of Dolupara hill valleys of Bandarban sadar during the season, 2021-22 and 2022-23 to develop improved management technologies for increasing the yield of existing cashewnut garden in chittagong hill tracts. Five treatments viz. T<sub>0</sub>= Control (No

management), T<sub>1</sub>= T<sub>0</sub>+Fertilization (2 times, pre-rainy season and post-rainy season), T<sub>2</sub>= T<sub>1</sub> + Mulch (before winter), T<sub>3</sub>= T<sub>2</sub> + Pruning (1 time after harvesting) and T<sub>4</sub>= T<sub>3</sub> + pesticide application (after pruning, pre-flowering and at nut set) were tested. For the year 2022-2023, all the four management based treatment combinations significantly increased percent canopy spread (3-17%) compared to T<sub>0</sub> in both E-w and N-S directions. Overall tree volume rises was more in T<sub>2</sub> (52%) which was identical to T<sub>4</sub>, T<sub>3</sub> and T<sub>0</sub> while lowest in T<sub>1</sub>. Among the all treatments, T<sub>4</sub> and T<sub>3</sub> provided higher yield attributing parameters. The mean nut yield/tree was non-significant due to improved management practices.

#### **Bio-rational based management techniques for the control of mango fruit fly, *bactrocera dorsalis* in Rajshahi region**

J.C. Barman, M.E.A. Pramanik and M.S. Hossain

Adaptive trials were conducted at farmer's field of Charchat 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 first week of 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).

#### **Bio-rational based management of pod borer, *helicoverpa armigera* hubner infesting chickpea**

J.C. Barman, M.E.A. Pramanik, M.S. Hossain and M.A. Sarker

The experiment was conducted in the farmer's field at Basantapur FSRD site, Godagari, Rajshahi during Rabi 2022-23 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) @ .5 ml/l of water (1.36 t/ha).

#### **Integrated management approach for controlling root rot (caused by *sclerotium rolfsii*) of sunflower**

K N Islam, Mm Islam and M S I Khan

The experiment was conducted at FSRD site, Jamla, Dumki, Patuakhali during rabi season of 2022-23 to find out suitable management approach for controlling root rot disease and to reduce root rot disease incidence in sunflower field in southern region of Bangladesh. Four treatments namely: T<sub>1</sub>: Seed treatment with Carboxin + Thiram (Provax 200WP) + three sprayings of Carbendazim (Autostin 50WDG), T<sub>2</sub>: Seed treatment with Carboxin+Thiram (Provax 200WP) + three sprayings of Difenconazole (Score 250EC), T<sub>3</sub>: Seed treatment with Carboxin+Thiram (Provax 200WP) + three sprayings of Mancozeb + Metalaxyl (Metaril 72WP), T<sub>4</sub>: Only seed treatment with Carboxin + Thiram (Provax 200WP) were evaluated. Statistically percent disease incidence (wilting) was the lowest (0.23%) at 30 DAS and 1.58% at 50 DAS in both T<sub>1</sub> while the highest disease incidence percentages were found at T<sub>4</sub> (Only seed treatment with Provax 200WP) in both 30 and 50 DAS. At 70 and 90 DAS, the percent disease incidence did not vary significantly. Among all the treatments, the highest yield was statistically observed at T<sub>1</sub> treated plot (1.95 t ha<sup>-1</sup>) while T<sub>4</sub> showed the lowest result (1.69 t ha<sup>-1</sup>). The maximum (1.21) benefit cost ratio (BCR) was returned from T<sub>1</sub> treated plot followed by (1.66) T<sub>2</sub>. Overall the research result revealed that, T<sub>1</sub> (Seed treatment with Provax 200WP + three sprayings of Autostin 50WDG) showed the lowest disease

incidence percentages for wilt and also gave the highest yield.

#### **Performance of early planted tomato under agroforestry system as affected by planting time**

M.A. Suborna, M. Maniruzzaman, M.Z. Hasan, M. A. Islam and M.R. Alam

A field experiment was conducted at farmer's field of Ganggarampur, Pabna Sadar, Pabna during 2022 to find out the optimum planting time for better performance of summer tomato under Agroforestry system. Seedlings of tomato were sown on four different dates viz. August 15, August 30, September 15 and September 30. Maximum tomato yield (37.2 t ha<sup>-1</sup>) and mango equivalent yield (15.5 t ha<sup>-1</sup>) was obtained from September 15 planting which was identical to August 30 planting while August 15 and September 30 planting exhibited lower performance regarding tomato yield and mango equivalent yield. Maximum gross return (Tk 930000 ha<sup>-1</sup>) and gross margin (Tk 548500 ha<sup>-1</sup>) and MBCR (2.68) was obtained from September 15 planting. Therefore, September 15 may be the best planting time for tomato in respect of yield and economic performance.

#### **Nutrient management for mango based agroforestry system in Cumilla region**

M. Jamal Uddin and S. K. Bhowal

The experiment was conducted at the MLT site Chandina, Kumilla during the rabi season, 2022-23 to evaluate the performance of crops due to nutrient management in mango-based agroforestry system. Four nutrient management practices viz. T<sub>1</sub>: 100% Soil test based (STB) fertilizer; T<sub>2</sub>: 75% STB fertilizer; T<sub>3</sub>: 50% STB fertilizer and T<sub>4</sub>: 25% higher of STB fertilizer was tested on mukhikachu (var. MARI Mukhikachu-2) in the study. Higher corm yield (15.92 t ha<sup>-1</sup>) of mukhikachu and mango equivalent yield (13.03 t ha<sup>-1</sup>) was obtained from 100% STB fertilizer for mukhikachu along with blanket dose of fertilizers as per FRG' 2018 for mango (T<sub>1</sub>) whereas the lowest corm yield (13.46 t ha<sup>-1</sup>) of mukhikachu and mango equivalent yield (11.01 t ha<sup>-1</sup>) in 50% STB fertilizer for mukhikachu along with blanket dose of fertilizers as per FRG' 2018 for mango. Maximum gross return (Tk.716650 ha<sup>-1</sup>) and gross margin (Tk. 576390 ha<sup>-1</sup>) was achieved from 100% STB fertilizer for mukhikachu along with blanket dose of fertilizers as per FRG' 2018 for mango (T<sub>1</sub>).

### Project III: On-Farm Trials with Advanced Lines and Technologies

#### On-farm trial of BARI brinjal varieties

M. J. Alam, A. A. Mahmud, M. S. Rana, J.A. Mahmud, M.M. Morshed and M.M. Hossain

The experiment was conducted at the farmers' field of Sadar, Sadullahpur and Saghata upazila of Gaibandha during Rabi season of 2021-22 and 2022-23 and Kushtia sadar upazila during Rabi season 2022-23 to evaluate the performance of BARI developed brinjal varieties in the farmers' field. Two brinjal varieties viz. BARI Begun-8 and BARI Begun-10 were evaluated with a local variety as check at Gaibandha whereat Three brinjal varieties viz. BARI Begun-8, BARI Begun-10 and BARI Begun-12 were used at Kushtia. The experiment was laid out in RCB design with six dispersed replications. At Gaibandha, BARI Begun-10 gave the highest average yield (24.95 t ha<sup>-1</sup>) during two consecutive years and local variety produced the lowest yield (14.45 t ha<sup>-1</sup>). At Kushtia, the highest fruit yield was obtained from BARI Begun-12 (42.00 t ha<sup>-1</sup>) which was at par with BARI Begun-10 (40.70 t ha<sup>-1</sup>).

#### On farm trail of BARI hybrid brinjal varieties

M. M. Rahman, A.K.M.Z.U. Noor, M.A. Rahman, S. Roy, M. A. Rahaman, T. Tasmima, M, S, Huda, G. Paul and K. Roy

The experiment was conducted at Sherpur, Bhola, Dinajpur, Gopalganj and Rajshahi during Rabi season of 2022-2023. BARI Hybrid Begun-4, BARI Hybrid Begun-5 and BARI Hybrid Begun-6, BARI Begun -12 against Purple King Hybrid as check at Sherpur; BARI Hybrid Begun -4, BARI Hybrid Begun -5, BARI Hybrid Begun- 6 against challenger Hybrid; BARI Hybrid Begun-4, BARI Hybrid -6, BARI Begun-7 and BARI Begun-12 against local Katali begun at Dinajpur; BARI Hybrid Begun-4, BARI Hybrid Begun-5, BARI Hybrid Begun-6 against Bizly Hybrid at Gopalganj; BARI Hybrid Begun-4, BARI Hybrid Begun-5, BARI Hybrid Begun-6, BARI Begun-12 against BNB-422 at Shyampur, Rajshahi; BARI Hybrid Begun-3, BARI Hybrid Begun-4, and Purple King Hybrid at Tangail. as check were evaluated. The highest yield was obtained from BARI Hybrid Begun-4 (42.65t ha<sup>-1</sup>) at Sherpur, challenger Hybrid (42.83 t ha<sup>-1</sup>) at Bhola, BARI Begun-12 (46.32 t ha<sup>-1</sup>) at Dinajpur, BARI Hybrid Begun-6 gave the

highest yield both at Gopalganj (36.2 t ha<sup>-1</sup>) and Puthia, Rajshahi (65.82 t ha<sup>-1</sup>). Purple King Hybrid produced the highest yield (35.34 t ha<sup>-1</sup>) followed by BARI Hybrid Begun-3 (34.32 t ha<sup>-1</sup>) whereas the lowest yield (19.52 t ha<sup>-1</sup>) from BARI Hybrid Begun-4.

#### On-farm trial of BARI country bean variety

S Ahmed, M S Huda, M Z H Sohel, M T Islam, I Hossain, M M. Anwar and M F Hossain

The experiment was conducted at the FSRD site, Faridpur, MLT site, Kishanbazar, Sadar of Dinajpur and hill valleys of Bandarban sadar during the Rabi season of 2022 to evaluate the performance of BARI developed country bean varieties in the farmers' field. The trial was laid out in RCB design with six dispersed replications. BARI Sheem-1, BARI Sheem-6 and BARI Sheem-8 against Rupban Hybrid at Faridpur; BARI Sheem-6, BARI Sheem-8, BARI Sheem-9 and BARI Sheem-10 against a local variety (Ghia) at Dinajpur and BARI Sheem-1, BARI Sheem-6 and BARI Sheem-10 against a local variety were evaluated in the hill valley of Bandarban. The highest pod yield (15.46 t ha<sup>-1</sup>) from BARI Sheem-1 was obtained at Faridpur statistically at par with BARI Sheem-8 (15.03 t ha<sup>-1</sup>) and the lowest yield (9.95 t ha<sup>-1</sup>) from BARI Sheem-6 was recorded. At Dinajpur, BARI Sheem-8 gave the highest yield (22 t ha<sup>-1</sup>) and the lowest yield (13.7 t ha<sup>-1</sup>) was obtained from the local variety. In the hill valley of Bandarban, BARI Sheem-6 gave the highest yield (18.36 t ha<sup>-1</sup>) whereas the lowest yield (12.66 t ha<sup>-1</sup>) was obtained from the local variety.

#### On-farm trial of BARI bitter gourd varieties

M. Jamal Uddin, M. M. Bashir, S.K. Bhowal, M.A. Islam and M.M. Zaman

The on-farm trial was carried out in the farmers' field of Usufpur under MLT site, Debidwar of Cumilla and Rampur under Trishal upazila of Mymensingh district during Kharif season of 2022 with view to evaluate the performance of BARI developed bitter gourd varieties in the farmers' field. BARI Korola-3 and BARI Korola-4 were tested against a commercial Hybrid Tia at Cumilla and BARI Hybrid Korola-3, BARI Hybrid Korola-4 were tested against a commercial Hybrid Bulet at Mymensingh. The experiment was laid out in RCB design with six dispersed replications. The highest fruit yield (16.65 t ha<sup>-1</sup>) was obtained from Tia



Hybrid compared to BARI Korola-3 (13.78 t ha<sup>-1</sup>) and BARI Korola-4 (15.18 t ha<sup>-1</sup>) at Cumilla region. Commercial Hybrid Bulet gave the highest yield (31.8 t ha<sup>-1</sup>) compared to BARI Hybrid Korola-3 (27.2 t ha<sup>-1</sup>) and BARI Hybrid Korola-4 (28.5 t ha<sup>-1</sup>) at Mymensingh.

#### **On-farm trial of BARI hybrid pumpkin variety**

M.A. Islam, M.M. Zaman, M.M. Rahman, A.K.M.Z.U. Noor, M.S. Rahman, M. I. Nazrul, M. A. Rahaman, T. Tasmima, K. Roy, S. Roy and G. Paul

The experiment was conducted at Mymensingh, Sherpur, Sylhet and Tangail during Rabi season of 2022-23 to evaluate the performance of BARI developed Hybrid and open pollinated pumpkin varieties in the farmers' field. BARI Mistikumra-1, BARI Mistikumra-2 and BARI Hybrid Mistikumra-1 against Lalima Hybrid at Mymensingh; BARI Hybrid Mistikumra-2, BARI Hybrid Mistikumra-3 against sweet plus Hybrid at Sherpur; BARI Hybrid Mistikumra-1, BARI Hybrid Mistikumra-2, BARI Hybrid Mistikumra-3 against Sweety and Lalima Hybrid at Sylhet and BARI Hybrid Mistikumra-1, BARI Hybrid Mistikumra-2 against Sweet ball Hybrid at Tangail were evaluated. BARI Hybrid Mistikumra-1 gave higher yield (36.67 t ha<sup>-1</sup>) than the check variety Lalima Hybrid (20.17 t ha<sup>-1</sup>) at Mymensingh; BARI Hybrid Mistikumra-3 (21.88 t ha<sup>-1</sup>) and BARI Hybrid Mistikumra-2 (20.69 t ha<sup>-1</sup>) gave higher and statistically similar yields compared to sweet plus Hybrid (18.75 t ha<sup>-1</sup>) at Sherpur; BARI Hybrid Mistikumra-2 produced the highest fruit yield (47.42 t ha<sup>-1</sup>) at Tangail; BARI Hybrid Mistikumra-2 (42.00 t ha<sup>-1</sup>) and Lalima Hybrid (41.33 t ha<sup>-1</sup>) gave the higher and statistically similar yields compared to BARI Hybrid Mistikumra-1 (32.33 t ha<sup>-1</sup>) at Sylhet.

#### **On-farm trial of BARI developed broccoli variety**

M.S. Islam and M.M. Bashir

An on-farm trial was conducted in three farmers' fields at Subarnachar, Noakhali during Rabi season of 2021-22 and 2022-23 to determine the best suited variety for Noakhali region. BARI developed broccoli variety BARI Broccoli-1 was tested against a commercial Hybrid Green Power. The trial was laid out in RCB design with six dispersed replications. Significant variations were observed in card length, single card weight, card yield of the

two broccoli varieties but days to card initiation and card breadth did not differ statistically between the varieties. On an average, higher card weight (440g) and card yield (14.27 t ha<sup>-1</sup>) were recorded in commercial Hybrid variety Green Power compared to BARI Broccoli-1 with card weight (338g) and card yield (13.16 t ha<sup>-1</sup>) in two consecutive years.

#### **Adaptive trial of bushbean varieties in Jashore region**

M. H. Rahman and K U Ahammad

The experiment was conducted at MLT site Jhikorgacha, Jashore during Rabi season of 2022-23 to evaluate the performance of bushbean varieties in farmers' field and to popularize BARI varieties among the farmers. Three bushbean varieties viz. BARI Jharsheem-1, BARI Jharsheem-2, and BARI Jharsheem-3 were used as planting material. The experiment was laid out in RCB design with six dispersed replications. The number of pods plant<sup>-1</sup> was higher and statistically similar (12) both in BARI Jharsheem-1 and BARI Jharsheem-2 while lower (10) in BARI Jharsheem-3. The green pod yield was higher and statistically at par (1.3 t ha<sup>-1</sup>) both in BARI Jharsheem-1 and BARI Jharsheem-2 whereas the lowest (0.7 t ha<sup>-1</sup>) was recorded in BARI Jharsheem-3.

#### **On-farm trial of BARI winter hybrid tomato varieties**

Gazi Nazmul Hasan, Md. Rashidul Hasan Anik, Md. Ruhul Amin, Md. Emdadul Haque, M. Asaduzzaman, Mm Islam, Kn Islam, Msi Khan, A.K.M.Z.U. Noor, M. M. Rahman and M.A. Rahman

The field experiment was conducted at Bhola, Manikganj, Narsingdi, Patuakhali and Sherpur during Rabi season of 2022-23 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-7, BARI Hybrid Tomato-9 against Mintu super Hybrid at Bhola; BARI Hybrid Tomato-7 and BARI Hybrid Tomato-9 against two commercial Hybrid (Beautiful Hybrid) and Bipul Plus Hybrid) at Manikganj; Three BARI Hybrid varieties viz. BARI Hybrid Tomato-5, BARI Hybrid Tomato-7, BARI Hybrid Tomato-9 against Surma Hybrid at Narsingdi; BARI Hybrid Tomato-

7, BARI Tomato-9 against Bizli Super Hybrid at Patuakhali; BARI BARI Hybrid Tomato-5, BARI Hybrid Tomato-7, BARI Hybrid Tomato-9, BARI Hybrid Tomato-11 against Udoyon Hybrid at Sherpur were evaluated. At Bhola, Mintu super Hybrid produced highest fruit yield ( $62.58 \text{ t ha}^{-1}$ ) followed by BARI Hybrid Tomato-7 ( $54.70 \text{ t ha}^{-1}$ ) whereas BARI Hybrid Tomato-9 gave minimum fruit yield ( $50.32 \text{ t ha}^{-1}$ ). At three tested locations of Manikganj, higher yield was obtained from commercial Hybrid varieties ( $77.05$  to  $81.45 \text{ t ha}^{-1}$ ) followed by BARI Hybrid Tomato-7 ( $72.62$  to  $73.05 \text{ t ha}^{-1}$ ) and BARI Hybrid Tomato-9 ( $65.55$  to  $74.91 \text{ t ha}^{-1}$ ). BARI Hybrid Tomato-9 had the late yield potentials compared to other varieties. At Narsingdi, BARI Hybrid Tomato-5 produced the maximum fruit yield  $97.48 \text{ t ha}^{-1}$  which was  $47.92\%$  higher than Surma Hybrid. At Patuakhali, Bizli Super Hybrid produced the highest yield ( $81.27 \text{ t ha}^{-1}$ ) followed by BARI Hybrid Tomato-9 ( $61.38 \text{ t ha}^{-1}$ ) and the lowest ( $53.73 \text{ t ha}^{-1}$ ) in BARI Hybrid Tomato-7. At Sherpur, the maximum fruit yield ( $98.54 \text{ t ha}^{-1}$ ) was found in BARI Hybrid Tomato-5 followed by BARI Hybrid Tomato-9 ( $92.02 \text{ t ha}^{-1}$ ) whereas the minimum in Udoyon Hybrid ( $75.96 \text{ t ha}^{-1}$ ).

#### **On-farm trial of BARI winter tomato varieties**

G. N. Hasan, R. H. Anik, M. Islam, Md. Jahangir Alam, Abdullah Al Mahmud, M. M. Howlader, Md. Ruhul Amin, Md. Emdadul Haque, M. S. Rahman, M.N.A. Siddique, M.J. Islam, M.M.I. Chowdhury, J.A. Mahmud, M.M. Morshed and M.M. Hossain

The experiment was conducted in the farmers' field at Bhola, Gaibandha, Gopalganj, Manikganj, Rajshahi, and Kushtia districts during Rabi season of 2022-23. Six winter varieties viz. BARI Tomato-16, BARI Tomato-17, BARI Tomato-18, BARI Tomato-19, BARI Tomato-21 against a local variety (Roma VF) at Bhola; BARI Tomato-17, BARI Tomato-18, and BARI Tomato-21 against a local variety at Gaibandha; BARI Tomato-15, BARI Tomato-16, BARI Tomato-17, BARI Tomato-18, and BARI Tomato-21 were evaluated at Gopalganj and Pirojpur; BARI Tomato-16, BARI Tomato-18 and BARI Tomato-21 against Lalteer Hybrid as check were evaluated at Manikganj; BARI Tomato-19 and BARI Tomato-21 were evaluated at Rajshahi and BARI tomato-15, BARI tomato-19 and BARI tomato-21 were used at

Kushtia. The experiment was laid out in RCB design with six dispersed replications. At Bhola, BARI tomato-21 ( $47.95 \text{ t ha}^{-1}$ ) gave higher yield followed by local variety (Roma VF) ( $52.36 \text{ t ha}^{-1}$ ) and the lowest in BARI Tomato-19 ( $32.59 \text{ t ha}^{-1}$ ). At Gaibandha, BARI Tomato-21 produced the highest average yield ( $77.45 \text{ t ha}^{-1}$ ) statistically at par with BARI Tomato-18 ( $72.75 \text{ t ha}^{-1}$ ) and BARI Tomato-17 ( $71.9 \text{ t ha}^{-1}$ ). At Gopalganj and Pirojpur, BARI tomato-16 produced significantly highest fruit yield ( $81.24 \text{ t ha}^{-1}$ ) followed by BARI Tomato-21 ( $77.29 \text{ t ha}^{-1}$ ) and the lowest from BARI Tomato-17 ( $65.06 \text{ t ha}^{-1}$ ). At Manikganj, higher yield was obtained from Lalteer hybrid ( $70.50 \text{ t ha}^{-1}$ ) followed by Tomato-16 ( $66.15 \text{ t ha}^{-1}$ ), BARI Tomato-21 ( $58.10 \text{ t ha}^{-1}$ ) and BARI Tomato-18 ( $52.70 \text{ t ha}^{-1}$ ). At Rajshahi, Singra, Natore BARI Tomato-21 gave  $13.68\%$  higher yield ( $99.71 \text{ t ha}^{-1}$ ) than BARI Tomato-19 ( $87.71 \text{ t ha}^{-1}$ ) at Natore but at Shyampur, Rajshahi, and BARI Tomato-19 produced  $25.18\%$  higher yield ( $62.03 \text{ t ha}^{-1}$ ) than BARI Tomato-19 ( $49.55 \text{ t ha}^{-1}$ ). BARI tomato-15 ( $76.00 \text{ t ha}^{-1}$ ) gave higher yield compared to BARI tomato-19 ( $67.70 \text{ t ha}^{-1}$ ) and BARI tomato-21 ( $64.06 \text{ t ha}^{-1}$ ) at Kushtia. Highest gross margin was also obtained from BARI winter tomato varieties at all the tested locations.

#### **On-farm trial of BARI developed lemon varieties in the hilly areas of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar and M. F. Hossain

The experiment was conducted at farmer's field in the hill slopes of Bandarban sadar during 2021-22 and 2022-23 to evaluate the performance of BARI lemon varieties and to select suitable variety for the hill areas of Bandarban. Vegetative and yield data were collected immediately after planting, on 18 May, 2022 and on 8 May, 2023. Vegetative growth of lemon varieties varied significantly. Plant height (( $343.33 \text{ cm}$ ), canopy development ((N-S:  $317.67 \text{ cm}$ ) (E-W:  $314 \text{ cm}$ ), tree volume ( $18.15 \text{ m}^3$ ), fruit length ( $12.63 \text{ cm}$ ), fruit diameter ( $7 \text{ cm}$ ), individual fruit weight ( $358.67 \text{ g}$ ) and juice content ( $83.33 \text{ ml}$ ) were found high in BARI Lebu-1. Thai seedless lebu showed the least results in terms of plant height ( $160.50 \text{ cm}$ ), canopy development (N-S:  $100 \text{ cm}$ , E-W:  $106.67 \text{ cm}$ ), tree volume ( $0.91 \text{ m}^3$ ), fruit length ( $3.67 \text{ cm}$ ), fruit diameter ( $3 \text{ cm}$ ), individual fruit weight ( $26 \text{ g}$ ), and juice content ( $4.48 \text{ ml}$ ). Highest number of

fruits plant<sup>-1</sup> (40.33) was found from BARI Lebu-4 followed by Chaina-3 Seedless Lebu (39.33) and lowest was found from Thai Seedless Lebu (8.00). Reproductive and yield data will be collected from the following year.

#### **Performance of BARI mango varieties in the hilly areas of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar and M. F. Hossain

A trial was conducted at farmer's field in the hill slopes of Bandarban sadar during 2021-22 and 2022-23 to evaluate the performance of BARI mango varieties along with other popular commercial varieties to find out the suitable one in hilly areas of Bandarban. Mango saplings were planted on 11 July, 2021 with a spacing of 6m × 6m. Vegetative data were collected immediately after planting, on 18 May, 2022 and on 8 May, 2023 to evaluate annual increment. Vegetative growth of mango varieties varied significantly for all the parameters. Tree volume rises more in Govibdavog Aam throughout the year (5.33 m<sup>3</sup>) followed by Himsagor Aam (3.82 m<sup>3</sup>) whereas BARI Aam-10 showed the least tree volume (0.35 m<sup>3</sup>) in second year. Highest increment percentage in plant height, stem girth and canopy were observed in BARI Aam-2 (127.1%), BARI Aam-1 (364%) and BARI Aam-11 (417.7% in N-S) and BARI Aam-4 (421.7% in E-W direction), respectively. Reproductive and yield data will be collected from the following year.

#### **On-farm trial of kharif watermelon varieties in costal region**

M M Islam and M S I Khan

The experiment was conducted at MLT site Amtoli, Borguna during Kharif-II season of 2022 to observe the yield performance and to find out suitable watermelon varieties for this region. Three watermelon varieties viz. OP variety BARI Tormuj-2 and two Hybrid varieties viz. Bangla Lion and Big Market were evaluated. The highest vine length (291 cm) was found in Big Market Hybrid. The highest number of fruits plant<sup>-1</sup> (2.13), single fruit weight (2.89 kg) and fruit yield (22.65 t ha<sup>-1</sup>) was in BARI Tormuj-2. The lowest number of fruits plant<sup>-1</sup> (1.69), single fruit weight (2.74 kg) and fruit yield (18.47 t ha<sup>-1</sup>) was found in Big Market Hybrid.

#### **Adaptive trial of robusta and arabica coffee in the hill valleys of bandarban, sherpur and mymensingh district**

M.T. Islam, F. Arshad, I. Hossain, A. Hossain, M.A. Rahman, M. M. Rahman, A.K.M.Z.U. Noor, M. A. Islam and M.M. Zaman

This study investigated the adaptive performance of *coffee robusta* and *coffee arabica* in seven upazila of Bandarban Hill District, in hill valley at Jinaighati, Sherpur District and hilly area of Haluaghat, Mymensingh. The study was conducted in two consecutive years 2021-2022 and 2022-2023 at Bandarban and Haluaghat, Mymensingh and during 2022-23 at Sherpur. The study aims to evaluate the growth, yield, and adaptability of coffee plants in the hilly regions of Bangladesh and identify the suitable varieties for commercial cultivation. *Coffee robusta* had a higher average plant height increment than *coffee arabica* in all seven upazila of Bandarban. The highest average plant height increment from 2021 to 2023 for *coffee robusta* was in Alikadam Upazila (88.01%), and for *coffee arabica* was in Ruma Upazila (83.67%). The highest average trunk girth increment for *coffee robusta* was in Rowangchhari Upazila (80.93%), and for *coffee arabica* was in Thanchi Upazila (91.33%). The highest average tree volume increment for *coffee robusta* was in Thanchi Upazila (516.23%), and for *coffee arabica* was in Alikadam Upazila (520.42%). In the hill valley of Jinaighati, Sherpur, the maximum plant height (131.1 cm) and leaf length (16.8 cm) and leaf breadth (10.2 cm) was recorded in *Coffea robusta*. On the other hand, higher number of branch (9.4) base girth (4.3 cm) and canopy (88.5 × 72.5 cm<sup>2</sup>) were found in *Coffea arabica*. At Haluaghat, Mymensingh, maximum Plant height (122.6 cm) was observed in *coffee robusta* and the lowest from *coffee arabica* (86.22 cm). Base girths (4.24), number of branch plant<sup>-1</sup> (11.4), and spread of canopy and leaf size also found higher in *Coffea robusta* compared to *Coffea Arabica*.

#### **On farm trial of BARI gladiolus varieties in Mymensingh region**

N. Sultana and M.M. Zaman

The experiment was conducted in the farmers' field in Mymensingh region during Rabi season of 2022-2023 to evaluate the performance of BARI released gladiolus varieties. The trial consisted of three gladiolus varieties viz. BARI Gladiolus-3, BARI



Gladiolus-4 and BARI Gladiolus-5. The highest spike yield was obtained from BARI Gladiolus-4 (377666 spike ha<sup>-1</sup>) followed by BARI Gladiolus-3 (310000 spike ha<sup>-1</sup>). The lowest yield of spike was recorded in BARI Gladiolus-5 (158000 spike ha<sup>-1</sup>). Maximum gross return (Tk. 4278955 ha<sup>-1</sup>) and gross margin (Tk. 4195665 ha<sup>-1</sup>) were estimated from BARI Gladiolus-4 followed by BARI Gladiolus-3 (Tk.3512300ha<sup>-1</sup> and Tk3429010 ha<sup>-1</sup>). The lowest gross return (Tk1790140ha<sup>-1</sup>) and gross margin (Tk. 1706850 ha<sup>-1</sup>) was obtained from BARI Gladiolus-5. Considering the spike yield potentiality, disease and insect infestation, BARI Gladiolus-4 and BARI Gladiolus-3 might have been chosen for promotion and dissemination in Mymensingh region.

#### **Adaptive trial with newly released potato varieties in different locations**

A.A. Mahmud, M.J. Alam, M.S. Rana, M. J. Uddin, S. Ahmed, M. R. Amin, M.E. Haque, M. Asaduzzaman, J.A. Mahmud, M.M. Morshed, M.M. Hossain, M.Z. Ferdous, M.E. Haque, M.A.A.H. Talukder, M.S. Rahman, M.N.A. Siddique, M.J. Islam, M.M.I. Chowdhury, M.H. Rashid, M.K. Islam, T.S. Munmun, M. Rahman, M.M. Rahman, A.K.M.Z.U. Noor, M.A. Rahman, M.A. Rahaman, T. Tasmima, K. Roy, S. Roy, G. Paul, M.T. Islam, M. I. Hossain, N. Sultana, M.M. Zaman, G.N. Hasan, R.H. Anik, M. Islam, M. Mohiuddin, M.Y.H. Rayhan, M.M. Howlader, D. Halder, M.M. Islam, K.N. Islam, M.S.I. Khan, M.M. Bashir and M.S. Islam

Under the direction of the On-Farm Research Division (OFRD), BARI, a series of trials were carried out at farmers' fields in twenty different locations during the rabi season of 2022–2023 to assess the performance of the 10 (Ten) high-yielding potato varieties and learn about farmers' preferences regarding the varieties. The highest average tuber yield of the studied potato types was produced by BARI Alu-79 (35.12 t ha<sup>-1</sup>), followed by BARI Alu-41 (33.60 t ha<sup>-1</sup>) and BARI Alu-62 (33.32 t ha<sup>-1</sup>), while BARI Alu-7 had the lowest yield (27.11 t ha<sup>-1</sup>). Location-wise, Mymensingh had the highest average tuber yield (39.93 t ha<sup>-1</sup>), followed by Kishoregonj and Gopalganj (38.25 t ha<sup>-1</sup> and 37.95 t ha<sup>-1</sup>, respectively), while Khulna had the lowest (22.65 t ha<sup>-1</sup>). Among the crop varieties, BARI Alu-41 produced the average highest gross return (533371

Tk. ha<sup>-1</sup>) and gross margin (339558Tk. ha<sup>-1</sup>) whereas the average lowest gross return (390003 Tk. ha<sup>-1</sup>) and gross margin (195308 Tk. ha<sup>-1</sup>) were found in BARI Alu-7.

#### **Promotion and dissemination of late blight-resistant potato varieties in different locations**

A.A. Mahmud, M.J. Alam, M.S. Rana, M.S. Rahman, M.N.A. Siddique, M.J. Islam, M.M.I. Chowdhury, M.Z. Ferdous, M.E. Haque and M.A.A.H. Talukder

During the Rabi season of 2022–2023, a total of 20 trials were carried out at farmers' fields in six locations in the districts of Gaibandha, Lalmonirhat, Kurigram, Rangpur, Nilphamari, and Rajshahi to assess the performance of the two late blight-resistant potato varieties (BARI Alu-53 and BARI Alu-77) as well as find out about farmers' perceptions of these varieties. BARI Alu-53 and BARI Alu-77, two of the studied potato varieties, outperformed the control variety (BARI Alu-8) in all areas and produced 13.02% and 13.21% more tuber yield, respectively. These two varieties had a late blight infection rate in the leaves reaching less than 5%. The late blight disease of the potato was thought to be very resistant to BARI Alu-53 and BARI Alu-77, which also reduced the cultivation costs without compromising tuber yield.

#### **Promotion and dissemination of newly released climate-smart (heat and salt tolerant) potato varieties**

A.A. Mahmud, M.J. Alam, M.S. Rana, M.H. Rashid, M.K. Islam, T.S. Munmun, M. Rahman, G.N. Hasan, R.H. Anik, M. Islam, M.S. Bhuiyan, M. Ahmed, M.M. Bashir and M.S. Islam, M.M. Islam, K.N. Islam, M.S.I. Khan

BARI Alu-72, BARI Alu-73, and BARI Alu-78, three climate-smart (heat and salt tolerant) potato varieties, underwent evaluation for yield performance at the farmer's field in six locations. The Khulna region's Batiaghata, Bagerhat, Koyra, and Dumuria recorded soil salinity while the remaining locations (Bhola, Noakhali, Patuakhali, Cox's Bazar and Borguna) were found to be non-saline. The average soil salinity in the Khulna region fluctuated from 1.13 to 5.21 dSm<sup>-1</sup>. The variety BARI Alu-72 (28.95 t ha<sup>-1</sup>) had the highest average tuber yield among all the varieties, next to BARI Alu-73 (27.32 t ha<sup>-1</sup>) and BARI Alu-78 (25.04 t ha<sup>-1</sup>). A larger average gross return and

gross margin were calculated from BARI Alu-72 for its higher yield.

#### **On farm trial of potato varieties in different locations**

A.A. Mahmud, M.J. Alam, M.S. Rana, A.K.M.Z.U. Noor, M.M. Rahman, M.A. Rahman, M.A. Rahaman, T. Tasmima, K. Roy, S. Roy and G. Paul

An on-farm trial was conducted at two locations during rabi season of 2022-23 to find out the performance of potato varieties among the farmers. The yield of tuber ranged from 22.67 to 38.83 t ha<sup>-1</sup> across the locations, where BARI Alu-41 produced the highest (38.83 t ha<sup>-1</sup>) and BARI Alu-72 produced the lowest (22.67 t ha<sup>-1</sup>) in Tangail. On an average, BARI Alu-41 yielded the highest (38.83 t ha<sup>-1</sup>) followed by BARI Alu-79 (36.67 t ha<sup>-1</sup>) and BARI Alu-62 (36.23 t ha<sup>-1</sup>) and the lowest yield found in BARI Alu-72 (26.09 t ha<sup>-1</sup>). The mean yield of potato varieties was slightly higher (31.83 t ha<sup>-1</sup>) in Sherpur compared to Tangail (30.83 t ha<sup>-1</sup>).

#### **Adaptive trial with anthocyanin rich potato varieties**

Md. Zannatul Ferdous, Md. Eakramul Haque and Md. Al-Amin Hossain Talukder

The field trials were conducted at on-station and farmers' field under sadar upazila, Rangpur during rabi, 2022-2023 to observe the performance of the anthocyanin rich potato varieties viz; BARI Alu-101 and BARI Alu-102 along with locally popular variety BARI Alu-8. BARI Alu-101 showed excellent performance and higher yield followed by BARI Alu-102. Farmers were happy to observe the performance of the anthocyanin rich varieties and demanded quality seed for next year cultivation.

#### **Adaptive trial of promising sweet potato varieties in different locations**

A.A. Mahmud, M.J. Alam, M.S. Rana, M.M. Rahman, A.K.M.Z.U. Noor, M.A. Rahman, M. Mohiuddin, M.Y.H. Rayhan, M.H. Rashid, M.K. Islam, T.S. Munmun, M. Rahman, M.I. Nazrul and M. Zulfiqar

Six sweet potato varieties were tested in field trials at five different sites in 2022-2023 in order to compare the performance of each variety and get local farmers' perspectives. Sweet potato varieties had a root yield that ranged from 16.87 to 37.13 t ha<sup>-1</sup>, where BARI Mistialu-12 produced the maximum root yield in Khulna (37.13 t ha<sup>-1</sup>) and

BARI Mistialu-15 produced the lowest root yield in the same site (16.87 t ha<sup>-1</sup>). When locations were taken into account, Sylhet had the highest mean root yield (28.28 t ha<sup>-1</sup>), followed by Khulna (27.85 t ha<sup>-1</sup>), while Jamalpur had the lowest (23.43 t ha<sup>-1</sup>) of all the sites. Among the varieties, the mean highest root yield was observed in BARI Mistialu-12 (31.1 t ha<sup>-1</sup>), followed by BARI Mistialu-14 (27.06 t ha<sup>-1</sup>).

#### **On-farm trial of BARI released sweet potato varieties**

A.A. Mahmud, M.J. Alam, M.S. Rana, J.A. Mahmud, M.M. Morshed, M.M. Hossain, T. Tasmima, M.A. Rahaman, K. Roy, S. Roy, G. Paul, N. Sultana and M.M. Zaman

To encourage the cultivation of the BARI-released sweet potato varieties, on-farm experiments with 6 (six) different sweet potato varieties were carried out in farmers' fields in Kushtia, Tangail, and Mymensingh in 2022-2023. BARI Mistialu (4, 8, 12, 15, 16, and 17) and the native cultivar were the tested varieties. According to the varieties, BARI Mistialu-15 had the highest average root yield (34.83 t ha<sup>-1</sup>) and the native cultivar had the lowest (16.05 t ha<sup>-1</sup>). The average maximum root yield was found to be 27.79 t ha<sup>-1</sup> in Tangail, followed by 24.66 t ha<sup>-1</sup> in Kushtia, and 19.47 t ha<sup>-1</sup> in Mymensingh.

#### **Adaptive trials with mukhikachu varieties in different locations**

A.A. Mahmud, M.J. Alam, M.S. Rana, M. Asaduzzaman, J.A. Mahmud, M.M. Morshed, M.M. Hossain, M.H. Rahman, K.U. Ahammad, M.A. Islam, M.M. Zaman, M.M. Rahman, A.K.M.Z.U. Noor and M.A. Rahman

During the Kharif season of 2022, the experiment was carried out at five different places with three different Mukhikachu varieties to assess how well they performed in farmers' fields and to gain popularity among them. The corm yield varied from 11.00 to 54.60 t ha<sup>-1</sup> depending on the site, with the local cultivar producing the maximum yield (54.60 t ha<sup>-1</sup>) in Chuadanga and BARI Mukhikachu-2 producing the lowest (11.00 t ha<sup>-1</sup>) in Magura. According to location, Chuadanga had the highest average corm yield (39.30 t ha<sup>-1</sup>), Mymensingh ranked second (28.83 t ha<sup>-1</sup>), and Magura had the lowest average corm yield (10.65 t ha<sup>-1</sup>).

### Adaptive trials with newly released panikachu varieties in different locations

A.A. Mahmud, M.J. Alam, M.S. Rana, M.M. Rahman, A.K.M.Z.U. Noor, M.A. Rahman, M.H. Rahman, K.U. Ahammad, M. Mohiuddin, M.Y.H. Rayhan, M.A. Islam, M.M. Zaman, M.I. Nazrul and M. Zulfikar

During the Kharif season of 2021–2022, the experiment was carried out in five distinct places to assess how eight Panikachu varieties and genotypes performed alongside native cultivars. The stolon yield of the Panikachu varieties ranged from 5.80 to 27.53 t ha<sup>-1</sup>, where BARI Panikachu-1 in Sylhet recorded the highest yield (27.53 t ha<sup>-1</sup>) and BARI Panikachu-5 in Magura recorded the lowest (5.80 t ha<sup>-1</sup>) values. The rhizome yield, on the other hand, varied from 14.23 to 69.31 t ha<sup>-1</sup>, with BARI Panikachu-6 in Mymensingh recording the highest yield (69.31 t ha<sup>-1</sup>) and BARI Panikachu-1 in Sylhet recorded the lowest (14.23 t ha<sup>-1</sup>). The average maximum stolon (23.97 t ha<sup>-1</sup>) and rhizome (37.52 t ha<sup>-1</sup>) were generated by BARI Panikachu-1 and Panikachu-4, respectively.

### On-farm trial of stolon producing taro varieties in different locations

A.A. Mahmud, M.J. Alam, M.S. Rana, M. Asaduzzaman, Q. Nahar, M.A. Hossain, M.F. Hossain, A. Chaki, T. Zahan, M.M. Anwar and M.R. Alam

The experiment was carried out in the Kharif season of 2021–2022 in Gazipur, Munshiganj, and Gaibandha to assess the performance of stolon producing taro varieties (BARI Panikachu-1, Panikachu-2, and local one) in farmers' fields. The stolon yield varied between the locations, from 7.40 to 22.11 t ha<sup>-1</sup>. The BARI Panikachu-1 at Gaibandha produced the highest stolon yield (22.11 t ha<sup>-1</sup>), followed by the BARI Panikachu-2 (20.57 t ha<sup>-1</sup>) at the same site. In Gazipur, the local variety produced the lowest yield (7.4 t ha<sup>-1</sup>).

### On-farm trial of lentil varieties in Faridpur

Selim Ahmed, Md Zahid Hasan Sohel and Md Saleh Uddin

An experiment was carried out at FSRD site, Sadar, Faridpur during *rabi* season of 2022-23. Three treatments viz. T<sub>1</sub>= BARI Masur-7, T<sub>2</sub>= BARI Masur-8, T<sub>3</sub>= BARI Masur-3 were used in the experiment. The experiment was laid out in RCB

design with 6 replications. The highest yield (1.83 t ha<sup>-1</sup>) was obtained from BARI Masur-8 followed by BARI Masur-7 (1.6 t ha<sup>-1</sup>) and the lowest was recorded from local (1.45 t ha<sup>-1</sup>).

### Validation of biofertilizer on the performance of lentil

M. Z. Hasan, M. Maniruzzaman, M. A. Suborna and M. A. Islam

The experiment was carried out at FSRD site, Gangarampur, Pabna during the *Rabi* season of 2022-23 to assess the effect of bio fertilizer on yield traits and yield of lentil (BARI Masur-8). The experiment was laid out in RCBD with three treatments and four replications. The treatments were: T<sub>1</sub> = PKSZn, T<sub>2</sub> = *Rhizobium* inoculant + PKSZn and T<sub>3</sub> = NPKSZn. The highest grain (1.30 t ha<sup>-1</sup>) and straw (1.80 t ha<sup>-1</sup>) yields were found in NPKSZn applied treatment. Other two treatments were almost similar in yield and yield contributing characters. The highest gross return (Tk. 125775 ha<sup>-1</sup>) and gross margin (Tk. 69675 ha<sup>-1</sup>) were also found in the NPKSZn fertilizer applied treatment. Therefore, *Rhizobium* was not found to have any effect on the yield of lentil.

### On-farm trial of grass pea varieties

S. Ahmed, M.Z.H. Sohel, M M Howlader, Kn Islam, M.M. Islam and M.S.I. Khan

An experiment was carried out at three scattered places e.g. FSRD site, Sholakunda, Faridpur, Moukuri Char, Sadar, Rajbari and Pearpur, Faridpur; four locations of Gopalganj: Gopalganj Sadar, Tungipara, and Muksedpur under Gopalganj district and Najirpur under Pirojpur; and in a coastal area of Dumki, Patuakhali during Rabi season of 2022-23. Four treatments viz. BARI Khesari-2, BARI Khesari-3, BARI Khesari-5 and Local at Faridpur, five selected grass pea varieties viz. BARI Khesari-2, BARI Khesari-3, BARI Khesari-4, BARI Khesari-5 and BARI Khesari-6 at Gopalganj; and four grasspea varieties viz. BARI Khesari-2, BARI Khesari-3, BARI Khesari-5 and BINA Khesari-1 at Patuakhali were used in the experiment. The experiment was laid out in RCB design with 6 replications at Faridpur, 4 replications at Gopalganj and 3 replications at Patuakhali. At Faridpur, the highest yield (1.77 t ha<sup>-1</sup>) was obtained from BARI Khesari-2 and the lowest was from Local (1.36 t ha<sup>-1</sup>), and the highest gross



margin (52862 Tk ha<sup>-1</sup>) and benefit cost ratio (2.24) was found BARI Khesari-2. At Gopalganj, the highest seed yield was obtained from BARI Khesari-6 (1.76 t ha<sup>-1</sup>) and the lowest grain yield (1.15 t ha<sup>-1</sup>) was obtained in BARI Khesari-2. At Patuakhali, the highest seed yield (1.68 t/ha) was obtained from BARI Khesari-5 followed by BARI Khesari-3 (1.59 t/ha) and BINA Khesari-1 (1.52 t/ha). BARI Khesari-2 gave the lowest yield (1.48 t/ha).

#### **On-farm adaptive trial of chickpea varieties in different locations of Bangladesh**

M. S. Rahman, M. N. A. Siddique, M. J. Islam, M. M. I. Chowdhury, M.E.A. Pramanik, J.C. Barman, M.S. Hossain, A. A. Mahmud, M. J. Alam, S. Ahmed and M.Z.H. Sohel

The on-farm field trial was carried out at four locations in Bangladesh – i) Alimganj, Paba, Rajshahi; ii) FSRD site, Basantapur, Godagari, Rajshahi, iii) MLT site, Saghata, Gaibandha, and iv) FSRD site, Faridpur during 2022-23 to evaluate the performance of BARI developed chickpea varieties. The tested varieties were BARI Chola-5, BARI Chola-9, BARI Chola-10 and BARI Chola-11 at Shyampur, Rajshahi and Godagari, Rajshahi (HBT); BARI Chola-9, BARI Chola-10, and BARI Chola-11 at Saghata, Gaibandha; and BARI Chola-9, BARI Chola-10, BARI Chola-11 and Local at Faridpur were evaluated at the farm level. At Paba, Rajshahi, BARI Chola-10 gave the maximum marketable yield (1.85 t ha<sup>-1</sup>) and gross margin (101775Tk ha<sup>-1</sup>) followed by BARI Chola-9 (yield: 1.75 t ha<sup>-1</sup>, GM: 93775 Tk ha<sup>-1</sup>), BARI Chola-5 (yield: 1.61 t ha<sup>-1</sup>, GM: 8275 Tk ha<sup>-1</sup>) and the lowest in BARI Chola-11 (yield: 1.38 t ha<sup>-1</sup>, GM: 64175Tk ha<sup>-1</sup>). At HBT, Rajshahi, BARI Chola-9 gave the maximum seed yield (1.62 t ha<sup>-1</sup>) followed by BARI Chola-5 (1.48 t ha<sup>-1</sup>) and the minimum seed yield was obtained from BARI Chola-10 (1.20 t ha<sup>-1</sup>) among the tested varieties. At Gaibandha, BARI Chola-9 produced the highest seed yield (1.96 t ha<sup>-1</sup> in 2021-22 and 1.51 t ha<sup>-1</sup> in 2022-23) and the lowest seed yield (1.15 t ha<sup>-1</sup> in 2021-22 and 1.05 t ha<sup>-1</sup> in 2022-23) was observed in BARI Chola-11 among the tested varieties. At Faridpur, the highest yield (1.9 t ha<sup>-1</sup>) was obtained from BARI Chola-10 followed by BARI Chola-9 (1.8 t ha<sup>-1</sup>) and the lowest was recorded from local (1.69 t ha<sup>-1</sup>).

#### **On farm trial of promising chickpea varieties in high barind tract**

M.E.A. Pramanik, J. C. Barman and M.S. Hossain

The field trial was carried out at the farmer's field of FSRD site, Basantapur, Godagari, Rajshahi during rabi season 2022-23 to select suitable chickpea variety under drought prone area. Two genotypes of chickpea viz. BCX-13005-3, BCX-13002-3 and two varieties BARI Chola-5 and BARI Chola-10 as check were tested in the farmer's field. Among the genotypes, BCX-13002-3 showed the maximum pods plant<sup>-1</sup> (66.93) followed by BARI Chola-5 (66.83) while minimum pods plant<sup>-1</sup> (39.93) from BARI Chola-10. The maximum 100- seed weight (19.07 g) was found in BCX-13002-3 while BARI Chola-5 gave the lowest (15.40g). BCX-13002-3 gave the maximum seed yield (1.62 t ha<sup>-1</sup>) followed by line BARI Chola-5 (1.45 t ha<sup>-1</sup>) and minimum from BARI Chola-10 (1.24 t ha<sup>-1</sup>).

#### **Regional yield trial of chickpea in HBT**

M.E.A. Pramanik, J. C. Barman and M.S. Hossain

The field trial was carried out at the farmer's field of FSRD site, Basantapur, Godagari, Rajshahi during rabi season 2022-23 to select suitable chickpea variety through regional yield trial (RYT) under drought prone area. Four genotypes of chickpea viz. ICCV-181627, ICCV-181624, ICCV-181633, ICCV-181634, and two varieties BARI Chola-5 and BARI Chola-10 as check were tested in the farmer's field. Among the genotypes, ICCV-181624 showed the maximum pods plant<sup>-1</sup> (60.83) followed by ICCV-181634 (54.93) and the minimum pods plant<sup>-1</sup> (34.10) from BARI Chola-10. The maximum 100- seed weight (21.69 g) was found in ICCV-181624 while BARI Chola-5 gave the lowest (15.43g). ICCV-181624 gave the maximum seed yield (1.62 t ha<sup>-1</sup>) followed by line ICCV-181634 (1.52 t ha<sup>-1</sup>) and minimum seed yield from BARI Chola-10 (1.17 t ha<sup>-1</sup>)<sup>1</sup>.

#### **On-farm trial of field pea varieties**

S. Ahmed, M. Z.H. Sohel, M.M. Islam and M.S.I. Khan

The field experiment was carried out at three different locations - Moukuri Char, Sadar, Rajbari and Dicir Char, Sadar, Faridpur under OFRD, Faridpur and Bauphal, Patuakhali (coastal area) during Rabi season of 2022-23.

Three treatments viz. BARI Motor-1, BARI Motor-3, local variety at Faridpur; and BARI Motor-1 and BARI Motor-3 at Patuakhali were used in the experiment. At Faridpur, the maximum pod yield ( $1.72 \text{ t ha}^{-1}$ ) was obtained from BARI Motor-3 followed by BARI Motor-1 ( $1.36 \text{ t ha}^{-1}$ ) and the lowest from Local ( $1.12 \text{ t ha}^{-1}$ ). At Patuakhali, the highest seed yield ( $2.09 \text{ t ha}^{-1}$ ) was obtained from BARI Motor-1.

#### **Regional yield trial of fieldpea in HBT**

M.E.A. Pramanik, J. C. Barman and M.S. Hossain

The field trial was carried out at the farmer's field of FSRD site, Basantapur, Godagari, Rajshahi during rabi season 2022-23 to select suitable fieldpea variety through regional yield trial (RYT) under drought prone area. Three genotypes of fieldpea viz. BFP-15004-8, BFP-1500-2, BFP-15004-5 and two varieties BARI Motor-1 and BARI Motor-3 as check were tested in the farmer's field. Among the tested genotypes and variety, BARI Motor-3 gave the maximum seed yield ( $1.38 \text{ t ha}^{-1}$ ) followed by BFP-1500-2 ( $1.28 \text{ t ha}^{-1}$ ) and the minimum seed yield was obtained from BFP-15004-5 ( $1.15 \text{ t ha}^{-1}$ ).

#### **Adaptive trial of different varieties of mungbean in coastal area**

K.N. Islam, M.M. Islam and M.S.I. Khan

The experiment was conducted at Kalaiya, Bauphal, Patuakhali during late rabi season of 2022-23 to evaluate the performance of released mungbean varieties in coastal area. Three Variety Viz. BARI Mung-6, BARI Mung-8 and BINA Moog-8 were evaluated as planting materials for this study. The growth parameters and yield contributing characters of mungbean plant was significantly affected by different varieties. BARI Mung-6 gave the better performance in respect of all growth and yield parameters. The maximum seed yield ( $1.62 \text{ t ha}^{-1}$ ) was obtained from var. BARI Mung-6 followed by BINA Moog-8 ( $1.55 \text{ t ha}^{-1}$ ) while lowest seed yield ( $1.07 \text{ t ha}^{-1}$ ) by var. BARI Mung-8. The maximum gross return (Tk. 113400/ha) was obtained from BARI Mung-6 as well as gross margin (Tk. 67800/ha) and BCR (2.49) while the lowest return was recorded from BARI Mung-8 (Tk. 74900/ha) and BCR (1.58).

#### **On faram trial of blackgram varieties in netrakona**

M. A. Islam and M.M. Zaman

An adaptive trial of blackgram was conducted in the farmer field of Rajendrapur, Challisha under Netrakona district during Kharif-II season of 2022 to evaluate the performance and adaptability. Three BARI developed blackgram varieties viz., BARI Mash-1, BARI Mash-3, BARI Mash-4 and local cultivar were tested. The maximum seed yield ( $1.43 \text{ t ha}^{-1}$ ) was recorded from BARI Mash-3 which was statistically similar with BARI Mash-4 ( $1.30 \text{ t ha}^{-1}$ ) and the lowest seed yield was obtained from local check ( $1.07 \text{ kg ha}^{-1}$ ).

#### **Participatory variety selection of blackgram in HBT**

M.E.A. Pramanik, J.C. Barman and M.S. Hossain

The field trial was carried out at the farmer's field of FSRD site, Basantapur, Godagari, Rajshahi during kharif-2 season 2022 to select suitable blackgram variety for High Barind Tract (HBT) under drought prone area. Four genotypes of blackgram viz. BBLXK2-08008-2-1, BBLXK2-12005-5, BBLXK2-12002-4, BBLXK2-12005-6 and two check varieties BARI Mash-3 and BARI Mash-4 were tested. Among the tested genotypes BBLXK2-08008-2-1 gave the maximum seed yield ( $1.45 \text{ t ha}^{-1}$ ) followed by BARI Mash-3 ( $1.32 \text{ t ha}^{-1}$ ) and minimum seed yield obtained from BARI Mash-4 ( $0.93 \text{ t ha}^{-1}$ ).

#### **Adaptive trial of different genotypes of cowpea in coastal area**

K.N. Islam, M.M. Islam and M.S.I. Khan

The experiment was conducted at Kuakata, Kalapara, Patuakhali during rabi season of 2022-23 to evaluate the performance of cowpea genotypes in coastal area. Two variety viz. BARI Felon-1 and Local Felon (Bhola) were evaluated as planting material. Cowpea var. BARI Felon-1 gave the better performance in respect of all growth and yield parameters. Higher seed yield ( $1.49 \text{ t ha}^{-1}$ ) was obtained from var. BARI Felon-1 whereas lower seed yield ( $1.12 \text{ t ha}^{-1}$ ) by Local var. Felon (Bhola).

### On-farm trial of short duration mustard varieties in different location of Bangladesh

M. Z. Hasan, M. Maniruzzaman, M. A. Suborna, M. A. Islam, M. T. Islam, I. Hossain, M. M. Anowar, M.F. Hossain, M. S. Rahman, M. N. A. Siddique, M. J. Islam, M. M. I. Chowdhury, G N Hasan, R H Anik, M Islam, M.E.A. Pramanik, J.C. Barman and M.S. Hossain

An on-farm trial was conducted at MLT site, Atgharia, Pabna, Reicha of Bandarban district, at MLT site, Shibpur, Puthia, and Tanor, Rajshahi, at Bhola sadar and Doulatkhan under Bhola district, at FSRD site, Basantapur, Godagari, Rajshahi and at Nikli, Karimganj, Hossainpur and Kishoreganj sadar in Kishoreganj district during the Rabi season of 2022-23 to assess the performance of short duration mustard varieties. Nine varieties were used for the trial viz. BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-17, BARI Sarisha-18, BARI Sarisha-20, BARI Sarisha-11, BARI Sarisha-9, BINA Sarisha-9 and BINA Sarisha-10. In Pabna, BARI Sarisha-17 performed the best in grain ( $1.80 \text{ t ha}^{-1}$ ) and straw ( $3.09 \text{ t ha}^{-1}$ ) yield, resulting in the highest gross margin (Tk. 89567  $\text{ha}^{-1}$ ). BARI Sarisha-14 gave the second highest grain ( $1.64 \text{ t ha}^{-1}$ ) and straw ( $2.75 \text{ t ha}^{-1}$ ) yield as well as the second highest gross margin (Tk. 76223  $\text{ha}^{-1}$ ). In Bandarban, BARI Sarisha-14 produced the highest seed yield ( $1.64 \text{ t ha}^{-1}$ ), the lowest seed yield was found in local ( $1.22 \text{ t ha}^{-1}$ ). The highest gross return was found from BARI Sarisha-14 (Tk.139400  $\text{ha}^{-1}$ ) and lowest was found from local one (Tk.103700  $\text{ha}^{-1}$ ). In Rajshahi, among five varieties, in Sibpur, Rajshahi BARI Sarisha-17 produced the highest yield ( $1.87 \text{ t ha}^{-1}$ ) and the highest gross margin (Tk 101398  $\text{ha}^{-1}$ ) was found in BARI Sarisha-17. In other hand in Tanor, Rajshahi BARI Sarisha-17 produced the highest yield ( $1.45 \text{ t ha}^{-1}$ ) and the highest gross margin (Tk 67798  $\text{ha}^{-1}$ ) was found in BARI Sarisha-17. In Bhola, among the varieties, BARI Sarisha-17 gave the average highest seed yield ( $1.42 \text{ t ha}^{-1}$ ) whereas BARI Sarisha 15, gave average lowest yield ( $1.23 \text{ t ha}^{-1}$ ). The highest gross return (120700Tk  $\text{ha}^{-1}$ ) and gross margin (73850 Tk  $\text{ha}^{-1}$ ) was also obtained from BARI Sharisha-17. In HBT Rajshahi, the seed yields of mustard varieties were identical for BARI Sarisha-15 ( $1.43 \text{ t ha}^{-1}$ ) and BARI Sharisha-20 ( $1.47 \text{ t ha}^{-1}$ ). The maximum straw yield was found in BARI Sharisha-17 ( $2.42 \text{ t ha}^{-1}$ ) and minimum was found in BARI Sharisha-20 ( $1.96 \text{ t ha}^{-1}$ ). It was found that BARI Sharisha-17

mustard variety gave better performance in the farmer's field.

### On-farm trial of medium duration mustard varieties in different location of Bangladesh

M. S. Rahman, M. N. A. Siddique, M. J. Islam M. M. I. Chowdhury, M.S. Hossain, J.C. Barman, M.E.A. Pramanik, F. Begum, Mt Hasan and M.S Alam<sup>3</sup>

The varietal trial was conducted at MLT site, Shibpur, Puthia, and Tanor, Rajshahi, FSRD site, Basantapur, Godagari, Rajshahi and the MLT site, Joypurhat during rabi season of 2022-2023 with a view to select medium duration variety for this region. In Shibpur, Puthia, the trial consists of four mustard varieties viz., BARI Sarisha-16, BARI Sarisha-18, BARI Sarisha-19 and Local (Rai). Yield and yield attributes were differed significantly among the varieties and similar trend was found in case of respond. Among four varieties, in Sibpur, Rajshahi BARI Sarisha-19 produced the highest yield ( $2.15 \text{ t ha}^{-1}$ ) followed by BARI Sarisha-16 ( $2.14 \text{ t ha}^{-1}$ ), BARI Sarisha-18 ( $2.12 \text{ t ha}^{-1}$ ) and Rai ( $2.12 \text{ t ha}^{-1}$ ). The highest gross margin (Tk 122598  $\text{ha}^{-1}$ ) was found in BARI Sarisha-19 followed by BARI Sarisha-16 (Tk 121798  $\text{ha}^{-1}$ ), BARI Sarisha-18 (Tk 120198  $\text{ha}^{-1}$ ) and Rai (Tk 120198  $\text{ha}^{-1}$ ). In other hand in Tanor, Rajshahi BARI Sarisha-16 produced the highest yield ( $2.5 \text{ t ha}^{-1}$ ) followed by BARI Sarisha-19 ( $2.23 \text{ t ha}^{-1}$ ), Rai ( $2.0 \text{ t ha}^{-1}$ ) and BARI Sarisha-18 ( $1.98 \text{ t ha}^{-1}$ ). The highest gross margin (Tk 150598  $\text{ha}^{-1}$ ) was found in BARI Sarisha-16 followed by BARI Sarisha-19 (Tk 136998  $\text{ha}^{-1}$ ), Rai (Tk 110598  $\text{ha}^{-1}$ ) and BARI Sarisha-18 (Tk 108998  $\text{ha}^{-1}$ ). In HBT, Rajshahi, three varieties of mustard viz. BARI Sharisha-18, BARI Sharisha-19 and BARI Sharisha-20 were tested in the trial. Among the tested varieties BARI Sarisha-18 gave the maximum seed yield ( $1.83 \text{ t ha}^{-1}$ ) and the BARI Sharisha-19 produced the lowest yield ( $1.46 \text{ t ha}^{-1}$ ). The MLT site, Joypurhat, three promising mustard varieties, i.e., BARI Sarisha-18, BARI Sarisha-19 and BARI Sarisha-20 regarding yield potentiality. The experimentation consisted of three treatments, i.e., BARI Sarisha-18, BARI Sarisha-19 and BARI Sarisha-20. The highest seed yield of  $1.97 \text{ t ha}^{-1}$  was recorded from BARI Sarisha-18, followed by BARI Sarisha-19 ( $1.55 \text{ t ha}^{-1}$ ), and the lower seed yield of  $1.47 \text{ t ha}^{-1}$  was obtained from BARI Sarisha-20.



### **Adaptive trial of advanced lines of *brassica rapa* L. Of different location of Bangladesh**

M. Maniruzzaman, M. A. Isalm, M. Z. Hasan, M. A. Suborna, M. Jamal Uddin, M. M. Bashir S. K. Bhowal, S. Roy, M. A. Rahaman, T. Tasmima, K. Roy, G. Paul, M. A. Islam and M.M. Zaman

An experiment was carried out at the FSRD site, Ganggarampur, Pabna, at the farmer's field of Sadar Dakkin (Gilatoli) under MLT site Barura in Cumilla, the FSRD site Atia, Tangail and Karli, Challisha under Netrokona district (AEZ-9) during the rabi season of 2022-23 to evaluate the performance of some advanced lines of short duration mustard. In 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 evaluated in this study. Among the tested lines BC-100614(8)-4 and BC-100614(4)-7 exhibited significantly higher seed yield 1.62 and 1.57 t ha<sup>-1</sup>, respectively. While the lowest seed yield 1.25 t ha<sup>-1</sup> was observed BARI Sarisha-14. Regarding economic benefit higher gross margin (Tk. 66550 ha<sup>-1</sup>) was also attained from BC-100614(8)-4. In Cumilla, three advanced lines i.e BC-100614(3)-1; BC-100614(8)-4; BC-100614(8)-4 and one rapeseed variety (BARI Sarisha-14) were used in the trial as a check. Among the tested varieties/lines, all lines produced lower disease severity and higher seed yield compared to BARI developed variety BARI Sarisha-14. In case of days to maturity, the advanced lines were more or less similar with check variety BARI Sarisha-14. The advanced line, BC-100614 (4)-7 produced the highest seed yield compared to other lines and check variety. In Tangail, three advanced lines viz. BC-100614(3)-1, BC-100614(4)-7, BC-100614(8)-4, with one variety as check viz. BARI Sarisha-14. The highest seed yield was observed in BARI Sarisha-14 (1.55 t ha<sup>-1</sup>) followed by BC-100614(3)-1 (1.31 t ha<sup>-1</sup>), and BC-100614(4)-7 (1.24 t ha<sup>-1</sup>) whereas lowest seed yield in BC-100614(8)-4 (1.18 t ha<sup>-1</sup>). The highest stover yield (1.90 t ha<sup>-1</sup>) was also observed from BARI Sarisha-14 and the lowest from BC-100614(8)-4 (1.48 t ha<sup>-1</sup>). The highest gross return and gross margin (Tk.125900 and Tk.65922 ha<sup>-1</sup>) were obtained from BARI Sarisha-14 and the lowest gross return and gross margin (Tk. 95880 and 35902 ha<sup>-1</sup>) from BC-100614(3)-1. In Mymensingh, significantly the highest seed yield was obtained from BC-100614(8)-4 (1990 kg ha<sup>-1</sup>) which was statistically

similar with BC-100614(4)-7 (1930 kg ha<sup>-1</sup>). The lowest seed yield was obtained from BC-100614(3)-1 (1730 kg ha<sup>-1</sup>) and BARI Sarisha-14 (1790 kg ha<sup>-1</sup>).

### **Adaptive trail of advanced lines of *brassica napus* L.**

M. Jamal Uddin, M. M. Bashir and S. K. Bhowal

An adaptive trial was conducted at the farmer's field of Titas under MLT site of Chandina in Cumilla during the *Rabi* season of 2022-23 with a view to select short duration high yielding variety of rapeseed to fit in between T.Aman – Boro rice. Two advanced lines such as NAP-0717-2, NAP-0733-1 and two rapeseed varieties viz. BARI Sarisha-8, BARI Sarisha-9 was used in this trial. Among the tested varieties/lines, all lines produced lower disease severity and higher seed yield compared to two BARI developed variety BARI Sarisha-8 and BARI Sarisha-9. In case of days to maturity, the advanced lines NAP-0717-2 was minimum and produced the highest seed yield. In case of variety, BARI Sarisha-8 obtained slightly higher yield but its day to maturity was higher compare than promising line NAP-0717-2.

### **On-farm trial of BARI sunflower varieties in southern region of Bangladesh**

M.S. Islam M. M. Bashir, Mm Islam, Kn Islam, Msi Khan, G N Hasan, R H Anik, M Islam, S. Sultana, N. Akter and M.M. Zaman

An On-farm trial was conducted at FSRD site of OFRD, BARI Noakhali, saline and non-saline soil of Amtoli, Borguna, different locations in Bhola sadar and Dawlatkhan upazila under Bhola district and Muktagachaupazila, Mymensingh district during the Rabi season of 2022-23 to observe the performance of sunflower varieties under farmers' field condition. Two open pollinated sunflower varieties BARI Surjamukhi-2, BARI Surjamukhi-3 and commercial Hybrid Hysun-33 were used in this trial. From the research trial, it was revealed that the yield of Hysun 33 produced the highest seed yield followed by BARI Surjamukhi-2 and it was statistically identical to BARI Surjamukhi-3. The highest gross return, gross margin and BCR was observed in Hysun 33. Total variable cost of Hysun 33 was also highest due to the high price of Hybrid seed.

### On-farm trial of groundnut varieties in different locations of Bangladesh

Selim Ahmed, Md Zahid Hasan Sohel, Ferdousi Begum, M M Howlader, M.M. Islam, K.N. Islam, M.S.I. Khan, Most. Ummay Salma Khatun, Md. Zannatul Ferdous<sup>and</sup> Md. Al-Amin Hossain Talukder

An adaptive trial of groundnut was conducted in farmer's field at Tungipara under Gopalganj district, Amtoli, Borguna and at charland of Faridpur and Chilmari, Kurigram during Rabi season of 2022-23 to find out the suitable groundnut variety(s) for different locations. Four BARI developed groundnut varieties viz., BARI Chinabadam-8, BARI Chinabadam-9, BARI Chinabadam-10 and BARI Chinabadam-11 were evaluated in the study. In every location Chinabadam Dhaka-1 was used as check. The experiment was laid out in RCB design with six dispersed replications except Faridpur and Chilmari, Kurigram where three compact replications were employed. All tested BARI varieties of groundnut produced significantly higher yield ranging from 31-55% in every location against local check variety Dhaka-1. Among the locations, BARI Chinabadam-9 (2.65 t ha<sup>-1</sup>) produced the highest nut yield in Faridpur; BARI Chinabadam-10 (2.23 t ha<sup>-1</sup>) in Gopalganj; BARI Chinabadam-10 (2.46 t ha<sup>-1</sup>) at Borguna and BARI Chinabadam-9 (1.70 t ha<sup>-1</sup>) at Kurigram. Obviously, the gross margin was maximum in the BARI developed varieties against check variety due to the highest yield potentiality and similar market price. Thus, BARI varieties can be extended in tested areas by replacing local check variety to boost up groundnut production in Bangladesh.

### Adaptive trial of groundnut

M.M. Bashir and M.S. Islam

An adaptive trial was carried out in the farmer's field of Nuru Patwari Hat, Sadar upazilla of Noakhali district during the Rabi season of 2022-2023 with a view to test the yield performance of groundnut advanced lines (ICGV-36-1, ICGV-07219 & ICGV-06285) with BARI Chinabadam-8 and local variety Dhaka-1 as check in the farmers' field. There was no significant variation the tested lines and varieties in terms of nut yield. Numerically the highest nut yield was recorded in BARI Chainabadam-8 (1.83 t ha<sup>-1</sup>) and the lowest in ICGV-36-1 (1.65 t ha<sup>-1</sup>).

### Adaptive trial of advanced lines of sesame

J. A. Mahmud, M. M. Morshed, M. M. Hossain, Selim Ahmed and Md. Zahid Hasan Sohel

An experiment was conducted at MLT Site, Bheramara, Kushtia and the FSRD site, Faridpur and MLT site, Rajbari during the season of 2022-23 in farmer's field to observe the performance of sesame lines/varieties. In Kushtia, five BARI released Sesame varieties viz. (Ses-MR-20, Ses-PR-20, Ses-0570, BARI Til-4 and BARI Til-6) were used. The maximum seed yield was recorded BARI Til-4 (1.54 t ha<sup>-1</sup>) followed by BARI Til-6 (1.41 t ha<sup>-1</sup>), Ses-PR-20 (1.39 t ha<sup>-1</sup>), Ses-MR-20 (1.36 t ha<sup>-1</sup>), Ses-0570 (1.35 t ha<sup>-1</sup>), respectively. Besides, in Faridpur region, nine (9) advanced lines viz. Ses-31, Ses-14, Ses-79, Ses-65, Ses-05115, Ses-05178, Ses-0570, Ses MR-20, Ses PR-20 along with three (3) check varieties viz. BARI Til-4, BARI Til-5 and BARI Til-6 were evaluated. The highest seed yield (1.86 t ha<sup>-1</sup>) was obtained from Ses-05178 due to moderate number of seeds siliqua-1 (46.2) with the highest thousand seed weight (2.92 g). The lowest seed yield (1.58 t ha<sup>-1</sup>) was calculated from Ses-31 due to lowest number of siliqua plant-1 (25.4) and the lowest seeds siliqua-1 (61.7). The seed yield of Ses-05178 was 10.7 and 7.5% higher than that of BARI Til-5 and BARI Til-6, respectively.

### On farm trial of sesame varieties in different location of Bangladesh

Selim Ahmed, Md. Zahid Hasan Sohel, M. A. Islam and M.M. Zaman

Two trials were conducted at the FSRD site, Faridpur and MLT site, Rajbari and Rajendrapur, Netrokona and Vabokhali Mymensingh during Kharif I, 2023 to evaluate the performance of BARI released sesame varieties in the farmer's field. The trials consist of five sesame varieties namely BARI Til-3, BARI Til-4, BARI Til-5, BARI Til-6 and local. The experiment was laid out in a randomized complete block design (RCBD) with six dispersed replications. In Faridpur, the highest seed yield (1.74 t ha<sup>-1</sup>) was obtained from BARI Til-4 due to highest seeds siliqua<sup>-1</sup> (71.72) while lowest seed yield (1.49 t ha<sup>-1</sup>) from BARI Til-3 due to lowest seed siliqua<sup>-1</sup> (58.06). Average yield obtained from two years' study revealed that BARI Til-6 (1.71 t ha<sup>-1</sup>) had 16% higher production than local one (1.48 t ha<sup>-1</sup>). In Mymensingh, the maximum seed yield was recorded from BARI Til-6 (1.29 t ha<sup>-1</sup>).

which was statistically similar with BARI Til-5 ( $1.21 \text{ t ha}^{-1}$ ) and the lowest seed yield from local check ( $0.97 \text{ kg ha}^{-1}$ ).

#### **On-farm trial of soybean varieties in saline area**

M. M. Bashir and M. S. Islam

The experiment was conducted in the farmer's field at East Nuru Patwarirhat, Sadar upazilla in Noakhali district during Rabi season of 2022-23 to select suitable soybean variety(s) for salinity affected char lands under rainfed condition. Among the tested varieties the maximum seed yield was obtained from BARI Soybean-6 ( $2.01 \text{ t ha}^{-1}$ ), followed by BARI Soybean-5 ( $1.82 \text{ t ha}^{-1}$ ) and BARI Soybean-7 ( $1.79 \text{ t ha}^{-1}$ ) and the lowest yield ( $1.27 \text{ t ha}^{-1}$ ) from local variety (Shohag). Soil salinity ranged from 4 to  $8 \text{ dSm}^{-1}$  in the seed formation stage.

#### **On farm trial of onion varieties in charland**

A.A. Mahmud, M.J. Alam, M.S. Rana, M. S. Alam, M. R. A. Mollah, G. Paul, M. A. Rahaman, T. Tasmima, K. Roy, S. Roy, M. Z. Hasan, M. Maniruzzaman, M. A. Suborna, M. A. Islam and T. Hasan

A field trial was conducted at Bogura, Gaibandha, Tangail and Pabna during the Rabi, 2022-2023, to evaluate the performance of modern onion variety under farmers' field conditions. Four varieties were used for the trial viz.  $T_1$  = BARI Piaz-4,  $T_2$  = BARI Piaz-5,  $T_3$  = BARI Piaz-6 and  $T_4$  = Local cultivar. BARI Piaz-6 gave the maximum bulb yield ( $16.30 \text{ t ha}^{-1}$ ) followed by BARI Piaz-4 ( $14.74 \text{ t ha}^{-1}$ ) and BARI Piaz-1 ( $13.52 \text{ t ha}^{-1}$ ). In Gaibandha, the maximum bulb yield ( $15.32 \text{ t ha}^{-1}$ ) was found from BARI Piaz-4, followed by BARI Piaz-6 ( $9.50 \text{ t ha}^{-1}$ ) and the lowest from local cultivar Taherpuri ( $6.58 \text{ t ha}^{-1}$ ). In Tangail, BARI Piaz-4 produced highest bulb yield of  $10.80 \text{ t ha}^{-1}$  followed by  $9.47 \text{ t ha}^{-1}$  from local (Taherpuri). In Pabna, BARI Piaz-6 showed the best performance in number of bulbs ( $47 \text{ bulbs kg}^{-1}$ ) and bulb yield ( $12.97 \text{ t ha}^{-1}$ ).

#### **On farm trial of onion varieties**

M. S. Rahman, M. N. A. Siddique, M. J. Islam, M. M. I. Chowdhury, A.A. Mahmud, M.J. Alam, M.S. Rana, M. I. Nazrul and T. Hasan

A field trial was conducted at Shyampur, Rajshahi, Gaibandha and Sylhet during the Rabi, 2022-2023, to evaluate the performance of modern onion variety under farmers' field conditions. Onion var.

BARI Piaz-6 gave the maximum bulb yield ( $14.08 \text{ t ha}^{-1}$ ) followed by Taherpuri ( $12.65 \text{ t ha}^{-1}$ ) and BARI Piaz-1 ( $11.98 \text{ t ha}^{-1}$ ) in Shibpur, Puthia, Rajshahi. In Gaibandha, the maximum bulb yield ( $16.70 \text{ t ha}^{-1}$ ) was found from BARI Piaz-4, followed by BARI Piaz-6 ( $9.87 \text{ t ha}^{-1}$ ) and BARI Piaz-1 ( $8.58 \text{ t ha}^{-1}$ ) whereas the lowest yield was produced by local cultivar ( $6.42 \text{ t ha}^{-1}$ ). In Sylhet, the maximum fresh bulb weight of  $50.00 \text{ g}$  and  $35.00 \text{ g}$  was observed in BARI Piaz-4 and local onion cultivar, respectively. On the other hand, the maximum total bulb yield of onion  $13.33 \text{ t ha}^{-1}$  was obtained from BARI Piaz-4, which was statistically at par with var. BARI Piaz-6.

#### **On-farm trial of garlic varieties**

M. S. Rahman, M. N. A. Siddique, M. J. Islam, M. M. I. Chowdhury, K.N. Islam, M.M. Islam, M.S.I. Khan, G. N. Hasan, R. H. Anik, M. Islam and T. Hasan

A field trial was conducted at Rajshahi, Patuakhali and Bhola during the Rabi season of 2022-2023, to evaluate the performance of BARI Rashun-1, BARI Rashun-2, BARI Rashun -3, BARI Rashun -4 and a local check (Italy) variety under farmers' field conditions. The experiment was designed in RCB with three dispersed replications. Among the varieties at Patuakhali and Bhola, BARI Roshun-3 gave highest yield  $5.27$  and  $5.24 \text{ t ha}^{-1}$  respectively and Rajshahi local ( $10.05 \text{ t ha}^{-1}$ ). Local Roshun gave the lowest seed yield  $4.68$  and  $4.15 \text{ t ha}^{-1}$  in Patuakhali, Bhola respectively. On basis of these findings, BARI Roshun-3 was the most productive variety under the coastal area and BARI Rashun-1, Local (Italy) was more profitable in Rajshahi.

#### **On-farm trial of chilli varieties at farmers field**

M.A. Islam, M.M. Zaman and T. Hasan

The experiment was conducted at farmers' field of Rajendrapur, Netrakona and Vabokhali, Mymensingh during rabi season of 2022-2023. The trial was consisted of three BARI released chilli varieties i.e. BARI Morich-1, BARI Morich-3 and BARI Morich-4; and two BINA released chilli varieties i.e. BINA Morich-1 and BINA Morich-2 with a local cultivar. The yield performance BARI Morich-4 and BARI Morich-1 appeared to be promising in the tested locations. However, maximum chilli yield was obtained from BARI Morich-4 ( $13.35 \text{ t ha}^{-1}$ ) followed by BARI Morich-



1 (1183 t ha<sup>-1</sup>) while lowest performance was observed in BARI Morich-3 (4.95 t ha<sup>-1</sup>).

#### **On farm trial of turmeric varieties**

M. Asaduzzaman, M. M. Howlader and T. Hasan

On farm trial of turmeric varieties were conducted at the farmers' field of Gopalganj and Narsingdi region during rabi season in 2022-23. Four turmeric varieties are evaluated under this experiment viz. BARI Halud-3, BARI Halud-4, BARI Halud-5 and local turmeric to select a suitable variety. The significantly highest yield was found from BARI Halud-4 (28.95 and 28.69 t/ha) and the lowest found from local variety (15.31 and 11.52 t/ha) in Gopalganj and Narsingdi respectively.

#### **On-farm trial of coriander in char land of Mymensingh**

S. Akhtar, M.M. Zaman and T. Hasan

The experiment was conducted at Trishal, Mymensingh during the rabi season of 2022-2023 to popularize the coriander varieties at farmers' fields. The coriander variety BARI dhonia-1, BARI dhonia-2, and local were used in this trial. The experiment was laid out in a randomized complete block design with three replications. Out of three coriander varieties, BARI dhania-1 showed the highest yield (1.30 t ha<sup>-1</sup>) and BARI dhonia-2 showed the lowest yield (0.94 t ha<sup>-1</sup>).

#### **Effect of different seedling ratios on the performance of coriander field pea mixed cropping system**

M. J. Uddin, M.M. Bashir, S. Bhawal and T. Hasan

An experiment was carried out at the farmer's field of Kachisair, Debiddar, Cumilla during the rabi season 2022-23 with view to investigate the effect of different mixed cropping arrangements of coriander and field pea and to find the land use advantage in the intercropping system. Out of the 8 treatments/combinations, the results show that the highest gross margin and BCR was obtained from the treatment of 100% coriander+ 30% field pea followed by 100% coriander+20% field pea and 100% coriander+ 10% field pea. There was no major disease found in the said treatment /combinations of the mixed cropping systems.

#### **Validation of intercropping garlic, onion,**

#### **fenugreek, black cumin with groundnut in charland areas**

S. Roy, M. A. Rahaman, T. Tasmima, G. Paul, K. Roy and T. Hasan

An experiment was conducted at the MLT site, Bhuapur, Tangail during the rabi season of 2021-22 and 2022-23 to find out the suitable intercrop combination of groundnut for higher productivity and profitability of charland areas stakeholders. Five treatments viz., T1= Sole groundnut (100%), T2= Two rows of black cumin in between two rows of groundnut, T3= One row of fenugreek in between two rows of groundnut, T4= One row of garlic in between two rows of groundnut, T5= One row of onion in between two normal rows of groundnut. Analysis of intercropping treatments revealed that one row of onion in between two rows of groundnut resulted in the highest groundnut equivalent yield (5.80 t ha<sup>-1</sup>) as well as gross margin (Tk. 388270 ha<sup>-1</sup>) and the lowest groundnut equivalent yield (1.74 t ha<sup>-1</sup>) as well as gross margin (Tk. 67795 ha<sup>-1</sup>) were obtained from T3 treatment.

#### **Performance trial of mint varieties for yield and quality in Sylhet region**

M. I. Nazrul and T. Hasan

An experiment was conducted at farming system research and development (FSRD) site, Kamal bazar, during March to July 2023 to evaluate comparative performance of four mint (*Mentha* sp.) genotypes for high yield and quality. Cuttings of selected four genotypes of mint (viz., BARI Pudina-1, BARI Pudina-2, Pudina local-1 and Pudina local-2) were used as plant materials. The highest plant height (42.75 cm) along with longest edible shoot (32.44 cm) was found in the genotype BARI Pudina-2 which was significantly differed from others. The highest number of leaves (108.83) per plant was produced by BARI Pudina-1, which was statistically similar to that of Pudina local-1 (104.17) but the lowest number of leaves (48.33) were found in Pudina local-2. The highest foliage yield (9.79 kg m<sup>-2</sup>) was produced by BARI Pudina-2, followed by Pudina local-1; and the lowest yield was obtained from BARI Pudina-1. BARI Pudina-1 is more greeneries compared to other samples.

### **On-farm trial of BARI developed barley varieties**

M.E.A. Pramanik, J.C. Barman, M.S. Hossain, G. Paul, M.A. Rahaman, T. Tasmima, K. Roy, S. Roy, M.K. Shahadat, M. Rahman, M.K. Islam, T.S. Munmun, M.H. Rashid, S. Ahmed, M.Z.H. Soheli and R. Sultana

The trial was conducted at Rajshahi, Tangail, Khulna and Faridpur districts during Rabi 2022-23 to observe the performance and popularize BARI barley varieties among the farmers. Three varieties of barley viz., BARI Barley-7, BARI Barley-8 and BARI Barley-9 and one advance line BHL-25 were tested in Rajshahi and Khulna. Two varieties of barley viz., BARI Barley-7, and BARI Barley-9 were tested in charland of Tangail. Four varieties of barley viz., T<sub>1</sub> = BARI Barley-6, T<sub>2</sub> = BARI Barley-7, T<sub>3</sub> = BARI Barley-9 and T<sub>4</sub> = local were used in Faridpur. In Rajshahi, out of four barley varieties/lines BARI Barley-8 gave the highest grain yield (1.93 t ha<sup>-1</sup>) followed by BARI Barley-9 (1.70 t ha<sup>-1</sup>). The lowest grain yield was produced by BHL-25 (1.37 t ha<sup>-1</sup>). In Tangail, between the varieties, the highest grain yield of 1.47 t ha<sup>-1</sup> was observed in BARI Barley-7.

### **Advanced yield trial of quinoa**

M.K. Shahadat, M. Rahman, M.K. Islam, T. S. Munmun and M. H. Rashid

Quinoa is a pseudo cereal, which is regarded as a super food for its high nutritional value. At the same time the crop is reported to be tolerant to moderate to high salinity and drought. The present study was undertaken in order to select salt tolerant advanced quinoa lines at MLT site, Koyra during 2022-23. Eight advanced lines were included in the trial, however, only genotypes survived and produced grain after re-sowing on 28 December 2022. There was no significant difference among the genotypes for growth and yield characters. However, from numerical point of view BQL-1 (E1) produced highest grain yield (2.31 t ha<sup>-1</sup>).

### **Advancing of F<sub>2</sub>, F<sub>3</sub> and F<sub>4</sub> generation of barley under saline condition**

M.K. Shahadat, M. Rahman, M.K. Islam, T. S. Munmun and M. H. Rashid

In order to select salt tolerant genotypes from F<sub>3</sub>, F<sub>4</sub> and F<sub>5</sub>, 8 F<sub>2</sub> and 49 F<sub>3</sub> and 58 F<sub>4</sub> generation of barley, a field trial was conducted at MLT site,

Koyra during 2022-23. Multi-trait genotype ideotypes distance indices were applied for selection of the genotypes from the multivariate data. Seven genotypes viz. K4-2, K4-43, K4-12, K4-7, S3-4, S3-5 and K4-6 were selected based on multivariate analysis of multi-trait genotype ideotype distance index. These genotypes should be used for further generation advancing and molecular studies.

### **Adaptive trials with BARI barley and oat varieties in char areas**

M. J. Alam, M. S. Rana and A. A. Mahmud

An adaptive trial was conducted under the char land situation at the MLT sites Saghata, Gaibandha to observe the performance of BARI Barley and Oat varieties in the Char areas during 2022-23. Two barley varieties viz., BARI Barley-7 and BARI Barley-9 along with BARI Oat-1 were tested in the Char areas. BARI Barley-9 produced a higher grain yield of 2.15-2.41 t ha<sup>-1</sup> with an average of 2.28 t ha<sup>-1</sup> followed by BARI Barley-7 which produced 1.98-2.35 t ha<sup>-1</sup> grain with an average of 2.17 t ha<sup>-1</sup>. BARI Oat-1 produced 0.9 to 0.96 t ha<sup>-1</sup> grain with an average of 0.93 t ha<sup>-1</sup>.

### **Up-scaling of BARI foxtail millet and proso millet varieties in char areas**

M. J. Alam, M. S. Rana and A. A. Mahmud

A trial with BARI developed foxtail millet and proso millet varieties was conducted at Saghata, Gaibandha during 2022-23 to disseminate and popularize BARI foxtail millet and proso millet varieties to the farmers of char areas. All the tested varieties produced satisfactory yield. Among them, the average maximum grain yield was recorded from BARI Kaon-4 (3.12 t ha<sup>-1</sup>) followed by BARI Kaon-2 (2.74 t ha<sup>-1</sup>) and BARI Kaon-3 (2.67 t ha<sup>-1</sup>) whereas the mean yield of BARI Cheena-1 was 2.69 t ha<sup>-1</sup>.

### **On-farm trial of foxtail millet varieties at farmers field**

E.A. Pramanik, J. C. Barman, M.S. Hossain, M. M. Rahman, A.K.M.Z.U. Noor, M.A. Rahman, M. A. Islam, M.M. Zaman, M. Z. Ferdous and M. A.A. H. Talukder

Adaptive trials with BARI-developed millet varieties were conducted at Rajshahi, Jamalpur, Mymensingh and Rangpur during Rabi season of 2022-23 to evaluate the performance of BARI developed high yielding foxtail millet varieties.

Among the tested varieties BARI Kaon 4 produced maximum grain yield in Rajshahi, Mymensingh and Rangpur whereas BARI Kaon 2 produced higher yield in Jamalpur. Grain yield  $1.97 \text{ t ha}^{-1}$  in Rajshahi,  $2.20 \text{ t ha}^{-1}$  in Mymensingh and  $2.77 \text{ t ha}^{-1}$  in Rangpur were found in variety BARI Kaon-4 and in Jamalpur  $1.90 \text{ t ha}^{-1}$  was recorded BARI Kaon 2.

#### **On farm trial of proso millet varieties in the char land and high barind tracts**

Ms Alam, Mra Mollah, Mt Hasan, M.S. Hossain, M.E.A. Pramanik and J.C. Barman

A field trial was conducted at Khatimarir char Sonatola, Bogura and at FSRD site, Basantapur, Godagari, Rajshahi during 2022-2023, to evaluate the performance of modern proso millet variety under farmers' field conditions. One proso millet variety BARI Cheena-1 and Local (check), were tested. In OFRD Bogura. Five lines viz., BD-777, BD-791, BD-1402, BD-1446, BD-1448 BD-1447 along with one BARI released variety BARI Cheena-1 and local one (check) were tested in the trial. BARI Cheena-1 gave a satisfactory yield ( $1.76 \text{ t ha}^{-1}$ ) in Charland area of Sonatola, Bogura, over the local variety ( $1.22 \text{ t ha}^{-1}$ ). Proso millet is a short duration crop and matures in 63 to 68\9 days. The thousand grain weight was also small ranging from 4.14-4.79 g. Among the tested genotypes, BD-1446 produced the maximum t grain yield ( $1.61 \text{ t ha}^{-1}$ ) followed by 1402 ( $1.52 \text{ t ha}^{-1}$ ) and BD-1448 ( $1.44 \text{ t ha}^{-1}$ ); and the lowest one from local cultivar ( $1.24 \text{ t ha}^{-1}$ ).

#### **Adaptive trials with finger millet lines in char areas**

M. Z. Ferdous and M. A. A. H. Talukder

The trial was conducted at farmers' field of Char Bongram, Chilmari under Ulipur MLT site, Kurigram to observe the performance of five finger millet lines. Five finger millet lines viz. IE-3392, IE-3077, IE-2043, IE-2619, IE-501 were tested. The highest grain yield ( $1.19 \text{ t ha}^{-1}$ ) was harvested from IE-3077 and IE-2619 ( $1.18 \text{ t ha}^{-1}$ ). No remarkable disease and insect infestation was observed in finger millet field.

### **Project IV: Integrated Farming**

#### **Integrated farming research and development for livelihood improvement in the plainland ecosystem**

S. Ahmed, M.Z.H. Sohel, M.A. Isalm, M.Z. Ferdous, M.A. Rahman, M.A. Rahman and M. Anwar

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 2022-23 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., Sholakundu (Faridpur), Gangarampur (Pabna), Ajoddhapur (Rangpur), Tarakandi (Sherpur) and Atia, Delduar (Tangail). 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 564 kg after intervention (AI), which was only 172 kg before intervention (BI), which was 228% increase. The average vegetable consumption after intervention (AI) was  $160 \text{ g head}^{-1}\text{day}^{-1}$  compared to  $55 \text{ g head}^{-1}\text{day}^{-1}$  before intervention (BI), which was 190% higher than BI. The average fruits produced per homestead 483 kg, which was only 255 kg during BI, which was 90% increase. The average consumption of fruits was also increased (128%) after intervention (AI). Animal product from fish, chicken and livestock could help to minimize the protein deficiency. Fruit tree management was created a good impact on farm households and a total of 113 fruit trees were brought under pest management and a total of 449 saplings of different fruits were distributed in different FSRD sites. Women participation (20-80%) 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 0.64, 0.84, 0.43, 0.54 and  $0.61 \text{ ha}^{-1}$  in



Faridpur, Pabna, Rangpur, Sherpur and Tangail area, respectively. Maximum gross margin (479016 tk ha<sup>-1</sup>) was came from Onion- Jute- T. Aman cropping pattern. Production program of different crops (mustard, onion, lentil, okra, yardlong bean) was successfully executed with modern varieties which was profitable i.e., gross margin ranging from 84000 to 343442 tk ha<sup>-1</sup>. In livestock component, after vaccination, the frequency of major diseases of cattle were reduced to about 5%. Mortality of poultry before vaccination was 19% (avg.) which drastically reduced to 2.5% (avg.) after vaccination (avg. 16.5% decrease). The average pond size was 0.03-0.06 ha over the locations. Seasonal fish culture with carp polyculture in seasonal pond was found promising. Carp polyculture gave a satisfactory fish yield (avg. 42 kg per decimal pond) and gross margin (avg. Tk. 5230 per decimal pond). From different types of off-farm activities, farmers also earned some extra money (avg. gross margin Tk. 5165 household<sup>-1</sup>). Among the different production components, field crop sector gave maximum gross margin (Tk. 118400- 126060 farm<sup>-1</sup>) but percent growth of gross margin was maximum at homestead vegetable production sector (74-875%), where average gross margin of five FSRD sites increased 78% after intervention.

### **Integrated farming of drought ecosystem for improving livelihood of resource poor farm households in a participatory approach**

M.S. Hossain, M. I. Nazrul and J.C. Barman

Prolonged drought, high temperatures, uneven distribution of rainfall due to climate change, soil acidity and low soil fertility are major stresses affecting agricultural production in drought and rainfed ecosystem. Furthermore, resource poor farm households are more concern with the decreasing of agricultural land. It needs to manage properly all the resources of a farm household in integrated approach. The integrated farming activities were carried out at FSRD site, Basantapur, Godagari, Rajshahi and Kamalbazar, Sylhet during 2022-23 to utilize available farm resources and to improve livelihood of the resource poor farm households. The research areas were i) Homestead production system ii) Crops and cropping system iii) Livestock production system, iv) Fisheries Production system and v) off- farm activities. All components of integrated farming such as vegetables, fruits, cereal crops,

livestock, fish and off-farm activities were brought under improved technological intervention and accordingly income was increased from these components. The overall results of those experiments showed that farmers obtained higher yield and economic return from their improved cropping pattern with improve variety (s). In Basantapur, results of homestead production program revealed that intake of vegetable were markedly increased (avg. 232.50%) by all families included in this system. Average intake of fruits per year was also increased (Avg. 156.25%) after intervention of the technology. Two improved cropping pattern trials were conducted of which Tomato-Boro-T. Aus gave the highest productivity and economic return. Newly released high yielding crop varieties were also introduced through on farm validation program where farmers obtained higher crop yields and gross margin. Gross return and gross margin were increased due to deworming and vaccination program of cattle. Mortality of poultry reduced (85-90%) after vaccination. Moreover, farm yard manure (FYM) production and utilization were created a good impact among the farm family. Duck rearing in the homestead created a good impact among the farm families as a good source of income. In fisheries production system, it was found that farmers sold most (Avg. 50.60%), consumed about 43.45% and distributed 5.93% among their neighbors, relatives. Among the seasonal fish culture carp polyculture gave higher gross margin (Avg. Tk. 11208 pond<sup>-1</sup>) at farmers' level. In Kamalbazar, vegetable production had increased significantly 246.15% compared to before intervention of the program. The vegetables and fruit productions per homestead were 587 and 509 kg, respectively. The gross margin of produced vegetables and fruits were Tk. 7066 and 10988, respectively based on the present market price in the locality. Inclusion and production of high yielding crop varieties eg. Potato (BARI Alu-41), BRRi dhan48 and Binadhan-7 in T. aus and T. aman rice season, respectively in the improved cropping pattern was enhanced higher economic return over farmers existing pattern. Finally, it can be concluded that interventions made in different components exerted a visible positive impact in improving farmers' socio-economic condition and livelihood as well. The daily nutritional requirements of the family members were supplemented considerably due to increased of consumption of vegetables and

fruits from the homestead gardening. The results of FSRD activates imply that by implementing the coordinated approach of farming systems at FSRD sites has brought a good impact on the resource-poor farmers for the betterment of livelihood.

## **Project V: Socioeconomic Studies**

### **Adoption and profitability of BARI hybrid tomato in some selected areas of Bangladesh**

M. Akhtar Hossain, M. M. Anwar, M F Hossain, M.S. Rahman, M. J. Uddin, M. Mohiuddin and N. Akter

The study was conducted in 15 districts over Bangladesh to explore adoption status of BARI hybrid tomato and to estimate profitability. Location was selected purposively with 140 sample farmers during the month of February and March 2023. Adoption level of BARI hybrid tomato-8 was found about 68%, BARI hybrid tomato-11 was about 19% and 13% for others hybrid tomato varieties in Jashore, Satkhira, Moulvibazar and Brahmanbaria districts. Net return was estimated at Tk. 1681740 per hectare of BARI hybrid tomato cultivation and BCR was 2.55 indicated that BARI hybrid tomato production was profitable to the farmers in the study area.

### **Adoption of nano input in brinjal farming of Mymensingh district**

M. E. A. Begum and M. M. Zaman

The study has estimated WTP for nanofertilizer using primary data collected from 200 brinjal growing farm households of Mymensingh district. WTP was estimated using a double bounded dichotomous choice model, and the mean WTP worked out to Tk. 580/100 ml. Farmers are WTP 45 per cent premium prices for nano fertilizer compared to conventional urea fertilizer of 50 kg. In the context of existing climatic scenarios, Bangladesh's agriculture policy should prioritize formulating farmers' group and strengthening extension service through a public-private partnership.

### **Economy of coriander cultivation in selected areas of Kishoreganj**

M. Mohiuddin

A survey study was carried out to assess the existing agronomic practices of coriander, its

profitability and problems of production in two selected coriander cultivated areas of Kishoreganj district during 2022-23 cropping season. The majority of the farmers sown their seeds during the second week of October to first week of November. Findings of the study revealed that on an average 25% of the total cost was involved for human labour followed by fertilizer (19%), seeds (17%) and land use (14%), respectively. The average yield of coriander was found to be 20.07 ton per hectare. The average gross margin was estimated at Tk. 136381.30 on variable cost basis. The production cost of coriander /kg was Tk. 5.20 and return was Tk. 11.25. High infestation of root rot disease, lack of scientific production technology, buyers syndicate and low output price were the major problems in the study areas. Farmers cultivate coriander for getting higher profit, maximum use of seasonal fallow land and easy growing.

## **Project VI: Transfer of Technology**

### **On-farm trial of BARI released Bt brinjal varieties in Bangladesh**

M.H. Rashid

The field trial was conducted at 58 farmers field of 14 districts in Bangladesh such as Bagura, Bhola, Faridpur, Gopalganj, Jashore, Khulna, Kishoreganj, Kushtia, Manikganj, Narsingdi, Noakhali, Rangpur, Sherpur and Tangail during 2022-2023 to observe the performance of transgenic BARI Bt brinjal varieties at the farmers' field. Tested two BARI Bt brinjal varieties performed better against non Bt counterparts, reduced brinjal shoot and fruit borer (BSFB) infestation produced maximum healthy fruit and offered higher gross margin in all locations. BARI Bt begun-2 showed 0.00% shoot, 0-1.20% fruit infestation by number, 0.00-1.40% fruit infestation by weight and 21.87-43.75 t ha<sup>-1</sup> yield against 21.32-35.50% shoot, 23.45-39.90% fruit by number, 25.45-41.30% fruit infestation by weight and 15.14-31.34 t ha<sup>-1</sup> yield in non-Bt counterparts. BARI Bt begun-4 showed 0.00-3.54% shoot, 0.00-5.57% fruit infestation by number, 0.00-4.20% fruit infestation by weight and 16.75-46.47 t ha<sup>-1</sup> yield against 9.66-36.00% shoot, 14.33-62.40% fruit by number, 13.96-60.50% fruit infestation by weight and 12.40-33.34 t ha<sup>-1</sup> yield in non-Bt counterparts. Among the 14 districts, field trial under 9 districts totally free from BSFB infestation.

## RARS Jashore

### Development of alternate cropping pattern field pea-Boro-T. Aman against mustard-Boro-T. Aman cropping pattern

MH Rahman and KU Ahammad

The trial was conducted at the farmers' field of Multilocation testing (MLT) site, Jhikargacha, Jashore during 2022-23 to develop Fieldpea (BARI Motor-3)-Boro (BRRI dhan63)- T. Aman (BRRI dhan75) rice cropping pattern. There were two treatments i.e, T<sub>1</sub>: Existing Cropping pattern: Mustard (BARI Sarisha-14)-Boro (BRRI dhan28)- T. Aman (Binadhan-7) and T<sub>2</sub>: Alternate Cropping pattern: Fieldpea (BARI Motor-3)-Boro (BRRI dhan63)-T. Aman (BRRI dhan75). Higher Rice Equivalent yield and gross margin were obtained from alternate cropping pattern over existing cropping pattern due to inclusion of new crops and marginal benefit cost ratio was 181.

### Development of alternate cropping pattern mustard-jute-T. Aman against lentil- jute- T. Aman cropping pattern

MH Rahman and KU Ahammad

A trial was conducted at the farmers' field of Multilocation testing (MLT) site, Shalikha, Magura during 2022-23 to develop Mustard (BARI Sarisha-18)- Jute (BJRI Tosha pat -8)- T. Aman (BRRI dhan87) cropping pattern. There were two treatments i.e, T<sub>1</sub>: Existing Cropping pattern: Lentil (BARI Masur-7)-Jute (O-9897)- T. Aman (Binadhan-7) and T<sub>2</sub>: Alternate Cropping pattern: Mustard (BARI Sarisha-18)-Jute (BJRI Tosha pat -8)- T. Aman (BRRI dhan87). Higher rice equivalent yield and gross margin were obtained from alternate cropping pattern over existing cropping pattern due to inclusion of new crops and marginal benefit cost ratio was 18.

### Adaptive trials with newly released varieties of panikachu

MH Rahman and KU Ahammad

An experiment was conducted to evaluate the performance of panikachu varieties in farmers' field and to popularize among the farmers. Plant height was the highest in BARI Panikachu-1 and the lowest in BARI Panikachu-4. The highest number of stolon per plant and weight of stolon per plant was also the highest in BARI Panikachu-1 followed by BARI Panikachu-2 and BARI

Panikachu-3. Stolon yield was the highest (23.3 t ha<sup>-1</sup>) in BARI Paniikachu-1 followed by BARI Panikachu-2 (20.8 t ha<sup>-1</sup>) and this was the lowest (5.8 t ha<sup>-1</sup>) for BARI Paniikachu-6. Rhizome yield was the highest (41 t ha<sup>-1</sup>) in BARI Panikachu-4 and this was the lowest (29.4 t ha<sup>-1</sup>) for BARI Paniikachu-1. The highest gross return, gross margin and MBCR were obtained from BARI Panikachu-1 compared to local one. Farmers expressed their satisfaction with the higher yield of BARI Paniikachu-1, BARI Paniikachu-2 and BARI Paniikachu-4 considering stolon and rhizome yield with gross return. They are interested to grow this variety in future.

### Adaptive trials with newly released varieties of mukhikachu

MH Rahman and KU Ahammad

The experiment was conducted at MLT site Shimakhali, Magura during the Kharif season of 2022 to evaluate the performance of mukhikachu varieties under farmers' field and to popularize among the farmers. The highest number of corms per plant and weight of corm per plant was also highest from BARI Mukhikachu-1. The highest corm yield (11.58 t ha<sup>-1</sup>) was found in BARI Mukhikachu-1 and this was the lowest (9.38 t ha<sup>-1</sup>) for local. The gross return (463200 Tkha<sup>-1</sup>), Gross margin (281500 Tk. ha<sup>-1</sup>) and marginal benefit cost ratio (13.1) were the highest for BARI Mukhikachu-1 compared to Local variety. Farmers expressed their satisfaction with the higher yield of BARI Mukhikachu-1 and BARI Mukhikachu-2 in terms of corn yield and gross return. They are interested to grow this variety in future.

### Adaptive trial of bushbean varieties in Jashore region

MH rahman and KU ahammad

The trial was conducted at MLT site Jhikorgacha, Jashore during Rabi season of 2022 to evaluate the performance of bushbean varieties in farmers' field and to popularize among the farmers. Three bushbean varieties namely, BARI Jharsheem-1, BARI Jharsheem-2, and BARI Jharsheem-3 were used as planting material. The number of pods per plant was higher both in BARI Jharsheem-1 and BARI Jharsheem-1. The green pod yield was higher both in BARI Jharsheem-1 and BARI Jharsheem-2 (1.3 t ha<sup>-1</sup>) whereas BARI Jharsheem-3 produced lower green pod yield (0.7 t ha<sup>-1</sup>).



Farmers expressed their satisfaction with the higher yield of BARI Jharsheem-1 and BARI Jharsheem-2 in terms of corn yield. They are interested to grow this variety in future.

#### **Production programme of BARI Bt. Begun-4**

MH Rahman and KU Ahammad

The production programme was conducted at MLT site Jhikorgacha, Jashore during Rabi season 2022-23. Fertilizers were applied at the rate of 300-200-200-100-10-10 kg Urea, TSP, MoP, Zypsum, ZnSO<sub>4</sub> and Boric acid respectively. Cowdung was applied @ 10 t ha<sup>-1</sup>. Bleaching powder was applied @ 21 kg ha<sup>-1</sup> before 10 days of planting and 33 kg furadon was applied at final land preparation. One third of MoP and all fertilizers except urea were applied as basal dose. Urea were splitted in to four equal amount and applied at 20 DAP, flowering stage, fruiting bearing stage and next fruiting stage. Rest amount of MoP were splitted into three equal amount and applied at 20 DAP, flowering stage, fruiting bearing stage. Brinjal plants were irrigated as and when necessary, pagasus was sprayed for controlling jassid and whitefly. Vertimech was used for controlling mite. Farmers expressed their satisfaction with the higher yield of BARI Bt begun-4. They are interested to grow this variety in future.

#### **Oroduction programme of BARI begun-12**

MH Rahman And KU Ahammad

The production programme was conducted at MLT site Jhikorgacha, Jashore during Rabi season 2022-23. Thirty-five days old seedlings were transplanted on 26 October 2022. Row to row distance was 1 m and plant to plant distance was 0.7 m. Fertilizers were applied at the rate of 300-200-200-100-10-10 kg Urea, TSP, MoP, Zypsum, ZnSO<sub>4</sub> and Boric acid respectively. Cowdung was applied @ 10 t ha<sup>-1</sup>. Bleaching powder was applied @ 21 kg ha<sup>-1</sup> before 10 days of planting and 33 kg furadon was applied at final land preparation. One third of MoP and all fertilizers except urea were applied as basal dose. Urea were splitted in to four equal amount and applied at 20 DAP, flowering stage, fruiting bearing stage and next fruiting stage. Rest amount of MoP were splitted into three equal amount and applied at 20 DAP, flowering stage, fruiting bearing stage. Brinjal plants were irrigated as and when necessary, pagasus was sprayed for controlling jassid and whitefly. Vertimech was used for controlling mite. Farmers expressed their satisfaction with the higher yield of BARI Begun-12. They are interested to grow this variety in future.

# PLANT PATHOLOGY

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## ***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 2023. 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. 18 fungus and 4 bacteria were evaluated in dual culture. Six isolates showed growth inhibition of NP on PDA. The highest mycelial growth inhibition percent and inhibition zone against NP were produced by EMGR4.

## **Identification of diseases of strawberry in Bangladesh**

M. Arifunnahar, K.M. Alam, F.E. Elahi, M.S. Akhter, M.M. Islam, M.I. Faruk And M.M. Rahman

Strawberry (*Fragaria × ananassa* Duch.) has recently become an economically important fruit crop in Bangladesh. The plants are affected by a large number of diseases caused by different factors. Disease diagnosis is very necessary for the commercial production of strawberry to avoid disease infection. To fulfill the purpose diseased plant samples were collected from different strawberry growing areas during 2022-23 cropping season in plant pathology division, BARI, Gazipur. Plant samples (viz.) leaf, root, crown and fruit 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 *Pestalotia* sp., *Alternaria* sp., *Rhizoctonia* sp. and *Botrytis cinerea* were isolated from the infected plant parts of Strawberry which were responsible for leaf spot, leaf blight, root rot and fruit rot disease of strawberry.

## **Multiplication, purification and maintenance of indigenous potato varieties**

A.K. Saha And M.M.E. Rahman

Indigenous cultivars of potato are famous for taste and dry matter and for long preservation quality under natural condition. During 2022-2023 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. There are 299 Kg seeds preserved in cold-storage of BSPC, Debiganj, Panchagarh for next year use.

## **Screening of lentil lines against stemphylium blight disease**

M. R. Humauan, B. Akhter And D. Sarkar

The experiment was conducted at the experimental field of Regional Agricultural Research Station, Ishurdi, Pabna during rabi season 2022-23 to find out the resistant sources against stemphylium blight disease of lentil. Thirty lentil lines and one check variety BARI Masur-1 were used in this experiment. Among the tested entries four lines showed moderately resistant, 7 lines showed moderately susceptible, 16 lines showed susceptible and rest three lines including check variety BARI Masur-1 showed highly susceptible reaction against *Stemphylium* blight disease. The highest yield (1874 kg/ha) was observed in genotype BD-3946 which statistically identical to BD-3988 (1822 kg/ha) and BD-3971 (1805 kg/ha) while the lowest (1186 kg/ha) was recorded in check variety BARI Masur-1.

**Screening of okra lines against okra yellow vein mosaic virus**

M. R. Humauan, B. Akhter And D. Sarkar

The experiment was conducted at the experimental field of RARS, Ishurdi, Pabna during kharif-1 season 2022-23 to find out the resistant sources against okra yellow vein mosaic virus disease. Seeds of thirteen okra genotypes viz. AE-002, AE-003, AE-004, AE-005, AE-007, AE-008, AE-009, AE-010, AE-011, AE-012, AE-013 and AE-014 including one check variety BARI Dherosh-2 were used in this experiment. Among the tested entries three okra genotypes namely AE-003, AE-004 and check variety BARI Dherosh-2 showed highly resistant reactions, eight genotypes AE-002, AE-007, AE-008, AE-009, AE-010, AE-011, AE-012 and AE-014 showed moderate resistant reactions and two genotypes namely AE-005 and AE-013 showed tolerant reactions against okra yellow vein mosaic virus disease. The highest yield (19.65 t/ha) was found in genotype AE-012 which statistically similar to the genotype AE-008 (19.50 t/ha), while the lowest (11.78 t/ha) was recorded in AE-013.

**Screening of mustard varieties/lines against alternaria blight and white mold disease**

M.M.E Rahman, S. Ghosh, M.S. Uddin 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 239 entries, a total of 7 entries showed moderately susceptible and rests of the entries were found susceptible to highly susceptible. On the other hand, white mold disease was observed all most all the entries.

**Screening of onion varieties and lines against purple blotch disease**

M. Monirul Islam, K.M. Alam, K.M. Khalequzzaman, M.I. Faruk, and M.M. Rahman

A screening experiment was conducted with 36 varieties and lines of onion to search the resistant variety against purple blotch disease of onion at the field of Plant Pathology Division, BARI, Gazipur during 2022-2023 cropping season. The highest

disease incidence 75% was found in AB8(422) and the lowest disease incidence 6% was found in AC-GAZ-384. The maximum disease severity 4.2 was found in the line AB8(422). The minimum disease severity 1.1 was found in AC-GAZ-384, AC-GAZ-380, AC-Bog423-AF5 and AB4(379), respectively.

**Screening of barley entries/lines against spot blotch disease caused by bipolaris sorokiniana through artificial inoculation**

M.M.E Rahman, A.H. Akhi, S.H. Omy, M.M. Rohman and A.K. Saha

Spot blotch is caused by fungus *Bipolaris sorokiniana* is one of the major diseases of barley. Varying level of disease resistance was recorded against spot blotch of barley during screening at RARS, BARI, Rangpur in 2022-23 growing season. No entry/line of barley was observed either immune or resistant against spot blotch disease. Among the 187 entries, only 62 entries showed moderately susceptible and rest of the entries was found susceptible to highly susceptible.

**Selection of resistant guava seedlings against nalanthamala psidii wilt disease pathogen**

K. M. Alam, M. Arifunnaher, M. Monirul. Islam

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 1143 seedlings were tested within a year. Disease occurring was observed in every stage of plant age at artificially inoculated condition. Guava seedlings showed difference in tolerance to *N. psidii* isolate NPB 001. Among the tested seedlings, 4 seedlings (July, 2021 sowing) showed tolerance more than 2 years to artificial disease pressure of isolate NPB 001 and 9 seedlings (November, 2021) showed almost 2 years.

**Evaluation of new fungicides against early blight of tomato**

MS Ali And Mb Anwar

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2022-23 to find out appropriate new chemical fungicides for controlling early blight of tomato. Sixteen new fungicides were evaluated in this study. Among the fungicides, the lowest disease severity (2.00) was recorded in T<sub>2</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>9</sub>, T<sub>10</sub>



and T<sub>16</sub> treated plot. On the other hand, the highest disease severity (5.00) was found in T<sub>17</sub> (control) plot. The highest reduction (87.50%) of disease severity over control was found in T<sub>10</sub> (928) treated plot and the lowest (56.25%) was found in T<sub>12</sub> (971) treated plot. The highest yield was recorded (45.80 t/ha) in T<sub>10</sub> (928) treated plot and the lowest (10.28 t/ha) in T<sub>17</sub> (control) plot.

#### **Comparison of bio-fungicide and chemical fungicides for the management of early blight of tomato grown on floating beds**

M.G. Kibria, M.Z. Rahman, M.M.R. Talukder, And B.C. Kundu

An experiment was conducted during 2022 and 2023 cropping year in controlling early blight of tomato by using biofungicides and chemical fungicide at RARS, Rahmatpur, Barishal. Fungicides viz; Bioderma, Dynamic and Rovral 50 wp along with control (Water spray) were used in the floating beds. Result showed that all the tested fungicides reduce the early blight disease over control. Rovral 50WP reduce the highest disease followed by Bioderma and Dynamic and highest yield was found in Rovral treated beds.

#### **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 2022-23 to evaluate 14 (fourteen) new fungicides against late blight of potato under natural inoculum pressure. More than 80% disease suppressions were observed due to the spray with 793 encoded fungicide. Among the fungicides, 793 coded fungicide most effectively managed late blight disease of potato and yielded more.

#### **Efficacy of new fungicides in controlling powdery mildew of sweet gourd**

MS Ali And Mb Anwar

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2022-23 to find out the effective new chemical fungicides against powdery mildew disease of sweet gourd. Fifteen new fungicides were evaluated in this study. Among the fungicides the lowest disease severity (4.00) was recorded in T<sub>4</sub> (364), T<sub>14</sub> (723) T<sub>10</sub> (486), T<sub>7</sub> (487) and T<sub>8</sub> (431) treated plot. On the other hand, the highest disease severity

(3.00) was found in T<sub>16</sub> (control) plot. The highest reduction (86.66%) of disease severity over control was found in T<sub>4</sub> (364) and T<sub>14</sub> (723) treated plot and the lowest (66.66%) in T<sub>3</sub> (349) treated plot. The highest yield (35.10 t/ha) was recorded in T<sub>4</sub> (364) treated plot followed by T<sub>14</sub> (723), T<sub>10</sub> (486), T<sub>11</sub> (487) and T<sub>8</sub> (431) treated plot, respectively and the lowest (15.25 t/ha) in T<sub>16</sub> (control) plot followed by T<sub>3</sub> (349) treated plot.

#### **Chemical and biological management of anthracnose disease of strawberry**

B. Akhter, M. R. Humauan And D. Sarkar

A field experiment was conducted at Regional Agricultural Research Station Ishurdi, Pabna during Rabi season of 2022-2023 to find out the effective chemicals and bio-control agents against anthracnose disease of strawberry. Seven different chemicals and bio-control agents and one untreated control were used in this experiment. The lowest incidence of anthracnose disease (5.40 %) was recorded in Score 250 EC (Difenoconazole) @ 2ml/l treated plots and the highest (14.96 %) was recorded from control plots. Disease reduction over untreated control ranged from (24.33 -63.90%) among the tested chemicals and bio-control agents. The highest weight of fruits/plant (409g) was recorded in Score 250 EC (Difenoconazole) @ 2 ml/l treated plots and the lowest (325g) was recorded in control plots. The highest yield (17.05 t/ha) was found in Score 250 EC (Difenoconazole) @ 2 ml/l treated plots while the lowest (13.28 t/ha) was recorded in control plots.

#### **Evaluation 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 Ghagurdhur, Shibgonj, Bogura district during 2022-2023 cropping season to evaluate second times trail of the efficacy of thirteen foliar 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, Silicar 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 (6.1%) was recorded in Bio-Libas 0.8% SC (Physson 0.8%) treated plot followed by Sting (Bacillus Subtilis) (6.8%) and the highest (86%) in control treatment. The highest yield (37.66ton/ha) was recorded in Bio-Libas 0.8% SC and the lowest (19 ton/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.

#### **Efficacy of different new fungicides in controlling sigatoka disease of banana**

Ms Ali And Mb Anwar

This experiment was conducted at farmer's field of Mohinikati, Jhikargacha, Jashore district during 2022-23 to find out the effective new chemical fungicides against sigatoka disease of banana. Sixteen new fungicides were evaluated in this study. Among the fungicides, the lowest disease severity (9.33) was recorded in T<sub>11</sub> (636), T<sub>14</sub>(703) and T<sub>15</sub> (704) treated plot. On the other hand, the highest disease severity (60.00) was recorded in T<sub>17</sub> (control) plot. The highest reduction (84.45%) of disease severity over control was found in T<sub>11</sub> (636), T<sub>14</sub>(703) and T<sub>15</sub> (704) treated plot and the lowest (66.66%) in T<sub>4</sub> (415) and T<sub>13</sub> (664) treated plot. The highest yield (52.00 t/ha) was recorded in T<sub>11</sub> (636) and T<sub>14</sub> (703) treated plot followed by T<sub>15</sub> and T<sub>10</sub> and the lowest (20.00 t/ha) was recorded in T<sub>17</sub> (control) plot followed by T<sub>3</sub> and T<sub>4</sub> treated plot.

#### **Effect of fungicides in controlling purple blotch disease of onion**

M. Monirul Islam, K.M. Alam, K.M. Khalequzzaman, M.I.Faruk, and M.M.Rahman

The experiment was conducted at Bangladesh Agricultural Research Institute (BARI), Gazipur, Spices Research Sub-Centre, Faridpur and Spices Research Centre, Shibgonj, Bogura during 2022-23 cropping season to find out the effective fungicides in controlling purple blotch disease of onion. Seven fungicides viz. Indofil, Amister Top, Cupravit, Luna sensation, Tilt, Rovral and Autostin was evaluated against the disease. Luna sensation, Amister Top and Rovral 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 Luna sensation followed by Amister Top and

Rovral at Gazipur, Faridpur and Bogura. The lowest yield was recorded in control treatment at all three locations.

#### **Evaluation of new fungicides for controlling purple blotch disease of onion**

MS Ali And Mb Anwar

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2022-23 to find out the effective new chemical fungicides against purple blotch disease of onion. Four new fungicides were evaluated in this study. Among the fungicides, the lowest disease severity (2.00) was recorded in T<sub>2</sub> (373) treated plot. On the other hand, the highest disease severity (5.00) was found in T<sub>5</sub> (control) plot. The highest reduction (81.25%) of disease severity over control was found in T<sub>2</sub> (373) treated plot and the lowest (62.25%) was found in T<sub>3</sub> (615) treated plot. The highest yield (15.92 t/ha) was recorded in T<sub>2</sub> (373) treated plot and the lowest (8.25 t/ha) in T<sub>5</sub> (control) plot.

#### **Management of fusarium 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. 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 effective management option (s) against the disease. BARI Marich-1 was planted at the research field of Plant Pathology Division, BARI Gazipur on January 2023 comprising seven treatments with three replications. Significant variation of disease incidence was found in different treatments. Disease incidence ranged from 12.00 to 32.00 % in different treatments. The lowest disease incidence was found 12.00 in treatment T<sub>4</sub> (Soil drenching with Aoutostin1 gm/L) and T<sub>5</sub> (Use of Trico-compost 4 t/ha). The highest yield (11.75 t/ha) was recorded from T<sub>5</sub> followed by T<sub>4</sub> (11.25 t/ha). The reduction of disease incidence was found 62.50 % in treatment T<sub>4</sub> and T<sub>5</sub> and maximum increase of yield 34.90 was recorded in treatment T<sub>5</sub> followed by T<sub>4</sub>. Both the treatments T<sub>5</sub> and T<sub>4</sub> 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 wilt disease of chilli caused by *Fusarium Sp.*

#### **Management of white mold disease of bush bean caused by *sclerotinia sclerotiorum* through the application of bio-control agents and different organic amendments**

M. R. Humauan, B. Akhter And D. Sarkar

The experiment was conducted at Regional Agricultural Research Station Ishurdi, Pabna during Rabi season of 2022-23 to develop an effective management package(s) against white mold disease of bush bean. Eight different treatments and control were used in this experiment. The lowest disease incidence (4.97%) was found in the treatment T<sub>4</sub> which was statistically similar to treatment T<sub>7</sub> (6.24%) and T<sub>1</sub> (6.54) while the highest (21.42%) was recorded in control plots. The highest pod yield (5852 kg/ha) was observed in treatment T<sub>4</sub> which was statistically identical to T<sub>7</sub> (5698 kg/ha) and T<sub>1</sub> (5576 kg/ha) on other hand the lowest yield (3484 kg/ha) was found in control plots. The highest net income (Tk. 68702/ha) was recorded from seed treatment with provax + Foliar spray with Folicur 250 EC @ 1ml/L treated plots followed by Tricho compost @ 1 t/ha + Foliar spray with Trichoderma biofertilizer @ 20ml/L (Tk. 46220/ha).

#### **Management of botrytis blight of marigold**

M. Arifunnahar, K.M. Alam, F.E. Elahi, M.M. Islam, M.I. Faruk And M.M. Rahman

Botrytis blight is a very serious disease of marigold. It attacks flower leaf and stem with the symptom of suishy black flower center, brownish black leaves and stem and rapid spreading of abnormal colour. A experiment was conducted at Plant Pathology division, BARI, Gazipur during 2022-23 cropping season with seven treatments, viz., Secure (Fenamidone+ Mancozeb 600 WG) @ 1gm/Lwater, Tilt (Propiconazole) @ 0.5 ml/L water, Decoprima ( Trichodermasp + Geobacillussp +Streptomycessp) @ 2 gm/L water, Dynamic wp (Bacillus amyloliquefaciens) @ 2 gm/L water, Score ( Difenconazole) @ 0.5ml/L water, Rovral (Iprodione) @ 2 gm/Lwater , Code 693(Mancozeb 80% )@ 4 gm/L water and Control. Inka Gadha was used as a marigold variety. The design was Randomized Block Design (RBD) with three replications. All the fungicides reduced the disease as compare to control. Total numbers of flowers were maximum in T<sub>4</sub> treatment after 2<sup>nd</sup> and 3<sup>rd</sup>

spray. The lowest number of infected flower and PDI were observed in treatment T<sub>6</sub> followed by T<sub>5</sub> in after 2<sup>nd</sup> and 3<sup>rd</sup> spray and highest number was from control. Disease reduction over control was maximum in T<sub>5</sub>, T<sub>6</sub> and T<sub>7</sub> treatment after 2<sup>nd</sup> spray, but after 3<sup>rd</sup> spray it as maximum in only treatment T<sub>6</sub> (66.20%) as compared to other treatment

#### **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 50.00 to 82.35% and 56.24 to 93.75% diseases suppression occurred in Alternaria blight and white mold disease, respectively. Among the fungicides, Amistar Top (Azoxystrobin + Difenconazole) was found to control Alternaria blight (82.35%) and white mold (93.75%) disease significantly. Moreover, Rovral (Iprodione) was also found to control the disease effectively considering both the diseases.

#### **Effect of date of sowing on the incidence and severity of purple blotch disease of onion**

M. Monirul Islam, K.M. Alam, K.M. Khalequzzaman, M.I. Faruk, and M.M. Rahman

The experiment was conducted at Bangladesh Agricultural Research Institute (BARI), Gazipur, Spices Research Sub-Centre, Faridpur and Spices Research Centre, Shibgonj, Bogura during 2022-23 cropping season to find out the effective sowing date in controlling purple blotch disease of onion. Five date of sowing viz. T<sub>1</sub> = 10 November, T<sub>2</sub> = 20 November, T<sub>3</sub> = 30 November, T<sub>4</sub> = 10 December and T<sub>5</sub> = 20 December was evaluated against the disease. November 30 and December 10 & 20 sowing plots were showed the better performance in reducing the purple blotch disease of onion at all the three locations. The highest yield of onion was found in November 20 sowing plot followed by November 10 sowing plot and November 30 sowing plot.

#### **Bio-rational based integrated management of powdery mildew disease of pumpkin**

Md. Iqbal Faruk

The experiments were conducted in the field of Plant Pathology Division, BARI during 2022-23



cropping season to observe the efficacy of different new bio-fungicides viz. Clybio, Dynamic, Fizimite, G-Derma, Biostartter and integration of Clybio, Dynamic and Fizimite with single spray with sulphur fungicide 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 this study, it was revealed that all treatment gave appreciable reduction powdery mildew disease incidence as well as increasing the yield of pumpkin. Among the treatment integration of bio-fungicide with single spray sulphur fungicide are the best treatments for reduction powdery mildew disease and increasing yield of pumpkin. Application chemical fungicide also performed better in reduction of powdery mildew disease and increasing the yield of pumpkin.

#### **Efficacy of and chemical and bio-fungicides against downy mildew disease of cucumber**

Md. Iqbal Faruk and M. M. Rahman

The experiments were conducted in the field of Plant Pathology Division, BARI during 2022-23 cropping season to test the efficacy of different chemical and bio-fungicides against downy mildew diseases caused by *Pseudoperonospora cubensis* under natural field condition. Results from the study revealed that none of bio-pesticides gave appreciable reduction (more than 80%) of downy mildew disease of cucumber. Among the treatments, application of Ridomil Gold 72 WP reduced 81.71% disease incidence and 86.57% disease severity and gave the highest yield which appeared 48.01% higher yield of cucumber compared to control.

#### **Screening of new bio-fungicides against seedling disease caused by *sclerotium rolfsii* and *fusarium oxysporum* of lentil**

Md. Iqbal Faruk

The field experiment was conducted in the field of Plant Pathology Division, BARI during 2022-23 cropping season to observe the efficacy of eight different new bio-fungicides viz. Clybio, Hariz 1% WP, CAD Tricho, G-Derma, Tricho-max, Trichoplus, Faicoderma, Lycomax (Soil Recharge) and one seed treating fungicide Provax 200 WP against foot and root rot disease of lentil caused by *Sclerotium rolfsii* and *Fusarium oxysporum*. The

present study revealed that soil amendment with bio-fungicides had significant effect for reducing seedling mortality and increasing plant growth parameter as well as increasing yield of lentil under field condition. Seed treatment with Provax also better treatment for management of foot and root rot disease and increasing yield of lentil.

#### **Bio-agent based management practice against foot and root rot of lentil**

MB Anwar, MS Ali And D Sarkar

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2022-23 to find out the effective bio-control agent against foot and root rot disease of lentil. Six different bio-control agents and one chemical are evaluated in this study. The lowest seedling mortality (6.44 %) was recorded from T<sub>7</sub> (Provax) which was statistically similar to T<sub>3</sub> (*Bacillus* sp-EMOs) and T<sub>4</sub> (Tricho-compost) treated plots and the highest (20.88 %) was recorded in T<sub>8</sub> (control) plot. The highest yield (1520 kg/ha) was found in T<sub>7</sub> (Provax) treated plot followed by T<sub>3</sub> (*Bacillus* sp-EMOs) and T<sub>4</sub> (Tricho-compost) treated plot and the lowest (980 kg/ha) was found in T<sub>8</sub> (Control) plot.

#### **Effect of biological agents and chemical fungicides for controlling foot and root rot of lentil**

M. Z. Rahman, M. G. Kibria, M. M. R. Talukder, Raziuddin and B.C. Kundu

The experiment was conducted at RARS, Rahmatpur, Barishal during 2022-23 to find out an effective management practice for the management of foot and root rot disease of lentil. Six management practices, one check, and one control were used as treatment. The lowest foot and root rot (7.17 %) was obtained from the check and a statistically similar result (9.33%) was obtained from a seed treatment with Provax 200 wp (Carboxin + Thiram) @ 3 g/kg and the highest incidence (22.00%) was obtained from untreated control. The highest yield (1736 Kg/ha) was recorded in check variety i.e., BARI Mosur -8 and a statistically similar result (1597 Kg/ha) was yielded seed treatment with Provax 200 wp @ 3 g/kg, and the lowest yield was obtained from untreated control plot (894 Kg/ha).

### **Evaluation of microbial products for controlling fusarium wilt of chickpea**

K. M. Alam, M. Monirul. Islam, M. Arifunnaher

Fusarium is soil-borne pathogens and are very difficult to control by any chemical means. An experiment was carried out to during 2022-2023 to mitigate wilt disease of chickpea by using microbial products. BARI Chola 5 was used for evaluation of four microbial products, namely Tricho-compost 1 (*Trichoderma harzianum* JFT)2, Acre-compost (*Acremonium cavaeaeum* GNF), Tricho-compost 2 (*Trichoderma harzianum* BNT), Decoprima (*Trichoderma* sp. + *Geobacillus* + *Streptomyces*), Tricho-compost 3 (*Trichoderma harzianum* TBAU), Tricho-compost 4 (*Trichoderma erinecium* RST). Significant effect was obtained in the microbial products for disease incidence and yield. Decoprima was the best microbial products for soil treatment to control fusarium wilt disease of chickpea.

### **Effect of biological agents and chemical fungicides on fusarium wilt disease in chickpea**

M. Z. Rahman, M. G. Kibria, M. M. R. Talukder, Raziuddin and B.C Kundu

The experiment was conducted at RARS, Rahmatpur, Barishal during 2022-23 to find out an effective management practice for the management of Fusarium wilt disease of Chickpea. Five management practices, and one control were used as treatment. The lowest disease incidence (8.92 %) was obtained from the seed treatment with Provax 200 wp (Carboxin + Thiram) @ 3 g/kg seed and the highest incidence (34.34.00%) was obtained from untreated control. The highest seed yield (1650 Kg/ha) was recorded in seed treatment with Provax 200 wp @ 3 g/kg, and the lowest yield was obtained from untreated control plot (1093 Kg/ha).

### **Effect of bio-fungicides in controlling purple blotch disease of onion**

M.M. Islam, M. I. Faruk, K.M. Alam and M.M. Rahman

The experiment was conducted with seven treatments viz. T1= Decoprima, T2=Paenamaxi, T3=Biosida, T4= Dynamic, T5= Lycomax, T6= Clybion and T7 = Control having three replications in the experimental field of Plant Pathology Division, BARI, Gazipur against purple blotch disease of onion. Onion variety BARI Piaz-4 was

used in the experiment. The highest disease incidence 74% was recorded in control treatment and the lowest 27 % was recorded in treatment five. The highest disease severity 4.40 was recorded in control treatment and the lowest 2.40 was recorded in treatment five. The maximum yield 18.50 t/ha was recorded in treatment five and the lowest 5.50 t/ha was recorded in control treatment.

### **Evaluation of bio-agents, botanicals and chemical fungicides against alternaria leaf spot of gerbera**

MB Anwar And MS Ali

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2022-23 to find out appropriate management practice against alternaria leaf spot of gerbera. Seven treatments including control were evaluated in this study. The highest reduction (83.33%) of disease severity over control was found in T<sub>5</sub> treated plot and the lowest (50.00%) was found in T<sub>3</sub> treated plot. The number of flowers was recorded within 6 months. The highest number of flowers per ha (4.40 lac) was recorded in T<sub>5</sub> treated plot followed by T<sub>6</sub> treated plot and the lowest (2.60 lac) in T<sub>7</sub> (control) plot.

### **Eco-friendly management of foot rot of gerbera**

MB Anwar and MS Ali

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2022-23 to find out appropriate eco-friendly management for controlling foot rot of gerbera. Six treatments including control were evaluated in this study. The lowest disease incidence (16.60 %) was found in T<sub>5</sub> treated plot which was statistically similar to T<sub>4</sub> and T<sub>1</sub> treated plot, respectively. whereas the highest disease incidence (40.00 %) was found in T<sub>6</sub> (control) plot. The number of flowers was recorded within 6 months. The highest number of flowers per ha (4.00 lac) was recorded in T<sub>5</sub> treated plot and the lowest (2.30 lac) in T<sub>6</sub> (control) plot.

### **Integrated management for controlling early blight of tomato**

MB Anwar and MS Ali

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2022-23 to find out suitable integrated management practice for controlling early blight of tomato.

Seven different treatments including control were evaluated in this study. The highest reduction (83.33%) of disease severity over control was found in T<sub>6</sub> treated plot and the lowest (50.00 %) was found in T<sub>3</sub> treated plot. The highest yield was recorded (46.82 t/ha) in T<sub>6</sub> treated plot followed by T<sub>1</sub> and T<sub>5</sub> treated plot, respectively and the lowest (18.24 t/ha) in T<sub>7</sub> (control) plot.

#### **Cultural, chemical, and biological control of fusarium wilt in watermelon**

M. Z. Rahman, M. G. Kibria, M. M. R. Talukder and B.C. Kundu

The experiment was conducted at RARS, Rahmatpur, Barishal during 2022-2023. Management of Fusarium wilt disease on watermelon was conducted by spraying with Azonil 56 EC (Azoxystrobin + Chlorothalonil) @ 1 ml/L; Spraying with TRICOST 1% WP (Trichoderma sp.) @ 5 g/L; Lycomax (Soil Recharge) @ 5 g/L; Dynamic WP (Bacillus amyloliquefaciens) @ 5 g/L; Trooper 75 WP (Tricyclazole) @ 3 g/L; Amistar top 325 SC (Azoxystrobin + Difenconazole) @ 1 ml/L; Bactroban 20 WP (Bismethiazol) @ 2 g/L; Dithane M-45 (Mancozeb) @ 4 g/L; Provax 200 WP (Carboxin + Thiram) @ 3 g/L; Autostin 50WDG (Carbendazim) @ 2 g/L. From this experiment, it was found treatment with Dithane M-45 @ 4 g/L / Autostin 50WDG @ 2 g/L / Dynamic WP @ 5 g/L can effectively control the Fusarium wilt on watermelon.

#### **Effect of sowing time on the development of sclerotinia rot disease of sunflower**

M. R. Humayan, B. Akhter And D. Sarkar

The experiment was conducted at Regional Agricultural Research Station, Ishurdi, Pabna during Rabi season of 2022-23 to find out the actual scenario for sclerotinia rot/white mold 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 2022. Among the sowing dates first disease symptoms observed between January 07 to March 10, 2023 when crop attained 61-71 days old. The highest disease incidence (53.65%) was recorded in Nov. 01 sowing date where the 1<sup>st</sup> date of disease initiation was found in January 07, 2023. The Second highest incidence (33.24%) was recorded in Nov.10 sowing

date where the 1<sup>st</sup> date of disease initiation was January 18, 2023 and they differed significantly with rest sowing times and the lowest incidence (1.51%) was found in Dec.30 sowing date. It was found that disease incidence (%) gradually decreased with delayed sowing. Yield ranged from 759.20 kg/ha to 1774.60 kg/ha. The highest yield (1774.60 kg/ha) was obtained in Jan.20 sowing date while the lowest yield was found in Nov. 01 (759.20 kg/ha).

#### **Development of integrated disease management (IDM) package in controlling purple blotch disease of onion**

M. Monirul Islam, K.M. Alam, K.M. Khalequzzaman, M.I.Faruk, and M.M.Rahman

The experiment was conducted at BARI, Gazipur, SRSC, Faridpur and SRC, Shibgonj, Bogura during 2022-23 cropping season to find out the effective IDM package in controlling purple blotch disease of onion. Four IDM package was evaluated against purple blotch disease of onion. The highest disease incidence 81.67% was found in control treatment at Bogura and the lowest disease incidence 3.67% was recorded in Luna sensation (0.1%) + N<sub>150</sub>P<sub>200</sub>K<sub>100</sub>S<sub>20</sub>Zn<sub>4</sub>B<sub>1</sub> kg/ha + 10cm plant spacing + Cow dung (3 t/ha) at Faridpur. The highest disease severity 4.60 was observed in control treatment at Bogura and the lowest disease severity 0.7 was observed in Luna sensation (0.1%) + N<sub>150</sub>P<sub>200</sub>K<sub>100</sub>S<sub>20</sub>Zn<sub>4</sub>B<sub>1</sub> kg/ha + 10cm plant spacing + Cow dung (3 t/ha) at Faridpur. The highest yield 25 t/ha was recorded in Luna sensation (0.1%) + N<sub>150</sub>P<sub>200</sub>K<sub>100</sub>S<sub>20</sub>Zn<sub>4</sub>B<sub>1</sub> kg/ha + 10cm plant spacing + Cow dung (10 t/ha) at Faridpur and the lowest yield 6.10 t/ha was recorded in control treatment at Bogura.

#### **Integrated management of anthracnose of chilli**

MM Karim, MB Anwar And MS Ali

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2022-23 to find out appropriate integrated management for controlling anthracnose of chilli. Eight different treatments including control were evaluated in this study. The lowest disease incidence (6.79 %) was found in T<sub>7</sub> treated plot which was statistically similar to T<sub>4</sub> and T<sub>3</sub> treated plot whereas the highest disease incidence (21.81 %) was found in T<sub>8</sub> (control) plot. The highest yield (15.12 t/ha) was recorded in T<sub>7</sub> treated plot



followed by T<sub>4</sub> treated plot and the lowest (7.23 t/ha) was recorded in T<sub>8</sub>(control) plot.

#### **Efficacy of chemical seed disinfecting methods for tomato seeds against bacterial leaf spot**

Ferdous-E-Elahi

A total of eight different doses of five chemicals were used to treat tomato seeds to find out their efficacy against bacterial leaf blight causing bacteria *Xanthomonas euvesicatoria*. Seeds were artificially inoculated and treated (per 0.1 L sterilized water) with cupric acetate 0.2% for 1 and 3 min, sodium hypochlorite 3% for 1 and 3 min, acetic acid 1% for 3 and 5 min, citric acid 1% 5 min, and lactic acid 2% for 5 min. Treated seeds were sown in the pots of Plant Pathology division, Bangladesh Agricultural Research Institute, Gazipur. However, there was no leaf spot disease was noticed in the seedlings up to 60 days of seed germination. This is might be due to any disturbance in weather, soil type, host susceptibility, pathogen virulence etc.

#### **Interactions between bari bt-brinjal varieties and ralstonia solanacearum in field condition**

K. Jahan, R. Islam, M.S. Akhter, M. Karim, and M. Rahman

Bacterial wilt is a major devastating soil-borne disease, caused by *Ralstonia solanacearum*, that impedes brinjal cultivation worldwide and also in Bangladesh. The progress in developing brinjal varieties or hybrids possessing insect-pests resistance is encouraging. Bt brinjal varieties are providing excellent pest suppression, but the cultivation of Bt brinjal facing problems with wilting diseases. The objective of this study was to assess the tolerance level of Bt-brinjal varieties against wilt disease. The study was carried out at the experimental field of Plant Pathology Division, BARI, Gazipur during 2022-23. Four Bt-brinjal and 2 non Bt-brinjal varieties were used as plant materials. The experimental design was a RCB with 3 replications. Each variety was considered as a treatment. The experiment was conducted under natural infection condition in the field. The six treatments were T<sub>1</sub>= BARI Bt Brinjal-1, T<sub>2</sub>= BARI Bt Brinjal-2, T<sub>3</sub>= BARI Bt Brinjal-3, T<sub>4</sub>= BARI Bt Brinjal-4, T<sub>5</sub>= BARI Brinjal-4, and T<sub>6</sub>= BARI Brinjal-8. Results of the study revealed that the different Bt and non Bt-brinjal varieties used in this study did not show any

wilt disease, except BARI Bt Brinjal-3 (79% wilted plants) and BARI Brinjal-4. This may happen due to climatic and soil condition during the experimental period.

#### **Control of bacterial wilt in advanced lines of brinjal**

M. T. Hossain, S. T. Nira, M. Alam, Z. A Firoz M. S. Rahman

The in vitro antagonistic activities by formulated product of EMOs (YC7007 + GL6) and their active inocula levels had been scrutinized for controlling bacterial wilt. Three advanced lines of eggplant have been treated by EMOs along with validamycin compared to control. Granular EMOs were scrutinized by one time drenching as a basal dose and formulated bacterial powder of EMOs was conducted by three times sprayings to the rhizosphere till to droplet. There was no diseases at 2-MAT (Months after transplanting) in the treated plot. Granular form of EMOs ( $1 \times 10^8$  CFU/g) for basal application and powder form formulated bacterial product ( $1 \times 10^9$  CFU/g) together revealed significantly (Tukey HSD,  $P < 0.05$ ) lower disease severity by  $0.3 \pm 0.1$ ,  $1.0 \pm 0.1$  and  $0.6 \pm 0.2$  than the control by  $2.0 \pm 0.3$ ,  $1.67 \pm 0.3$  and  $2.0 \pm 0.3$  in the advanced lines of SM Hat 04, SM Hat 09 and SM Hat 12 respectively, out of 0-5 disease rating scales in the treatment combination. Single factor, EMOs also revealed significantly (Tukey HSD,  $P < 0.05$ ) higher yield by 56.5 than the control by 42.8 ton/h. The treatment combination has significantly impact by 59.4 compared to control by 40.81 ton/h in the combination of variety SM Hat 04 with EMOs. We concluded that formulated EMOs are key vital biological agents to *Ralstonia solanacearum* for controlling bacterial wilt

#### **Testing efficacy of new bacillus species for control of panama disease of banana**

M. T. Hossain, S. T. Nira, M. M. Rahman, Z. A Firoz M. S. Rahman

Bacillus species have been being used in the agriculture fields to control the different devastating disease as well as for plant growth promotion for higher yield since last decade. In our country it is rudimentary uses. In our study, four novel strains have been used to control the panama/ *Fusarium* wilt compared with carbendazim and control. The strong antagonistic bioassay has been conducted and *Bacillus* strains revealed significantly inhibition zone compared to control. A

very clear and distinct inhibition zones were observed at in vitro cell bioassay, indicating strong antagonistic strains to *Fusarium oxysporum*. EMOs (effective microbial organisms) made of *Bacillus oryzicola* YC7007 and *Bacillus tropicus* K3 which revealed significantly (Tukey HSD,  $P < 0.01$ ) lower disease severity by  $1.67 \pm 0.1$ , than the control by  $2.67 \pm 0.1$  in the banana seedlings with artificial inoculation. In the field data, there were no significant differences among the treatments in the panama disease severity index. However, strain K3 showed significantly PGP (plant growth promotion) performances in the different parameters compared to control.

#### ***In-vitro* and in-vivo test of bacillus based emos with molecular study for controlling greening disease on sweet orange**

M. T. Hossain, S. T. Nira, M. M. Rahman, Z. A Firoz M. S. Rahman

Greening disease of orange is a serious threat over the world. Generally, the chemical pesticides are being used for controlling the vector, insects. But, there are 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 had been being used in agriculture field 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. Those two strains revealed significantly lower greening disease severity. In the Pummelo root-stock, *Bacillus siamensis* YC7012 showed the best performance in respect to free infection of greening disease by  $1.56 \pm 0.2$  scaling compared with control by  $2.69 \pm 0.2$ . In the seedling stage at nursery bed, YC7007 revealed significantly ( $p < 0.01$ ) lower greening disease index by  $0.78 \pm 0.14$  compared with control by  $3.8 \pm 0.12$ . Depending on our data, EMOs made by the strain YC7007 and GL6

revealed significantly ( $P < 0.01$ ) lower greening disease severity by  $1.6 \pm 0.1$ , than the control by  $3.09 \pm 0.13$  in the BARI Malta 1 by root stocks with rough lemon at 4 years old plant.

#### **Test of an antagonistic bacillus (*Bacillus velezensis* gl6) against in-vitro growth of *Lasiodiplodia theobromae* causing stem end rot of mango**

M. T. Hossain, S. T. Nira, M. M. Rahman, Z. A Firoz M. S. Rahman

*Bacillus velezensis* GL6 is the strong antagonistic endophytic biological agent to degrade the propiconazole properties that had been showed in our previous studies. A very clear and distinct inhibition zone was observed at in vitro cell bioassay. Strain GL6 showed ++++ reaction to inhibit the fungal pathogen, indicating strong antagonistic strain GL6 to *Lasiodiplodia theobromae*. It revealed significantly (Tukey HSD,  $P < 0.01$ ) lower disease severity by  $1.5 \pm 0.3$ , than the control, Tilt-250 EC and hot water by  $4.0 \pm 0.5$ ,  $1.75 \pm 0.2$  and  $3.0 \pm 0.4$ , respectively in the mango fruit (postharvest condition) by the artificial inoculation before treatment in 2022. In current year 2023, artificial inoculation will be done after treatment, which was not conducted yet. Only PGP (plant growth promotion) data based on number of mangoes in the BARI Aam 4 have been measured.

#### **Heterologous expression of recombinant truncated coat protein of three potato infecting viruses (PVY, PLRV and PVX) in *Escherichia coli***

MS Akhter, MS Rahman, KE Jahan, M M Islam, MI Faruk and Matiar Rahman

Cocktail of polyclonal antibodies (PAb) will help to detection of multiple viruses by serological method like ELISA. With a view to expressed the truncated recombinant fusion protein in *E. coli* and purification of considerable amount of the fusion protein we successfully joined the conserved truncated coat protein of three potato infecting viruses such as Potato virus Y (PVY), Potato virus X (PVX) and Potato leaf roll virus (PLRV) by overlapping PCR. The heterologous expression of the recombinant fusion protein in *E. coli* are in progress.

### **Identification of the viruses that infecting country bean and associated weeds which acts as a reservoir of the viruses**

M.S. Akhter, M.S. Rahman, Mi Faruk, M.M. Karim And Matiar Rahman

Yellowing disease is the severe constrain of country bean production in Bangladesh. Our serological and molecular results revealed that two species of potyvirus and several geminivirus species are associated with yellowing disease of country bean in Bangladesh. On the other hand, six weeds namely *Ageratum conyzoides*, *Croton bonplandianus*, *Physalis angulate*, *Acalypha indica*, *Senna occidentalis* and *Parthenium hysterophorus* which are frequently infected by viral diseases. We identified the presence of viruses mostly whitefly transmitted geminivirus species by symptomatology and PCR.

### **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 Bangladesh. The molecular characterization based on the partial CP gene sequencing and genotype specific RT-PCR 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 are yellowing, stem pitting and vein clearing also observed in *Citrus reticulata*, *Citrus sinensis*, *Citrus aurantifolia*.

### **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. PRSV is producing eight different symptoms in field condition. Our serological and molecular results suggested that

different tomato infecting geminivirus species synergistically interact with PRSV that developed severe leaf curl disease (upward and downward curling) in papaya. We observed that the leaf curl disease of papaya is increasing sharply and it is dominant over PRSV. 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. The host virus interactions are now in progress in Plant Pathology, Division, BARI.

### **Induce systemic resistance against cucumber mosaic virus of chilli by trichoderma harzianum**

M. S. Rahman, M. I. Fruk, M.M. Islam And M. M. Rahman

The ability of *Trichoderma harzianum* (Bioderma), to induce resistant against Cucumber mosaic virus (CMV) in chilli plants were examined in growth chamber of Plant Pathology Laboratory, BARI during the year 2022-2023. The plants treated with *Trichoderma harzianum* (TH) led to a significant modulation of symptoms, in all two conditions that is plant's root (T1) and leaves (T2) first treated with TH, and after 7 days inoculated with CMV. These two conditions the disease severity was very low and few leaves showed only mild mosaic (Severity point 2.0 and 2.5). Cucumber mosaic virus accumulation in systemically infected leaves was measured by DAS-ELISA. The highest OD value was found 1.98 in plants treated with CMV and the lowest was found 0.124 in healthy control. The plants first treated with TH (root or leaves T<sub>4</sub> & T<sub>5</sub>) and after 7 days inoculated with CMV showed positive but the mean absorbance value (OD at 405nm) was very low (0.218 & 0.285). Therefore, the virus accumulation was higher in only CMV inoculated plants as compared to plants treated with TH. TH enhanced chilli growth in terms of plant height, led to a systemic resistance by jasmonic acid/ethylene and salicylic acid signaling pathways. In conclusion, the data reported here indicate that the TH based strategy may be the most effective against CMV.

### **Screening of country bean germplasm against bean mosaic viruses**

M.S. RAHMAN And M. M. RAHMAN

Country bean (*Lablab purpureus* L) is an important vegetable and pulse crop. Bean mosaic virus is



considered as the most serious virus disease of country bean and causes severe yield loss. Fifteen varieties/germplasm were evaluated against mosaic virus of country bean in field condition during the year 2022-23. Out of 15 varieties/germplasm, no variety/cultivar showed highly resistant response against the virus. Among the tested germplasm only one genotype BD8802 was found resistant against the virus. Four varieties namely BARI Shim-3, 7, 8, and 9 were found moderately resistant where the disease severity ranged from 13.50 to 15.50 %. Six germplasm namely BARI Shim-1, 4, 5, 6, 10 and BD8796 were graded as moderately susceptible category having disease severity 15.50 to 25.00 %. Two germplasm (BD8792 and BD8795) showed disease severity 32.50 to 35.50 % and another two (BARI Shim -2 and BD8793) showed 52.50 to 55.00 % were graded as susceptible and highly susceptible respectively.

#### **Screening of papaya germplasm against papaya ring spot virus (PRSV)**

M.S. Rahman, M. R. Karim And M. M. Rahman

Papaya (*Carica papaya* L) is an important vegetable and fruit crop. Papaya ringspot virus (PRSV) is a destructive disease and causes severe yield loss up to 100 %. Fifteen papaya varieties/germplasm were evaluated against PRSV in field condition during the year 2022-23. Out of 15 varieties/germplasm, no variety/cultivar showed highly resistant response against the virus. Among the tested germplasm only two genotype CP 018H and CP 005 were found resistant against the virus. Four genotypes namely CP 009, CP 018F, CP 017 and Shahi x CP005 were found moderately resistant where the disease severity ranged from 30.00 to 35.00 %. Seven germplasm namely CP 022, Shahi, Bicrom, Babu, Red Lady, Kishorgonj local and Badarban-2 were graded as moderately susceptible category where disease severity range were 52.50 to 65.00 %. Two germplasm (Badarban-1 and Gazipur local) showed disease severity 84.00 to 87.00 % were graded as susceptible category. However, none of the fifteen germplasm was found highly resistant and most of the germplasm were in moderately susceptible group.

#### **Bio-rational based management of cucumber mosaic virus (CMV) of cucumber**

M.S. Rahman

Cucumber (*Cucumis sativus*) is an important commercial vegetables crop having export

potential. Mosaic disease caused by Cucumber mosaic virus (CMV) is considered as the most serious virus disease of cucumber and causes severe yield loss. The research work was undertaken to develop eco-friendly management option against CMV of cucumber. The experiment was conducted in the research field of Bangladesh Agricultural Research Institute, Gazipur during rabi season 2022-23. Five treatments including an untreated control were tested under field condition. All the treatment packages appreciably reduced CMV incidence of cucumber over control. Disease incidence was reduced 53.48 to 63.95 % over control and yield was increased 21.67 to 40 % in the treatments compared to control. Two treatments T1 - Four spray of Dynamic @ 2g/L water at 12 days interval and T3- 4 spray of No-virus @ 3 ml/L water at 12 days interval were found better on the basis of disease reduction and increase yield.

#### **Management of leaf curl disease of tomato by using beneficial microbes and vector control**

MM Hossain, MB Anwar, MS Ali, And MS Akter

This experiment was conducted at Regional Agricultural Research Station, Jashore during rabi 2022-23 to find out beneficial microbes for controlling leaf curl virus of tomato. Seven different treatments including control were evaluated in this study. The lowest disease incidence (12.34%) was found in T<sub>6</sub> treated plot followed by T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> whereas the highest disease incidence (33.33%) was found in T<sub>7</sub> (control) plot. The highest yield was recorded (45.93 t/ha) in T<sub>6</sub> treated plot followed by T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> treated plot, respectively and the lowest (15.50 t/ha) in T<sub>7</sub> (Control) plot.

#### **Molecular characterization of root-knot nematodes (meloidogyne spp.) Of tomato**

Ferdous-E-Elahi

A total of four root-knot nematode infected tomato root samples were collected from different locations of Gazipur, Bangladesh. Two methods of PCR were used to detect Meloidogyne spp. on tomato. One is molecular characterization by DNA sequencing of the ribosomal DNA (rDNA) 28SD2/D3 gene and another is PCR using species-specific SCAR primers. In the phylogenetic tree, the obtained sequences; OR351387, OR351388, OR351389 and OR351390 clustered with specific Meloidogyne incognita clade with a strong

bootstrap support value of 100%. Species-specific primers produced a fragment of 399 bp for *Meloidogyne incognita*. Thus, utilizing species-specific marker and analyzing the result of phylogenetic tree made from amplified 28S D2/D3 gene region revealed the association of *Meloidogyne incognita* on tomato root-knot disease in Bangladesh.

#### **Screening and evaluation of tomato varieties against root-knot nematode, *Meloidogyne* spp.**

Ferdous-E-Elahi

Fifteen Bangladesh Agricultural Research Institute (BARI)-released tomato varieties were evaluated against root-knot nematode (*Meloidogyne incognita*) in the pothouse of Plant Pathology division (PPD), BARI, Gazipur. Only three levels of susceptibility were observed in all the tested varieties. Variety BARI Tomato-18 was resistant to nematode attack with no gall formation on the roots while variety BARI Hybrid Tomato-4 was found susceptible showing the number of galls 100 with a root gall index 4. However, all the other thirteen variety were highly susceptible to root-knot nematode with the formation of >100 galls on the roots (gall index 5.0). The highest average shoot length, fresh shoot weight, dry shoot weight, root length, fresh root weight, dry root weight was recorded for the variety BARI Tomato-18, where no gall formation was seen.

#### **Screening of new bio-fungicides against root-knot nematode *Meloidogyne incognita* of tomato**

Md. Iqbal Faruk

The experiment was conducted to observe the efficacy of new bio-pesticides viz. Bio-Nemasis, CAD Tricho 1.5 WP, Hariz 1% WP, G-Derma, Biolead, Tricho-plus, Bioderma and nematicide Rugby 10 against root knot nematode of tomato caused by *Meloidogyne incognita* both in pot house and in the field of Plant Pathology Division, BARI. Root knot nematode infested pot and field soils were treated with those bio-pesticides as well as nematicide Rugby 10G. The present study revealed that all bio-pesticides significantly reduced root knot nematode disease severity and gave higher plant growth parameters as well as yield of tomato compared to control. Among the bio-fungicides, Biolead, Tricho-plus, Bo-derma and --- are the best for reduction of root knot disease severity compared to other treatments in the pot house

condition but in the field all the treatment are significantly similar. From this study it may conclude that bio-fungicide are effective against root knot nematode and increasing yield of tomato.

#### **Test of composts and biochars against root knot nematode of tomato**

Md. Iqbal Faruk

Tricho-compost, organic compost, vermi-compost and biochars have the potential to improve soil fertility and crop productivity. The experiment was carried out both in the pot house and in the field Plant Pathology Division, Bangladesh Agricultural Research Institute, Gazipur to observe the efficacy of Tricho-compost, vermi-compost, organic-compost and four different biochars against root knot nematode, *Meloidogyne incognita* of tomato. Results from this study revealed that all the treatments significantly reduced root knot nematode disease severity and increasing the plant growth parameters as well as yield of tomato compared the control. 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 tomato.

#### **Development of bio-rational based disease management package against root knot nematode disease of bottle gourd**

Md. Iqbal Faruk and M. M. Karim

The experiments were conducted in the field of Plant Pathology Division, BARI during 2022-23 cropping season to develop eco-friendly integrated management technology against root knot nematode caused by *Meloidogyne incognita* of bottle gourd. Root knot nematode infested pit soils were treated with different treatment viz. Trichoderma based Tricho-composts with lower dose of chemical nematicide Rugby 10G, poultry refuse, mustard oil cake and saw dust burning with lower dose of chemical nematicide Rugby 10G. Rugby 10 G was also used for comparison. It was revealed that all the treatments gave appreciable reduction of root knot gall development on roots and increased plant growth parameters such as shoot and root growth as well as yield of bottle gourd. Among the treatments, integration poultry refuse with Rugby 10G or Trichoderma based bio-fungicides Tricho-composts with Rugby 10G or mustard oil cake with Rugby 10G are the best

treatments in reducing root-knot nematode disease as well as increasing plant growth and yield of bottle gourd.

#### **Survey, isolation and identification of diseases of summer tomato**

M. N. Islam, M. S. Rahman, M. S. Akhter, M. M. Karim, M. I. Faruk, and M. M. Rahman

A survey program was carried out in summer tomato growing area of Benarpota and Kolaroya upazila of Sathkhira district during 2022-23 cropping season. Ten tomato field were selected from each upazila for diseases surveillance and documentation. Disease plant as well as fruit samples were collected and cultured for identification of the pathogen in Plant Pathology laboratory, BARI, Gazipur following standard survey method. From the survey, three types of disease were identified from summer tomato fruit and leaf sample viz. i) Fusarium wilt caused by *Fusarium* sp. ii) Tomato rot caused by *Alternaria* sp. (fruit) and iii) Early blight of tomato caused by *Alternaria* sp. (leaf). It was also found that 08% tomato plant were infected by *Fusarium* wilt disease whereas 13% of total plants were attacked Early blight of tomato and only 03% fruit were infected by Tomato fruit rot disease. Through pathogenicity test it is confirmed that *Fusarium* sp. is causal agents of fusarium wilt disease of tomato and *Alternaria* sp. is the causal agent of Early blight and Tomato rot diseases of tomato respectively.

#### **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 Southern part of Bangladesh 2022-23 cropping season. Growth stunting, short internode with necrosis of twig of watermelon was observed with a high prevalence (70-90%) in the surveyed area. The symptomatic samples were further tested by serological and molecular diagnosis that revealed the occurrence of thrips transmitted member of the Orthotospovirus a Watermelon bud necrosis virus and Groundnut bud necrosis virus. Among the fungal diseases *Fusarium* wilt, gummy stem blight and *Alternaria* leaf blight disease were observed. Watermelon bud

necrosis virus (WBNV), Ground nut bud necrosis virus (GBNV) which are the member of Orthotospovirus and are the major threats to watermelon production in Bangladesh.

#### **Survey of major diseases of selected fruits and vegetables in northern region**

M.M.E Rahman, M.S. Akhter, M.S. Huda, M. Afroz And A.K.Saha

Diseases of some exotic fruits and commercially grown fruit and vegetables were being considered as an important bottle neck for the production these crops in the country. A total of 15 different fruits and vegetables including malta, dragon, mango, litchi, custard apple, coconut, date palm, fig, watermelon, melon and capsicum were surveyed in the Northern region to know their disease status from 2021 to 2023. Depending on the disease's nature and crop type, 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. Several symptoms like citrus yellowing, extensive inflorescence and fruit rot of mango and litchi were observed. Some minor diseases were observed to become severe threats in some areas.

#### **Survey of the major diseases of citrus SP in southern part of Bangladesh**

R Islam, MS Akhter, MI Faruk, KE Jahan, MZ Karim and Matiar Rahman (PPD); MH Hossain, (RARS, Akbarpur), MZ Rahman, (RARS, Barishal); MM Hossain, MB Anwar, (RARS Jashore) MH Rahid (OFRD, Khulna)

A survey was conducted to identify citrus diseases in Bangladesh's southern and eastern parts in the 2022-23 cropping season. Although more than 18 citrus spp were cultivating in Bangladesh, we have focused on *Citrus reticulata* and *Citrus sinensis* throughout the survey. Among the diseases we observed, yellowing is the common problem in both locations, with a moderate prevalence (20-30%). The symptomatic samples were further tested by molecular diagnosis that revealed the occurrence of Asian psyllid transmitted *Candidatus Liberibacter asiaticus* (CLas), which causing greening disease and aphid transmitted member of the Closterovirus, Citrus tristeza virus (CTV). Citrus canker was observed as a moderate disease incidence with a 40-50% disease incidence. White-pink-grey mycelial mass, the characteristic



symptom of the pink disease of citrus, was observed in an established Citrus sinensis orchard at RARS, Akbarpur with a high prevalence of 90%.

### **Survey and monitoring of major guava and litchi diseases at Ishurdi region**

B. Akhter, M. R. Humayan And D. Sarkar

A comprehensive survey was conducted at six guava and five litchi orchards of four villages of Ishurdi upazilla to identify the incidence and severity of different existing diseases as well as new diseases of guava and litchi during season 2022-2023. From the survey it was found that anthracnose and wilt diseases of guava are predominant. Colletotrichum psidii and Fusarium oxysporum f. sp. psidii were isolated from the infected parts of guava which caused anthracnose and wilt. Sunburn symptom was collected from most of the orchard which was caused by inadequate rainfall. Anthracnose and fruit cracking of litchi were the major problem in the surveyed area. The isolated pathogen from litchi anthracnose was Colletotrichum sp. No pathogen was isolated from fruit cracking of litchi.

### **Survey on pre and post-harvest diseases of onion in Bangladesh**

M. Monirul Islam, K.M. Alam, K.M. Khalequzzaman, M.I.Faruk, and M.M.Rahman

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 2022-2023 cropping season. Purple blotch, black mould and soft rot diseases of onion are predominant in all surveyed locations. The highest incidence of purple blotch disease 77% was found in Rajbari district and the lowest incidence of purple blotch disease 54% was recorded in Magura district. The maximum incidence of black mould disease 28% and soft rot disease 25% were found in Lalmonirhat. The minimum incidence of black mould disease 18% and soft rot disease 14% were found in Magura. The highest severity of purple blotch, black mold and soft rot diseases were found 4.20, 3.33 and 3.10 in Rajbari, Lalmonirhat and Lalmonirhat, respectively. The lowest severity of these three diseases 3.51, 2.64 and 2.33 were found in Magura.

### **Validation of selected chemicals in controlling common scab disease of potato**

A.K. Saha And M.M.E. Rahman

There were 03 (three) effective chemicals viz. Stable bleaching powder (SBP), Blitox (Copper Oxy-Chloride) and Timsen™ (n-alkyl dimethyl benzyl ammonium chloride 40% + Stabilized urea 60%) were validated against common scab of potato at RARS, BARI, Burirhat, Rangpur in 2022-2023 cropping season. The chemicals were used as T<sub>1</sub>: SBP 25 Kg/ha just before final land preparation + Seed treatment with SBP @ 2 g/lit. water + Soil drenching (SD) with SBP @ 2 g/lit. water 30, 45 and 60 Days after seed plantation (DAP); T<sub>2</sub>: Seed treatment with Blitox @ 2 g/lit. water + SD with Blitox @ 2 g/lit. water 30, 45 and 60 DAP and T<sub>3</sub>: Seed treatment with Timsen™ @ 1 g/lit. water + SD with Timsen @ 1 g/lit. water 30, 45 and 60 DAP. Out of these three chemicals, Timsen™ was the best one in controlling common scab (disease incidence 1.37% and disease severity PDI 0.30 and tuber yield 33.46 t ha<sup>-1</sup>) followed by Blitox and Stable bleaching powder.

### **Demonstration of management technology for different foliar diseases (purple blotch, stemphylium leaf blight, downy mildew and botrytis leaf blight) of onion**

A.K. Saha And M.M.E. Rahman

Demonstration trial was conducted at RARS, BARI, Burirhat, Rangpur and farmer's field of Rangpur to confirm the efficacy of selected fungicides and its combination like Luna sensation (Fluopyram 25% + Trifloxystrobin 25%) @ 1 ml/lit. water, Rovral 50 WP (Iprodione 50%) @ 2 g + Headline™ @ 2.5 g / lit. water and Amistar Top (Azoxystrobin 20% + Difenoconazole 8%) @ 1 ml / lit water for controlling foliar diseases of onion during 2022-2023 cropping season. All the tested fungicides significantly managed foliar diseases of onion and increased yield over control. Out of them, Luna sensation @ 1ml/liter water was the best for controlling diseases (96% disease reduction over control ranged 93 to 95%) and the highest bulb yield 17.95 t ha<sup>-1</sup> (ranged 17.05 to 18.85 t ha<sup>-1</sup>), followed by Rovral 50 WP @ 2g + Headline™ @ 2 g / lit. water controlled diseases 88% over control (ranged 87 to 89%) and bulb yield 16.32 t ha<sup>-1</sup> (ranged 15.59 to 16.50 t ha<sup>-1</sup>) and Amistar Top @ 1 ml / lit water reduced diseases 86% over control

(ranged 85 to 87%) and bulb yield 16.32 t ha<sup>-1</sup> (ranged 15.59 to 16.50 t ha<sup>-1</sup>).

#### **Validation trial of emos for controlling the bacterial wilt in tomato**

M. T. Hossain, S. T. Nira, M. Alam, Z. A Firoz M. S. Rahman

The in vitro antagonistic activities by formulated product of EMOs (YC7007+GL6) and their active inocula levels had been scrutinized against for controlling bacterial wilt. In the current year 2022-2023, BARI hybrid tomato 8 and local Bahubali varieties have been treated by EMOs compared to control in the farmer's field of Sitakunda, Chattogram. Granular EMOs were scrutinized by one time drenching as a basal dose and formulated powder of EMOs was conducted by three times sprayings to the rhizosphere till to droplet. There were no diseases at 3 MAT (Months after transplanting) in the treated plot at farmer's field. Granular form for basal application, EMOs ( $1 \times 10^8$  CFU/g) and powder form formulated bacterial product ( $1 \times 10^9$  CFU/g) together revealed significantly (Tukey HSD,  $P < 0.05$ ) lower disease severity by  $0.7 \pm 0.2$  and  $0.3 \pm 0.1$  than the control by  $2.3 \pm 0.3$  and  $1.6 \pm 0.2$  in the BARI Hybrid tomato 8 and local Bahubali respectively, out of 0-5 disease rating scales. We concluded that EMOs are key vital biological agents to *Ralstonia solanacearum* for controlling bacterial wilt.

### **HRC Pathology Section**

#### **Screening of eggplant germplasm for resistance to bacterial wilt**

M. Afroz, L. Yasmin And M. M. Rahman

Seventeen eggplant varieties/accessions were evaluated for resistance to *Ralstonia solanacearum* grown under artificial epiphytotic conditions during 2022-2023 cropping seasons. Among them, only one variety and five lines of eggplant such as BARI Begun-8, SM-233, SM-232, SM-310A, SM-312-A and SM-220 showed resistant reaction. Six lines such as SM-23A, SM-035, SM-216, SM-223, SM-405 and SM-275 showed moderately resistant reaction. Only one variety and one line i.e. BARI Begun-006 and SM-253-B showed moderately susceptible reaction. Only one variety and two lines i.e. BARI Begun-04, SM-217-A and SM-262 showed highly susceptible reaction to *R. solanacearum*.

#### **Screening of eggplant germplasm against root-knot nematode**

L. Yasmin, M. Afroz And M. M. Rahman

Fourteen eggplant varieties/accessions were tested in a nematode infested sick bed for their resistance to root-knot nematode during 2022-2023 cropping season. Among them, four accessions viz: SM-405, SM-216, SM-035 and SM-332 were found resistant, ten accessions SM-23-A, BARI Begun-006, SM-310-A, SM-233, SM-275, SM-220, SM-323, SM-312-A, SM-253-B and SM-217-A showed moderately resistant to root knot nematode.

#### **Screening of tomato germplasm against root-knot nematode**

L. Yasmin, M. Afroz And M. M. Rahman

Twenty tomato varieties/accessions were tested in a nematode infested sick bed for their resistance to root-knot nematode during 2022-2023 cropping season. Among them, six accessions (SL-0405, AVTO-1229, GP-0039, BARI Tomato-11, GP-4069 and SL-3119) showed resistant, six accessions (SL-0411, GP-4039, SL-0413, SL-0403, AVTO-1317, AVTO-1316) showed moderately resistant, one accessions (BARI Tomato-19) showed moderately susceptible, six accessions (GP-0389, BARI Tomato-14, GP-4059, GP-0099, GP-3109 and BARI Tomato-15) showed susceptible, one accession (SL-0416) showed highly susceptible reaction to root knot nematode.

#### **Screening of okra germplasm resistance to okra yellow vein mosaic virus**

L. Yasmin, M. Afroz & M. A. Rahman

Twenty okra germplasm were evaluated for resistance to Okra yellow vein mosaic virus (OYVMV) grown under natural conditions during 2023 cropping seasons. Among them, three accessions of okra such as BD-12109, BD-12110 and BD-12116 showed tolerant reaction, nine accessions such as Sabuzshathi (shek agro seed), Sabuzshathi, Duranta (Munir seed), Agam plus, OK-285, BD-12108, BD-12123, BD-12122, BD-12117 showed moderately susceptible reaction. Four accessions showed (BD-12119, BD-12112, Krishan seed and BD-12128) susceptible reaction. Four accessions showed (BD-12107, BD-12121, BD-12125 and BARI Derosh -1) highly susceptible to Okra yellow vein mosaic virus (OYVMV).

### **Screening of tomato germplasm for resistance to tomato leaf curl virus and blight disease under field condition**

M. Mahfuzur. Rahman, L. Yasmin, M. Afroz And Siddique Alam

The experiment was conducted in Horticulture research field, BARI, Gazipur during winter 2022-2023 cropping season with promising germplasm and variety of tomato to find out resistant sources against Tomato Leaf Curl Virus (TYLCV) disease. A total of 27 tomato variety/ accessions were evaluated including susceptible check. Nine germplasm were showed resistant and twelve germplasm were found moderately resistant to disease and rest of the moderately susceptible. The highest yield was recorded in BARI Hybrid tomato 7 (27.52 ton/ha) and lowest yield was obtained in SL 0010 (7.65 ton/ha) respectively. Moreover, the highest blight disease incidence was found SL0010 (61.10) was observed lowest disease incidence compare to other tested germplasm.

### **Screening of country bean germplasm for resistance to bean yellow mosaic virus under field condition**

M. Mahfuzur. Rahman, L. Yasmin, M. Afroz And Siddique Alam

The experiment was conducted in Horticulture research field, BARI, Gazipur during winter 2022-23 cropping season with germplasm and variety of country bean to find out resistant sources against country bean yellow mosaic virus (YMV) disease. A total of 32 country bean variety/ germplasm were evaluated including susceptible check. Four germplasm have been performed highly resistance to the mosaic virus disease. BD 10518 germplasm produced the highest yield (26.18 ton/ha) with 66.67% disease incidence followed by DL 032 (24.14 ton/ha) & LD 0002 (23.86 ton/ha), with disease incidence 50% and 66.67% disease incidence whereas the lowest yield was obtained from BD10520 (7.09 ton/ha) respectively. Yield of BARI Sheem-1 was 19.43 t/ha with disease incidence 33.33%.

### **Screening of cucumber germplasm for resistance to cucumber mosaic virus under field condition**

M. Mahfuzur. Rahman, L. Yasmin, M. Afroz And Bahauddin Ahmed

The experiment was conducted in Horticulture research field, BARI, Gazipur during summer 2023 cropping season with promising germplasm of

cucumber to find out resistant sources against cucumber mosaic virus (CMV) disease. A total of 19 cucumber germplasm were evaluated including susceptible check (MynamatiF1 & AlviF1). Seven germplasm were showed highly resistant and four germplasm were found moderately susceptible to disease and rest of the susceptible to the disease. The highest yield was recorded in CS-79-7-3-1 (17.9 t/ha) followed by CS-17-10-3 (16.6 ton/ha), CS-44-5-2-6 (16.2), CS-25-20-4-2 (16.1) with 41.67% , 41.67%, 0.00%, 41.67% disease incidence and the lowest yield was obtained in CS-0086 (11.4 t/ha) followed by CS-18-1-3-4 (11.9 t/ha), respectively with 50% disease incidence.

### **Survey on bacterial wilt of solanaceous vegetable crops**

M. Afroz, Z.H. Prodhan, A. K. M. Khorsheduzzaman, L. Yasmin And M. M. Rahman

A comprehensive survey was conducted during July-June, 2022-2023 cropping season throughout in four major eggplant and tomato growing districts such as, Bogura, Thakurgaon, Narsingdi and Rangpur to record the incidence of bacterial wilt of eggplant and tomato. During reporting period, four districts were surveyed that covered 105 farmers field and trial sites. Data on area surveyed, wilt incidence (%), etc. were recorded at the time of survey. A total of 180 wilt infected plant samples of eggplant and tomato were collected from Narsingdi, Bogura, Thakurgaon, Gazipur and Dinajpur districts during January-December 2022. A total 151 isolates *R. 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 confirm identification of those isolates. Molecular Characterization of *R. solanacearum* were also performed.

### **Integrated disease management of bacterial wilt in eggplant**

M. Afroz, Z. H. Prodhan, A. K. M. Khorsheduzzaman, L. Yasmin And M. M. Rahman

The experiment was conducted at Tuber Crop Research Sub Centre, BARI, Seujgari, Bogura, Farmer's filled, Sherpur, Bogura, Agricultural Research Station, BARI, Thakurgaon and Farmer's field Thakurgaon during October, 2022 to April, 2023 to find out the effective control tactics in



integrated approach against bacterial wilt and to enhance yield of eggplant. There were six treatments were used, such as T<sub>1</sub>= Stable Bleaching Powder @ 25 kg/ha + Burning of rice husk @ 10 t/ha (ii), T<sub>2</sub>=Stable Bleaching Powder @ 25 kg/ha + *Bacillus cereus*, T<sub>3</sub>= Burning of rice husk (5 cm thick) @ 10 t/ha + *Bacillus cereus*, T<sub>4</sub>= Stable Bleaching Powder @ 25 kg/ha+ Burning of rice husk (5 cm thick) @ 10 t/ha + *Bacillus cereus*, T<sub>5</sub>= Farmer's practice and T<sub>6</sub>= Susceptible check (BARI Begun-4). Among the treatments, T<sub>4</sub> showed the lowest incidence of the disease and provided highest yield.

#### **Integrated disease management of bacterial wilt in tomato**

M. Afroz, Z. H. Prodhan, A. K. M. Khorsheduzzaman, L. Yasmin And M. M. Rahman

The experiment was conducted at Tuber Crop Research Sub Centre, BARI, Seujgari, Bogura, Farmer's field, Sherpur, Bogura, Agricultural Research Station, BARI, Thakurgaon and Farmer's field Thakurgaon during October, 2022 to April, 2023 to find out the effective control tactics in integrated approach against bacterial wilt and to enhance yield of tomato. There were six treatments were used, such as T<sub>1</sub>= Stable Bleaching Powder @ 25 kg/ha + Burning of rice husk @ 10 t/ha (ii), T<sub>2</sub>= Stable Bleaching Powder @ 25 kg/ha + *Bacillus subtilis* 38, T<sub>3</sub>= Burning of rice husk (5 cm thick) @ 10 t/ha + *Bacillus subtilis* 38, T<sub>4</sub>= Stable Bleaching Powder @ 25 kg/ha+ Burning of rice husk (5 cm thick) @ 10 t/ha + *Bacillus subtilis* 38, T<sub>5</sub>= Farmer's practice and T<sub>6</sub>= Susceptible check (SL-0009). Among the treatments, T<sub>4</sub> showed the lowest incidence of the disease and provided the highest yield.

#### **Integrated management of tomato yellow leaf curl virus infecting tomato (*solanum lycopersicum* L.) In Bangladesh**

M. Mahfuzur. Rahman And L. Yasmin

The experiment was conducted in Plant Pathology Section research field in HRC, BARI, Gazipur during the winter, 2022-2023. Eight treatments, viz. T<sub>1</sub>= Yellow polythene mulch+2 spray of imadicloprid+2 spray of neem oil, T<sub>2</sub>= Yellow polythene mulch+ 2 spray of neem oil, T<sub>3</sub>= Silver polythene mulch+ 2 spray of imadicloprid+2 spray of neem oil, T<sub>4</sub>= Silver polythene mulch+neem oil, T<sub>5</sub>= Yellow sticky trap+2 spray of imadicloprid+2 spray of neem oil, T<sub>6</sub>= Yellow sticky trap+4 spray of neem oil, T<sub>7</sub>= Farmer's practice and T<sub>8</sub>= Untreated control were used. Among the treatments, treatment, yellow polythene mulch+2 spray of imadicloprid+2

spray of neem oil at 15 days interval were showed lowest disease incidence, white fly number and increase the yield of tomato.

#### **Efficacy of chemical, biological and cultural approach on management of foliar and fruit rot disease in strawberry**

M. Mahfuzur. Rahman, L. Yasmin And M. Afroz

The experiment was made to manage strawberry foliar and fruit disease caused by *Pestalotiopsis* sp through the chemical, biological and cultural practices. The experiment was conducted in Plant Pathology Section, HRC, BARI, and Gazipur field and the laboratory during 2022-2023. There were seven treatments such as: i) Propiconazole 5EC (0.05%), ii) Carbendazim fungicide (0.2%), (iii) Mencozeb 75 WP (0.2%), iv. Neem oil. (0.5%), v. Iprodione @ 0.2%, vi. Plastic mulch+ soil drenching with Carbendazim, and vii. Untreated control was used in the field experiment whereas three treatments (Hexaconazole (0.2%), copperoxicloeride (0.2%) and *Bacillus subtilis* 38 were included along with seven treatments to the laboratory test. In field experiment, there was no significant differences were found among the treatments in reducing disease incidence and seedling mortality and yield. However, in the laboratory, among the treatments, hexaconazole (0.2%), copperoxicloeride (0.2%) and *Bacillus subtilis* 38 was found effective to suppress the mycelium growth of the pathogen.

#### **Survey on botrytis blight disease in lilium**

L. Yasmin, M. Afroz M. A. Rahman & F. N. Khan

Survey was conducted in Floriculture research field of Horticulture Research Centre, BARI, Gazipur during December 2022 to March 2023 to record the incidence and severity of botrytis blight disease of lilium. The surveyed germplasm were Lil-001, Lil-002, Lil- 018, Lil -021, Lil -022, Lil- 023, Lil -024, Lil- 025, Lil- 027, Lil -028, Lil -029, Lil -036, Lil- 041and Lil- 042, Oriental (white) and Oriental (Pink). Disease incidence of botrytis blight of lilium was 0-35% in Lil-001, Lil-002, Lil- 018, Lil -021, Lil- 025, Lil -028, Lil -029, Lil -036, Lil- 041, Lil- 042, Oriental (white) and Oriental (Pink). Disease incidence was 60-70% in Lil- 023, Lil -024, Lil- 027 and Lil -022. The highest PDI was 67% in Lil-028 and lowest was 0% in Lil-002. The PDI was 10-56% in Oriental (white), Oriental (Pink), Lil -036, Lil- 018, Lil -021, Lil -027, Lil-001, Lil -042, Lil -023, Lil -024, Lil -022, Lil -041, Lil -025 and Lil -028.

## RARS Jashore

### Bio-agent based management practice against foot and root rot of lentil

MB Anwar, MS Ali, D Sarkar and KU Ahammad

This experiment was conducted at Regional Agricultural Research Station, Jashore during Rabi 2022-23. The experiment was laid out in a RCB design with three replications. The unit plot size was 3 m × 2 m. The date of sowing was 5 December, 2022 and the variety was BARI Masur-1. Eight treatments including control such as T<sub>1</sub>= Seed treatment with bio-derma @ 10 g/kg seed, T<sub>2</sub>= Seed treatment with trico-st @ 10 g/kg seed, T<sub>3</sub>= Soil amendment with *Bacillus* sp-EMOs granule @ 500kg/ha + spraying with *Bacillus* sp-EMOs (Effective Microbial Organisms made by *Bacillus oryzicola* YC7007 and *Bacillus velezensis* GL6) powder @ 1 g/L of water, T<sub>4</sub>= Soil amendment with tricho-compost @ 3 t/ha + spraying with tricho-leachate @ 20 ml/L of water, T<sub>5</sub>= Spraying with soil recharge (Lycomax) @ 3 g/L of water, T<sub>6</sub>= Seed treatment with Lentil rhizobium @ 10 g/kg seed, T<sub>7</sub> = Seed treatment with Provax-200WP @ 3 g/kg seed and T<sub>8</sub>= Control. The objective was to find out the effective bio-control agent against foot and root rot disease of lentil. The lowest seedling mortality (6.44 %) was recorded from T<sub>7</sub> (Provax) which was statistically similar to T<sub>3</sub> (*Bacillus* sp-EMOs) and T<sub>4</sub> (Tricho-compost) treated plots and the highest (20.88 %) was recorded in T<sub>8</sub> (control) plot. The highest yield (1520 kg/ha) was found in T<sub>7</sub> (Provax) treated plot followed by T<sub>3</sub> (*Bacillus* sp-EMOs) and T<sub>4</sub> (Tricho-compost) treated plot and the lowest (980 kg/ha) was found in T<sub>8</sub> (Control) plot. Among the treatments seed treatment with Provax-200WP performed better.

### Management of leaf curl disease of tomato by using beneficial microbes and vector control

MM Hossain, MB Anwar, MS Ali, MS Akhter and KU Ahammad

This experiment was conducted at Regional Agricultural Research Station, Jashore during Rabi 2022-23 to find out beneficial microbes for controlling leaf curl virus of tomato. Seven treatments including control such as T<sub>1</sub> = Seed treatment with *Trichoderma harzianum* + three consecutive spray with imidachloprid; T<sub>2</sub> = Drench application of *Trichoderma harzianum* + three

consecutive spray with imidachloprid; T<sub>3</sub>= Seed treatment with *Trichoderma harzianum* + drench application of *Trichoderma harzianum* + three consecutive spray with imidachloprid; T<sub>4</sub> = Seed treatment with *Bacillus* sp-EMOs (Effective Microbial Organisms made by *Bacillus oryzicola* YC7007 and *Bacillus velezensis* GL6) powder + three consecutive spray with imidachloprid; T<sub>5</sub> = Drench application of *Bacillus* sp (EMOs) granule + three consecutive spray with imidachloprid; T<sub>6</sub> = Seed treatment with *Bacillus* sp (EMOs) powder + drench application of *Bacillus* sp (EMOs) granule + three consecutive spray with imidachloprid; T<sub>7</sub> = Control were evaluated in this study. The lowest disease incidence (12.34%) was found in T<sub>6</sub> treated plot followed by T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> whereas the highest disease incidence (33.33%) was found in T<sub>7</sub> (control) plot. The highest yield was recorded (45.93 t/ha) in T<sub>6</sub> treated plot followed by T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> treated plot, respectively and the lowest (15.50 t/ha) in T<sub>7</sub> (control) plot. Among the management practices seed treatment with *Bacillus* sp (EMOs) + drench application of *Bacillus* sp (EMOs) + three consecutive sprays with imidachloprid and seed treatment with *Trichoderma harzianum* + drench application of *Trichoderma harzianum* + three consecutive spray with imidachloprid performed better against leaf curl virus disease of tomato.

### Integrated management for controlling early blight of tomato

MB Anwar, MS Ali and KU Ahammad

This experiment was conducted at Regional Agricultural Research Station, Jashore during Rabi 2022-23 to find out suitable integrated management practice for controlling early blight of tomato. Seven treatments including control such as T<sub>1</sub>= Seed treatment + foliar spray with Bioderma, T<sub>2</sub>= Seed treatment + foliar spray with Trico-st, T<sub>3</sub>= Seed treatment + foliar spray with Triko L, T<sub>4</sub>= Seed treatment + foliar spray with Dynamic, T<sub>5</sub>= Seed treatment + foliar spray with Tricho-leachate, T<sub>6</sub>= Seed treatment with Provax-200WP + foliar spray with Rovral 50WP, T<sub>7</sub>= Control were evaluated in this study. The highest reduction (83.33%) of disease severity over control was found in T<sub>6</sub> treated plot and the lowest (50.00 %) was found in T<sub>3</sub> treated plot. The highest yield was recorded (46.82 t/ha) in T<sub>6</sub> treated plot followed by T<sub>1</sub> and T<sub>2</sub> treated plot, respectively and the lowest

(18.24 t/ha) in T<sub>7</sub> (control) plot. Among the integrated management practice seed treatment with Provax-200WP + foliar spray with Rovral 50WP and seed treatment + foliar spray with Bioderma performed better for controlling early blight disease of tomato.

#### **Evaluation of bio-agents, botanicals and chemical fungicides against alternaria leaf spot of gerbera**

MB Anwar, MS Ali and KU Ahammad

This experiment was conducted at Regional Agricultural Research Station, Jashore during Rabi 2022-23 to find out appropriate management practice against alternaria leaf spot of gerbera. Seven treatments including control such as T<sub>1</sub> = Foliar spray with Triko L, T<sub>2</sub> = Foliar spray with Tricholeachate, T<sub>3</sub> = Foliar spray with Neem leaf extract, T<sub>4</sub> = Foliar spray with Mahogoni seed extract, T<sub>5</sub> = Foliar spray with Rovral 50WP, T<sub>6</sub> = Foliar spray with Luna sensation 50WP, T<sub>7</sub> = control were evaluated in this study. The highest reduction (83.33%) of disease severity over control was found in T<sub>5</sub> treated plot and the lowest (50.00%) was found in T<sub>3</sub> treated plot. The number of flowers was recorded within 6 months. The highest number of flowers per ha (4.40 lac) was recorded in T<sub>5</sub> treated plot followed by T<sub>6</sub> treated plot and the lowest (2.60 lac) in T<sub>7</sub> (control) plot. Among the management practice foliar spray with Rovral 50WP and foliar spray with Luna sensation 50WP performed better against alternaria leaf spot of gerbera.

#### **Eco-friendly management of foot rot of gerbera**

MB Anwar, MS Ali And KY Ahammad

This experiment was conducted at Regional Agricultural Research Station, Jashore during Rabi 2022-23 to find out appropriate eco-friendly management practice against foot rot of gerbera. Six treatments including control such as T<sub>1</sub> = Spraying with Bioderma @ 3 g/L of water in the rhizosphere, T<sub>2</sub> = Spraying with Tricost @ 3 g/L of water in the rhizosphere, T<sub>3</sub> = Spraying with Soil recharge (Lycomax) @ 3 g/L of water in the rhizosphere, T<sub>4</sub> = Spraying with Zeoderma @ 3 g/L of water in the rhizosphere, T<sub>5</sub> = Soil amendment with Trico-compost @ 3 t/ha+ spraying with tricholeachate @ 20ml/L of water in the rhizosphere, T<sub>6</sub> = control were evaluated in this study. The lowest disease incidence (16.60 %) was found in T<sub>5</sub> treated plot which was statistically similar to T<sub>1</sub> and T<sub>2</sub> treated plot, respectively. whereas the highest

disease incidence (40.00 %) was found in T<sub>6</sub> (control) plot. The number of flowers was recorded within six months. The highest number of flowers per ha (4.00 lac) was recorded in T<sub>5</sub> treated plot and the lowest (2.30 lac) in T<sub>6</sub> (control) plot. Among the eco-friendly management practice soil amendment with Trico-compost + spraying with tricho-leachate in the rhizosphere performed better for controlling foot rot disease of gerbera.

#### **RARS Ishurdi, Pabna**

##### **Effect of sowing time on the development of sclerotinia rot disease of sunflower**

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

Sunflower (*Helianthus annuus* L.) is one of the most common oil crops widely grown in different parts of the world. It is a thermo neutral crop growing both in Rabi and Kharif seasons in anywhere in Bangladesh. *Sclerotinia sclerotiorum* and *S. minor* are important soil borne pathogens of sunflower. Both species can infect the root system and cause a basal stem rot and wilt. Temperature at a range of 15-22 °C and high relative humidity (90-100%) are highly favourable for disease development. At present it is an emerging problem and great obstacle for crop production especially for winter crops. The disease appears as havoc and attacks all plant parts means both below and above ground portion of the crops like root, stem, branches, leaf petiole, inflorescence and fruit, resulting adverse effect on yield. In view of the above facts the present research work was undertaken to find out the actual scenario for disease development in different sowing times. The experiment was conducted at Regional Agricultural Research Station, Ishurdi, Pabna during Rabi season of 2022-23. Seeds of BARI Shurjomukhi-3 were sown on different dates viz. November 01, 10, 20, 30, December 10, 20 and 30 in 2022. Among the sowing dates first disease symptoms observed between January 07 to March 10, 2023 when crop attained 61-71 days old. The highest disease incidence (53.65%) was recorded in Nov. 01 sowing date where the 1<sup>st</sup> date of disease initiation was found in January 07, 2023. The Second highest incidence (33.24%) was recorded in Nov.10 sowing date where the 1<sup>st</sup> date of disease initiation was January 18, 2023 and they differed significantly with rest sowing times and the lowest incidence (1.51%) was found in Dec. 30 sowing date. It was found that disease incidence (%) gradually decreased with



delayed sowing. Yield ranged from 759.20 kg/ha to 1774.60 kg/ha. The highest yield (1774.60 kg/ha) was obtained in Jan.20 sowing date while the lowest yield was found in Nov. 01 (759.20 kg/ha).

#### **Management of white mold disease of bush bean caused by *Sclerotinia sclerotiorum* through the application of bio-control agents and different organic amendments**

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

Bush bean (*Phaseolus vulgaris* L.) belongs to the family leguminosae (Aliet *al.*, 2015) and is one of the most important leguminous vegetables in the world (Senet *al.*, 2010). In Bangladesh, this crop is known as “Farashi Sheem” (Purse-glove., 1992). *Sclerotinia sclerotiorum* (Lib.) de Bary is considered as a widespread and destructive pathogen, thriving disease on more than 500 plant species causing white mould symptoms with fluffy white mycelium cottony appearance (Sharma *et al.*, 2015). The pathogen severely affecting bean plants from December till early March, causing significant economic losses in bean fields. Therefore, the present study has been taken to find out the effective management package(s) against white mold disease of bush bean. The experiment was conducted at Regional Agricultural Research Station Ishurdi, Pabna during Rabi season of 2022-23. Eight different treatments viz. T<sub>1</sub>=Tricho compost T<sub>32</sub> @ 1 t/ha + Foliar spray with Trichoderma biofertilizer @ 20 ml/L, T<sub>2</sub>= Poultry litter @ 5t/ha + Foliar spray with Trichoderma biofertilizer @ 20 ml/L, T<sub>3</sub>=Mustard oil cake @ 800 kg/ha+ Foliar spray with Trichoderma biofertilizer @ 20 ml/L, T<sub>4</sub>=Neem oil cake @ 800 kg/ha+ Foliar spray with Trichoderma biofertilizer @ 20 ml/L, T<sub>5</sub>= Decoprima @ 2 g/l (during 3-4 days before sowing) + Foliar spray with Trichoderma biofertilizer @ 20 ml/L, T<sub>6</sub>=Recharge @ 5g/l (during final land preparation) + Foliar spray with Trichoderma biofertilizer @ 20 ml/L, T<sub>7</sub>=Seed treatment with Provax 200 WP @ 2.5 g/kg + Foliar spray with Folicure 250 EC (Tebuconazole) @ 1ml/L and control were used in this experiment. The lowest disease incidence (4.97%) was found in the treatment T<sub>4</sub> which was statistically similar to treatment T<sub>7</sub> (6.24%) and T<sub>1</sub> (6.54) while the highest (21.42%) was recorded in control plots. The highest pod yield (5852 kg/ha) was observed in treatment T<sub>4</sub> which was statistically identical to T<sub>7</sub> (5698 kg/ha) and T<sub>1</sub> (5576 kg/ha) on other hand the lowest yield (3484 kg/ha) was found in control plots.

#### **Screening of lentil lines against stemphylium blight disease**

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

Stemphylium blight of lentil (*Lens culinaris*. Medik.) caused by *Stemphylium botryosum* Wallr. is one of the major diseases of much economic importance. Stemphylium blight of lentil is a foliar fungal disease and attacks the crop in the early pod setting stage. Stemphylium blight causes severe leaf drop, resulting in defoliated plants. Diseased plants are often left with only terminal leaves, thereby severely affecting the assimilation of photosynthesis, decreasing crop yield and reducing the quality of seed. The disease is increasing tremendously in the recent years and continued to be a serious threat to the successful cultivation of lentil. Under severe conditions it causes yield losses of up to 62% (Bakr, 1991). Varietal screening is a process where to find out a good source of resistance against the disease. So, the experiment was carried out to find out the resistant sources against stemphylium blight of lentil. The experiment was conducted at the experimental field of Regional Agricultural Research Station, Ishurdi, Pabna during rabi season 2022-23. 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 four lines namely BD-3984, BD-3944, BD-3946 and BD-3971 showed moderately resistant, 7 lines namely BD-3965, BD-3988, BD-3964, BD-3943, BD-3976, BD-3967, BD-3985 showed moderately susceptible, 16 lines namely BD-3972, BD-3995, BD-3978, BD-3977, BD-3968, BD-3936, BD-3970, BD-3950, BD-3975, BD-3955, BD-3974, BD-3983, BD-3954, BD-3957, BD-3937, BD-3945 showed susceptible and rest three lines namely BD-3963, BD-3956 and BD-3958 including check variety BARI Masur-1 showed highly susceptible reaction against *Stemphylium* blight disease. The highest yield (1874 kg/ha) was observed in genotype BD-3946 which statistically identical to BD-3988 (1822 kg/ha) and BD-3971 (1805 kg/ha) while the lowest (1186 kg/ha) was recorded in check variety BARI Masur-1.

### Chemical and biological management of anthracnose disease of strawberry

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

Strawberry (*Fragaria ananassa*) is a promising fruit crop cultivated in Bangladesh. In Bangladesh, day by day it is becoming more popular and its importance as a commercial product is increasing. Anthracnose is a serious disease of strawberry that affects the foliage, runners, crowns and, most importantly, the fruit. Anthracnose is responsible for major losses of strawberry production worldwide (Howard et al., 1992). Therefore, the present study was conducted to find out the effective chemicals and bio-control agents against anthracnose disease of strawberry. A field experiment was conducted at Regional Agricultural Research Station Ishurdi, Pabna during Rabi season of 2022-2023. Seven different treatments viz. T<sub>1</sub>= Contaf 5 EC (Hexaconazole) @ 1ml/l, T<sub>2</sub>= Metaril 72 WP (Metalaxyl+ Mancozeb) @ 2g/l, T<sub>3</sub>= Score 250 EC (Difenoconazole) @ 2ml/l, T<sub>4</sub>= Indofil M 45 (Mancozeb) @ 2g/l, T<sub>5</sub>= Neem oil @ 5ml/l, T<sub>6</sub>= Trichoderma liquid @ 12.5 ml/l, T<sub>7</sub>= Secure 600 WG (Fenamidione+Mancozeb)@ 2g/l and one untreated control were used in this experiment. The lowest incidence of anthracnose disease (5.40 %) was recorded in Score 250 EC (Difenoconazole) @ 2ml/l treated plots and the highest (14.96 %) was recorded from control plots. The highest yield (17.05 t/ha) was found in Score 250 EC (Difenoconazole) @ 2 ml/l treated plots while the lowest (13.28 t/ha) was recorded in control plots. The highest net income (Tk. 1307950/ha) was recorded from Score 250 EC treated plots followed by Contaf 5EC (Tk. 1034700/ha) and Metaril 72 WP (Tk. 1010400/ha).

### Survey and monitoring of major guava and litchi diseases at Ishurdi region

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

Recently a large number of farmers at Ishurdi region are involved with guava and litchi production in large scale. Farmers are facing some disease problems for guava and litchi production. A comprehensive survey was conducted at six guava and five litchi orchards of four villages of Ishurdi upazilla to identify and record the incidence and severity of existing diseases as well as new diseases during season 2022-2023. From the survey it was found that anthracnose and wilt diseases of guava are predominant. Severity of Anthracnose was recorded 05%-15% and incidence of wilt was 25%-30%. Sunburn symptom was found 30%-50% from most of the orchard caused by

inadequate rainfall. No pathogen was isolated from sunburn symptoms. *Colletotrichum psidii* and *Fusarium oxysporum* f. sp. *psidii* were isolated from the infected parts of guava which cause anthracnose and wilt disease. Anthracnose and fruit cracking of litchi were also the major problem in the surveyed area. The incidence of litchi anthracnose ranged from 6%-48% and fruit cracking of litchi was recorded 5%-30%. The isolated pathogen from litchi anthracnose was *Colletotrichum* sp. No pathogen was isolated from fruit cracking of litchi.

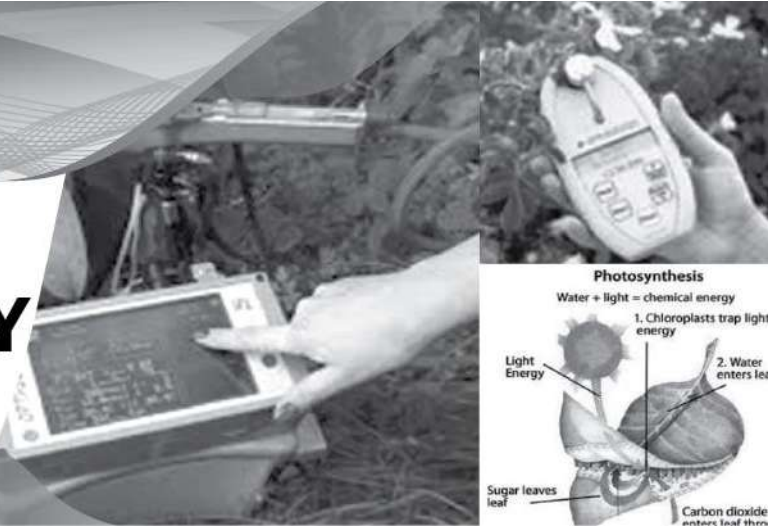
### Screening of okra lines against okra yellow vein mosaic virus

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

Okra [*Abelmoschus esculentus* (L.) Moench] is placed in Malvaceae family and originated in tropical Africa but can be grown in tropical and sub-tropical regions of the world (Ali et al., 2012). In Bangladesh, the annual okra production is 54.901 thousand metric tons from 28.106 thousand hectares of land (BBS. 2017.). Among the various biotic diseases yellow vein mosaic virus (YVMV) is a most serious disease and caused substantial yield losses (80-90%) in okra crops (Sastri and Singh 1974, Ali et al., 2005). In a study, it was found that the infection rate has reached up to 100% if field yield loss ranges between 50% and 94% (Ali et al. 2012). Search for resistance to okra yellow vein mosaic virus of okra is considered to be an essential part of disease management program. So, the experiment was conducted at Regional Agricultural Research Station Ishurdi, Pabna, during kharif-1 season 2022-23 to find out the resistant sources against okra yellow vein mosaic virus disease. Seeds of thirteen okra genotypes viz. AE-002, AE-003, AE-004, AE-005, AE-007, AE-008, AE-009, AE-010, AE-011, AE-012, AE-013 and AE-014 including one check variety BARI Dherosh-2 were used in this experiment. Among the tested entries three okra genotypes namely AE-003, AE-004 and check variety BARI Dherosh-2 showed highly resistant reactions, eight genotypes namely AE-002, AE-007, AE-008, AE-009, AE-010, AE-011, AE-012 and AE-014 showed moderate resistant reactions and two genotypes namely AE-005 and AE-013 showed tolerant reactions against okra yellow vein mosaic virus disease. The highest yield (19.65 t/ha) was found in genotype AE-012 which statistically similar to the genotype AE-008 (19.50 t/ha), while the lowest (11.78 t/ha) was recorded in AE-013.

# PLANT PHYSIOLOGY

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## **Morpho-physiological evaluation of selected linseed genotypes under drought condition at vegetative stage**

SN Mahfuza, N Mocarroma, Ahmr Talukder, Aamm Mustakim And F Ahmed

Morpho-physiological evaluation of selected linseed genotypes under drought condition was done at the vinyl house of Plant Physiology Division, BARI, Gazipur, Bangladesh during November, 2022 to March 2023. This experiment included 2 treatments viz. control ( $90 \pm 5\%$  FC), and drought stress ( $40 \pm 5\%$  FC). Drought stress was imposed at 30 days after emergence during vegetative stage. Ten selected linseed genotypes including two varieties BARI Tishi-1(Neela) and BARI Tishi-2 were evaluated in this study. The experiment was done in Randomized complete block design with three replications. Plastic pot (top dia: 25 cm, bottom dia: 18 cm and height 25 cm; 12 kg soil) was filled up with the mixture of air-dried soil and cow dung (4:1). Fertilizer at the rate of 30-10-16-6 kg ha<sup>-1</sup> NPKS (FRG, 2018) in the form of Urea, Triple super phosphate, Muriate of potash, and Gypsum were incorporated in the soil. Results revealed that relative values of biomass accumulation, root volume and dry weight, total chlorophyll and carotenoid content and yield contributing characters as indices of G2, G8, G4 and G10 showed more tolerant to drought stress than rest of the genotypes.

## **Morpho-physiological and biochemical response of groundnut genotypes to drought stress**

AFMS Ahsan, Aamm Mustakim, MM Kadir And F Ahmed

A pot-culture experiment was conducted at the pot-house of the Plant Physiology Division, BARI, Gazipur, from December 2022 to May 2023 to investigate the physiological and biochemical responses of three groundnut genotypes-BARI

Chinabadam-8, BARI Chinabadam-9 (relatively susceptible), and advanced line DF-090035 (tolerant) to drought stress. Plastic pots containing a mixture of sandy loam soil and decomposed cowdung were used for cultivation. Drought stress was specifically applied during the flowering stage, encompassing three treatments: a control group maintained at around 95-100% field capacity (FC), 60% and 40% FC. The experiment followed a randomized complete block design with three replications. Monitoring of pot soil's field capacity was conducted using a digital TDR 300 soil moisture meter, calibrated twice via gravimetric methods for precision. The genotypes were evaluated for growth parameters, physiological indicators, and detection of reactive oxygen species. Results highlighted the significant impact of drought stress on all genotypes, with the advanced line (DF-090035) demonstrating superior performance. Particularly under 40% FC conditions, the advanced line exhibited increased plant height, leaf area, pod number, total dry matter, and seed yield compared to other genotypes. Additionally, it displayed superior physiological responses, including elevated RWC, reduced MDA levels, and maximum proline content under 40% FC conditions. The advanced line showed improved photosynthetic activity, with higher total chlorophyll content and Fv/Fm ratio (Chlorophyll fluorescence parameter). Histochemical staining also revealed diminished accumulation of reactive oxygen species (H<sub>2</sub>O<sub>2</sub> and O<sub>2</sub><sup>-</sup>) in the advanced line at 40% FC, indicating its superior drought tolerance.

## **Effect of elevated temperature on flowering, seed yield and quality of onion**

AAMM Mustakim, IM Ahmed, Ahmmr Talukder, Sn Mahfuza AFM Shamim Ahsan, N Mocarroma And F Ahmed,

A pot experiment was conducted in the *rabi* season of 2022–2023 to ascertain the effects of high



temperature stress on onion seed quality and yield. The study included five distinct treatments: T<sub>1</sub>= open field (control), T<sub>2</sub>= planting to maturity under poly tunnel, T<sub>3</sub>= flowering initiation to 15 days under poly tunnel, T<sub>4</sub>= flowering initiation to 30 days under poly tunnel and T<sub>5</sub>=flowering initiation to maturity under poly tunnel. The experiment followed a randomized complete block design with ten replications. BARI Piaj-1 seedlings were transplanted in plastic pots, and fertilizers were applied accordingly. After 10 days, plants were thinned to five per pot. At harvest, yield and yield components were collected and analyzed statistically. After harvest seeds were collected and tested for germination. The impact of heat stress on pollen viability was also examined, with pollen from freshly opened flowers randomly selected from each treatment. To enforce the high temperature a polythene-covered chamber was used with a temperature of 1.0 to 6.0 °C higher than the outside air. Among the heat induced treatment comparatively viable pollen was observed in T<sub>3</sub> treatments (296). T<sub>1</sub> had the largest seed yield (6.98 g plant<sup>-1</sup>) and T<sub>2</sub> produced the lowest seed yield (1.97 g plant<sup>-1</sup>). The % of germination also showed a similar pattern. Number of umbel plant<sup>-1</sup>, number of seeds umbel<sup>-1</sup>, seed yield plant<sup>-1</sup>, 1000-seed weight were found highest in T<sub>3</sub> compared to control.

#### **Evaluation of selected garlic varieties against salinity in coastal region**

AHM Motiur Rahman, SN Mahfuza, AFM Shamim Ashan, F Ahmed, OA Fakir, MSU Khan

The experiment was executed in the field of the Agriculture Research Station (ARS), Benarpota, Satkhira during *rabi* season, 2022-2023. The aim of the study was to evaluate the performances of selected Garlic varieties against salinity. The land type was medium highland with fluctuated soil salinity level (dSm<sup>-1</sup>). During crop planting period, the average soil salinity of the experimental field was 5.90 dSm<sup>-1</sup>. Minimum (5.25 dSm<sup>-1</sup>) and maximum (15.3 dSm<sup>-1</sup>) soil salinity was recorded at 20 DAP and harvesting period respectively. BARI Rashun-3 and BARI Rashun-4 together with Natore local, were the three types of varieties/cultivars with the experimental material. The experiment was laid out in a Randomized Complete Block Design with three replications. During crop planting period, the average soil

salinity of the experimental field was 5.90 dSm<sup>-1</sup>. The total numbers of plot were 9 and size of each plot was 1 m × 1 m. Agronomic parameters of Garlic cultivars like total dry matter weight (g plant<sup>-1</sup>), yield contributing and bulb yield indices were measured of varieties/cultivars, regardless of salinity level. Total dry matter weight (g plant<sup>-1</sup>) measurement was started from 70 DAS and continued at harvest scheduling at 15 days intervals. Plants sample were divided into leaf and bulb categories. The separated parts were dried in an oven for 72 hours at 70 °C and dry weight was recorded. Among the three varieties/cultivars, BARI Rashun-4 gave the highest yield (2.28 t ha<sup>-1</sup>) and Natore local produced the lowest yield (1.89 t ha<sup>-1</sup>).

#### **Screening of mustard genotypes against waterlogging**

SN Mahfuza, AFM Shamim Ahsan, AHM Rahman Talukdar, N Jahan, F Ahmed

A field experiment was conducted at the research field of Plant Physiology Division, BARI, Gazipur during *rabi* season of 2022. Thirty mustard genotypes were sown as test crop under normal and waterlog condition. The experiment was laid out in Randomized Complete Block design with 3 replications. Seeds were sown on 21<sup>st</sup> November 2022. Fertilizers were applied @100-30-80-20-3-1 kg<sup>-1</sup>ha NPKSZnB. Half of N and all other fertilizers were applied as basal and remaining N was applied at 20 days after sowing (DAS). Mustard genotypes were evaluated at vegetative stage to identify tolerant genotypes by imposing waterlogging for 48 hours duration. Waterlog was imposed at 25 days after sowing where water was maintained about 5 cm above the soil surface. After the treatment period, water was drained out from the plot and plants were allowed to grow at normal condition up to maturity. The characters studied were leaf area, total dry weight plant<sup>-1</sup>, plant height, 1000-seed weight and seed yield plant<sup>-1</sup>. Our results from the experiment showed that relative total dry matters, leaf area, plant height, 1000-seed weight were significantly reduced in plants under waterlog compared to their control condition. Considering tolerance index (TOL) and Yield stability Index (YSI) Genotypes BD 7115, BD 7121, BD 7133, BD 7830 and BD 11583 showed the least reduction, indicating their high tolerance to waterlog stress.

### **Screening of mungbean genotypes against waterlogging stress at vegetative stage**

AFM Shamim Ahsan, SN Mafuza, AHM Motiur Rahman, R A Chhanda And F Ahmed

An experiment was conducted during the kharif-1 season of 2023 to assess waterlogging tolerance among 23 mungbean genotypes. Employing a randomized complete block design with three replications, plastic pots were utilized, with dimensions (top diameter: 25 cm, bottom diameter: 18 cm, height: 25 cm) and a capacity of 12 kg soil. The pots were filled with a well-mixed combination of soil and decomposed cowdung in a 4:1 ratio. On March 7, 2023, ten mungbean seeds were sown in each pot, and fertilizers (N-P-K-S-Zn-B at 24-32-48-24-3-1.5 kg/ha) were applied before three days of sowing. The genotypes were subjected to 72-hour and 96-hour waterlogging stress, as well as normal conditions. Waterlogging stress was induced by submerging pots in a water tub, maintaining the water level around 5 cm above the soil surface, followed by a return to normal conditions until maturity. During harvest, relative values of yield and yield components data were collected from two plants/replication. Among the genotypes, G21, G20, G22, G10, and G18 exhibited higher relative seed yield under 96-hour waterlogged conditions, while G2 and G6 showed the lowest seed yield. Stress tolerance indices further confirmed the tolerance G21, G20, G17, G18, G22, and G10 genotypes against waterlogging stress. Based on the relative yield, yield-contributing characters, and stress tolerance indices G21, G20, G22, G10, and G18 mungbean genotypes can be considered relatively tolerant to waterlogging stress.

### **Screening of black-gram genotypes to waterlogging stress**

AFM Shamim Ahsan, N Mokarroma, Akmm Alam And F Ahmed

An investigation was conducted through a pot experiment to assess the impact of waterlogging stress on various blackgram genotypes. Seeds of blackgram were sourced from PRC, BARI, Gazipur, and grown in the hydroponic facility of Plant Physiology Division, BARI. After selecting healthy and uniform-sized seeds, they were surface sterilized and sown in cell trays containing a potting mixture composed of coconut peel (2/3 parts) and sandy-loam soil (1/3 part). Following

emergence, seedlings were thinned to three per cell based on size and health. Waterlogging stress, saturated conditions, was initiated at the first trifoliate leaf stage (15 DAE) and continued for seven days and control plants not exposed to waterlogging stress were also cultivated. The experiment followed a completely randomized design with three replications. After waterlogging, the seedlings were returned to normal conditions upto 23 DAE. Measurements of root length, shoot length, root dry weight, and shoot dry weight were taken from both waterlogged and control seedlings. Plant parts were dried in an oven for 72 hours at 70 °C and dry weight was recorded. Among the 36 genotypes tested, five were unable to survive under 7-day waterlogged conditions. At the same time, the remaining 31 genotypes exhibited decreased shoot and root lengths compared to non-waterlogged conditions. Results revealed that, waterlogging led to reduced shoot dry weight and root dry weight. The waterlogging tolerance coefficient (WTC) ranged from 0.1 to 0.79, and the survival rate varied from 29.41% to 100% among the surviving seedlings. Moreover, the experiment identified eight genotypes (PH-10 Gp, DH-18 Gp, DH-5 Gp, Ru-81 Gp, Ru-179 Gp, DHL-16 GP, DHL-5 GP, and DHL-14 GP) that exhibited significant adventitious root formation, suggesting a crucial role in enhancing waterlogging tolerance. These genotypes can be considered waterlogging-tolerant based on their ability to survive under waterlogged conditions.

### **Growth, yield and physiological features as influenced by drought and salinity stress in barley genotypes at vegetative and reproductive stage**

AHM Motiur Rahman Talukder, N Mokarrama, F Ahmed

To study how combined drought and salinity stress affected the development, yield, and physiochemical traits of barley genotypes/varieties, an experiment was conducted in the pot-house of the Plant Physiology Division, BARI, during the winter (*rabi*) season of 2022-2023. This study was done following the split-plot (RCB) design, with stress treatments as the main plot and genotypes as the sub-plot with ten replicates and each pot represented one replication. A total of 120 plastic pots (26 cm top diameter, 20 cm base diameter, and 25 cm height) were organized in the

pot-house of the plant physiology division of BARI, with 10 pots placed in each replicate blocks. Soil was collected from paddy produced farm (depth 0-15 cm). 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 (12 L, 26 cm top diameter, 20 cm base diameter, and 25 cm height), each holding around 11.5 kg of soil. Fertilizers @ 18-18-24-12-2.0-1.2 kg ha<sup>-1</sup> of N-P-K-S-Zn-B were applied in the form of urea, triple super phosphate, muriate of potash, zypsum, zinc sulfate, and Boron respectively. The barley genotypes salinity-tolerant cultivar CM-72 and drought/salinity tolerant T-16, and drought tolerant variety BARI Barley-8 was used in this study. The result showed significant reductions in plant growth, chlorophyll content and photosynthetic parameters were caused by either drought (D) or salt (S) alone or in combination (D+S) conditions, with combined stress causing the highest suppression, and the T-16 genotype demonstrating more tolerance than CM-72. Following D + S, water usage efficiency (WUE) greatly enhanced in T-16 and BARI Barley-8 but not in CM-72. In comparison to CM-72, T-16 and BARI Barley-8 demonstrated the highest potentiality for bearing of K<sup>+</sup> level and as well as K<sup>+</sup>/Na<sup>+</sup> ratio in plants during D + S stress. Additionally, T-16 and BARI barley-8 showed greater increases in the amount of catalase (CAT), ascorbate peroxidase (APX), and guaiacol peroxidase (POD) activities under D+S vs control than CM-72. Compared to control, all stress treatments meaningfully reduced grain yield and 1000-grain weight; however, T-16 and BARI Barley-8 were less affected than CM-72.

#### **Phenology, growth and yield of potato as influenced by planting time**

AHM Motiur Rahman Talukder, Faruque Ahmed

A field experiment was conducted in Plant Physiology Division research field of BARI during *rabi* season of 2022-2023 to observe the phenology, growth and yield of potato varieties as influenced by planting times. Two potato varieties viz. BARI Alu-25 and BARI Alu-41 were planted in four different time scheduling 10-days intervals viz. 20 November, 01 December, 10 December and 20 December respectively. The seeds tuber was planted with spacing of 60 cm × 25 cm. Fertilizers

were applied @ 150-45-125-20 kg ha<sup>-1</sup> N-P-K-S in the form of urea, tripple super phosphate, muriate of potash and gypsum respectively. The emergence and maturity date was established when about 90% of the plants emerged and the leaves of plants turned yellow respectively. Plant height, leaf area plant<sup>-1</sup> and dry weight of plant parts was determined by collecting two plants from each plot from 30 DAS at 15 days intervals and up to harvest. The growth duration was shortened by up to ~12 days for delaying 20-day's in planting. Differences in leaf and tuber growth rate as well as tuber yield were found among the planting times, potato varieties sown on 20 November provided the maximum leaf and tuber growth as well as tuber yield. Data on dry matter was estimated at different DAPs and total tuber yield t ha<sup>-1</sup> from 1.2 m × 4.0 m area was taken at harvest as the sum of marketable and non-marketable tuber yields. Sowing time significantly decreased growth rate of potato varieties with greatest suppression sown on 20 December.

#### **Dormancy breakdown and germination acceleration of BARI alu-62 through chemical treatments**

AHM Motiur Rahman Talukder, Faruque Ahmed

A study was conducted at the Research field of Plant Physiology Division, BARI, Gazipur, during 2022-2023. The 240 tuber seeds were separately treated by spraying GA<sub>3</sub> and KNO<sub>3</sub> chemical solution. The experiment was laid out in RCB design with three replications. The seeds tuber of potato variety was planted with spacing of 60 cm × 25 cm. Fertilizers were applied @ 150-45-125-20 kg ha<sup>-1</sup> N-P-K-S in the form of urea, tripple super phosphate, muriate of potash and gypsum respectively. To assess the effect of chemical treatments on the initiation of germination, soils were dug up and recorded at daily basis and number of germinated seeds on particular day was also noted and percentage of emergence was recorded at the weekly interval. The emergence date was established when about 90% of the seedlings emerged, from the observations of 2 to 3 days intervals. Data on dry matter was estimated at different DAPs and total tuber yield t ha<sup>-1</sup> from 1.2 m × 3.5 m area was taken at harvest as the sum of marketable and non-marketable tuber yields. Two plants were harvested from each plot at 30, 45, 60, 75 DAP and at harvest which was separated into



leaves, stems, roots, and tubers. The plant parts were dried in an oven for 72 hours at 80 °C and dry weight was measured as a sum of individual parts. The treatment consisted singly GA<sub>3</sub> (0.1%) and combined application of GA<sub>3</sub> and KNO<sub>3</sub> resulted in earliest seedling emergence (ca. 21.0 days), maximum seedling emergence (ca. 90%), and subsequent seedling growth e.g. highest leaf area, and TDM, yield and yield contributing traits.

#### **Effect of potassium on dry matter, starch and sugar content of potato processing variety**

AAMM Mustakim, IM Ahmed, F Ahmed, SN Mahfuza, Afm Shamim Ahsan, Ahmmr Talukder, N Mekarroma

A field experiments was carried out during the *rabi* season of 2022–2023, in order to compare the effects of different sources and dosages of K fertilizer on potato yield and quality. Graded K doses of 0, 100, 150, and 200 kg ha<sup>-1</sup> K from sulfate of potash (SOP) and muriate of potash (MOP) were used. BARI Alu-28, was used as test crop. The experiment was setup in randomized complete block design with three replications. Potassium treatment was applied at the rate of 0, 100, 150, 200 kg ha<sup>-1</sup> from both of the source's sulfate of potash (SOP) and muriate of potash (MOP) as basal. Nitrogen, 150 kg ha<sup>-1</sup> and phosphorus, 45 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>, gypsum 20 kg S ha<sup>-1</sup> were applied. Full amount of TSP, gypsum and 50% of urea were applied as basal during land preparation and the remaining amount of urea was side dressed at 30 days after planting. Intercultural operations and Irrigation were done as and when required. First 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. After measurement of plant height, plants were separated into leaves and shoots, and dried at 80°C for 72 h, and then weighted. In compared to control a significant increase in tuber production was noted with 150 kg ha<sup>-1</sup> K from both sources. The increase in tuber production with 200 kg ha<sup>-1</sup> K was statistically non-significant. Application of SOP increased the quality indicators such as dry matter, specific gravity, and starch contents significantly but tuber yield was non-significant. Among the graded doses of potassium 150 kg ha<sup>-1</sup> K from SOP found suitable.

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#### **Effect of plant growth regulators on the performance of lady's finger**

M. Moniruzzaman and R. Khatoon

Field experiments on lady's finger were conducted at the Plant Physiology Section Research Field of HRC, BARI, Gazipur during three consecutive years of 2020, 2021 and 2022 to study the effect of plant growth regulators on growth and yield of the crop. The experiment was laid out in split-plot design with three replications assigning two varieties in main plot and PGRs in sub-plot. The experiment consisted of seven PGRs treatments viz., two NAA concentrations (100 and 200 ppm), two GA<sub>3</sub> concentrations (100 and 200 ppm), two CCC concentrations (200, and 400 ppm) and tap water as control, and two okra varieties, namely BARI Dheros-2 and OK-1820. The unit plot size was 2.00 m x 2.00 m (4.0 m<sup>2</sup>) having 16 plants. Manures and fertilizers were applied to the soil @ 5 kg Cowdung, 200 kg N, 150 kg P, 150 kg K, and 20 kg S per hectare and their sources were Urea, TSP, MoP and gypsum. The total amount of cowdung, TSP, gypsum and one-fourth quantity of urea and MoP were applied prior to planting seeds and the remaining three- fourth quantity of Urea and MoP was top dressed into three equal installments 30, 45 and 60 days after planting. Seeds of two okra varieties were dibbled at the rate of 2 seeds/hill maintaining 50 x 50 cm plant spacing. The control plants were sprayed with tap water, whereas aqueous solutions of NAA, CCC and GA<sub>3</sub> were sprayed thrice on the plants i.e. 4 weeks after sowing, at 1<sup>st</sup> flowering and three weeks after 1<sup>st</sup> flowering

Among all foliar agents, the response of GA<sub>3</sub> was found better. The three year' results revealed that plant height at last harvest (170.27 cm in BARI Dheros-2 and 163.11 cm in OK-1820), Leaf Area Index (LAI) (7.31 in BARI Dheros-2 and 6.45 in OK-1820), dry weight/plant (242.71 g in BARI Dheros-2 and 200.45 g in OK-1820), fruit length (14.08 cm in BARI Dheros-2 and 14.42 cm in OK-1820), fruit diameter (15.20 cm in BARI Dheros-2 and 15.53 cm in BARI Dheros-2), individual fruit weight (18.99 g in BARI Dheros-2 and 18.60 g in OK-1820), number of fruits/plant (45.71 in BARI Dheros-2 and 48.31 in OK-1820) were found maximum from 100 ppm GA<sub>3</sub> followed by 200 ppm GA<sub>3</sub>, but maximum fruit weight/plant was obtained from the application of 200 ppm GA<sub>3</sub> (760.83 g in BARI Dheros-2 and 851.73 g in OK-1820)

followed by 100 ppm GA<sub>3</sub> ( 751.03 g in BARI Dheros-2 and 838.37 g in OK-1820). The average three years' results indicated that the highest fruit yield per hectare (23.29 t/ha in BARI Dheros-2 and 24.04 t/ha in OK-1820) was recorded with the application of 200 ppm GA<sub>3</sub> which was followed by 100 ppm GA<sub>3</sub> (21.98 t/ha in BARI Dheros-2 and 23.42 t/ha in OK-1820). All the parameters along with fruit yield were found minimum from control. Based on this result, it can be recommended to cultivate lady's finger by foliar spray of GA<sub>3</sub> @ 100-200 ppm singly in 3 equal sprays at 4 weeks after sowing, first flowering and 3 weeks after first flowering for higher fruit yield.

#### **Effect of gibberellic acid on growth, flowering and yield of lady's finger varieties during off-season**

M. Moniruzzaman and R. Khatoun

Field experiments were conducted at the Plant Physiology Section Research Field of HRC, BARI, Gazipur during summer seasons of 2020 and 2022 to study the effect of GA<sub>3</sub> on growth and yield of off-season lady's finger. The experiment consisted of four GA<sub>3</sub> concentrations viz., 0.0, 100, 200 and 300 ppm, and three okra varieties viz, BARI Dheros-2, OK-1820 and Bullet (ACI). The experiment was conducted in randomized complete block design with three replications. The unit plot size was 2.00 m x 1.60 m (3.2 m<sup>2</sup>) having 20 plants. Seeds of three okra varieties were dibbled at the rate of 2 seeds/ hill on 27 October 2020 and 13 October 2022 maintaining 50 x 40 cm plant spacing. Prior to planting, seeds were soaked in tap water for 24 hours for uniform and better germination. After completion of the germination thinning was done leaving one seedling in each hole. The harvesting of green fruit was done every alternate day. The control plants were sprayed with tap water, whereas aqueous solutions of GA<sub>3</sub> were sprayed thrice on the plants i.e. 21, 30, 45 and 75 days after sowing. In the middle of December, okra crop was affected by leaf hopper, jassid and fruit fly and unknown disease complex. To control insects, Imitaf @ 1.5 ml/L H<sub>2</sub>O and fungicides Autostin (@ 2 g/ L H<sub>2</sub>O), Rovral (@ 1.00 ml/H<sub>2</sub>O) were sprayed, but no improvement was not occurred. This problem was seen in both the years

Irrespective of plant growth regulators Ok-1820 gave maximum number of fruits/plant (10.09 in 2020 and 9.63 in 2022), weight of fruits/plant

(139.79 g in 2020 and 174.01 g in 2022) and fruit yield/ha (5.11 t in 2020 and 4.49 t in 2022). Irrespective of variety, in 2020, 200 ppm GA<sub>3</sub> recorded maximum plant height at harvest (125.31 cm), dry weight/plant (175.85 g), number of fruits/plant (11.33), weight of fruits/plant (187.85 g) and fruit yield (6.81 t/ha), but in 2022, all growth regulators performed well with regard to growth characters (plant height and dry weight/plant) but these GA<sub>3</sub> concentrations exerted negative effect on yield attributes. In 2020 OK-1820 in combination with 200 ppm GA<sub>3</sub> gave the highest fruit yield (210.11 g/plant) and 7.57 t/ha, but in 2022, in absence of GA<sub>3</sub>, the variety OK-1820 gave maximum fruit yield (300.81 g/plant and 8.56 t/ha). In the 1<sup>st</sup> year GA<sub>3</sub> spray improved growth as well as yield parameters, but in the 2<sup>nd</sup> year, GA<sub>3</sub> improved growth parameters, but fruit set was not occurred as per desire and consequently good fruit yield was not obtained from any GA<sub>3</sub> treatments. During off-season cultivation, crop faces winter climate and growth of the plants did not occur well and the plants were attacked by a number of diseases. It is concluded that okra seed will be sown in such time so that fruit harvest ends in the middle of December. GA<sub>3</sub> is not suitable to spray for the production of off-season okra.

#### **Response of tomato to gibberellic acid application under salinity stress at lab condition**

M. Moniruzzaman and R. Khatoun

A lab study was conducted at Plant Physiology Section Laboratory of HRC, BARI to explore the interactive amendment effects of exogenous gibberellic acid (GA<sub>3</sub>) and salinity on seed germination process of tomato during 2022 and 2023. Seeds were presoaked in different levels of GA<sub>3</sub> water solutions (0, 100, 200 and 300 ppm) and then applied in NaCl solutions (0, 8 and 12 dS/m), thus there were 12 treatment combinations in this experiment. The experiment was conducted at completely randomized design (CRD) with three replications. Each petri dish of 9 cm in dia contained 15 seeds. The duration of the experiment in 2022 was 16 March to 27 March 2023 while the duration was 14 November to 25 November 2023 in the 2<sup>nd</sup> year. In both the years the experiment was continued upto 12 days. The effects of salinity and external GA<sub>3</sub> on germination percentage, germination characteristics such as germination index, germination value, mean germination time,

seedling growth characters viz. shoot length, root length and seed dS/m salinity levels and dry weight were investigated. The two years' average results were presented. The salinity stress of 12 dS/m recorded lower seed germination (23.06%), germination index (151.81), germination value (0.22), germination rate of index (2.51) and coefficient value of germination (10.23) followed by at 8 dS/m salinity stress where seed germination (25.39%), germination index (213.91), germination value (1.82), germination rate of index (3.47) and coefficient value of germination (15.59) where as at control condition seed germination (86.70%), germination index (940.70), germination value (47.95), germination rate of index (18.27) and coefficient value of germination (22.07). Mean germination time was observed highest 10.20 days at 10 dS/m salinity stress while at 8 dS/m salinity stress mean germination was recorded 6.69 days where mean germination time at 10 and 8 dS/m salinity levels mean germination time was 5.44 and 1.93 days higher, respectively than that of control. Salinity stress 8 dS/m in presence of 100 ppm GA<sub>3</sub> gave 83.76% seed germination, higher seed germination index (945.30), germination value (53.09), germination rate of index (18.49) and coefficient of velocity of germination (23.60) and lowest mean germination time (4.42). Salinity stress of 8 dS/m recorded lower seedling length (9.46 cm) and seedling dry weight (1.03 mg) compared to control (seedling length: 8.01 cm and seedling dry weight: 2.05 mg), but this salinity level in presence of 100 ppm GA<sub>3</sub> gave the highest seedling length (11.39 cm) and seedling dry matter (3.08 mg). Therefore, it revealed that GA<sub>3</sub> @ 100 ppm prominently relieved salt stress and improved the seed germination, germination properties and seedling growth of tomato seeds under salinity stress.

#### **Effect of gibberellic acid and humic acid on germination and seedling growth in tomato (*Solanum lycopersicum* L.) under induced salinity stress**

M. Moniruzzaman and R. Khatoun

The lab experiment was conducted to explore the interactive amendment effects of exogenous gibberellic acid (GA<sub>3</sub>) as well as Humic Acid (HA) and salinity stress created by NaCl and CaCl<sub>2</sub> mixing at the ratio of 2:1 on seed germination process of tomato during 8 December to 18

December 2023. Seeds of the BARI Tomato-18 was used in this experiment. Seeds were presoaked in different levels of GA<sub>3</sub> water solutions (100 and 200 ppm) as well as HA acid water solutions (100 and 200 ppm) and then applied in salinity stress levels (0, 8 and 10 dS/m). Thus there were 15 treatment combinations in this experiment. The experiment was conducted following completely randomized design (CRD) with three replications. Each petri dish of 9 cm in dia contained 20 seeds. The experiment was continued upto 11 days. The effects of salinity and external GA<sub>3</sub> and HA on final germination percentage, germination characteristics such as mean germination time, germination index, germination value, and seedling growth characters viz. shoot length, root length, seedling length, and seedling dry weight and seedling vigor index were investigated. At 10 dS/m salinity stress, the lowest final germination percent (FGP) (58.33%), germination index (GI) (388.33), germination value (GV) (314.67), shoot length (4.50 cm), root length (4.80 cm), seedling length (9.30 cm), seedling dry weight (1.16 mg), seedling vigour index-I SVI-I (6.05) and seedling vigour index-II (SVI-II (75.29) but at 8 dS/m salinity stress, FGP (76.67%), GI (576.67), GV (373.61), shoot length (6.10 cm), root length (4.70 cm), seedling length (10.80 cm), seedling dry weight (1.30 mg), SVI-I (7.93) and SVI-II (95.03) were observed while at control condition (distilled water), FGP (98.33%), GI (968.33), GV (799.87), shoot length (6.67 cm), root length (5.90 cm), seedling length (12.57 cm), seedling dry weight (1.36 mg), SVI-I (12.36) and SVI-II (133.55) were obtained. Seed germination at control condition took 3.16 days, whereas 8 dS/m and 10 dS/m salinity levels took 5.29 and 6.36 days, respectively. In presence of 100 ppm GA<sub>3</sub> 10 and 8 dS/m salinity stress gave higher FGP (75% and 90%), GI (498.33 and 736.67), GV (195.12 and 293.94), shoot length (6.60 and 6.87 cm), root length (6 and 7.03 cm), seedling length (12.60 and 13.90 cm), seedling dry weight (1.89 mg and 1.74 mg), SVI-I (9.47 mg and 12.51 mg) and SVI-II (142.10 and 156.90), but lower MGT were required (6.35 days at 10 dS/m and 4.83 days at 8 dS/m) compared to those of 10 and 8 dS/m salinity levels only for seed germination. On the contrary, in presence of 200 ppm HA 10 and 8 dS/m salinity levels recorded better FGP (90% and 90%), GI (653.33 and 721.67), GV (74.02 and 110.22), shoot length (7.37 cm and 7.83 cm), root length (7.70 cm



and 6.73 cm), seedling length (13.10 and 14.57 cm), seedling dry weight (1.82 mg and 1.66 mg), SVI-I (12.36 and 10.92) and SVI-II (164.10 and 154.68), but lower MGT (5.73 days at 10 dS/m and 4.98 at 8 dS/m) were required for germination compared to those of 10 and 8 dS/m salinity levels only. Therefore, it revealed that GA<sub>3</sub> @ 100 ppm and HA @ 200 ppm prominently relieved salt stress and improved the seed germination, germination properties and seedling growth of tomato seedlings under salinity stress.

#### **Salinity stress mitigation by gibberellic acid and humic acid application in tomato (*Solanum lycopersicum* L.)**

M. Moniruzzaman and R. Khatoon

The pot experiment was conducted at the Research Field of Plant Physiology Section of HRC, BARI using GA<sub>3</sub> @ 200 ppm and humic acid (HA) @ 1000 ppm with control in presence of salinity levels of 8 and 10 dS/m during November 2022 to April 2023. There were 12 treatment combinations all together. Every treatment consisted of 4 buckets. The BARI Tomato-18 was used in this experiment. Data were taken from only two buckets and other two buckets were kept for fresh weight and dry weight determination. From leaf dry weight, leaf proline and carotene content were determined. Twenty six day-old healthy seedlings were transplanted in bucket @ 2 seedlings/pot. After 15 days one seedling was removed keeping the better one. Salinity was imposed on 07 January 2023 (21 days after transplanting). The range of minimum and maximum temperature was 11.75-19.90°C and 22.300-32.94°C, respectively and the crop received 103 mm rainfall during experimentation. The field capacity of pot soil was 32%. The study was evaluated under Randomized Complete Block Design (RCBD) with three replications. Seedling was transplanted in plastic bucket (height- 34 cm, dia 32.5 cm at the top and 24 cm at the bottom; capacity 20 L) on 17 December 2022 which contained around 18.0 kg air dried soil collected from Kodda, Kaliakoir, Upazilla, Gazipur district. The pot soil contained organic matter (1.25%), total N (0.07%), K (0.29 meq/100 ml), P (16.1 ppm), Mg (2.15 meq/100 ml), B (0.56 ppm) and Zn (1.47 ppm) having pH 7.11 and EC (0.68 dS/m). Fertilizers were applied to each pot @ Urea 0.30 g, TSP 9 g, MoP 3.6 g, Gypsum 3 g, Zinc sulphate 0.22 g, and Boric Acid 0.25 g during pot filling

mixing with air dried soil (12.0 % moisture). Fertilizer was applied 4 times, at the rate of 6.0 - 3.0-3.5.0 g of Urea, TSP and MoP per pot on 15 January 2023, 9 February 2023, 05 March 2023 and 30 March 2023 at 25 days interval. Weeding was done as per requirements. Ridomyl Gold was sprayed @ 0.2% at 15% interval. The pots had five small holes at the bottom. At the bottom of the pot, some pieces of broken bricks were and the brick pieces were covered with a small piece of mosquito net. Salt solution was prepared by dissolving calculated amount of NaCl with distilled water. Soil salinity was measured by soil EC meter and EC meter (liquid). The salt solution was applied with an increment of 2.5 dSm<sup>-1</sup> every alternate day till the respective salinity level is attained. Treatment solution was applied in excess so that the extra solution can be dripped from the bottom of the pots. The irrigation was applied thrice a week upto the field capacity. Plants were sampled for chemical analysis at 60 days after transplanting (DAP) from 2 pots and the remaining 2 pots were allowed to grow until fruit yield. GA<sub>3</sub> and HA were sprayed after 30 days after transplanting (DAT) at 15 days interval. During pot filling stage, HA @ 3 g/kg soil was applied to the pot soil.

Different growth characters viz., leaf area/plant (decrease 14.17% at 8 dS/m and 28.66% at 10 dS/m), SPAD value (decrease 7.22% at 8 dS/m and 11.66% at 10 dS/m), fresh weight (decrease 17.26% at 8 dS/m and 17.35% at 10 dS/m) and dry weight/plant (decrease 18.01% at 8 dS/m and 27.09% at 10 dS/m) and yield attributes viz., number of fruits/plant (decrease 5.40% at 8 dS/m and 8.50% at 10 dS/m), individual fruit weight (decrease 26.29% at 8 dS/m and 35.71% at 10 dS/m) and fruit yield (decrease 43.01% at 8 dS/m and 46.93% at 10 dS/m) were decreased at salinity levels created by NaCl compared to control where distilled water was sprayed. Spraying GA<sub>3</sub> @ 200 ppm gave better leaf area/plant (92.77 dm<sup>2</sup> at 8 dS/m and 86.98 dm<sup>2</sup> at 10 dS/m), fresh weight/plant (384.70 g at 8 dS/m and 361.20 g at 10 dS/m), dry weight/plant (61.84 g at 8 dS/m and 58.21 g at 10 dS/m), SPAD value (44.08 g at 8 dS/m and 44.72 g at 10 dS/m), number of fruits/plant (56.59 at 8 dS/m and 44.92 g at 10 dS/m), individual fruit weight (46.77 g at 8 dS/m and 42.98 g at 10 dS/m) and fruit yield/plant (1.10 kg at 8 dS/m and 1.06 kg at 10 dS/m) whereas HA @ 1000 ppm also gave higher leaf area/plant

(88.11 dm<sup>2</sup> at 8 dS/m and 82.12 dm<sup>2</sup> at 10 dS/m), fresh weight/plant (398.67 g at 8 dS/m and 381.70 g at 10 dS/m), dry weight/plant (64.28 g at 8 dS/m and 61.50 g at 10 dS/m), SPAD value (52.47 at 8 dS/m and 50.57 at 10 dS/m), number of fruits/plant (52.25 at 8 dS/m and 44.66 at 10 dS/m), individual fruit weight (51.63 at 8 dS/m and 45.21 g at 10 dS/m) and fruit yield/plant (1.48 kg at 8 dS/m and 1.27 kg at 10 dS/m). Soil application of humic acid @ 3 g/kg also recorded higher growth and yield attributes and yielded compared to salinity levels. Proline content and TSS were increased with increasing salinity levels, but carotenoid contents were decreased at salt stress. Spraying of 200 ppm GA<sub>3</sub>, 1000 ppm HA and soil application of HA @ 3 g/kg soil gave better performances in respect of proline, carotenoid and TSS contents of tomato at 8 and 10 dS/m salinity levels. Spraying of HA @ 1000 ppm increased fruit yield by 31.08% over 8 dS/m salt stress and 25.20% over 10 dS/m salt stress. It was concluded that 1000 ppm (1000 mg/L concentration) HA sprays could be successfully used to obtain better growth and yield in tomato in saline prone areas of Bangladesh.

#### **Screening of bitter gourd genotypes against salinity at germination and early seedling growth stage**

R. Khatoon, M. Moniruzzaman, M. Moniruzzaman and M. A. T. Masud

Lab experiments were carried out at the Plant Physiology Section Laboratory of HRC, BARI, Gazipur during two consecutive years of 2021 and 2022 to find out the salinity tolerant bitter gourd genotypes during germination and early seedling growth stages. The response of 10 bitter gourds, namely G<sub>1</sub> = AVBG-1308, G<sub>2</sub> = AVBG-1310, G<sub>3</sub> = AVBG-1320, G<sub>4</sub> = AVBG-1324, G<sub>5</sub> = MC-117-1-2-3 and G<sub>6</sub> = MC-25-2-6-3-1-5-4, G<sub>7</sub> = BARI Karala-1, G<sub>8</sub> = BARI Karala-2, G<sub>9</sub> = BARI Karala-3, G<sub>10</sub> = BARI Karala-4 against three levels of salinity (0, 6 and 10 dS/m) were studied. The seeds were arranged in a completely randomized design (CRD) moistened with respective treatment in three replications. Seven healthy seeds of each genotype were placed on sterilized petri dish lined with tissue paper and were kept in normal room temperature (25-28°C) for germination. The seeds were sterilized by soaking in a 5% solution of sodium hypochlorite for 5 min and placed on the petri dish.

Salt solution was prepared by dissolving calculated amount of commercially available NaCl with tap water. After 14 days, the shoot and the root length of five selected seedlings from each replicate were measured. The two year's average results were presented. In the 1<sup>st</sup> year, the maximum germination percentage was obtained in G<sub>6</sub> (94.44%), followed by G<sub>9</sub> (88.89%), G<sub>3</sub>, G<sub>4</sub> and G<sub>8</sub> (83.33%), shoot length in G<sub>9</sub> (8.80 cm) followed by G<sub>7</sub> (8.6 cm), G<sub>2</sub> (8.03 cm), G<sub>3</sub> (7.83 cm), root length in G<sub>6</sub> (7.13 cm) followed by G<sub>9</sub> (6.40 cm), G<sub>4</sub> (6.30 cm) and G<sub>2</sub> (6.00 cm), shoot fresh weight in G<sub>9</sub> (9.80g) followed by G<sub>4</sub> (9.2g), G<sub>1</sub> (8.17g), root fresh weight G<sub>4</sub> (2.86g), G<sub>9</sub> (2.67g) and G<sub>2</sub> (2.20g) and vigour index in G<sub>9</sub> (13.45) followed by G<sub>4</sub> (11.27.80), G<sub>6</sub> (1085.57), G<sub>6</sub> (1069.97), G<sub>8</sub> (1005.57) and G<sub>2</sub> (840.57) at 8 dS/m salinity stress. All the characters in all genotypes were decreased drastically at 10 dS/m compared to 8 dS/m salinity level in 2021. In the 2<sup>nd</sup> year the highest germination percent was recorded in G<sub>2</sub> (95.24%) followed by G<sub>1</sub> and G<sub>7</sub> (85.71%) and G<sub>8</sub> (71.43%), root length in G<sub>9</sub> (8.66 cm) followed by G<sub>8</sub> (7.82 cm), G<sub>4</sub> (7.17 cm) and G<sub>5</sub> (6.40 cm), shoot length in G<sub>4</sub> (14.17 cm) followed by G<sub>2</sub> (10.87 cm), G<sub>9</sub> (9.60 cm) G<sub>3</sub> and G<sub>8</sub> (8.07%), relative total dry weight (RTDW) in G<sub>2</sub> (95.16%) followed by G<sub>1</sub> (93.36%), G<sub>4</sub> (93.30%), G<sub>6</sub> (92.65%) and G<sub>7</sub> (83.01%) at 8 dS/m salinity stress. In 2022, the genotypes G<sub>2</sub>, G<sub>3</sub>, G<sub>5</sub>, G<sub>6</sub>, G<sub>7</sub> and G<sub>8</sub> also gave better relative total dry matter% at 10 dS/m salinity stress. In comparison with 10 bitter gourd genotypes, it can be concluded that in respect of relative total dry weight percent G<sub>2</sub>, G<sub>3</sub>, G<sub>5</sub>, G<sub>6</sub>, G<sub>7</sub> and G<sub>8</sub> were tolerant, G<sub>4</sub> moderately tolerant and G<sub>1</sub>, G<sub>9</sub> and G<sub>10</sub> were susceptible at 10 dS/m salinity level.

#### **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, 8.0 and 12 dS/m) was tested on 36 bottle gourd genotypes/varieties at the laboratory of Plant Physiology Section, HRC, BARI from 07 February 2023 to 22 February 2023. The genotypes consisted of 36 bottle gourd germplasm (5 BARI released varieties and 31 bottle gourd lines). The seeds of all genotypes were collected from Olericulture Division of HRC, BARI. Required number of petri

dishes each with a diameter of 9 cm were used in the experiment and arranged in a completely randomized design (CRD) moistened with respective treatment in three replications. Three layers of commercial tissue paper were used in each petri dish for retaining required amount of water for imbibition of seeds. Five healthy and equal sized seeds of each variety/genotype were selected and placed on sterilized petri dish lined with tissue paper. The petri dishes with seeds of the selected varieties/genotypes of bottle gourd were kept in normal room temperature ( $24\pm 2^{\circ}\text{C}$ ) for germination. The seeds were sterilized by soaking in 0.1% mercuric chloride solution for 5 min and placed on the petri dish lined with filter paper. Salt solution was prepared by dissolving calculated amount of commercial NaCl with distilled water. The respective NaCl solution was poured into the petri dish. The germination count was taken after 72 hours of placing seeds. The petri dishes were covered to prevent the loss of moisture by evaporation. Number of seeds germinated was counted daily and data recording were continued up to 16 days. On 16th day 3 seedlings (shoot + root) were weighed by the electrical balance and this weight was considered as fresh weight of seedling. On 16th day, the shoot and the root length of seedlings from each replicate were kept separately in an oven at  $72^{\circ}\text{C}$  for one week for recording dry weight of shoot and root. The experiment was studied to find out the salt tolerant bottle gourd genotypes at germination and early seedling growth stage. Growth and germination parameters of bottle gourd genotypes/varieties were investigated under salt stress. Results of this study showed a considerable decrease in growth criteria (shoot length) but increase in root length at salinity levels. Among 36 genotypes/varieties 5 viz.,  $G_1$  (BARI Lau-1),  $G_2$  (BARI Lau-2),  $G_4$  (BARI Lau-4),  $G_{19}$  (LS-231) and  $G_{22}$  (LS-146A1) did not germinate completely whereas other 10 germplasm viz.,  $G_5$  (BARI Lau-5),  $G_6$  (B-1 x B-2),  $G_9$  (B-2 X LS-231),  $G_{10}$  (B-1 x LS-232),  $G_{11}$  (B-3 x B-4),  $G_{13}$  (B-4 x B-3),  $G_{20}$  (LS-232),  $G_{27}$  (LS-171 x B-3),  $G_{31}$  (LS-231 x LS-232) and  $G_{32}$  (LS-154 x LS-232) germinated only in control and failed to germinate under salinity levels lines. All the genotypes failed to germinate at 12 dS/m salinity stress. Fourteen genotypes  $G_{25}$  (LS-146A x LS-232),  $G_8$  (B-2 X LS-154),  $G_3$  (BARI Lau-3),  $G_{15}$  (B-1 x LS-154),  $G_7$  (B-1 x LS-231),  $G_{14}$  (B-4 x LS-231),  $G_{24}$  (LS-171),  $G_{26}$  (LS-171 x LS-232),  $G_{29}$  (LS-154 x LS-231),  $G_{23}$

(LS-254 x LS-171),  $G_{21}$  (LS-154),  $G_{12}$  (B-3 x LS-232),  $G_{17}$  (1 x 1 x B-1) and  $G_{18}$  (B-171 x B-4) were identified as moderately salinity tolerant genotypes (8 dS/m salt stress) and the remaining 15 genotypes viz.,  $G_{16}$  (B-4 x LS-154),  $G_{28}$  (LS-231 x LS-154),  $G_{30}$  (LS-232 x LS-231),  $G_{33}$  (LS-232 x LS-154),  $G_{34}$  (LS-171 x LS-232),  $G_5$  (BARI Lau-5),  $G_6$  (B-1 X B-2),  $G_9$  (B-2 X LS-231),  $G_{10}$  (B-1 x LS-232),  $G_{11}$  (B-3 x B-4),  $G_{13}$  (B-4 x B-3),  $G_{20}$  (LS-232),  $G_{27}$  (LS-171 x B-3),  $G_{31}$  (LS-231 X LS-232) and  $G_{32}$  (LS-154 x LS-232) as salinity susceptible based on the results of rank score of stress tolerance index (STI) of shoot length, root length, shoot fresh weight, root fresh weight, total fresh weight, shoot dry weight, root dry weight, total dry weight, final germination percentage, germination index, coefficient velocity of germination, germination speed index, germination value and mean germination time.

#### **Influence of biochar on the growth and yield of tomato under salinity stress**

M. Moniruzzaman, R.Khatoun, M. Moniruzzaman, M.A.Quddus and M.A.Goffar

The pot experiment was conducted at the Research Field of Plant Physiology Section of HRC, BARI, Gazipur during November 2022 to April 2023 to find out the optimum biochar doses for enhancing tomato adaptation in saline conditions. The variety BARI tomato-16 was subjected to three different levels of biochar viz; 0%, 5%, and 10% (w/w) of 12 kg air dried soil per pot, designated as  $Bc_1$ ,  $Bc_2$ , and  $Bc_3$ , respectively. They were also exposed to four levels of NaCl salinity viz., 0.0, 4.0, 8.0, and 12.0  $\text{dS m}^{-1}$ , designated as  $S_1$ ,  $S_2$ ,  $S_3$  and  $S_4$ , respectively. The experiment was laid out in RCBD with three replications. Each treatment consisted of four pots. After 7 days of seedling transplantation, NaCl treatments were added to each pot to achieve the desired salinity levels. Salt solution with an electrical conductivity of 2.5 dS/m was added to each pot, except for the control, every alternate day to raise the desired salinity level. The experiment was laid out a Completely Randomized Design (CRD) with three replications. Twenty five-day-old seedlings were transplanted into plastic pots (height 29 cm, diameter 32 cm at the top, and 21 cm at the bottom; capacity 14 L) containing approximately 12.0 kg of soil from Koddia, Kaliakoir, Upazilla, Gazipur district. The pot soil contained organic matter (1.25%), total N (0.07%), K (0.29 meq/100



ml), P (16.1 ppm), Mg (2.15 meq/100 ml), B (0.56 ppm) and Zn (1.47 ppm) having pH 7.11 and EC (0.68 dS/m). Rice husk biochar was used, which contained organic carbon (OC) 21.1%, Ca 1.71%, Mg 0.60%, N 0.49%, P 0.016%, K 0.56%, S 0.012%, Cu 0.005%, Fe 0.034%, MN 0.057% and Zn 0.012% having pH 6.1 and EC 37.0 ms/cm. The results showed that increasing soil salinity levels caused significant decreases in fruit yields and yield components. The  $Bc_1 \times S_1$  combination gave maximum plant height (81.95 cm) closely followed by  $Bc_2 \times S_1$ ,  $Bc_3 \times S_2$ ,  $Bc_3 \times S_3$  combinations. Leaf area/plant and SPAD value were found maximum from  $Bc_3 \times S_1$  (706.12 cm<sup>2</sup> and 62.59) closely followed by  $Bc_3 \times S_2$  combinations. The combination  $Bc_3 \times S_1$  combination produced maximum number of fruits/plant (39.64) which was statistically similar to  $Bc_1 \times S_1$  (38.11),  $Bc_2 \times S_1$  (38.88),  $Bc_2 \times S_2$  (37.96),  $Bc_3 \times S_2$  (38.09) and  $Bc_3 \times S_3$  (36.96) combinations. Maximum individual fruit weight was recorded from  $Bc_3 \times S_1$  (33.02 g) closely followed by  $Bc_3 \times S_2$  (32.86 g),  $Bc_3 \times S_3$  (31.28 g),  $Bc_3 \times S_3$  (29.90 g),  $Bc_1 \times S_1$  (29.44 g),  $Bc_2 \times S_1$  (31.79 g) and  $Bc_2 \times S_2$  (30.42 g) combinations. The combination  $Bc_3 \times S_1$  gave maximum fruit yield (1.48 kg/plant) followed by  $Bc_3 \times S_2$  (1.28 kg/plant),  $Bc_2 \times S_1$  (1.26 kg/plant),  $Bc_2 \times S_2$  (1.09 kg/plant),  $Bc_3 \times S_2$  (1.08 kg/plant) and  $Bc_3 \times S_3$  (1.02 kg/plant). At biochar application @ 5% and 10% (w/w) of pot soil, biochar increased the tomato fruit yield by 11.90% and 25%, respectively, compared to the control (0% biochar). When biochar was applied @ 5% of pot soil (w/w) under salinity stress of 4, 8 and 12 dS/m, fruit yield increased 15.60, 21.73 and 13.41%, respectively at 4, 8 and 12 dS/m salinity whereas at 10% biochar application fruit yield increased 28.13, 28.70 and 30.39%, respectively at 4, 8 and 12 dS/m salinity compared to control (no salinity and no biochar). Under 5% biochar, fruit yield decreased by 13.49, 26.98 and 34.92%, respectively at 4, 8 and 12 dS/m salinity stress compared to no salinity while under 10% biochar, fruit yield decreased by 13.51, 27.03 and 31.08%, respectively at 4, 8 and 12 dS/m salinity stress compared to no salinity. The results revealed that application of biochar @ 10% (w/w) improved tomato plant growth and increased yield under salinity stress, indicating that the effects of salt stress were ameliorated. Therefore, it was concluded that biochar amendment had the potential to ameliorate salt stress and enhances tomato production.

### Evaluation of hyacinth bean varieties for drought tolerance through yield-based selection indices

M. Moniruzzaman and R. Khatoun

Identification of drought-tolerant crop genotypes/varieties is fundamental to enhance productivity and for effective breeding and conservation. 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 consecutive three years of 2021, 2022 and 2023. Drought was imposed after 4 weeks of transplanting of 14 days old seedlings in the pit (30 cm x 30 cm x 30 cm). Hyacinth bean grows best where average daily temperature is 17.78°C-30°C. Daily average maximum and minimum temperatures ranged between 18.68°C and 28.08°C during the growing season. In the study, the total rainfall received by the crop during the growing season was 934.0 mm but not uniformly. The study was designed using a  $9 \times 2$  factorial experiment involving 9 hyacinth bean varieties under drought stress (DS) and non-stressed condition (NS). A total of 18 treatment combinations were laid out using a split plot design with two replications totaling 36 experimental units (unit plots measuring 2 m x 2 m). Drought (irrigation) treatment was allocated in main plot and genotypes were allocated in subplot. One plant of each genotype was planted in a plot at a spacing of 2 m between rows and 2 m between plants. Nine varieties of hyacinth bean were evaluated considering non-stressed yield, drought stressed yield and different drought tolerant indices viz., mean productivity index (MPI), drought stress intensity (DSI), tolerance index (TOL), geometric mean productivity (GMP), stress susceptibility index (SSI), stress tolerance index (STI) yield index (YI), yield stability index (YSI), harmonic mean (HM), Relative Efficiency Index (REI), Modified stress Tolerance Index 1 (MpSTI1), Modified stress Tolerance Index 2 (MsSTI2), Relative Drought Index (RDI), abiotic Tolerance Index (ATI), Golden Mean (GM), Mean Relative Performance (MRP), Sensitivity Drought Index (SDI), Stress Susceptibility Percentage Index

(SSPI), Stress/Non-Stress Production Index (SNPI), Relative Decrease in Yield (RDY), Schneider's stress severity index (modified) (SSSI). These indices were calculated based on average values of stressed and non-stressed pod yield. Then rank scores of different drought indices for every variety were calculated each year and based on these overall rank scores were determined. 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 over three years under DS and NS conditions was 3.09 and 5.63 kg/plant, respectively. Drought stress reduced fruit yield by 24.34% on an average over three years. In 2020, BARI Shim-6, BARI Shim-4, BARI Shim-1 and BARI SHIM-10 ranked 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> in 2021 BARI Shim-4, BARI Shim-6, BARI Shim-1 and BARI Shim-10 ranked 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> and in 2022 BARI Shim-1, BARI Shim-4, BARI Shim-10 and BARI Shim-6 ranked 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> according to overall scores. Therefore, on the basis of three year's results, the three varieties BARI Shim-1, BARI Shim-4 and BARI Shim-6 were identified as drought tolerant varieties for drought tolerance breeding or direct cultivation in drought prone areas.

#### **Germination and seedling growth of brinjal as influenced by seed priming agents**

M. Moniruzzaman and R. Khatoon

Two lab experiments were conducted at the laboratory of Plant Physiology Section of Horticulture Research centre, BARI during two consecutive years of 2022 and 2023, in the month of March 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.,  $T_1 = 289 \mu\text{M GA}_3$ ,  $T_2 = 0.25\% \text{ KNO}_3$ ,  $T_3 = 40 \mu\text{M H}_2\text{O}_2$ ,  $T_4 = 1 \mu\text{M TRIA}$ ,  $T_5 = 50 \text{ ppm NAA}$ ,  $T_6 = 40 \text{ mM NaCl}$ ,  $T_7 = \text{Hydro priming by distilled water with no priming as control } (T_8)$ . Required number of petri dishes, each with a diameter of 9 cm were used in the experiment and arranged in a completely randomized design (CRD) moistened with respective treatment in three replications. The seeds were sterilized by soaking in a 0.1% solution of mercuric chloride for 5 min before soaking in

respective prime solution. The ratio of seed weight to solution volume (w/v) was 1:5. After 18 hours, the primed seeds were washed with water for 3-4 times and dried in shade at  $26 \pm 2^\circ\text{C}$  until the moisture content was decreased to initial moisture content. Three layers of tissue paper were used in each petri dish for retaining required amount of water for imbibition of seeds. Fifteen equal sized seeds of each variety were selected and placed on sterilized petri dish lined with filter paper. The petri dishes with seeds of the selected varieties of brinjal were kept in normal room temperature ( $26 \pm 2^\circ\text{C}$ ) for germination. The solution was changed after 12 hours to facilitate aeration in seeds. The 5 ml of prime solutions were added separately in the petri dishes. The petri dishes were covered to prevent the loss of moisture by evaporation. Number of seeds germinated was counted daily and data recording were continued up to 13 days. At 13 days 10 seedlings (shoot + root) were weighed by the electrical balance and this weight was considered as fresh weight of seedling, and these seedlings were kept in an oven at  $72^\circ\text{C}$  for 1 week for recording dry weight of seedling. After 13 days, the shoot and the root length of ten randomly selected seedlings from each replicate were measured. The number of seeds was recorded daily for upto 13 days. These seeds were considered germinated whose root length was more than 3 mm.

Germination percentage of seeds of two brinjal varieties treated with all priming agents was significantly higher over control. Seed priming with  $40 \mu\text{M H}_2\text{O}_2$  gave maximum final Germination percent (FGP) (90.84% in BARI Begun-6 and 100% in BARI Begun-10), germination index (GI) (1026.8 in BARI Begun-6 and 1288 in BARI Begun-10), Germination value (GV) (265.99 in BARI Begun-6 and 465.66 in BARI Begun-10) and Seedling Vigour Index-II (SVI-II) (357.03 in BARI Begun-6 and 296.00 in BARI Begun-10) followed by 0.25%  $\text{KNO}_3$  (FGP-83.33% and 87.65%, GI-821.68 and 1089.25, GV-184.97 and 307.89 and SVI-II-342.75 and 262.27, respectively in BARI Begun-6 and in BARI Begun-10). The lowest mean germination time (MGT) was recorded in control (6.62 days in BARI Begun-6) and in 40 mM NaCl treatment (5.92 days in BARI Begun-10) followed by  $40 \mu\text{M H}_2\text{O}_2$  (6.95 days in BARI Begun-6 and 6.24 days in BARI Begun-10), hydro-priming

(6.95 days in BARI Begun-6 and 6.32 days in BARI Begun-10) and 0.25% KNO<sub>3</sub> (7.65 days in BARI Begun-6 and 6.41 days in BARI Begun-10). In BARI Begun-6, the highest shoot length (5.07 cm) was recorded from 289 µM GA<sub>3</sub> closely followed by 0.25% KNO<sub>3</sub> (5.00 cm) and the followed by 40 µM H<sub>2</sub>O<sub>2</sub> (3.88 cm) whereas, in BARI Begun-10 maximum shoot length was observed in 0.25% KNO<sub>3</sub> (4.78 cm) followed by 289 µM GA<sub>3</sub> (4.49) and 40 µM H<sub>2</sub>O<sub>2</sub> (4.26). Root length was found highest from control (1.64 cm in BARI Begun-6 and 1.75 cm in BARI Begun-10) followed by 40 mM NaCl (1.86 cm in BARI Begun-10), 289 µM GA<sub>3</sub> (1.29 cm in BARI Begun-6 and 1.62 in BARI Begun-10) followed by 40 µM H<sub>2</sub>O<sub>2</sub> (1.22 cm in BARI Begun-6), 0.25% KNO<sub>3</sub> (0.87 cm in BARI Begun-6) and 40 µM H<sub>2</sub>O<sub>2</sub> (0.83 cm in BARI Begun-10) and 0.25% KNO<sub>3</sub> (0.79 cm in BARI Begun-10). In BARI Begun-6, Seedling Vigour Index-I (SVI-I) was found maximum from 0.25% KNO<sub>3</sub> (489.98) closely followed by 40 µM H<sub>2</sub>O<sub>2</sub> (464.56) and 289 µM GA<sub>3</sub> (411.70) while in BARI Begun-10, maximum SVI-I was recorded from 40 µM H<sub>2</sub>O<sub>2</sub> (508.10) closely followed by 0.25% KNO<sub>3</sub> (488.54). Maximum seedling dry weight was also obtained from 0.25% KNO<sub>3</sub> (4.11 mg in BARI Begun-6 and 2.99 mg in BARI Begun-10) closely followed by 40 µM H<sub>2</sub>O<sub>2</sub> (3.93 mg in BARI Begun-6 and 2.96 mg in BARI Begun-10). Therefore, it was observed that germination properties viz., seed germination, germination index, germination value, were enhanced significantly in both the varieties at 0.25% KNO<sub>3</sub> and 40 µM H<sub>2</sub>O<sub>2</sub>. Seedling growth (shoot length, seedling dry weight and seedling vigour index) were also increased at 0.25% KNO<sub>3</sub> and 40 µM H<sub>2</sub>O<sub>2</sub>. MGT was less in 0.25% KNO<sub>3</sub> and 40 µM H<sub>2</sub>O<sub>2</sub> for germination of seeds. Root length was negatively affected by priming with all chemicals except GA<sub>3</sub>.

The results revealed that H<sub>2</sub>O<sub>2</sub> and KNO<sub>3</sub> were found to be the most important priming agents to increase seed germination, germination speed, shoot length and seedling dry weight and seedling vigour index. It is suggested before sowing seeds of brinjal/or going to breeding work brinjal seeds should be soaked in 40 µM H<sub>2</sub>O<sub>2</sub> or 0.25% KNO<sub>3</sub> for 18 hours.

### **Response of seed priming by gibberellic acid and potassium nitrate to germination and seedling growth of sweet pepper (*Capsicum annuum* L.) in seed bed**

R. Khatoon, M. Moniruzzaman, M. Moniruzzaman and L. Akter

The experiment was conducted at the Research Field of Plant Physiology Section of HRC, BARI during 15 November 2022 to 22 December 2022 to investigate the priming agents for higher germination percentage and seedling growth of sweet pepper seeds. The experimental treatments consisted of three GA<sub>3</sub> concentrations (250 ppm, 500 ppm, 750 ppm) and four KNO<sub>3</sub> concentrations (0.25%, 0.50%, 0.75% and 1%), and distilled water as control. At first seeds were soaked in GA<sub>3</sub>, KNO<sub>3</sub> and distilled water for 12 hours. Next day seeds were ringed with distilled water and then air dried for few minutes under shade and then sown in seed bed. The experiment was laid out in RCBD with three replications. For each treatment 15 seeds of the selected varieties of sweet pepper were used. Number of seeds germinated was counted daily and data recording were continued up to 15 days. After 30 days 5 seedlings (shoot + root) were uprooted and weighed, these seedlings were rinsed with water to remove soil, then seedling length, number of leaves were recorded and these seedlings were kept in an oven at 72°C for 3 days for recording dry weight of seedling.

Maximum seedling emergence was recorded from 0.50% KNO<sub>3</sub> (78.41%) closely followed by 0.25% KNO<sub>3</sub> and 250 ppm GA<sub>3</sub> (77.14%), 0.75% KNO<sub>3</sub> (71.90%) and the lowest from control (56.82%) in BARI Mistimorich-1, whereas in BARI Mistimorich-2, maximum seedling emergence was obtained from 0.50% KNO<sub>3</sub> (79.52%) closely followed by 0.75% KNO<sub>3</sub> and 250 ppm GA<sub>3</sub> (73.97%) and 0.25% KNO<sub>3</sub> (69.52%) and its lowest value from control (41.27%). Seed priming with 0.25% KNO<sub>3</sub> gave maximum number of leaves/plant (5.00 in BARI Mistimorich-1 and 4.77 in BARI Mistimorich-2) which was statistically similar to 250 ppm GA<sub>3</sub> (4.67 in BARI Mistimorich-1 and 4.55 in BARI Mistimorich-2), 500 ppm GA<sub>3</sub> (4.67 in BARI Mistimorich-1 and 4.44 in BARI Mistimorich-2) and 0.25% KNO<sub>3</sub> (4.44 in BARI Mistimorich-2). The control treatment gave the lowest number of leaves/plant in both the varieties. Maximum shoot length was recorded from 250 ppm GA<sub>3</sub> (10.57 cm) closely



followed by 0.25% KNO<sub>3</sub> (9.96 cm), 0.50% KNO<sub>3</sub> (9.91 cm) and 500 ppm GA<sub>3</sub> (9.80 cm) in BARI Mistimorich-1 while in BARI Mistimorich-2, maximum root length was observed in 0.50% KNO<sub>3</sub> (10.69 cm), closely followed by 250 ppm GA<sub>3</sub> (10.36 cm), 500 ppm GA<sub>3</sub> (10.21 cm), 0.25% KNO<sub>3</sub> (9.68 cm), 0.75% KNO<sub>3</sub> (9.96 cm) and 750 ppm GA<sub>3</sub> (8.76 cm). In BARI Mistimorich-1, seed priming with 250 ppm GA<sub>3</sub> gave maximum shoot dry weight (0.388 g) which was statistically similar to 0.50% KNO<sub>3</sub> (0.375 g) whereas, in BARI MISTImorich-2, seed priming with 0.50% KNO<sub>3</sub> gave maximum shoot dry weight (0.328 g) which was identical with all the treatments except control and 750 ppm GA<sub>3</sub>. In BARI Mistimorich-1, maximum total dry weight was observed in 250 ppm GA<sub>3</sub> (0.466 g) closely followed by 500 ppm GA<sub>3</sub> (0.463 g), 0.750% KNO<sub>3</sub> (0.453 g), 0.50% KNO<sub>3</sub> (0.421) while in BARI Mistimorich-2, 0.50% KNO<sub>3</sub> recorded maximum total dry weight (0.395 g) which was statistically similar to 0.25% KNO<sub>3</sub>, 0.75% KNO<sub>3</sub> and 250 ppm GA<sub>3</sub>.

The overall results revealed that the higher values of seedling emergence percentage, seedling growth characters viz., number of leaves/plant, shoot length, root length and seedling dry weight of sweet pepper seeds of BARI Mistimorich-1 and BARI Mistimorich-2 were recorded from the seeds treated with 250 ppm GA<sub>3</sub> compared to control treatment. Seeds priming with 0.50% KNO<sub>3</sub> also performed better compared to control treatment with regard to seedling emergence percentage and seedling growth characters.

**Response of seed priming by gibberellic acid and potassium nitrate to germination and seedling growth of sweet pepper (*Capsicum annuum* L.)**

R. Khatoon, M. Moniruzzaman, M. Moniruzzaman and L. Akter

Lab experiments were conducted at the Laboratory of Plant Physiology Section of HRC, BARI during two consecutive years of 2021 (from 4 November 2021 to 18 November 2021) and 2022 (from 6 November 2022 to 24 November 2022) to determine the suitable concentration of GA<sub>3</sub> and KNO<sub>3</sub> used as seed priming agents for higher germination percentage and seedling growth of sweet pepper seeds. In 2022 the experimental treatment consisted of two varieties, namely BARI Mistimorich -1 and BARI Mistimorich-2, three

concentrations of GA<sub>3</sub> viz., 250, 500 and 750 parts per million (ppm) and 4 concentrations of KNO<sub>3</sub> viz., 0.25, 0.50, 0.75 and 1% and distilled water as control, but in 2021 the treatment lacked in variety BARI mistimorich-2, other treatments were same. The experiment was laid out in completely randomized design (CRD) with four replications. The perti dishes with seeds of the selected variety of sweet pepper were kept in normal room temperature for germination. The average room temperature was 25.4±2°C. Number of seeds germinated was counted daily and data recording were continued up to 14 days. After 14 days 5 seedlings (shoot + root) were weighed and these seedlings were kept in an oven at 72°C for 3 days for recording dry weight of seedling. In case of BARI Mistimorich-1, average values of two years were presented while in case of BARI Mistimorich-2, one year result (2022) was presented. In BARI Mistimorich-2, final germination percentage (FGP) (85%), germination index (GI) (945), germination value (297.96), germination energy (GE) (46.67), shoot length (SL) (5.52 cm), root length (RL) (2014 cm) and seedling dry weight (SDW) (0.052 g) were found maximum from 0.25% KNO<sub>3</sub> closely followed by 250 ppm GA<sub>3</sub> (FGP-78.33%, GI-838.33, GV-241.56, GE-41.47, SL-5.25 cm, RL-2.16 and SDW-0.046 g). The lowest mean germination time (MGT) and T50 (days required for 50% germination) was recorded from 0.25% KNO<sub>3</sub> (MGT-6.65 days and T50-2.97 days) followed by 250 ppm GA<sub>3</sub> (MGT-6.99 days and T50-4.71 days) in BARI Mistimorich-1. In BARI Morich-2, FGP (90.00) was recorded from 250 ppm GA<sub>3</sub> closely followed by 0.25% and 0.50% KNO<sub>3</sub> (83.33%), 500 and 750 ppm GA<sub>3</sub> (80.00%) whereas GI (936.67), GV (281.15), GE (53.33%), SL (5.52 cm), RL (2.14 cm) and SDW (0.033 g) was found highest from 0.25% KNO<sub>3</sub> closely followed by 250 ppm GA<sub>3</sub> (GI-883.33, GV-241.56, GE-40%, SL-5.70 cm, RL-2.16 cm and SDW-0.030 g) from the same variety. In the variety BARI Morich-2 lowest MGT (5.76 days) identical with control (5.53 days) and the lowest T50 value (1.06 days) were recorded from 0.25% KNO<sub>3</sub> followed by 500 ppm GA<sub>3</sub> (MGT-5.97 days and T50-1.69 days) and 250 ppm GA<sub>3</sub> MGT-6.37 days and T50-2.11 days).

The overall results revealed that the higher values of final germination percentage, other germination related properties viz. germination index,

germination value and germination energy and seedling growth characters viz. shoot length, root length and seedling dry weight of BARI Mistimorich-1 and BARI Mistimorich-2 sweet pepper seeds were recorded from 0.25% KNO<sub>3</sub> compared to control treatment. The lowest mean germination time and T50 values were also obtained from this KNO<sub>3</sub> concentration. GA<sub>3</sub> 250 ppm seed priming also performed better in respect of these characters compared to control treatment.

#### **Effect of foliar spray of boron on flower retention and pod yield of summer country bean**

R. Khatoon, M. Moniruzzaman, M. Moniruzzaman and M. S. Alam

A field experiment was conducted at the research field of Plant Physiology Section, Horticulture Research Centre, BARI during summer season of 2022 to determine the optimum rate of boron for maximizing the yield of summer country bean (var. BARI Sheem-7). The treatment consisted of five levels each of boron (0, 0.1%, 0.2%, 0.3%, 0.4% as foliar spray and soil application @ 2 kg/ha). The soil test values (boron) showed that the experimental soil was below critical level (0.15 mg/kg). The experiment was conducted using randomized complete block design with 4 replications. The unit plot size was 2 m x 2 m. Twenty day old seedlings of BARI Sheem-7 were transplanted on 4 April, 2022. Foliar application was done 10 days before flowering stage, at flowering stage and fruit setting stage. Soil application of boron was applied as boric acid in the pit along with blanket dose. Blanket dose of 50 kg N, 40 kg P, 60 kg K 20 kg/ha S and 2 kg/ha Zn in the form of urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, Zinc Sulphate and cowdung at 5 t/ha were added to every plot. TSP, MoP, gypsum, Zinc Sulphate, cowdung and half of urea were applied in the pits as basal and remaining half of urea was applied 20 days after transplanting. Intercultural operations were done as and when required.

Spray of 0.2% boron (B) gave the maximum number of fruits/spike (2.93) which was statistically similar to soil application of B @ 2 kg/ha (2.87), spraying 0.1% B (2.67) and spraying 0.3% B (2.53). Maximum percent of fruit set was recorded from spraying 0.2% B (16.56%) closely followed by spraying 0.1% B (15.90%), soil application of B @ 2 kg/ha (15.44) and spraying

0.3% (15.12%). Number of fruits/plant was found maximum from spraying 0.2% B (308.66) followed by spraying 0.1% B (224.00) and soil application of B @ 2 kg/ha (221.33). Spray of 0.2% B produced the highest fruit weight/plant (1527.67 g) which was identical with spraying 0.1% B (1315.67 g), soil application of B @ 2 kg/ha (1315.33 g) and 0.3% B (1022.00 g). Fruit length (8.09 cm), fruit breadth (1.92 cm), individual fruit weight (6.62 g) number of seeds/fruit (4.40) and seed weight/pod (1.55) were found maximum from spraying 0.2% B.

The results revealed that foliar spray of 0.2% boron or soil application of boron @ 2 kg/ha in combination with a blanket dose of 50 kg N, 40 kg P, 60 kg K and 20 kg S, 3kg Zn/ha plus cowdung 5 t/ha might be optimum for summer country bean cultivation.

#### **Incidence of spongy tissue in BARI Aam-3**

R. Khatoon, M. Moniruzzaman, M. S. Uddin and B. C. Sarker

A study was conducted to determine incidence of spongy tissue formation in BARI Aam-3 during 25 June to 29 July, 2023. The spongy affected tissue was visible only when the ripe fruit was cut into two halves. The experiment consisted of ripe mangoes of BARI Aam-3 collected from local market as well as from the orchard of Pomology Division. Nine samples from local market and four samples from the orchard of Pomology Division totaling 13 samples were collected. Fruits were collected from different sources on three different dates viz. 25.06.2023, 03.06.2023 and 13.07.2023. Each sample was considered as treatment where one sample comprising 8 ripe mango fruits of BARI Aam-3. The experiment was arranged in a completely randomized design (CRD) with three replications. Mature green fruits of uniform size were hand-picked from the tree without causing any damage to the fruit. Then the fruits were washed with water and were air-dried at room temperature. The mangoes were kept in normal room temperature (25-28°C) and RH (70±5%) for ripening. The percent incidence of spongy tissue was determined based on visual scoring of ripe fruits from each treatment after cutting them open.

At 1<sup>st</sup> harvest (25.06.2023) maximum percentage of spongy tissue (4.17%) was found from the fruits collected from Plant-1, Plant-2, Plant-3, Sample-4 and Sample-5 and there was no spongy tissue

percentage in other treatments. In spongy fruit, TSS% was found lowest compared to non-affected fruit and TSS% of affected portion was found very low. The lowest TSS% was found from Plant-1 (15.5% in affected fruit and 13.5% in affected portion) compared to healthy fruit. At 2<sup>nd</sup> harvest maximum spongy tissue percentage (8.33% from both sides of stones of the fruit and 8.33% from one side of stone of the fruit) was found from Plant-1. At 2<sup>nd</sup> harvest, minimum TSS% was found in Sample-3 (15.0% in affected fruit and 11.0% in affected portion). Maximum percentage of spongy tissue was found from 3<sup>rd</sup> harvested fruits of BARI Aam-3. At 3<sup>rd</sup> harvest, maximum spongy tissue percentage (29.16% from both sides and 8.33%

from one side) was found from Plant-3 and minimum TSS (16.3% and 13.0%) was obtained from Sample-6 and Sample-8, respectively. Sponginess was found less in early harvest. It is seen that sponginess was found more in late harvest. It may be prolonged due to exposure to high intensity of sunlight or high temperatures affect the physiology of the fruit.

The results revealed that early harvest may reduce the incidence of spongy tissue. Harvesting of fruits at the last week of June in Gazipur region may reduce sponginess while late harvesting at the 2<sup>nd</sup> week of July may aggravated this problem in BARI Aam-3.



# SEED TECHNOLOGY

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## **Effect of flower stalk (scape) retention on seed yield and quality of onion**

P. C. Sarker, M. S. Rahman, M. A. Hossain, and M. A. H. S. Jahan

The experiment was conducted at Seed Technology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh during 2022-23 to identify a suitable number of flower stalk retention for higher seed yield and quality of onion. The tested variety was BARI Piaj-4. The experiment was carried out in a randomized complete block design in the field for seed production and completely randomized design in the laboratory for seed quality testing. There were five treatments of onion scape retention viz., T<sub>1</sub>= 1 scape/plant, T<sub>2</sub>= 2 scapes/plant, T<sub>3</sub>= 3 scapes/plant, T<sub>4</sub>= 4 scapes/plant, T<sub>5</sub>= 5 scapes/plant. There was found significance variation among 1 to 5 scapes per plant in case of number of umbel per plant, number of seed per umbel and seed yield per plant of onion, but seed quality parameters were found non-significant. Four scapes per plant showed the best performance regarding number of umbel per plant and seed yield per plant.

## **Effect of vermi-compost stimulated integrated nutrient management on seed yield and quality of onion**

P. C. Sarker, M. S. Huda, M. S. Rahman and M. A. H. S. Jahan

The study was undertaken to find out a suitable vermi-compost based integrated nutrient management for quality seed production of onion. The experiment was laid out in a randomized complete block design with three replications to determine the optimum doses of vermicompost with fertilizers for maximizing quality true seeds of onion at Agricultural Research Station, BARI, Dinajpur during October 2022 to May 2023. Onion

variety was BARI Piaj-4. The experiment was consisted with six treatments such as T<sub>1</sub>: Recommended dose of chemical fertilizer (BARC 2018), T<sub>2</sub>: T<sub>1</sub>+ 1 t ha<sup>-1</sup> Vermicompost, T<sub>3</sub>: T<sub>1</sub>+ 2 t ha<sup>-1</sup> Vermicompost, T<sub>4</sub>: T<sub>1</sub>+ 3 t ha<sup>-1</sup> Vermicompost, T<sub>5</sub>: T<sub>1</sub>+ 4 t ha<sup>-1</sup> Vermicompost<sup>1</sup>, T<sub>6</sub>: T<sub>1</sub>+ 5 t ha<sup>-1</sup> Vermicompost. The inorganic fertilizer 105-45-60-20-2-1.5 kg ha<sup>-1</sup> of NPKSZnB respectively with vermicompost up to 2-3 ton ha<sup>-1</sup> was the best to increase the seed yield and germination per cent of onion.

## **Influence of paclobutrazol on growth, seed yield and quality in onion**

S.A. Bagum and P. C. Sarker

The experiment was conducted at the research field of Seed Technology Division, BARI, Joydebpur, Gazipur, during the period from November 2022 to April 2023. To find out the suitable concentrations of paclobutrazol for better growth, yield and quality seed production of onion. The tested variety was BARI Piaj-4. The experiment was laid out in randomized complete block design with three replications. The treatment comprises of seven doses of paclobutrazol viz. T<sub>1</sub>=Soaking of bulbs in 80 ppm paclobutrazol solution, T<sub>2</sub>=Foliar spray of paclobutrazol @ 80 ppm, T<sub>3</sub>=Soaking of bulbs in 80 ppm paclobutrazol + foliar spray of paclobutrazol @80 ppm, T<sub>4</sub>=Soaking of bulbs in 100 ppm paclobutrazol solution, T<sub>5</sub>=Foliar spray of paclobutrazol @ 100 ppm, T<sub>6</sub>=Soaking of bulbs in 100 ppm paclobutrazol + foliar spray of paclobutrazol @100 ppm and T<sub>7</sub>=Control. BARI Piaj- 4 was used as test variety. Significantly the highest seed yield (795 kg ha<sup>-1</sup>) was obtained from foliar spray of paclobutrazol @ 100 ppm at seedling stage. The lowest seed yield (587 kg ha<sup>-1</sup>) was obtained from T<sub>1</sub> treatment. In the case of seed quality parameters the germination %, was significant and root length, shoot length, seedling

dry weight and seed vigour was significantly influence by different doses of treatments. From the study it can be concluded that foliar spray of paclobutrazol @ 100 ppm at seedling stage (795 kg/ha) is gave for higher seed yield and higher value for good quality seed.

#### **Effect of different threshing method(s) on seed quality of mungbean**

A. N. M. A. Karim, M. A. H. S. Jahan, M. A. Hossain and Sarker, P. C.

The experiment was conducted in the laboratory of Seed Technology and Farm Machinery and Post Harvest Engineering Division, BARI, Gazipur during 2023, Bangladesh to find out suitable threshing method(s) for better seed quality of mungbean. The experiment was laid out in a CRD with BARI Mung- 6 and two threshing method viz. 1. Open stick beating 2. Multi crop power thresher with 600,700, 800 and 900 rpm. Among the treatment in threshing method of multi crop power thresher with 700 rpm showed significantly better seed quality such as highest unseparated seeds (5.63%), germination (91.66%), root length (10.18 cm), shoot length (8.54 cm) and vigour index (1019.0).

#### **Effect of different weed management practices on yield and seed quality of groundnut**

A. N. M. A. Karim, M. A. H. S. Jahan, M. S. Miah , S. A. Brgum, M. A. Hossain and P. C. Sarker

The experiment was carried out at the research field and laboratory of Seed Technology Division, BARI, Gazipur during 2022-23 to find out the suitable weed management practices on yield and seed quality of groundnut. The experiment was laid out in RCBD with BARI Chinabadam-9 and four weed management practices viz., 1. control (no weeding), 2. hand weeding at 25 DAS and 45 DAS, 3. pre sowing weedicide: Gluconate 25 days before sowing 4. post emergence weedicide: Fenoxaprop P ethyl 9.3% EC at 25 DAS. Among the treatment hand weeding at 25 DAS and 45 DAS showed significantly better seed yield and quality parameters such as plant height (43.03 cm ), number of branches/plant (36.42 ), number of seed/pod (2.66), 100 seed weight (47.30 g), seed yield (2.75 t/ha), seedling root length (24.80 cm), seedling shoot length(16.59 cm) and vigor index (532.3).

#### **Effect of water stress on seed yield and seed quality of chickpea**

A.N.M. A. Karim , M. A. Hossain and P. C. Sarker

The experiment was carried out at the research field and laboratory of Seed Technology Division, BARI, Gazipur during 2022-2023 to find out the effect of water stress on seed yield and seed quality of chickpea varieties under drought stress condition. The experiment was set in a Completely Randomized Design (CRD) with two chickpea variety BARI Chola-5 and BARI Chola-9 and four moisture regimes viz., Control (without irrigation), 50% field capacity, 70% field capacity, and 90% field capacity.

BARI Chola-9 at 90% field capacity gave better seed yield/plant (10.40 g) alongwith 97.21% seed germination. Seed yield was reduced gradually with decreasing of field capacity and reduction was higher in BARI Chinabadm-5 compare to BARI Chinadam-9. But seed yield/plant reduction of this variety at 70% field capacity was lowest 8.77% along with 2.08% germination per cent reduction.

#### **Seed quality of chilli as influenced by different drying methods**

R. Chakma, M.A.Hossain, M.A.H.S. Jahan, M.S. Rahman, M. Islam and P.C. Sarker

Influence of different drying methods on seed quality was studied at the research field and laboratory of Seed Technology Division, BARI, Gazipur during 2022-2023. The aim was to identify the best drying method for chilli seeds .The variety was BARI Morich-3. The chilli seeds were dried under five different drying methods viz., T<sub>1</sub>= Sun drying of seed on tarpaulin upon concrete floor under the sun, T<sub>2</sub>= Air/fan drying of seed under shade on tarpaulin, T<sub>3</sub>= Artificial drying of seed at 35°C (Oven), T<sub>4</sub>= Artificial drying of seed at 40°C (Oven), and T<sub>5</sub>= Common practices (drying full ripened fruits). Seeds dried by mechanical drying (oven at 35°C) and seeds dried under shade/fan on tarpaulin recorded higher germination ( 92.33% and 90.33%), shoot length (3.86 cm and 3.54 cm), root length (3.86 cm and 3.54 cm), seedling dry weight (0.0180 mg and 0.0179 mg) and vigour index (1.6623 and 1.6159), thus indicating better seed quality.

### **Seed yield and quality of sweet pepper as influenced by nutrient management**

M. A. H. S. Jahan, M. S. Rahman, M. A. R. Gazi, M. N. Uddin, M. H. H. Khan, M. M. Rahman, H. M. Naser, R. Chakma and P. C. Sarker

This experiment is conducted at STD research field during Rabi season 2022-23 to find out a suitable nutrient management system of sweet pepper on aspect of seed yield and quality. The experiment design was carried out in a RCB design with three replications. The experiment comprises five treatments viz. T<sub>1</sub>= Control (Native nutrient), T<sub>2</sub>= Organic fertilizer only (STB) – Biologically Active Organic Fertilizer (BIOFER) + BARI IMO-1 + BARI IMO-2, T<sub>3</sub>= Inorganic fertilizer only (STB), T<sub>4</sub>= Both organic and inorganic fertilizer – IPNS (25% organic + 75% inorganic) and T<sub>5</sub>= Recommended fertilizer. Individual fruit weight, number of fruit/plant, fruit yield (kg/ha), seed yield (kg/ha), 1000 seed weight, germination % and vigour index were significantly influenced by different treatments. Treatment 2 showed better performance in terms of number of fruit/plant, fruit yield (kg/ha), seed yield (kg/ha), germination % and vigour index.

### **Determination of harvest maturity and seed quality of okra as influenced by picking time of fruits**

M. A. Hossain, M. Islam, M. S. Rahman and P.C. Sarker

A field experiment was conducted to the field and laboratory of seed technology division, BARI, Gazipur during kharif season of 2022-2023 to determine the effect of optimum stage of harvest on seed quality of okra as influenced by picking time of fruits. The variety was BARI Dherosh-2. The experiments were consisted of eight (8) fruit picking times. The fruit picking times were T<sub>1</sub>= 25 days after anthesis (DAA), T<sub>2</sub>=30 days after anthesis (DAA), T<sub>3</sub>=35 days after anthesis (DAA), T<sub>4</sub>=40 days after anthesis (DAA), T<sub>5</sub>=45 days after anthesis (DAA), T<sub>6</sub>=50 days after anthesis (DAA), T<sub>7</sub>=55 days after anthesis (DAA) and T<sub>8</sub>=60 days after anthesis (DAA). The fruit length and diameter progressively increased and reached its peak at 30 days after anthesis by recording 12.42 cm and 17.09 mm respectively and subsequently decreased slightly. Seed maturation and quality parameters were highly significant at different fruit picking stages. Fresh fruit weight was found to be

maximum (16.69 g) at 25 days after anthesis, while fresh weight of seeds (4.32 g) were also maximum at 25 days after anthesis. Seed dry weight (2.40 g), 100 seed weight (6.01 g) and number of seed per pod (43.36) were maximum at 40 days after anthesis. However, to obtain optimum germination percentage (98.66%) and vigor index (4989), the fruits should be picked on at 40 days after anthesis.

### **Growth, seed yield and seed quality parameters of okra as influenced by different growth regulators**

M. A. Hossain, M. Islam, M. S. Rahman, and P.C. Sarker

A field experiment was conducted in the field and laboratory of Seed Technology Division, BARI, Gazipur during kharif season of 2022-2023 to study the effect of different plant growth regulators on growth, seed yield and seed quality of okra. The variety was BARI Dherosh-2. The experiments were consisted of eight (8) treatment combinations. The treatments were T<sub>1</sub>= Control (no foliar application), T<sub>2</sub>=100 ppm GA<sub>3</sub>, T<sub>3</sub>=200 ppm GA<sub>3</sub>, T<sub>4</sub>=100 ppm NAA, T<sub>5</sub>=200 ppm NAA, T<sub>6</sub>=100 ppm GA<sub>3</sub> + 100 ppm NAA, T<sub>7</sub>=200 ppm GA<sub>3</sub>+100 ppm NAA and T<sub>8</sub>=200 ppm GA<sub>3</sub>+200 ppm NAA. The number of branches plant<sup>-1</sup>, the number of leaves plant<sup>-1</sup> and plant height was higher in plants when sprayed with GA<sub>3</sub> and NAA @ 200+100 ppm as well as with GA<sub>3</sub> and NAA @ 200+200 ppm. The number of pods plant<sup>-1</sup>, pod length, the number of seeds pod<sup>-1</sup> and seed quality (in terms of 100-seed weight, germination percentage (96.00 %) and seed yield (1.54 t/ha) were maximum in plants receiving foliar spray of both GA<sub>3</sub> and NAA @ 200+200 ppm.

### **Determination of seed maturity index of capsicum**

M. A. Hossain, M. Islam, M. S. Rahman, P.C. Sarker and A.H.S. Jahan

A field experiment was conducted at the research field and laboratory of Seed Technology Division, BARI, Gazipur, during 2022-2023 to know the determination of optimum seed maturity index of capsicum. The variety was BARI Mistimorich-2. The treatments were four viz. T<sub>1</sub>= turning yellow, T<sub>2</sub>= 50% yellow, T<sub>3</sub>=100% yellow and T<sub>4</sub>= fully yellow and shrinkage. Individual fruit weight, number of seeds per fruit, 1000 seed weight, and days to fruit maturity from anthesis, seed



germination, seedling dry weight and vigor index significantly varied with respect to different treatments. The best maturity index was observed from 100% yellow at 72 days to seed maturity from anthesis in respect of 1000 seed weight (8.30 g), Seed germination (90 %), seedling dry weight (23.66 mg) and vigor index (2121).

#### **Germination and seedling performance of watermelon as influenced by seed priming**

M. Islam, M. S. Rahman and P. C. Sarker

An experiment was conducted in the laboratory of seed technology division, BARI, Gazipur-1701 during 2022-23 to know the effect of seed priming in watermelon to overcome germination problem. There were eight treatment including a control. Seeds of BARI Tormuj-2 was subjected to priming with 1%, 2%, 3% of KNO<sub>3</sub>, CaCl<sub>2</sub> and fresh water for 24 hours and no seed priming as control. 1% KNO<sub>3</sub> gave higher germination (97.00%) and emergence index (92.00%) than the other treatments. Higher germination speed was recorded from hydropriming and priming with 1% KNO<sub>3</sub> solution. Maximum root length (5.33 cm), seedling length (12.76 cm), vigor index length (1236.5) and vigor index mass (5.943) was also obtained from seed priming with 1% KNO<sub>3</sub> solution. Therefore, priming of watermelon seed with 1% KNO<sub>3</sub> would be helpful to increase germination and develop better quality seedling.

#### **Effect of seedling age on flowering and seed yield potential of capsicum**

M. Islam, A. Hossain and P.C. Sarker

An experiment was conducted in the laboratory of seed technology division, BARI, Gazipur-1701 during 2022-23 to know the effect of seedling age for transplanting on flowering and seed yield of capsicum. There were 20, 25, 30, 35, 40 days transplants of BARI Mishtimorich-2 that were grown in the field following RCBD with 3 replications. Early flowering and fruiting was observed in 35 days transplants where individual fruit weight was found higher in 20 days transplant. On the other hand maximum number of fruit per plant (10), number of seed per fruit (97.66), seed yield per plot (21.301g), germination (91.66%) was obtained from 25 days transplants. Therefore, seedling of 25days old is suitable age for transplanting in the field that would give higher seed yield in capsicum.

#### **Quality seed production of mustard under unfavorable condition (drought)**

M. Islam, P. Roy and P. C. Sarker

An experiment was conducted in the laboratory of seed technology division, BARI, Gazipur-1701 during 2022-23 to know the effect of irrigation at different growing stage on seed yield and seed quality of rapeseed mustard. The variety of mustard BARI Sharisha-18 was used in the experiment. The experiment was done following RCBD with four replications. There were 6 treatment including control i.e., T<sub>1</sub>= Irrigation as and when necessary, T<sub>2</sub>= Irrigation at vegetative and flowering stage, T<sub>3</sub>= Irrigation at vegetative and seed development stage, T<sub>4</sub>= Irrigation at flowering and seed development stage, T<sub>5</sub>= Irrigation at vegetative, flowering and seed development stage T<sub>6</sub>= Rainfed irrigation. Maximum plant height was found applying three irrigations where number of seed per pod, seed yield, seedling dry weight and seedling vigor index was found higher than other when two irrigations were given at vegetative and seed development stage. Minimum plant height, number of seed per pod, seed yield and vigor index was found in case of rainfed condition. Therefore, to get higher seed yield with better quality seed it is wise to give two irrigations at vegetative and seed development stages in rapeseed cultivation.

#### **Assessment of seed quality of rapeseed-mustard through accelerated aging method**

S.A. Bagum and P. C. Sarker

The experiment was conducted at the Laboratory of Seed Technology Division, BARI, Gazipur during 2022-23 to evaluate how seed aging affects rapeseed-mustard seed quality. The experiment comprised of sixteen BARI released rapeseed-mustard varieties and four ageing time treatments with control viz. (i) T<sub>1</sub> = Control (0 hour), (ii) T<sub>2</sub> = 24 hours, (iii) T<sub>3</sub> = 48 hours, (iv) T<sub>4</sub> = 72 hours and (v) T<sub>5</sub> = 96 hours. The experiment was laid out in a CRD design with four replications at 45 ± 1°C and 90% relative humidity. Seeds were accelerated aged for 24, 48, 72, and 96 hours. Seed quality parameters were evaluated between artificially aged and unaged seeds. Accelerated aging treatments reduced germination. Accelerated aging (AA) decreased seedling length, seed vigor index, dry weight, and germination %. From probit analysis, it can be concluded that the BARI Sharisha-14 and Tori-7 storage relatively long time in store with

80% germination. Accelerated aging decreased rapeseed-mustard seed viability. Finally, the findings demonstrated that accelerated aging reduced the viability of rapeseed-mustard seeds.

#### **Effect of different storing methods on seed quality of groundnut under ambient condition**

A. N. M. A. Karim, M. A. Hossain and P. C. Sarker

The experiment was carried out at the laboratory of Seed Technology Division BARI, Gazipur 2022-23 to find the effect of storing methods on seed quality of groundnut. The experiment was laid out in a CRD with BARI Chinabadam-9 and six storing methods viz. 1. Pod storing in at normal polythene bag, 2. pod storing at air tight polythene bag, 3. Pod storing in normal polythene bag with anhydrous calcium chloride, 4. Seed storing in at normal polythene bag, 5. seed storing in air tight polythene bag and 6. seed storing in normal polythene bag with anhydrous calcium chloride. Among the storing method seed storing in at normal polythene bag with anhydrous calcium chloride showed significantly better seed quality parameters such as moisture content(16.03 % ), germination percent (82.00), seedling root length (29.97 cm), seedling shoots length (32.11cm) and vigor index(512.00) after 9 month of storage.

#### **Seed quality status of soybean as influenced by packaging materials and time after outlet from the cool room**

M. S. Rahman and P. C. Sarker

During Rabi 2022-2023, a laboratory experiment was carried out at the Seed Technology Division, BARI, Gazipur, Bangladesh, to standardize the duration of germination potential and vigor of soybean (BARI Soybean-7) seed shortly after exit from the cool room. The results showed that BARI Soybean-7 should be planted in the field within 18 days of being taken out from the cool room.

#### **Develop a user friendly germinator assistant using internet of things**

M. S. Rahman, S. A. Imran, and P. C. Sarker

To give plants the perfect environment, an IoT-based germinator has been created or is currently being developed (temperature sensing, light intensity measurement, humidity, and soil moisture measurement). The sensor and camera are the two key codes used by the implementation system. It is fairly user-friendly and has attributes like low cost, simple operation, and portability. The integration of this technology in the germination process offers a plethora of advantages, making it a promising solution for modern agriculture practices.

# VERTEBRATE PEST

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## **Survey of squirrel damage in common fruits in selected areas of Bangladesh**

A T M Hasanuzzaman and M S Alam

The study was conducted in the squirrel infested area of Rajshahi and Naogaon regions during 2022-23. Four upazillas of Rajshahi and one upazilla of Naogaon district were selected for this study. Questionnaire survey on squirrel damage in fruit was conducted amongst fruit and vegetables growing farmers. 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. According to the farmers' opinion, vegetables and fruit crops were frequently damaged by the squirrels whereas striped squirrel was pre dominant in study areas. Most affected fruits were ber, mango, litchi, coconut, guava and pumelo. Farmers reported that they lost 37.09% guava, 12.47% mango, 27.15% ber, 7.47% litchi and 16.29% pumelo due to squirrel in last year. Farmer lost 725.00 taka per guava tree per year due to squirrel attack while it was 424.17 taka for mango tree, 731.50 taka for ber, 447.71 taka for litchi and 530.00 taka for pumelo tree. Farmers were unknown about breeding habit of squirrel.

## **Efficacy of newly designed trap for capturing rodent**

A T M Hasanuzzaman and M S Alam

The experiment was conducted in outdoor rat enclosure at vertebrate pest division and different experimental fields in BARI, Gazipur during 2022-23 to evaluate the comparative efficacy of newly designed kill trap and commonly used live and kill trap. 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 36.00% whereas commonly used kill trap showed only 28.00% success. In field, the average success of newly designed snap trap and live trap was 40.57% and 35.52% respectively whereas commonly used kill trap showed 26.83% success.

## **Evaluation of kerosene mixed cow dung as a repellent of burrowing rodent**

A T M Hasanuzzaman and M S Alam

Three indigenous rodent control techniques were evaluated considering three treatments in this experiment viz. applying kerosene mixed cow dung, engine oil and water in burrow opening. There was an untreated control where no control measure was used. Only active burrows were used for this experiment. In wheat and mustard crop, about ten active burrows were used for each treatment on the basis of burrow availability. The highest rodent repelling success was achieved in case of using kerosene mixed cow dung (71.39% success) which was followed by engine oil (32.23% success) that was statistically similar with water (30.55% success).

## **Evaluation of rodenticidal properties of some plant extract against rat in laboratory**

M. S. Alam and ATM Hasanuzzaman\

Different approaches for controlling rodent including attractant and repellents are needed to mitigate crop losses. Two attractant Calendula flower powder, Akanda leaf) and two repellent (Cumin and Coriander) 10% and 20% were evaluated as rat repellents in laboratory trials. The results showed that rat was able to distinguish untreated and treated bait during preference test. Repellent bait consumption was lower than the untreated bait and rat consumed higher amount of attractant bait compared to control bait.



### **Efficacy of different repellent techniques against pest birds in sunflower**

M S Alam and A T M Hasanuzzaman

Efficacy of different combination of repellent on sunflower against pest birds were evaluated. Four treatments viz., Plastic bottle wind mill, only top netting, whole plot netting and Untreated control (without repellent) were used in this experiment. From this experiment, 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 48.33% plant damage and 61.2% head damage were happened by the birds whereas the lowest damage was recorded in treatment where whole plot covered by net (5.67% plant and 4% head damage) treated plots and only top netting

treated plot (22.22% plant and 39.03% head damage). Highest Marginal Benefit cost ratio was found in Plastic bottle windmill (0.44) followed by whole plot netting (0.35) and only top netting treated plots (0.02).

### **Field evaluation of rodenticide for controlling rats**

M S Alam and A T M Hasanuzzaman

Effectiveness of Bromadiolone 0.005% (Emirat, Hit rat kill and Raha) and Zinc phosphide 80% (Phoszinc) were evaluated. In “choice” feeding test in laboratory all the rodenticide showed more than 90% mortality of Bandicoot rat was recorded. In field trial test all the rodenticide showed more than 80% rodent control success was recorded. The average poison bait consumption was 1.1 to 2.53 g/rat/day in all the tested bait.

# POSTHARVEST TECHNOLOGY

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## **Physicochemical properties and bioactive compounds of some selected coffee lines and cashew nut in hilly areas of Bangladesh**

M.G.F. Chowdhury, M.A. Hossain, M.H.H. Khan, M.R. Ahmad, M.T. Islam, M.M. Molla, S. Pervin, B.C. Dey, P. Sen

This study was conducted to generate information on physicochemical and bioactive compounds of selected coffee and cashew nut line in hilly areas of Bangladesh. Six coffee lines and 3 coffee samples were collected from Khagrachari and two cashew nut samples were from local cashew nut processors. Six coffee lines and 3 coffee samples exhibited the range of percent moisture, dry matter, ascorbic acid content, fat, starch, beta-carotene, phenolic compounds, and antioxidant capacity were from 2.22 to 12.24%, 82.20 to 98.31%, 5.80 to 123.48 mg/100g, 12.54 to 18.35%, 28.84 to 36.80%, 6.25 to 76.23 mg/100g, 88.23 to 163.13 GAE/100g, 60.57 to 77.29 % inhibition, respectively where as non-roasted and roasted cashew nut samples showed the percent moisture, ash, ascorbic acid, titratable acid and antioxidant were 0.77 & 1.41%, 1.67 & 1.53%, 3.27 & 4.47 mg/100g, 0.38 & 0.55%, 53.47 & 47.99 % inhibition, respectively.

## **Effect of heat stress and edible coating on improving quality retention and shelf life of mango fruit during ambient storage**

M.G.F. Chowdhury, M.H.H. Khan, M.M. Rahman, M.M. Molla, M.S. Akhter, A.A. Sabuz

This experiment was conducted to study the effect of hot water treatments and fruit coatings that stimulate the fruit antioxidant system and will maintain postharvest quality of mango at ambient storage condition. BARI Aam-3 dipped into hot water at 55°C for 5 mins and wax coating was applied as a surface coating. Postharvest treatment was applied to control disease for the study. Fruit

immediately after HWT using hand applicator on a washing & waxing line or left uncoated. Among the treatments, hot water treatment with Endura Fresh™370) coated fruit performed best in terms of overall quality, and it significantly reduced weight loss (~9%) after 18 days fruit harvested. Wax coated fruit significantly increases fruit peel appearance and coated fruit also showed more firmer than non-coated fruit after 3 weeks.

## **Effect of vacuum frying on the nutritional and keeping quality of pineapple chips**

M.G.F. Chowdhury, M.H.H. Khan, M. M. Molla, S. Pervin, A.A. Sabuz, P. Sen, B.C. Dey

The aim of the study was to evaluate the effect of vacuum fried pineapple chips processing using BARI developed vacuum fryer at suitable frying temperature and time. Uniform size of pineapple were collected and peeled and then thinly sliced. Corn flour (16% & 18%) were added with raw chips and stored in the refrigerator (-14°C) for 12-24 hrs. Pineapple chips were vacuum fried at 100, 105 and 110°C for 60 mins and then were de-oiled at 1400 rpm for 2 mins and packed in metalex foil packet (3 layer, ~60 micron) for 3 month quality evaluation. Pineapple chips mixed with 16% corn flour and then fried at 105°C for 60 mins performed better among the treatments in terms of quality attributes and shelf life during 3 months of storage.

## **A comparative study on the use of cooking oils, food habits, dietary habits, lifestyle habits and health attitudes with the focus to rural, peri-urban and urban people in Bangladesh**

M.M. Molla, M.H.H. Khan, A.A. Sabuz, S. Pervin, M.G.F. Chowdhury, M.M. Rahman, B.C. Dey And P. Sen

The purpose of the study was to find out the different cooking oils and mostly used cooking oils

and explores the health attitudes regarding food and lifestyle habits of the respondents. Results reveal that 80-82 % people consume soybean oil, 10-12 % people mustard oil, 3-4 % people extra virgin olive oil and 1-2 % extra virgin coconut oil. Approximately 76.90 % respondent goes to late sleeping from 11:00-12:00 am, arise in the morning (5:00-6:00 am) 46.20 % and 84.60 % respondents do not walk and exercise regularly. During the study, the heart attack, stroke, high blood pressure and diabetes were recorded as 25 %, 37.50 %, 25 % and 12.50 % respectively. The highest consumption oil was recorded as 10 L per family consisted 3-6 members.

#### **Shelf life extension of pineapple pomace ball (laddu) through postharvest treatments**

M.M.Molla, M.H.H.Khan, A.A. Sabuz, M.G.F. Chowdhury, S.Pervin, M.M.Rahman, B.C.Dey, P.Sen, M.S.Zaman, R.Podder, P.Bhowmik And A.Khatun

The purpose of the study was to develop pineapple by-product (small ball-laddu) using pineapple pomace. There were four treatments with 3 replications and the experiment was laid out in complete randomized design (CRD). Then developed laddus were stored in polyethylene Terephthalate (PET) boxes at ambient temperature for storage studies. The studies confirmed that all treated potassium metabisulphite (KMS), potassium sorbet (KS) and KMS+KS treated laddus could be extended more than 60 days, whereas the control sample could be stored up to 30 days only.

#### **The nutritional, physicochemical, minerals and bioactive compounds analysis of cooked lentil**

M.M.Molla, M.H.H.Khan, A.A.Sabuz, S.Pervin, M.G.F.Chowdhury, M.M.Rahman, B.C.Dey And P. Sen

An attempt has been taken to cook lentil with edible portion and peel to determine their nutrition and antioxidant status as a part of reducing milling cost. All the analysis was performed by internationally recognized method using HPLC and Double Beam Spectrophotometer. Then the obtained data has been verified with reputed national and international journals and books. Results revealed that lentil cooked with peel is the rich source of physicochemical nutritional and antioxidant activities. Highest crude protein (28 %) and lower fat (5.73 %) was recorded in lentil

cooked with peel. Sensory data also confirmed that all the evaluator was highly satisfied to the cooked lentil with peels although non-significant differences were found between peel and without peel.

#### **Effect of moisture content on recovery percentage of lentil during dehulling process**

M.M. Molla, M.H.H. Khan, A.A. Sabuz, M.G.F. Chowdhury, S.Pervin, M.M.Rahman, B.C.Dey, P.Sen, M.S.Zaman, R.Podder, P.Bhowmik And A.Khatun

An investigation was carried out to determine the effect of moisture content on recovery percentage of lentil during dehulling. It was bothering to maintain desired moisture level. There was five moisture level viz. 6 %, 8 %, 10 %, 12 % and 14 %. The desired moisture levels were maintained by adding calculated amount of distilled water, thoroughly mixing and then sealed in separate polythene bags. The sealed lentil was kept at 5 °C in a refrigerator for 7 days to allow a uniform distribution of moisture throughout the lentil. Before conducting the test, the required quantity of lentil was allowed to warm up to room temperature for 12 h for conditioning. Results revealed that 8 % moisture contributed to get maximum recovery percentage of lentil during dehulling.

#### **Effect of different milling methods on recovery percentage of lentil**

M.M. Molla, M.H.H. Khan, A.A. Sabuz, M.G.F. Chowdhury, S.Pervin, M.M.Rahman, B.C.Dey, P.Sen, M.S.Zaman, R.Podder, P.Bhowmik And A.Khatun

A study was conducted to investigate the effect of different milling on recovery percentage of lentil. It was difficult to prepare uniform seeds during milling as it is pre-requisite to get highest recovery yield. Maximum dehulling efficiency (DE) (87.03 %), milling recovery (MR) (75.19 %) percentage and football recovery (FR) (8.11 %) was obtained by the commercial dehuller than others. Lowest broken (14.2 %) and powdery percentage (1.78 %) was also observed by the commercial dehuller. Local pulse dehuller operated manually caused significant losses in yield by enhancing higher broken percentage (36.04 %) and powder form (10.31 %). The study recommends using clean and uniform seeds for maximizing the good milling recovery yield with football recovery percentage.



### **Optimization of processing method for plum jam and analysis of the changes in quality characteristics during storage**

S. Pervin, M.H.H Khan, M.G.F. Chowdhury, M.M. Molla And A.A. Sabuz

Plum is a versatile fruit with limited availability during a specific season. To promote year-round consumption, plum can be processed into value-added products like jam. This study aimed to optimize the processing method for plum jam using the BARI Alu bukhara-1 variety and investigate the changes in quality characteristics during 12 months of storage. Five treatments with varying sucrose percentages were analyzed. The pH decreased during storage, while acidity decreased significantly. The color intensity gradually shifted from light-yellow to light red. Microbial growth was not observed for up to nine months, and panelists favored jam made with 100% sucrose for its balanced sweetness and appealing flavor. The findings contribute to enhancing plum utilization and providing a nutritious and convenient food option through plum jam consumption.

### **Standardization of processing method for osmo dehydrated sugar coated plum**

S. Pervin, M.H.H. Khan, M. M. Molla, M.G.F. Chowdhury And A. A. Sabuz

The study aimed to standardize the processing method for osmo-dehydrated sugar-coated plum to enhance its shelf life, overall quality and minimize postharvest losses. Plum fruits were treated with 40, 50, and 60 °Brix sugar syrup and sugar coating. Texture analysis revealed a decrease in firmness during storage due to cell structure breakdown and enzymatic activity. Color intensity decreased significantly over 12 months of storage, while total phenolic content declined with increasing brix and prolonged storage. Osmo-dehydrated plum exhibited excellent energy content. The highest overall rating was given to plum treated with 50 °Brix sugar syrup and sugar coating. In conclusion, osmotic dehydration with sugar coating is a viable method to enhance plum preservation and create a value-added product.

### **Optimization of processing method for dragon fruit jam**

S. Pervin, M.H.H Khan, M.G.F. Chowdhury, M.M. Molla, A.A. Sabuz And A.S.M.H. Rashid

This research aimed to optimize the processing method for dragon fruit jam and assess its quality

parameters during long-term storage at ambient temperature in Bangladesh. Five treatments were employed, varying the sugar content in the dragon fruit pulp. The pH, acidity, TSS (%), color, microbial growth, and sensory evaluation were conducted over a storage period of six months. The results revealed that higher sugar content led to lower initial pH and higher acidity in the jam. TSS values were highest in treatment T<sub>5</sub> (100% sugar in pulp). Color intensity decreased during storage, and microbial growth remained within acceptable limits. Sensory evaluation indicated that jam with 80% sugar in pulp (T<sub>4</sub>) received the highest overall rating. These findings offer valuable insights for optimizing dragon fruit jam processing for extended shelf life and consumer acceptance.

### **Standardization of processing method for dragon fruit jelly**

S. Pervin, M.H.H Khan, M.M. Molla, M.G.F. Chowdhury, M.M. Rahman And A. A. Sabuz

Dragon fruit jelly is a popular fruit-based product, and this study aimed to standardize its processing method and assess the changes in quality characteristics during storage at ambient temperature in Bangladesh. Six treatments were employed, varying the juice and sugar proportions in the jelly. The pH, acidity, TSS (%), color, and microbial growth were analyzed during a storage period of one year. The results indicated that the pH decreased and acidity increased over time. TSS increased during storage with 33% juice+70% sugar in jelly exhibiting the highest level. Color intensity decreased and lightness values reduced during prolonged storage. Microbial growth was minimal and within acceptable limits for human consumption. Sensory evaluation revealed 33% juice+50% sugar in jelly was the highest overall acceptance.

### **Blanching effect on the quality and shelf life of taro root**

S. Pervin, M.H.H. Khan, M.M. Rahman, M.G.F. Chowdhury, M.M. Molla, And A. A. Sabuz

Taro is a valuable tropical root crop in Bangladesh, but its perishable nature presents storage challenges. Blanching is commonly used to enhance product stability during freezing. This study investigates the effect of blanching on frozen taro roots to optimize storage and product quality. Seven blanching treatments were evaluated for

physicochemical quality parameters over six months. Blanching significantly affected texture, color, and antioxidant property. Blanching at  $80\pm 1^\circ\text{C}$  for 6 minutes demonstrated the most suitable attributes. Overall, blanching improved the shelf life and quality of frozen taro roots.

#### **Preservation of aonla by osmotic dehydration method**

S. Pervin, M.H.H Khan, M.M. Molla, M.G.F. Chowdhury, M.M. Rahman And A. A. Sabuz

The study aims to optimize dehydration conditions for producing high-quality value-added products with extended shelf life. Eight treatments were used to osmo-dehydrate aonla, and the physicochemical properties were analyzed during a 6-month storage period. The results revealed that the texture, vitamin C, and total phenolic content of osmo-dehydrated aonla decreased with increasing storage period and osmotic solution concentration. The color intensity also decreased significantly during prolonged storage. Sensory evaluation indicated that osmo-dehydrated aonla maintained overall acceptability throughout the storage period. Overall, the research demonstrates the potential of osmotic dehydration as an effective preservation method for aonla, yielding value-added products with enhanced quality and shelf life.

#### **Effect of moisture level on processing and quality of lentil chips**

M.M. Molla, M.H.H .Khan, A.A. Sabuz, M.G.F. Chowdhury, S.Pervin, M.M.Rahman, B.C.Dey, P.Sen, M.S.Zaman, R.Podder, P.Bhowmik And A.Khatun

The study was conducted to develop lentil chips through find out the proper moisture level and barrel temperature of the single screw extruder. The single screw extruder was installed successfully in the postharvest Technology Division of BARI. Several trial based on moisture level has been done and outlet dice of the single screw extruder has been modified to develop quality chips. Then the product has been incorporated to evaluate by forming of judgments panel groups consist of interdisciplinary trained scientists, staffs and child (6-10 years). Then the quality product has been packed into metalex and polypropylene pouches for storage studies at ambient condition. Results show that moisture at 20% conditioning 2-3 h produced

high quality chips that has been acceptable by the consumers.

#### **The physicochemical, nutritional, minerals and bioactive compound analysis of different edible parts of selected BARI kachu varieties**

M.M. Molla, M.H.H. Khan, A.A. Sabuz, S. Pervin, M.G.F. Chowdhury, M.M. Rahman, B.C.Dey, P. Sen And M.S. Alam

The purpose of the study was to analyze the physicochemical, nutritional, bioactive compounds and minerals of different edible portions of the BARI Pani Kachu varieties. The seven BARI Pani Kachu varieties were selected for the study. Results reveal that vitamin-C content found higher at rhizome ( $8.23\pm 0.03$  mg/100 g), stolon ( $18.10\pm 0.10$  mg/100 g) and leafblade ( $47.06\pm 0.06$  mg/100 g) of the BARI Pani Kachu-3. Petiole of BARI Pani Kachu-1 contained higher amount of vitamin-C ( $7.24\pm 0.04$  mg/100 g). Fe and Zn were highly present at rhizome and stolon portion of BARI Pani Kachu-3 and BARI Pani Kachu-6. Leafblade of BARI Pani Kachu-6 was rich source of Fe ( $337.00\pm 3.00$  ppm) and Zn ( $56.86\pm 0.04$ ). Petiole of BARI Pani Kachu-5 and BARI Pani Kachu-6 was superior for Fe and Zn.

#### **Physicochemical and quality evaluation of dried tomato slices**

M.H.H. Khan, M.M. Molla, S. Pervin, M.M. Rahman, M.G.F. Chowdhury, A.A. Sabuz, B.C. Dey, P. Sen

The main purpose of this study was to investigate the physicochemical and quality evaluation of dried tomato slices. Tomatoes were dried by two different methods viz. cabinet and freeze-drying and changes in nutrient content of tomato slices were examined. As a result of drying applications, the initial moisture content of fresh tomato samples was determined to be 95.43%, whereas dried samples ranged from 11.80% to 15.85%. Losses of nutritional contents of cabinet-dried samples were high compared to others. Between the methods used, it was observed that freeze-dried tomato slices scored highest for color and all other nutritional qualities. Thus, it could be concluded that the freeze-drying method resulted in better end products retaining natural color and nutrients, also employing a simple technique and minimal energy.

**Effect of maltodextrin and sugar coating on nutritional and bioactive compounds of freeze-dried jackfruit chips**

M.G.F. Chowdhury, M.H.H. Khan, M.M. Molla, S. Pervin, A.A.Sabuz, M.Kamal

The aim of the study was to standardize the freeze-dried jackfruit chips processing protocol by application of maltodextrin and sugar coating. Jackfruit chips were prepared from matured khaja type jackfruit. The harvested jackfruit was cut into halves and separated into the bulbs. The seed was removed, and bulb was sliced into about 5 mm thickness and treated with 5, 10, 15% maltodextrin and 40% sugar solution then packaged in high density polyethylene packet (~60 micron) and frozen at -18°C for 24-36 hrs. Then the frozen slices were dried in freeze dryer at -53°C for 72 hrs. The dried chips were packaged in foil (~50 micron) packet without nitrogen. According to the quality attributes, 10% maltodextrin coated slices exhibited

better quality during 6 months of storage at ambient condition.

**Efficacy of clove essential oil and carnauba wax in extending shelf life of mango**

M.M. Rahman, M.G.F. Chowdhury, M.H. H. Khan, S. Pervin, M.M. Molla, A. A. Sabuz, B. C. Dey, P. Sen

The current experiment examined the effects of clove essential oil and carnauba wax coating for controlling stem end rot and anthracnose caused by *Botryodiplodia theobromae* and *Colletotrichum gloeosporioides*, respectively of mango to extend shelf life. Clove essential oil at 1 mL<sup>-1</sup> premixed with ethanol (1 mL L<sup>-1</sup>) as stabilizer and Triton-X100 (40 mg L<sup>-1</sup>) as surfactant in combination with carnauba wax has shown potential inhibition of the fungi with shelf life extension of mango. This experiment needs more trials for confrontation.



# 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 has been made to develop a micropropagation protocol of gerbera. Capitulum explant of purple pink, red, pink and magenta cultivars were cultured on MS media supplemented with four different concentrations and combinations of BAP, NAA and IAA. Early shoot initiation (22 days) and maximum shoot (120) was observed in purple pink cultivar from 2.0 mg/l BAP + 0.5 mg/l NAA. The maximum root number (4.0) was obtained from  $\frac{1}{2}$  MS media supplemented with 1.5 mg/l IBA. For *ex vitro* establishment, well developed plantlets were transferred to greenhouse in four different potting media. Highest percent (95%) of plantlets survived in PM<sub>2</sub> potting media which comprised of one part of both soil and cocodust mixture.

### Micropropagation of lilium

M. M. Khatun and S. C. Halder

To establish a micropropagation protocol for BARI Lilium-1, nodal explants were used for continuous *in vitro* multiplication. The MS media supplemented with eight different concentrations and combinations of BAP, NAA, IAA and IBA which 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 IAA + 1.0 mg/l IBA. Root number was highest 7.5 roots/shootlet in 1.5 mg/l IBA treated medium. For *ex vitro* establishment, well developed plantlets were transferred to greenhouse in seven different potting media. The highest percent (100%) of plantlets survived in M<sub>1</sub> potting media which comprised of

one part soil and two parts of cocodust. The tissue culture technique is 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 and BARI Strawberry-3 were cultured on MS media supplemented with different concentrations and combinations of BAP, Kn and GA<sub>3</sub>. Four different treatments were tested in this study. For shoot elongation, 1.0 mg/l BAP + 0.5 mg/l Kn + 1.5 mg/l GA<sub>3</sub> treatment was found most suitable for BARI Strawberry-2 and 0.5 mg/l BAP + 0.5 mg/l Kn + 1.5 mg/l GA<sub>3</sub> was for BARI Strawberry-3. In rooting,  $\frac{1}{2}$  MS medium without hormone produced maximum root than full strength of MS medium. For *ex vitro* establishment, hundred percent plantlets were survived in potting media with soil and cocodust mixture at the ratio of 1: 1. In 2022-2023, all together 1806 plantlets were produced in Lab and 441 plantlets were distributed among the farmers and other interested people and rest of the plantlets were maintained in the greenhouse.

### 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 the farm field of Hill Agricultural Research Station, Raikhali, Rangamati. Shoot tips were separated from those suckers and cultured on different shooting and rooting media for *in vitro* plantlet production. In BARI Kala-3, 60% explants were survived and average number of shoots per explant was 7.2, whereas in BARI Kala-4, 62.85% was survived and average number of shoots per explant was 7.1.

**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 double cotyledonary nodes of BARI Mung-7 was used as explants source. There were four treatments which consist of different concentrations of BAP and NAA for shoot regeneration. Shoot bud initiation started earlier at 6 days and latter at 18 days after inoculation of explant in the medium using double cotyledonary node explant. The maximum shoot number (3.00), highest shoot length (5.15 cm), maximum number of leaves (5.5) and higher number of roots (6) were obtained from 1.0 mg/l BAP + 0.2 mg/l NAA treatment. The highest responsive explants (90%) were obtained from 1.0 mg/l BAP + 0.2 mg/l NAA and 3.0 mg/l BAP + 0.2 mg/l NAA treatments in embryonal axes explant.

***In vitro* regeneration of country bean**

N. Bilkish, M. K. Hasan, M. M. Khatun and M. A. Y. Akhond

A study was undertaken to develop an efficient regeneration protocol for country bean.

Cotyledonary node explants of BARI Sheem-3 and BARI Sheem-8 were cultured on MS media supplemented with different concentrations and combinations of growth regulators. Shoot bud initiation started at 5-6 days after inoculation of explant in different treatments. Among the different treatments, 3.0 mg/l BAP showed better response for shoot formation in both varieties BARI Sheem-3 (88%) and BARI Sheem-8 (77%).

**Rescue of Amritsagar banana from extinction through biotechnological approaches**

S. C. Halder and M. A. Y. Akhond

Several clones of Amritsagar banana was collected from different location of the country and a mother orchard has been established at the research field of Biotechnology Division, BARI, Gazipur. Amritsagar banana collected from Gafargaon and Kapashia were found to be better than other varieties and were compared with each other by following the standard descriptor for Banana (*Musa* spp.). Among the two varieties for morphological data, Amritsagar Gafargaon performed better in average number of fruits per plant (68), number of

hands per plant (6), weight of single fruit (112.2 gm) and bunch weight (9 kg). Shoot tips of Amritsagar banana (Gafargaon & Kapashia) were cultured on MS medium supplemented with 5 mg/l BAP. Amritsagar Gafargaon produced maximum number of shoots than Amritsagar Kapasia.

**Development of an *in vitro* regeneration protocol for blackgram**

M. K. Hasan, M. N. Amin, M. M. Khatun and M. A. Y. Akhond

An attempt has been made to develop an *in vitro* regeneration protocol of blackgram using explants from axillary shoots originating from the nodes of seedlings germinated in cytokinin containing medium. Four different concentrations and combinations of BAP, NAA and TDZ used in MS media. In shoot formation, 2.0 mg/l BAP treatment performed better and for rooting, 1.5 mg/l IBA treatment showed good root system.

**Development of an efficient *in vitro* regeneration protocol for field pea**

A.Saha, K. Nahar, M.M. Khatun and M.A.Y. Akhond

A study was undertaken to develop an efficient regeneration protocol for BARI Motor-2. Sliced embryonal axes were used as explants source. There were six different treatments and one control which consist of modified MS media containing different concentrations of BAP and NAA for callus induction. Explant treated with 2 mg/l BAP and 1 mg/l NAA treatment produced maximum number of callus (98%). Among the five treatments for shoot formation, 4.5 mg/l BAP and 0.02 mg/l NAA treatment showed highest regeneration (49%) and maximum number of shoots (11.2) whereas the highest length of shoot (3.5 cm) was observed in 5.0 mg/l BAP and 0.02 mg/l NAA treatment.

**Varietal improvement of oyster mushroom through induced variation**

S.Yesmin, K. Nahar and M. M. Khatun

Pure culture, mother culture and spawn packets of seven species (*Pleurotus* sp.) of oyster mushrooms (PO<sub>2</sub>, OS, Ob, POP, HK, PO<sub>10</sub>, WS) were produced in tissue culture laboratory, Biotechnology Division under *in vitro* condition.

### ***In vitro* conservation of mycelia of oyster mushroom**

S. Yesmin, M. K. Hasan and M. M. Khatun

Two species of oyster mushrooms (OS, POP) were preserved in sterile distilled water and paraffin oil at 4°C. Other five species were placed in PDA media and after completion of mycelium running those were also preserved in same way.

## **Molecular Genetics and Genetic Engineering**

### **Transformation of tomato for broad spectrum resistance against leaf curl viruses**

M. A. Y. Akhond, K. Nahar, S. Ahmed and M. R. Kabir

Several experiments were conducted with a view to genetically transform tomato plants for broad-spectrum resistance against leaf curl viruses. Two binary vectors harbouring different promoter-terminator combinations having GUS and GFP reporter genes have been constructed for optimisation of transformation protocol. Based on the genome sequence of various ToLCV strains, DNA fragments from three diverse ToLCV species along with two tomato introns were amplified and cloned. Both the virus and intron sequences were assembled into sense/antisense configurations into *Escherichia coli* using standard protocols. In-house made vectors were tentatively named pBPA-BARI followed by a number. All the plasmid vectors were mobilised into electro-competent *Agrobacterium* cells prepared in-house and their presence in the *Agrobacterium* was confirmed by PCR analyses. Transformations were carried out using the confirmed *Agrobacterium* clones resulted in plant regeneration.

### **Exploring the development of gametophyte – mediated genetic transformation systems in crop plants**

M. A. Y. Akhond, K. Nahar, N. Bilkish and Roland Schafleitner

Genetic transformation is a powerful tool for plant improvement programmes. Most of the transformation methods developed are based on *Agrobacterium*-mediated transformation and biolistic bombardment which are time- and labour-intensive. Therefore, it is desirable to develop

alternate simple and rapid transformation protocols for development of transgenic plants without a prolonged tissue culture and regeneration process. Although it has been shown that plant gametophytes could be a potential target for transformation as an alternative to produce transgenic plants, a reproducible method is still lacking in most of the crop plants. To fulfill the objectives of the experiment, stages of flower buds of eggplant and mustard harbouring male gametophytes at mid uninucleate stage have been identified. Three pollen-specific promoters and one reporter gene has been cloned. Results obtained in this experiment could lead the way for an optimized system for gametophyte-mediated transformation for crop plants in future.

### **Development of an efficient regeneration and an *Agrobacterium*-mediated transformation and gene editing protocol for an elite BARI lentil variety**

K. Nahar, P. Bhowmik, Andrew G. Sharpe and M. A. Y. Akhond

To establish an efficient genetic transformation protocol of a BARI lentil variety, shoot regeneration and rooting media is being tested. For regeneration of lentil, embryonic axis were sliced and cultured on MS medium supplemented with B5 vitamins and different growth regulators. Total 175 explants of BARI Masur-4 (BM-4), 100 explants of BARI Masur-8 (BM-8), 75 explants of BARI Masur-9 (BM-9) and 25 explants of CDC Maxim were cultured on callus induction medium. BM-4 produced 138 callus, BM-8 produced 31 callus, BM-9 produced 70 callus and CDC Maxim produced 15 callus. Higher percentage of callus producing explants were found in BM-4 and BM-9.

### **Performance evaluation of black gram mutants**

M.N. Amin, S.C. Halder M. K. Hasan and M.A.Y. Akond

The selection was made across the BARI Mash-3 mutant populations, searching for mutants for earliness, increased number of pods per plant, increased pod length, increased pod numbers per cluster, increased seed numbers per pod, and single plant yield. Randomly selected 89 M<sub>2</sub> generation seeds of individual plants were collected and preserved for growing M<sub>3</sub> generation.



## Validation/On-Farm Trials

### Validation trial of tissue cultured plantlets of BARI strawberry varieties under field condition

M.M. Khatun, S.C. Halder and M.A.Y. Akhond

Tissue cultured plantlets of BARI Strawberry-2 and BARI Strawberry-3 were used in this study. For morphological traits, BARI Strawberry-2 plantlets performed better in leaves number per plant at different days after planting (DAP). The maximum leaves per plant 17.7 and 33.3 were counted at 55 DAP and 80 DAP. In plant height, at 30 DAP and 55 DAP, BARI Strawberry-3 gave higher plant height but at 80 DAP, BARI Strawberry-2 produced highest plant height (18.90 cm). In yield contributing characters, the higher fruits/plant (36), single fruit weight (17.76 g) and fruit yield/plant (631.00 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.

### Feed the Future Bt Eggplant and LBR Potato Research Activities

#### Sustaining of Bt eggplant in Bangladesh by implementing effective stewardship practices

M. K. Hasan, A. Saha, A. K. M. Quamruzzaman and M. A. Y. Akhond

The overall aim of the stewardship approach is to maximize the benefits, minimize any risk, and make the technology durable. To sustain the first GE crop Bt eggplant in the long run some activities were performed like maintenance and purification of the Bt eggplant varieties/lines, seed production, Bt trait assessment, field study to select the agronomically superior line to develop further Bt eggplant varieties. Shiny and oval shaped fruits were selected from desired fruits of BARI Bt Begun-3 and seeds were kept separately. Total 497 Kg seeds of different BARI Bt Begun varieties were harvested in 2022-2023. Presence of Bt gene

in the Bt eggplant plants in different seed sources were assessed by qualitative ELISA test and all the plants showed positive results. For selection of genetically superior line, local cultivar 'Bhangor' performed better among the other cultivar/lines.

#### 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. The SSR markers used in the present study were not able to differentiate genotypes divergence.

#### Confined field trial of transgenic 3R-gene late blight resistant potato events

M. M. Khatun, S. C. Halder, M. M. Begum, P. Wharton, K. Hokanson, D. Douches and M. A. Y. Akhond (PD)

In confined field trial, a comparison of agronomic characteristics, including phenotype and efficacy against late blight pathogen in Bangladesh was investigated. Plant started to emerge 7.5 days after planting. Due to late planting, emergence was very slow. After 15 days, 71.09-75.00% plants and after 35 days, 98.44 - 99.22% plants were emerged from all 3 lines. Phenotypically there was no significant difference between the two events compared to Non-GM Diamant in all the parameters studied. These results indicated that there were no unanticipated differences between GM and Non-GM Diamant. Due to late planting and high temperature all the time, tuber production was hampered. Only very few tubers were formed. Among the two events, DIA-MSU-UB015 produced more number of tuber and higher weight (g) than DIA-MSU-UB255.

# SOIL MANAGEMENT

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## Physical Aspects of Soil Management

### Determination of crop co-efficient values of cauliflower through Lysimetric study

A.T.M.A.I. Mondol, M.J. Alam, M.S. Islam, R.S. Smriti and H.M. Naser

A study was conducted to determine the Kc value of cauliflower using a Lysimeter for the Gazipur region (AEZ-28). Four irrigation water regimes viz; T<sub>1</sub>: Irrigation up to FC at 5-day intervals (13 irrigations), T<sub>2</sub>: Irrigation up to FC at 10-day intervals (7 irrigations), T<sub>3</sub>: Irrigation up to FC at 15-day intervals (5 irrigations), and T<sub>4</sub>: Irrigation up to FC at 20-day intervals (3 irrigations) were tested based on field capacity (FC) following the RCB design with three replications. The irrigation scheduling significantly influenced the yield of cauliflower. The highest yield (75.47 t ha<sup>-1</sup>) was obtained in T<sub>2</sub> treatment. Similarly, the same treatment has been provided the superior estimated Kc values of 0.50, 0.55, 1.05, and 0.62 for initial, crop development, mid-season, and late-season stages, respectively. However, the Kc value can be utilized to quantify the amount or schedule the irrigation water for individual crops of a specific area.

### Different ages compost influence carbon dioxide emission, soil properties, and yield of red amaranth

A.T.M.A.I. Mondol, M.S. Islam, M.J. Alam, R.S. Smriti and H.M. Naser

The study was conducted to evaluate the CO<sub>2</sub> emission and changes in soil physical and chemical properties including the yield of red amaranth (AEZ-28). The treatments like; T<sub>1</sub>: 30, T<sub>2</sub>: 45, T<sub>3</sub>: 60, T<sub>4</sub>: 75 days ages of compost were compared with T<sub>5</sub>: chemical fertilizers followed by RCBD design with three replications. The different ages of compost significantly affected the soil properties. Application of 75 DAC increased nutrient content,

moisture content (50%), OM (16%), and reduced soil compaction by 27.9% compared to fertilizer while the lowest emission of CO<sub>2</sub> resulted in the same treatment over the amended treatments. Of the treatments, 75 DAC provided higher root mass density (85%) and yield (112%) over chemical fertilizers. However, fully mature compost could be utilized as a substitute for chemical fertilizers for the production of red amaranth.

### Effect of conservation tillage 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, M.S. Islam, R.S. Smriti and H.M. Naser

A field experiment on Cabbage-Indian spinach-T.aman rice cropping pattern was conducted in Grey Terrace soil (AEZ-28) to investigate the crop performance in said cropping pattern and to observe the soil physico-chemical properties. 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 rice equivalent yield than conventional tillage whereas IPNS package gave the maximum rice equivalent than other to nutrient packages. Strip tillage along with IPNS packages gave more field capacity, pH, OM and soil nutrient elements and less soil bulk density and penetration resistance.

### Requirement of nitrogen for Mustard-Okra-T.Aman cropping system under on conservation tillage practices

M.J. Alam, A.T.M.A.I. Mondol, M.S. Islam, R.S. Smriti and H.M. Naser

A field experiments on Mustard-Okra-T.aman rice cropping pattern was conducted in Grey Terrace

soil (AEZ-28) to investigate suitable tillage and nitrogen rate on crop performance and to evaluate the effect of nitrogen and tillage on soil physico-chemical properties. There were 3 types of tillage such as strip tillage (ST), zero tillage (ZT) and conventional tillage (CT). In addition, nitrogen management 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. Zero tillage performed the best for mustard, okra and T. aman rice and rice equivalent yield compare to other two tillages. 25% extra nitrogen of recommended dose gave the highest result for component crops and rice equivalent yield. Both the soil physical and chemical characters were improved little bit in some content compare to initial soil value.

#### **Integrated nutrient management for cutting of Kangkong under minimum tillage system**

A.T.M.A.I. Mondol, M.J. Alam M.S. Islam, R.S. Smriti and H.M. Naser

A field experiment on transplanting Kangkong was conducted in (AEZ-28) to determine the suitable rate of IPNS-based fertilizer for Kangkong production through cutting transplanting and to observe the change of soil physico-chemical properties. The study included six nutrient treatments such as 80% ( $T_1$ ), 100% ( $T_2$ ), 120% ( $T_3$ ), RD of chemical fertilizer, 80% RD of chemical fertilizer with 7.5 t ha<sup>-1</sup> cowdung ( $T_4$ ), 100% RD of chemical fertilizer with 5.0 t ha<sup>-1</sup> cowdung ( $T_5$ ), 120% RD chemical fertilizer with 2.5 t ha<sup>-1</sup> cowdung ( $T_6$ ) as soil test basis in a randomized complete block design with 3 replications. Integrated nutrient management packages significantly affected the growth and yield of Kangkong. Among the treatments  $T_4$  demonstrated the higher yield (53.75 t ha<sup>-1</sup>) at par to  $T_5$  (47.16 t ha<sup>-1</sup>) while the lowest yield (37.83 t ha<sup>-1</sup>) found from  $T_1$ . However,  $T_4$  treatment increased 42% higher yield compared to  $T_1$ . Thus,  $T_4$  package can be applied for Kangkong production under the minimum tillage practice.

#### **Integrated nutrient management for cutting of Indian spinach under minimum tillage system**

M.J. Alam, A.T.M.A.I. Mondol, M.S. Islam, R.S. Smriti and H.M. Naser

A field study was performed on transplanting of Indian spinach cutting in (AEZ-28) to observe crop

performance under minimum tillage and IPNS-based fertilizer management and also to assess the changes in soil physico-chemical properties. The six nutrient packages with and without organic amendment such as 100% ( $T_1$ ), 120% ( $T_2$ ), 80% ( $T_3$ ) of recommended chemical fertilizer, 80% of recommended chemical fertilizer with 7.5 t ha<sup>-1</sup> cowdung ( $T_4$ ), 100% of recommended chemical fertilizer with 5.0 t ha<sup>-1</sup> cowdung ( $T_5$ ), 120% of recommended chemical fertilizer with 2.5 t ha<sup>-1</sup> cowdung ( $T_6$ ) as soil test basis in a randomized complete block design with 3 replications. The IPNS-based fertilizer management significantly influenced the growth and yield of transplanting Indian spinach. Of the nutrient packages, the highest value of yield (32.34 t ha<sup>-1</sup>) was obtained in  $T_4$  while the lowest was noted (26.67 t ha<sup>-1</sup>) from  $T_1$ . Nevertheless, the yield increased 21% in  $T_4$  over the  $T_1$  treatment. Little increment of soil physico-chemical properties was occurred compare to initial soil

#### **Response of mustard to fertilizer management under zero tillage in Mustard-Fallow-B. Aman cropping pattern in Cumilla region**

M. M. H. Bhuiyan, M. O. Kaisar and H. M. Naser

The program was carried out at the farmer's field at Sreerampur, Nabinagar, Brahmanbaria during 2022-23 to determine how zero tillage (relay cropping) affects mustard production when grown using the Mustard-Fallow-B. Aman cropping pattern and to provide balanced fertilizer recommendations for increasing mustard yield under zero tillage conditions. The experiment was laid out in a randomized complete block design with four treatments (75%, 100%, and 125% of RDCF (FRG-2018) for mustard and Farmers' practice) replicated three times. The seed yield and yield attributes like siliqua plant<sup>-1</sup> and thousand seed weight were influenced significantly due to chemical fertilizer application amounts under zero tillage conditions. The highest seed yield (2216.7 kg ha<sup>-1</sup>) was found at 125% of RDCF (FRG-2018) for mustard. But the highest BCR (4.73) was achieved in 75% of RDCF (FRG-2018) for mustard.

#### **Response of sunflower to fertilizer management under zero tillage in Sunflower-Fallow-B. Aman cropping pattern in Cumilla region**

M.M.H. Bhuiyan, M.O. Kaisar and H M Naser

The program was initiated at the farmer's field at Sreerampur (AEZ-17), Nabinagar, Brahmanbaria in



2022–2023 to figure out how zero tillage (relay cropping) impacts sunflower productivity when cultivated utilizing the sunflower–Fallow–B. Aman cropping pattern and to provide balanced fertilizer recommendations for growing sunflowers under zero tillage conditions. Four treatments (75%, 100%, and 125% of RDCF (FRG-2018) for mustard and Farmers' practice) were used in the experiment, which was set up in a randomized complete block design and replicated three times. Chemical fertilizer application rates had a major effect on seed yield and yield parameters such as head diameter, number of seeds per head, and 1000 seed weight under zero tillage conditions. The highest seed yield (2274.3 kg ha<sup>-1</sup>) was noted at 125% of RDCF (FRG-2018) but the greatest BCR (5.38) was attained in 75% of RDCF (FRG-2018) for sunflowers.

## 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, Nazmus Salahin, Ms Alam and H. M. Naser

A long-term field experiment was conducted from 2000 to 2022 in the High Ganges Floodplain soils (AEZ-11) of RARS, Jashore, and Ishurdi to evaluate sustainable fertilizer recommendations for the Wheat-Mungbean-T.Aman cropping pattern. The study utilized a randomized complete block design with six treatments ranging from 125% recommended dose (RD) to native nutrient and farmers' practice. The results consistently showed that the 125% RD treatment consistently yielded the highest crop yields, similar to the yields obtained with the 100% RD treatment. The T<sub>1</sub> treatment (125% RD) had the highest total rice yield at 14.75 tons per hectare per year, highest gross margin of 154,198 Tk-1ha<sup>-1</sup>yr<sup>-1</sup>, and a benefit-cost ratio of 2.09. These findings suggest that using 125% RD can be recommended for sustainable yields, soil health, and economic returns in the Wheat-Mungbean-T.Aman cropping pattern.

### Nutrient management for sustaining soil fertility and yield of Mustard-Mungbean-T.aman cropping pattern

M M Masud, N U Mahmud, Nazmus Salahin, M Sultana and H. M. Naser

A long-term field trial from 2000-2022 in Jashore and Ishordi evaluated the Mustard-Mungbean-

T.Aman cropping pattern in High Ganges Floodplain Soils (AEZ 11). Objectives included determining sustainable fertilizer doses, monitoring soil health, and estimating nutrient uptake. Different levels of N, P, and K were tested. The combination of 120-54-70-40-3-1 kg ha<sup>-1</sup> of NPKSZnB (T<sub>5</sub>) resulted in the highest mustard seed yield (1.54 t ha<sup>-1</sup>) and mungbean and T.aman rice grain and straw yield. T<sub>5</sub> treatment achieved the highest total rice (system) yield (14.89 t ha<sup>-1</sup>yr<sup>-1</sup>) and gross margin (1,37,151 Tk-1ha<sup>-1</sup>yr<sup>-1</sup>) with a BCR of 1.85. Nutrient balance showed removal of N, P, K, and Zn from the soil, with N and K removal exceeding the amount added. Ploughing down 90 t ha<sup>-1</sup> of mungbean biomass added P, S, and Zn to the soil.

### Effect of co-composting biochar on Cabbage-Indian spinach-T.aman productivity

M.M. Masud, M. Sultana and H. M. Naser

A field study at the BARI research field from 2021 to 2023 explored the effects of Co-Composting Biochar (COMBI) on soil fertility, carbon sequestration, and crop yield in a Cabbage-Indian spinach-T.aman cropping pattern. Six treatments, including chemical fertilizer, compost, rice husk biochar (RHB), and COMBI, were tested along with a control group. The treatment with 80% recommended chemical fertilizer and 5 t ha<sup>-1</sup> COMBI (T<sub>4</sub>) yielded the highest rice equivalent yield (REY), with over 172% increase compared to the control. Applying 5 t ha<sup>-1</sup> organic compounds, particularly COMBI, increased yields by 9% to 29%, while 3 t ha<sup>-1</sup> COMBI resulted in a 20% REY increase. T<sub>4</sub> treatment yielded the highest gross margin (BCR 6.99) and benefit-cost ratio suggesting that COMBI provides stable nutrient supply for Cabbage-Indian spinach-T.aman in Grey Terrace Soil.

### Development and performance evaluation of composite fertilizers using maize

M.M. Masud, M. Sultana and H. M. Naser

Composite fertilizers were developed using biochar with varying surface charges and combined with macro and micronutrients. A field study on popcorn cultivation in Grey Terrace Soil at the Central Research Field, BARI, Gazipur demonstrated that these fertilizers significantly enhanced nutrient uptake and crop yields. Among the composite fertilizer, BS<sub>1</sub>(Biochar@ 0.75 t ha<sup>-1</sup>+

$N_{64}P_{34}K_{105}S_{26}B_{0.98}Zn_{1.35}Mo_{0.30}Mg_{4.95}$  Kg ha<sup>-1</sup>) composite fertilizer, showed the most favorable outcomes in terms of plant height, cob characteristics, grain yield, and economic viability. These findings highlight the importance of nutrient management for sustainable pop corn farming in Bangladesh.

#### **Efficacy of different form of urea on nitrogen availability and yield of maize**

M.M. Masud, M. Sultana and H. M. Naser

A maize experiment was conducted at BARI, Gazipur tested different forms of urea during the rabi season of 2022-23. Four treatments were tested: T<sub>1</sub> (N-control), T<sub>2</sub> (225 kg ha<sup>-1</sup> of nitrogen as Prilled urea), T<sub>3</sub> (200 kg ha<sup>-1</sup> of nitrogen as urea super granule or USG), and T<sub>4</sub> (205 kg ha<sup>-1</sup> of nitrogen as neem coated urea). The experiment followed a randomized complete block design with three replications. T<sub>3</sub> (urea super granule) had highest yield (10.81 tha<sup>-1</sup>), followed by T<sub>4</sub> (neem coated urea, 10.03 tha<sup>-1</sup>). T<sub>1</sub> (N-control) had lowest yield (7.09 tha<sup>-1</sup>). T<sub>3</sub> had highest gross margin (157365 Tk/ha) and MBCR (13.2). Neem coated treatment had slightly lower results. Prilled urea had lowest values. USG performed best in yield and efficiency, followed by neem coated urea.

#### **Effect of different form and doses of urea fertilizer on nitrous oxide emission, nitrogen use efficiency and yield of broccoli**

M. R. Khatun, M. M. Masud, M. M. Sultana, I. S. M. Farhad, A. Barman and H. M. Naser

The experiment evaluated three types of urea (i.e. Prilled Urea, Neem Coated Urea, Urea Super Granules) at the rates of 100, 140, and 180 kg N ha<sup>-1</sup> on broccoli (var. green magic) crop. The RCB design with three replications was used, applying P, K, S, Zn, and B @ 60, 90, 20, 3 & 1.5 kg ha<sup>-1</sup> as basal. Results showed that, T<sub>9</sub> treatment (180 kg N ha<sup>-1</sup> as USG) produced highest yield (16.38 t ha<sup>-1</sup>), closely followed by T<sub>6</sub> treatment (180 kg N ha<sup>-1</sup> as NCU) with yield 16.18 t ha<sup>-1</sup>. T<sub>9</sub> treatment had the highest nitrogen use efficiency (51%) and highest yield increase over control (56%), and it was similar to T<sub>6</sub> treatment (55% yield increase). Cost and return analysis revealed, T<sub>6</sub> treatment (180 kg N ha<sup>-1</sup> as NCU) gave the highest gross margin and highest BCR.

#### **Development of fertilizer recommendations for Onion-Linseed intercropping**

M. R. Khatun, M. M. Masud, M. M. Sultana, I. S. M. Farhad, A. Barman and H. M. Naser

The experiment conducted at Gazipur (AEZ-28) aimed to develop a fertilizer recommendation for onion-linseed intercropping. Six treatments (T<sub>1</sub>: 100% RDCF of Onion, T<sub>2</sub>: T<sub>1</sub> + 20% RDCF of Linseed, T<sub>3</sub>: T<sub>1</sub> + 30% RDCF of Linseed, T<sub>4</sub>: T<sub>1</sub> + 40% RDCF of Linseed, T<sub>5</sub>: T<sub>1</sub> + 50% RDCF of Linseed, T<sub>6</sub>: T<sub>1</sub> + 60% RDCF of Linseed) were tested in a RCB design with three replications. Onion (var. BARI Piaz-4) and linseed (var. Nila) were used in the experiment. The results showed significant effects of different treatments on onion and linseed yield and yield-contributing characters. The highest yields (onion: 13.47 t ha<sup>-1</sup> and linseed: 1.06 t ha<sup>-1</sup>) were obtained in T<sub>6</sub> treatment, which received 100% RDCF of onion and 60% RDCF of linseed. Economic analysis indicated that, T<sub>6</sub> had the highest gross margin and highest BCR (3.10). The yield increase over the control was 31.6% for onion and 49.1% for linseed. However, as it was the first-year experiment, repetition is necessary.

#### **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 was conducted in Gazipur from 2008 to 2022 to determine the suitable fertilizer combination for sustainable yield in the Maize-Mungbean-T.Aman cropping pattern. Six treatments were tested, including native fertility and various combinations of chemical fertilizers (based on soil tests) with cow dung (CD), and poultry manure (PM). The experiment was laid out in RCB design with four replications. Data revealed that, the T<sub>5</sub> (100% STB chemical fertilizer + 3 t ha<sup>-1</sup> PM) produced the highest total rice (system) yield of 16.28 t ha<sup>-1</sup> yr<sup>-1</sup>. Similar trends were observed in average crop yields (maize, mungbean & T. Aman). The control treatment (T<sub>1</sub>) had the lowest yield of 6.53 t ha<sup>-1</sup> yr<sup>-1</sup>. Incorporating organic manure and chemical fertilizers improved the nutrient status in soil, with positive phosphorus balance and negative balances in nitrogen, potassium, and sulfur. Cost and return analysis showed that treatment T<sub>5</sub> had the highest gross margin (2,36,881/- Tk ha<sup>-1</sup>) and highest MBCR (2.20), making it a preferable option.

for farmers due to its higher profitability and sustainable soil fertility.

#### **Effect of different organic manures on carbon accumulation in soil and yield of crops in Mustard-Mungbean-T.Aman rice cropping pattern**

M. R. Khatun, M. M. Masud, M. Sultana, I. S. M. Farhad, A. Barman and H. M. Naser

A field experiment in Gazipur (AEZ-28) from 2021 to 2023 assessed the effect of different organic manures on soil carbon accumulation and crop yield under Mustard-Mungbean-T.Aman rice cropping pattern. Nine treatments, including different type and rate of organic manures combined with integrated plant nutrient system (IPNS) and a control, were tested. Mustard (var. BARI Sarisha-17), mungbean (BARI mung 6), and T. Aman rice (BRRIdhan 75) were the tested crops and varieties. The data indicated that IPNS treatments significantly influenced yield characteristics and grain yield. The highest average grain yields for mustard ( $2.05 \text{ tha}^{-1}$ ), mungbean ( $1.46 \text{ tha}^{-1}$ ), and T. Aman rice ( $5.27 \text{ tha}^{-1}$ ) were observed in the  $T_4$  treatment ( $7.5 \text{ tha}^{-1}$  Bioslurry + IPNS).  $T_4$  treatment also resulted in improved nutrient status in soil after harvest. Cost and return analysis revealed,  $T_4$  had the highest gross return and gross margin, while the highest BCR was found in the  $T_3$  treatment ( $5 \text{ tha}^{-1}$  Bioslurry + IPNS).

#### **Effect of different levels of sulphur and boron on yield and nutrient uptake of sesame**

M. R. Khatun, M. M. Masud, M. M. Sultana, I. S. M. Farhad, A. Barman and H. M. Naser

The experiment conducted at Gazipur (AEZ-28) focused on investigating the effect of different levels of sulphur and boron on the yield and nutrient uptake of sesame during the 2022-23. Two sulphur levels (i.e.  $15$  &  $30 \text{ kg ha}^{-1}$ ) and four boron levels (i.e.  $0.5$ ,  $1.0$ ,  $1.5$ , &  $2 \text{ kg ha}^{-1}$ ) were tested in a randomized complete block design with ten treatments. The sesame variety used was BARI Till 4. Results indicated that yield-contributing characters and seed yield were significantly influenced by the fertilizer treatments. The highest seed yield was obtained in  $T_8$  treatment ( $30 \text{ kg ha}^{-1}$  sulphur and  $2.0 \text{ kg ha}^{-1}$  boron), which also exhibited the highest nutrient uptake by the sesame crop. Cost and return analysis revealed that the  $T_8$

treatment had the highest gross return, gross margin and BCR. It was first-year experiment, and its repetition is necessary.

#### **Utilization of banana peel fertilizer on increasing tomato yield and improving soil fertility**

M. R. Khatun, M. M. Masud, M. M. Sultana, I. S. M. Farhad, A. Barman and H. M. Naser

A pot experiment was conducted at BARI, Gazipur from 2021 to 2023 to investigate the effect of banana peel fertilizer (BPF) on tomato yield and soil fertility. Six treatments were tested, including different combinations of recommended dose of chemical fertilizer (RDCF) with varying percentages of BPF. The tomato variety used was BARI tomato 16. The experiment followed a CRD with four replications. Results showed that the growth and yield of tomato were significantly influenced by the treatments. The highest tomato yield ( $2.36 \text{ kg plant}^{-1}$ ) was achieved with the  $T_3$  treatment ( $100\%$  RDCF +  $20\%$  BPF), while the control treatment ( $T_6$ ) had the lowest yield ( $0.20 \text{ kg plant}^{-1}$ ). The  $T_3$  treatment also exhibited the highest nutrient uptake by the tomato crop. Post-harvest soil analysis revealed, increased nutrient content compared to initial soil, particularly in  $T_3$  treatment.

#### **Effect of organic and inorganic fertilizers on growth, yield, quality and nutrient uptake of linseed**

Marufa Sultana, M M Masud and H. M. Naser

A field experiment was conducted during the rabi season of 2022-23 at Bangladesh Agricultural Research Institute, Gazipur, aiming to identify an optimal and cost-effective fertilizer dose for maximizing linseed yield. The experiment consisted of eight treatments with varying fertilizer compositions, replicated three times in a randomized complete design. The results indicated that the combined application of  $75\%$  of the recommended dose along with  $5 \text{ tha}^{-1}$  vermicompost (VC) yielded significantly superior outcomes compared to other treatments. This treatment exhibited remarkable results, including maximum plant height ( $55.5 \text{ cm}$ ), number of branches per plant ( $6.8$ ), number of capsules per plant ( $66.7$ ), number of seeds per capsule ( $9.73$ ), thousand seed weight ( $5.31 \text{ g}$ ), straw yield ( $2.84 \text{ tha}^{-1}$ ), and seed yield ( $1.28 \text{ tha}^{-1}$ ). This integrated



approach using inorganic fertilizers and VC can enhance linseed production and soil fertility.

### **Effect of organic and inorganic fertilizer on soil properties and yield and quality of safflower**

Marufa Sultana, M M Masud and H M Naser

The present study aimed to assess the impact of different fertilizer compositions on soil properties, as well as the yield and quality of safflower seeds (*Carthamus tinctorius* L.) of the "BARISaf-1" cultivar. Six treatments with varying fertilizer compositions were replicated thrice in a randomized complete design. The field trial results revealed that the combined application of 50% recommended dose (RD) of fertilizer along with compost at a rate of 4 t ha<sup>-1</sup> resulted in the best outcomes. This treatment exhibited statistically significant improvements in various parameters, including maximum plant height (164.4 cm), number of branches per plant (8.77), number of capsules per plant (34.33), number of seeds per capsule (47.37), thousand seed weight (41.11 g), straw yield (3110 kg ha<sup>-1</sup>), and seed yield (465.11 kg ha<sup>-1</sup>), surpassing all other treatments.

### **Nutrient management for watermelon**

Marufa Sultana, S. Yesmin, M. Ratna, N. Akter, M M Masud, Hm Naser and M.I.A. Howlader

A field experiment was carried out at the research field of Regional Horticulture Research Station, Lebukhali, Patuakhali to assess optimum fertilizer dose for watermelon. The experimental treatments were arranged in randomized complete block design with three replicates. From the study it was observed that T<sub>11</sub> (N<sub>60</sub>P<sub>60</sub>K<sub>75</sub>S<sub>20</sub>) and T<sub>14</sub> (N<sub>60</sub>P<sub>60</sub>K<sub>75</sub>S<sub>20</sub>) gave the highest yield, but TSS was lower in this dose. Maximum TSS was recorded in T<sub>4</sub> (N<sub>120</sub>P<sub>60</sub>K<sub>50</sub>S<sub>20</sub>) and T<sub>5</sub> (N<sub>180</sub>P<sub>60</sub>K<sub>50</sub>S<sub>20</sub>). Lowest yield and quality was obtained from T<sub>1</sub> (Native fertility). Yield was moderate in this dose. The experiment will be carried out next year for further evaluation.

### **Development of fertilizer recommendation for chilli with onion intercropping system**

I.S.M. Farhad, H.M. Naser, M.M. Masud, R. Khatun, M. Sultana and A. Barman

An experiment was conducted at Central Research Farm, BARI, Gazipur to develop a fertilizer recommendation for chilli with onion intercropping system. Six treatment combinations were tested

where main crop received 100 % recommended doses and companion crop received 0 to 50% of the recommended doses of chemical fertilizer. Significantly highest yield of chilli (12.18 t ha<sup>-1</sup>) and onion (8.13 t ha<sup>-1</sup>) were obtained from T<sub>6</sub> treatment (100% RDCF of chilli +50% RDCF of onion) which was statistically similar with T<sub>5</sub> treatment (100% RDCF of chilli +40% RDCF of onion). T<sub>6</sub> provided the highest CEY (21.93 t ha<sup>-1</sup>) followed by T<sub>5</sub> (21.88 t ha<sup>-1</sup>). Though T<sub>6</sub> treatment gave higher yield over all the treatments yet it showed lower BCR compared to T<sub>5</sub> 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. Sultana and A. Barman

A field experiment was conducted at Central Research Farm, BARI, Gazipur 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 treatments including different combinations of RDCF and Kitchen waste compost at varying rates were tested. The significantly highest curd yield (16.31 t ha<sup>-1</sup>) was recorded in T<sub>3</sub> treatment (100% RDCF + Kitchen waste compost @5.0 t ha<sup>-1</sup>) whereas the lowest curd yield (5.92 t ha<sup>-1</sup>) was observed from native fertility treatment (T<sub>6</sub>). The highest BCR (2.86) was obtained from T<sub>3</sub> treatment whereas the lowest BCR (1.30) was obtained from native fertility (T<sub>6</sub>) treatment. Application of kitchen waste compost along with chemical fertilizers slightly increased total N, available P, exchangeable K, available S, available Zn, available B as well as carbon accumulation in post-harvest soil. The overall results indicated that 100% RDCF + Kitchen waste compost @ 5.0 t ha<sup>-1</sup> is more effective than other fertilizer management packages in respect of yield as well as economic return for broccoli cultivation at Gazipur district of Bangladesh.

### **Development of fertilizer recommendation for knolkhol maize intercropping system**

I. S. M. Farhad, R. Sen, H. M. Naser, M. M. Masud, R. Khatun, M. Sultana and A. Barman

An experiment was conducted at Central Research Farm, BARI, Gazipur to develop a fertilizer recommendation for maize with knolkhol

intercropping system. Seven treatment combinations were tested where main crop received 100 % recommended doses and companion crop received 0 to 60% of the recommended doses of chemical fertilizer. Significantly the highest yield of maize (8.88 t ha<sup>-1</sup>) and knolkhol (32.14 t ha<sup>-1</sup>) were obtained from T<sub>7</sub> treatment (100% RDCF of Maize +60% RDCF of Knolkhol) which was statistically similar with T<sub>6</sub> treatment (100% RDCF of Maize +50% RDCF of Knolkhol). The results showed that T<sub>7</sub> provided the highest MEY (30.30 t ha<sup>-1</sup>) followed by T<sub>6</sub> (30.13 t ha<sup>-1</sup>). The highest BCR (3.87) were obtained from T<sub>6</sub> treatment whereas the lowest BCR (3.16) were observed in T<sub>1</sub> treatment. Though T<sub>7</sub> treatment gave higher yield over all the treatments yet it showed lower BCR compared to T<sub>6</sub> treatment due to higher cost involvement for inorganic fertilizer.

#### **Effect of tricho-compost on the yield of chili and sustaining the soil health**

F S Shikha, M Yasmin, M M Kadir, M M Masud and H M Naser

A field trial conducted at RARS, Jamalpur investigated the effects of tricho-compost on chili growth, yield, and soil health. Eight treatments were tested, including different combinations of STB (FRG-2018) and tricho-compost at varying rates. The treatment T<sub>4</sub> (70% STB + 3 t/ha tricho-compost) resulted in the highest green chili yield (9.64 t ha<sup>-1</sup>) in 2022-23, while the control plot (T<sub>8</sub>) had the lowest yield (2.72 t ha<sup>-1</sup>). Tricho-compost application increased organic carbon content (0.98%) compared to 100% STB treatment (0.87%). The combined application of 3 t/ha tricho-compost with STB significantly improved nutrient uptake and carbon accumulation. This integrated approach using inorganic fertilizers and tricho-compost can enhance chili production and soil fertility.

#### **Development of fertilizer recommendation for Groundnut-Linseed intercropping system**

F.S.Shikha, M.Yasmin, M M Kadir, M M Masud and H M Naser

A field trial was conducted at Regional Agricultural Research Station (RARS), Jamalpur to develop a suitable and economic fertilizer dose for maximizing the yield for groundnut with linseed

intercropping system. Seven treatments were tested, Significantly the highest yield (1.93 tha<sup>-1</sup> for groundnut and 1.26 tha<sup>-1</sup> for linseed ) was obtained from 100% RDCF of groundnut + 50% RDCF of linseed treatment. The lowest yield (0.91 tha<sup>-1</sup> for groundnut and 0.58 tha<sup>-1</sup> for linseed) from only 100% RDCF of groundnut. The highest groundnut equivalent yield (GEY) (3.06 tha. <sup>-1</sup>) and BCR (2.43) was obtained from 100% RDCF of groundnut + 50% RDCF of linseed treatment and the lowest GEY (1.43 tha. <sup>-1</sup>) and BCR (1.22) from only 100% RDCF of groundnut treatment.

#### **Fertilizer recommendation for bari sarisha-18**

M Yasmin, F S Shikha, M M Kadir, M M Masud and H M Naser

A field trial was conducted at RARS, Jamalpur to determine suitable fertilizer dose for growth and yield of BARI Sarisha-18 crop. Fourteen treatments were tested including four levels of four nutrients (nitrogen, phosphorus, potassium and sulfur). The results showed that the treatment employing N<sub>160</sub> P<sub>20</sub> K<sub>100</sub> S<sub>30</sub> kg ha<sup>-1</sup>, where the moderate dosage of N, P, K, and S was utilized, produced the highest seed yield (2.47 t ha<sup>-1</sup>) and that yield decreased with greater doses of these components. From an economic perspective, this treatment was appropriate and useful. As a result, these fertilizers might be used at the proper rate for BARI Sarisha-18 to produce a larger yield and perform better at Jamalpur region.

#### **Integrated potash management for mustard**

M Yasmin, F S Shikha, M M Kadir, M M Masud and H M Naser

A field trial conducted at RARS, Jamalpur investigated the effects of integrated potash management for higher yield of mustard crop. Six treatments were tested, including potassium rich organic amendments (rice husk ash and rice straw compost) and STB dose at varying rates. In comparison to control or sole STB fertilizer dose, treatment package receiving STB with rice husk ash @ 2 t ha<sup>-1</sup> yielded highest seed yield (1.43 t ha<sup>-1</sup>) and produced maximum BCR (2.72). The highest potassium uptake (97.53 kg ha<sup>-1</sup>) was found in the same treatment. So, the results showed that STB with rice husk ash @ 2 t ha<sup>-1</sup> is superior to other packages in terms of yield and potassium uptake.

### **Integrated nutrient management for potato productivity and soil health**

M Yasmin, F S Shikha, M M Kadir, M M Masud and H M Naser

At RARS, Jamalpur a field trial was conducted investigated the effects of integrated nutrient management for better yield of potato and to improve organic carbon stock in soil. Six treatments were tested, including different compost (compost, kitchen waste compost, vermicompost and trichocompost) and STB dose at varying rates. Results revealed that, the highest tuber yield ( $35.94 \text{ t ha}^{-1}$ ) was found in treatment getting 80 % STB with vermicompost @  $2.5 \text{ t ha}^{-1}$  compare to 100% STB ( $28.90 \text{ t ha}^{-1}$ ) which indicated that sole application of chemical fertilizer was unable to provide enough nutrients to plants. The maximum benefit cost ratio and maximum carbon accumulation were also found in vermicompost treated treatment. The lowest tuber yield of  $19.09 \text{ t ha}^{-1}$  was recorded in the control treatment. Therefore, 80 % STB and vermicompost @  $2.5 \text{ t ha}^{-1}$  may be recommended for higher tuber yield of potato and maintaining soil fertility.

### **Application of vermiwash on yield and quality of tomato**

M Yasmin, F S Shikha, M M Kadir, M M Masud and H M Naser

A field trial conducted at RARS, Jamalpur investigated the effects of foliar application of vermiwash on tomato plant for optimizing the yield and improved nutrition of tomato. Five treatments were tested, including 4 levels of vermiwash rate (10%, 20%, 30%, 40% v/v) and chemical fertilizer. Results revealed that, the highest tomato fruit yield ( $71.52 \text{ t ha}^{-1}$ ) was found in plants receiving 20% concentration of vermiwash and the lowest ( $63.48 \text{ t ha}^{-1}$ ) came from control. On the other hand, nutritional quality (moisture content, TSS, lycopene,  $\beta$  carotene and vitamin C) were seen to be higher in vermiwash treated treatment compared to control. The study suggests that, 20% vermiwash could be used as effective foliar spray for eco-friendly and higher yield of tomato.

### **Effect of different substrate composition on yield of dragon fruit in an extensive green roof**

M A Rahman, M Yasmin, F S Shikha, M M Kadir, M M Masud and H M Naser

A trial was run at the rooftop, RARS, Jamalpur to examine the effects of applying two organic

substrates (biochar and vermicompost) in combination with farm soil in order to improve the quality of the substrate and increase the yield of dragon fruit. Nine treatment combinations were examined, including farm soil and three rates of vermicompost and biochar (0%, 30%, and 40% v/v). The results demonstrate that, combined application biochar and vermicompost were shown to be more effective than their single application. Therefore, treatment combination of farm soil mixed with 30% biochar and 30% vermicompost may be considered as suitable dose for dragon fruit cultivation in rooftop at Jamalpur region of Bangladesh.

### **Development of fertilizer recommendation for winter stem amaranth in Cumilla region**

M M H Bhuyian, Sabikunnahar, M O Kaisarand, H M Naser

A field experiment was conducted at the Regional Agricultural Research Station, BARI, Cumilla to determine the optimal fertilizer dosage for maximizing winter stem amaranth yield. Fourteen treatment combinations of N (0, 40, 80 and  $120 \text{ kg ha}^{-1}$ ), P (0, 10, 20 and  $30 \text{ kg ha}^{-1}$ ), K (0, 30, 60 and  $90 \text{ kg ha}^{-1}$ ) and S (0, 10, 20 and  $30 \text{ kg ha}^{-1}$ ) were tested, along with a control treatment. The experiment followed a randomized complete block design with three replications. The variety used was BARI danta-3. Data was collected at 45, 75, and 120 days after sowing (DAS). The highest plant height (49.6 and 68.5 cm) and stem yield (19.7, 58.8, and  $72.0 \text{ t ha}^{-1}$ ) were achieved with the fertilizer combination  $T_4$  ( $N_{120}P_{20}K_{60}S_{10}$ ) at 45, 75, and 120 DAS, respectively. Increasing nitrogen had a positive impact on yield and yield-contributing parameters, while the control treatment had the lowest values. The  $T_4$  treatment also resulted in the longest stem length and diameter at 120 DAS. The effect of increasing P, K, and S on yield and yield attributes was less significant throughout the growing period.

### **Integrated nutrient management for pineapple in Barishal region**

M.R. Islam and B. C. Kundu

A field experiment was carried out at RARS, Rahmatpur, Barishal during October 2021 to develop proper dose of nutrient for pineapple production in Barishal region of Bangladesh. The crop variety was Giant queue (Rumai). There were eight treatments viz.  $T_0$ : Native fertility  $T_1$ :



$N_0P_{10}K_{50}$   $kg\ ha^{-1}$ ,  $T_2$ :  $N_{50}P_{10}K_{50}$   $kg\ ha^{-1}$ ,  $T_3$ :  $N_{100}P_{10}K_{50}$   $kg\ ha^{-1}$ ,  $T_4$ :  $N_{50}P_0K_{50}$   $kg\ ha^{-1}$ ,  $T_5$ :  $N_{50}P_2K_{50}$   $kg\ ha^{-1}$ ,  $T_6$ :  $N_{50}P_{10}K_0$   $kg\ ha^{-1}$  and  $T_7$ :  $N_{50}P_{10}K_{100}$   $kg\ ha^{-1}$  which was replicated for four times. Fertilizers management had influence on plant yield and yield attributes of pineapple. The highest fruit length (24.75 cm) and breadth (46.00cm) was found in  $T_3$  treatment which was statistically identical to  $T_5$ ,  $T_2$  and  $T_7$  treatments. The highest individual fruit weight (1.48 kg) was found in  $T_3$  treatment which is statistically similar to  $T_5$  and  $T_2$  treatments but significant over  $T_0$  treatment. The highest % TSS (22.65%) was found in native fertility. The maximum fruit yield ( $65.45\ t\ ha^{-1}$ ) obtained from  $T_3$  treatment which is 34.39% higher over control treatment.

#### **Study on soil properties variation through the soil profile in saline areas of seven upazilas of Satkhira district**

O. A. Fakir, M. M. Masud and H.M. Naser

The study investigated the spatial distribution of salt accumulation in the soil profile across seven locations in Satkhira: Satkhira Sadar, Kolaroa, Assasuni, Tala, Kaligonj, Debhata, and Shymnagar. Soil samples were collected from five different depths ( $D_1 = 0-7$  cm,  $D_2 = 8-15$  cm,  $D_3 = 16-23$  cm,  $D_4 = 24-31$  cm, and  $D_5 = 32-39$  cm) at each location. The highest electrical conductivity (EC) value was recorded as  $7.92\ dSm^{-1}$  in Shymnagar at a depth of 16-23 cm, while the lowest value was found in Tala at the same depth with  $0.42\ dSm^{-1}$ . The pH values across all soil depths were generally neutral to slightly alkaline, except in Debhata where it was strongly alkaline. Most of the soils examined exhibited high to medium organic matter content, which decreased significantly with increasing depths across different land uses.

#### **Effect of variety and level of phosphorus on growth and yield of lentil**

M.S. Alam, M.M. Kamal, M M Masud and M.M Uddin

A field experiment at PRC, BARI, Ishurdi assessed lentil varieties (Masur-3, Masur-6, Masur-8) with phosphorus levels ( $P-12\ kg\ ha^{-1}$ ,  $P-18\ kg\ ha^{-1}$ ,  $P-27\ kg\ ha^{-1}$  RDCF). Masur-8 with  $P18\ kg\ ha^{-1}$  exhibited superior results in nodulation, plant population, pod, and yield ( $3.21\ t\ ha^{-1}$ ). Masur-6 with  $P-12\ kg\ ha^{-1}$  had lower yield ( $2.45\ t\ ha^{-1}$ ). Masur-8 with  $P-$

$18\ kg\ ha^{-1}$  had the highest nodule number (22), while Masur-3 with  $P12\ kg\ ha^{-1}$  had the lowest (20). Yield increase ranged from 6.02% to 16.20%. Masur-8 with  $P-18\ kg\ ha^{-1}$  showed higher income, gross margin, and MBCR (6.80). Rhizobium-treated seeds improved lentil production.

#### **Evaluation of physical, chemical, and microbiological soil properties of six unfavourable ecosystems of Bangladesh**

Md Harunur Rashid, M.M.Masud, M. E. Ali, A T M A Mondal and H MNaser

With a view to identifying the constraints of soils in the unfavourable ecosystems of Bangladesh this study was carried out. Surface soils from different locations of Khagrachhari and Khulna were collected and analysed in laboratories of soil science division, BARI, Gazipur during 2022-2023. Results demonstrate that the soils of Khagrachhari and Khulna have the capacity to supply all essential macro and micronutrients adequately for proper crop growth with Khulna soil showing severe zinc deficiency.

#### **Micronutrient Aspects of Soil Management**

##### **Nano scale zinc oxide particles for improving yield and quality of tomato**

H. M. Naser, S. Sultana, M. Akter, M. B. Banu and M. R. Khatun

A field experiment was carried out to study the effectiveness of soil and foliar application of Zn on the yield of tomato. The micronutrients - zinc (Zn) in the form of zinc oxide (ZnO) nanoparticles (NPs) and zinc sulphate heptahydrates ( $ZnSO_4 \cdot 7H_2O$ ) were applied as foliar and basal on the yield of tomato. Zinc supplied to the soil boosted yields, however they were lower than Zn nutrients foliar applied either ZnO nanoparticles or  $ZnSO_4 \cdot 7H_2O$ . The increment of yield were 6.46 to 45.8, 2.62 to 27.0 and 3.90 to 25.0%, respectively over control, soil application ZnO nanoparticles and soil application of  $ZnSO_4 \cdot 7H_2O$ . The treatment with 15 ppm of ZnO nanoparticles produced the highest levels of TSS ( $5.21^\circ$  Brix), vitamin C ( $32.6\ mg\ 100g^{-1}$ ) and  $\beta$  carotene ( $22.6\ mg\ 100g^{-1}$ ). 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, M. R. Khatun and H. M. Naser

A field experiment was conducted to study the effect of boron on the yield and quality of bitter gourd (cv. BARI Karola-4) at Soil Science Division, BARI, Gazipur (AEZ-28) during kharif-1 of 2022-2023. 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 yield and yield contributing character of bitter gourd were significantly influenced by boron application, showing a higher tendency in  $T_4$  treatment except for flower shedding. The highest yield ( $23.42 \text{ t ha}^{-1}$ ) and reduction of flower shedding (50.90%) were observed in  $T_4$  ( $1.5 \text{ kg ha}^{-1}$  B) treatment and these were significantly higher than control plants. The application of boron reduced flower shedding while enhancing the yield and quality of bitter gourd.

**Foliar application of boron on reproductive growth of sunflower**

M. B. Banu, M. Akter, S. Sultana, M. R. Khatun and H. M. Naser

A field experiment was conducted to study the foliar application of boron on the reproductive growth of sunflower (cv. BARI Surjamukhi-3) at Soil Science Division, BARI, Gazipur (AEZ-28) during rabi season of 2022-2023. The objectives of the study were to determine the effect of foliar spray of boron on yield contributing characters of sunflower and to find out the optimum rate of boron for maximizing the yield and quality of sunflower. Boron, as boric acid ( $H_3BO_3$ ), was sprayed at 20-25 and 40-45 days after sowing. Treatment combinations were  $T_1$ : control (distilled water),  $T_2$ :  $50 \text{ mg L}^{-1}$  B,  $T_3$ :  $100 \text{ mg L}^{-1}$  B,  $T_4$ :  $150 \text{ mg L}^{-1}$  B, and  $T_5$ :  $200 \text{ mg L}^{-1}$  B. Treatment  $T_4$  ( $150 \text{ mg L}^{-1}$  B) yielded the most ( $2.25 \text{ t ha}^{-1}$ ), similar to  $T_5$  ( $200 \text{ mg L}^{-1}$  B).  $T_4$  treatment also had the lowest empty seed (19.99%). Foliar application of boron effectively enhanced the reproductive growth of sunflower in Gazipur.

**Bioremediation of heavy metals polluted soil from industrial effluents polluted areas using microbes and biochar**

S. Sultana, H. M. Naser, M. Akter, M.B. Banu and M.R. Khatun

This study was conducted to determine the effects of microbes and biochar to remediate soil contaminated with heavy metals. The lead (Pb), cadmium (Cd), and nickel (Ni), uptake was increased by application of microbes. Biochar immobilized metals in soil and decreased the metal content in plants, except chromium (Cr). Uptakes of metal were increased in amaranth with application of microbes by 2.15 to 29.9, 10.9 to 24.7, and 7.43 to 14.2%, respectively for Rhizobium, Azotobacter, phosphorus solubilizing bacteria. While metal uptake decreased for water hyacinth, barnyard grass and fern plant biochar were 25.8 to 43.4, 30.9 to 48.2 and 23.9 to 46.7%, respectively. The highest value of transfer coefficient was found for (Ni: 0.55) in plant grown in azotobacter treatment and lowest for (Cd: 0.12) in water hyacinth biochar. However, mobilization or immobilization techniques might be used to remediate soil which contaminated with heavy metals.

**Foliar application of manganese on growth and yield of groundnut**

S. Sultana, M. Akter, M. B. Banu, M. R. Khatun and H. M. Naser

A study was conducted at BARI, Gazipur from 2021 to 2023 to assess the effect of foliar-applied manganese on the growth, yield and quality of groundnut (BARI chinabadam 9). The experiment followed a RCB design with three replications, encompassing 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  $0.5 \text{ kg ha}^{-1}$ ,  $T_5$ : Soil application of Mn  $1.0 \text{ kg ha}^{-1}$ . Significantly higher yield ( $2.71 \text{ t ha}^{-1}$ ) was found from 0.04% Mn foliar spray applied to the plants. This trend was consistent across various yield-contributing factors in groundnut. The untreated treatment produced the lowest yield ( $1.83 \text{ t ha}^{-1}$ ). Crude oil, protein% and micronutrient content were also high in the foliar spray treated treatments. 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, R. Khatun and H. M. Naser

A pot experiment was conducted to determine the critical limit of zinc for chickpea grown in twenty soils collected from five AEZs in Bangladesh. The experiment was laid out in a factorial and completely randomized design with two levels of Zn (0 and 5 ppm) using three replications. The available Zn content of soils was estimated by the extraction method using 0.005 M Diethylene Triamine Penta acetic Acid (DTPA). The amount of DTPA extractable Zn in different soils ranged from 0.50 to 2.8 ppm. 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 0.66 ppm in soils and 25.7 ppm in plant tissue as determined by Cate and Nelson's graphical procedure.

### **Effect of zinc and biochar on the yield and nutrient content of sweet gourd**

M. Akter, S. Sultana, M. B. Banu, R. Khatun and H. M. Naser

An experiment was conducted to assess the effect of zinc and biochar on the yield of sweet gourd, to determine the Zn concentration and uptake of sweet gourd, and to identify a suitable combination of Zn application with biochar. Among the eight treatments, the highest yield (30.2 t ha<sup>-1</sup>), highest B-Carotene content (41.4 mg 100 g<sup>-1</sup>) and highest TSS content (7.57°Brix) were obtained in T<sub>6</sub> treatment (2 kg Zn ha<sup>-1</sup> and biochar 3 t ha<sup>-1</sup>). Zn content (89.2 mg kg<sup>-1</sup>) and Zn uptake (0.16 kg ha<sup>-1</sup>) in fruit were also highest in T<sub>6</sub> treatment. Applying Zn and biochar together enhances yield more than applying either one alone. Combined application of 2 kg Zn ha<sup>-1</sup> and biochar 3 t ha<sup>-1</sup> could be a promising strategy for enhancing sweet gourd production in Bangladesh.

### **Effect of soil and water quality on arsenic uptake by irrigated winter upland crops in southwest Bangladesh**

O. A. Fakir and H.M. Naser

Two types of saline soils, S<sub>1</sub> (> 8.0 dSm<sup>-1</sup>) and S<sub>2</sub> (< 8.0 dSm<sup>-1</sup>), were used in the experiment. Arsenic was applied at rates of 0.00 and 0.05 mg L<sup>-1</sup> to both the soil and irrigation water. The test crops, BARI

Begun-12 and BARI Tomato-17, were grown on the experimental soil. Overall, there were no statistically significant differences in yield and major yield contributing parameters for both crops. However, BARI Tomato-17 exhibited statistically significant variations in certain parameters. The highest uptake of As was observed in the fruit of BARI Begun-12 (0.015 ppm) at a salinity level of >8 dSm<sup>-1</sup> and 0.05 mg L<sup>-1</sup> of As, as well as in the fruit of BARI Tomato-17 (0.015 ppm) at a salinity level of <8 dSm<sup>-1</sup> and 0.00 mg L<sup>-1</sup> of arsenic.

### **Effect of zinc and boron on the yield of BARI Sharisa 18**

F S Shikha, M Yasmin, M M Kadir and H M Naser

Zinc (Zn) and boron (B) are essential microelements, playing a vital role in plant processes like metabolism and nutrition. An experiment was conducted at RARS, Jamalpur during 2022-23 to estimate the optimum dose of zinc and boron on the yield and yield components of BARI Sarisha 18. The experiment followed a RCB design with three replications, using four levels of zinc fertilization (0, 2.5, 3.5 & 4.5 kg ha<sup>-1</sup>) and four levels of boron fertilization (0, 1.5, 2.0 & 2.5 kg ha<sup>-1</sup>). Data showed that, the highest seed yield (2.49 t ha<sup>-1</sup>) and produced maximum BCR (3.06) was obtained from Zn<sub>3.5</sub> B<sub>2.5</sub> kg ha<sup>-1</sup> treatment, while the lowest seed yield (1.51 t ha<sup>-1</sup>), BCR (2.36) resulted from control (Zn<sub>0</sub> B<sub>0</sub>) treatment. These recommended Zn and B packages can effectively increase canola seed yield.

### **Microbiological Aspects of Soil management**

#### **Assessment of arbuscular mycorrhizal association in different field crops**

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

Rhizosphere soils including fine roots of some field crops were collected from Central Research Farm, Bangladesh Agricultural Research Institute, Gazipur during 2022-2023 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 64.40 (Joan) to a maximum of 249.0 (Onion). A considerable variation was



observed in average spore numbers recorded in different field crops. Among the field crops, the highest root colonization (40.0%) was found in onion and lower colonization (10.0%) was found in some of the crops like potato, sunflower, garlic, black cumin etc.

#### **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

Eleven rhizosphere soil samples were collected from selected locations of different AEZs of Bangladesh to know the total bacteria, *Rhizobium*, Freelifving bacteria, Phosphate Solubilizing bacteria (PSB), Actinomycetes and Fungal population at different AEZs of Bangladesh. *Rhizobium* was grown in YMA media and *Rhizobium* colonies were counted. Different types of media were prepared for growing of total bacteria, *Rhizobium*, Freelifving bacteria, Phosphate Solubilizing bacteria (PSB), Actinomycetes and Fungal colonies. After serial dilution one drop of solution was poured in a petridish having different types of media. The petriplates were incubated three days for counting total bacteria, *Rhizobium*, Freelifving bacteria, PSB, Actinomycetes and Fungal colonies. The population of different microbes varied in respect of crop and location.

#### **Response of lentil varieties to elite strains of *Rhizobium***

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

Field experiment was conducted at research field of Soil Science Division, Bangladesh Agricultural Research Institute, Gazipur during 2022-2023 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-104) 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, shoot weight and seed yield compared to non-inoculated plants. Among 4 varieties, BARI Masur-

8 produced the highest nodule number (24.50 plant<sup>-1</sup>) and seed yield (1.11 t ha<sup>-1</sup>).

#### **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 2022-2023 in the research field of Soil Science Division, BARI, Joydebpur, Gazipur to find out the effect of different biofertilizer inoculation 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 piyaj-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<sup>8</sup> cells ml<sup>-1</sup> liquid inoculant. Arbuscular mycorrhiza (AM) was used in the seed bed while producing seedling. There were nine treatments viz. T<sub>1</sub> : 100% NPKSZn of RD (Recommended Dose), T<sub>2</sub> : 80% N + *Azotobacter* inoculum, T<sub>3</sub> : 80% P + PSB inoculum, T<sub>4</sub> : 50% P + AM inoculum, T<sub>5</sub> : 80% NP + *Azotobacter* + PSB, T<sub>6</sub> : 80% N + 50% P + *Azot.* + AM, T<sub>7</sub> : 50% P + AM + PSB, T<sub>8</sub> : 80% N + 50% P + *Azot.* + AM + PSB and T<sub>9</sub>: Control. Results of the experiment revealed that the highest bulb yield of onion (21.26 t ha<sup>-1</sup>) was found in T<sub>6</sub> (80% N + 50% P + *Azot.* + AM) treatments which was statistically identical with all other treatments except control. This result suggested that use of *azotobacter* and AM inoculum in combination with reduced dose of N and P fertilizer was beneficial for onion production in the Grey Terrace soils of Gazipur (AEZ 28) and it could reduce 20% of nitrogenous and 50% of phosphatic fertilizer.

#### **Effect of arbuscular mycorrhizal fungi and phosphorus on broccoli**

M.E. Ali, 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, Gazipur during Rabi season of 2022-2023 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 the 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<sup>-2</sup> in seedbed for producing broccoli seedlings. The treatment combinations were: T<sub>1</sub>P<sub>1</sub>U: 0% P × without AM, T<sub>2</sub>P<sub>2</sub>U: 50% P × without AM, T<sub>3</sub>P<sub>3</sub>U: 100% P × without AM, T<sub>4</sub>P<sub>1</sub>AM: 0% P × with AM, T<sub>5</sub>P<sub>2</sub>AM: 50% P × with AM, T<sub>6</sub>P<sub>3</sub>AM: 100% P × with AM. Mycorrhizal inoculation significantly increased plant height (cm), curd height (cm) and curd yield (t ha<sup>-1</sup>). Root length (cm), and curd circumferences (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 25.98 t ha<sup>-1</sup> 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 biofertilizer, vermicompost and chemical fertilizers on cowpea**

M.E. Ali, M.F.A. Anik, M. Rahman and H.M. Naser

A field experiment was conducted at Central Research Farm, Soil Science Division, Bangladesh Agricultural Research Institute, Gazipur during Rabi season of 2022-2023 with the objectives to evaluate the effect of *Rhizobium* biofertilizer, vermicompost and chemical fertilizers on cowpea. The crop variety was cowpea (BARI Fellon-1) and *Rhizobium* strain was BARI RVu-602. There were nine treatments viz. T<sub>1</sub>: Control, T<sub>2</sub>: Vermicompost (VC) @ 2.5 t ha<sup>-1</sup>, T<sub>3</sub>: VC @ 5 t ha<sup>-1</sup>, T<sub>4</sub>: VC @ 2.5 t ha<sup>-1</sup> + Integrated Plant Nutrient System (IPNS) based NPKSZnB, T<sub>5</sub>: VC @ 5 t ha<sup>-1</sup> + IPNS based NPKSZnB, T<sub>6</sub>: VC @ 2.5 t ha<sup>-1</sup> + *Rhizobium* + IPNS based NPKSZnB, T<sub>7</sub>: VC @ 5 t ha<sup>-1</sup> + *Rhizobium* + IPNS based NPKSZnB, T<sub>8</sub>: 100% NPKSZnB, T<sub>9</sub>: *Rhizobium* + 100% NPKSZnB which were replicated three times. Peat based rhizobial inoculum was used at the rate of 1.5 kg ha<sup>-1</sup> as seed inoculant. *Rhizobium* inoculated cowpea with vermicompost @ 5 t ha<sup>-1</sup> and IPNS based NPKSZnB increased nodule number and nodule weight. It was observed that the same treatment produced the highest seed yield (1.04 t ha<sup>-1</sup>, 55.22% higher over control) of cowpea which was differ with all other

treatment except T<sub>5</sub> treatment. This indicates that application of vermicompost @ 5.0 t ha<sup>-1</sup> plus *Rhizobium* inoculant can reduce a considerable amount of chemical fertilizers during cowpea production.

#### **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 biomass, colonization, and yield characters of maize in 8 dS m<sup>-1</sup> saline soil. The experiment was carried out under pot culture conditions in the net house. The experiment was designed in CRD with eight treatments and four replications. The result showed that AM + Vermicompost @ 3 t ha<sup>-1</sup> treatment (T<sub>7</sub>) produced the highest kernel yield (101 g pot<sup>-1</sup>, 91.9% higher over control in 2022 and 60.0 g pot<sup>-1</sup>, 62.2% higher over control in 2023) of maize which was significantly different from 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

The study's objectives were to evaluate the potentiality of arbuscular mycorrhizal inoculation on the plant height, leaf number, colonization, sporulation, yield, and yield attributes of maize treated with different salinity levels. The experiment was designed in factorial randomized completely block design with four replications. With increasing salinity concentration plant height, leaf number, colonization, sporulation, yield and yield attributes decreased significantly. It was observed that 0 dSm<sup>-1</sup> + AM treatment produced the highest ear weight (102 g pot<sup>-1</sup> in 2022 and 105 g pot<sup>-1</sup> in 2023) and kernel yield (58.5 g pot<sup>-1</sup> in 2022 and 67.3 g pot<sup>-1</sup> in 2023) 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-Dhaincha-T.Aman rice cropping pattern

M. Rahman, M. E. Ali, M. F. A. Anik and H. M. Naser

A field experiment was conducted to evaluate the effect of biofertilizer, biochar, and chemical fertilizers on yield and qualitative properties of groundnut-dhaincha-T. Aman rice cropping pattern during the Rabi season of 2021-22 and 2022-23. The highest groundnut nut yield ( $2.42 \text{ t ha}^{-1}$  in 2021-22 and  $3.16 \text{ t ha}^{-1}$  in 2022-23) and stover yield ( $4.09 \text{ t ha}^{-1}$  in 2021-22 and  $3.61 \text{ t ha}^{-1}$  in 2022-23) were observed in  $T_7$  (Biochar @  $10 \text{ t ha}^{-1}$  + *Rhizobium* + IPNS based PKSZnB) treatment which was identical with the  $T_6$  (Biochar @  $5 \text{ t ha}^{-1}$  + *Rhizobium* + IPNS based PKSZnB) treatment. The highest T. aman grain yield ( $5.92 \text{ t ha}^{-1}$ ) and straw yield ( $8.46 \text{ t ha}^{-1}$ ) were found in  $T_9$  treatment ( $R^* + 100\%$  PKSZnB) which was statistically identical with the  $T_7$  treatment.

### 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

An experiment conducted 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-11) and  $T_5$ = PSB isolate IV (AEZ-09). Among five different treatment combinations,  $T_4$  (PSB isolate III, AEZ-11) performed better in different growth parameters and showed higher seed and straw yield ( $33.88 \text{ gm/10 plants}$ ,  $50.02 \text{ gm/10 plants}$ ). The maximum amount of nutrient content and enormous PSB population was also found in the same isolates (PSB isolates-III) compare to all others during barley production.

### 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

An experiment (2022-23) was conducted at central farm of Bangladesh Agricultural Research Institute

(AEZ-28) to evaluate the effects of biofertilizer and chemical fertilizer on nodulation pattern, nodule initiation date and yield of grasspea varieties. The experiment was designed in randomized complete block (RCBD) with 2 factors (three fertilizer doses and three varieties) having 3 replications in each treatment. The grasspea varieties required 16-17 days for their first nodulation. The nodulation pattern trend was BARI khesari-3 > BARI khesari-5 > BARI khesari-6, respectively. Among the three varieties and fertilizer doses, BARI khesari-3 and 100% NPKSZnB fertilizer dose performed better in yield ( $1.74 \text{ t/ha}$ ,  $1.57 \text{ t/ha}$ ) of grasspea. But in interactions, microbial population ( $4.0 \times 10^5$ ) and nutrient uptake was found higher in 100% PKSZnB + *Rhizobium* with BARI khesari-5 during grasspea production.

### Effect of different fertilizer combination on groundnut in Barishal region

M.R. Islam, B. C. Kundu, M.E. Ali and H.M. Naser

A field experiment was carried out at RARS, Rahmatpur, Barishal during December 2022 to May 2023 to find out the response of fertilizer on groundnut production in Barishal region. The crop variety was BARI Chinabadam-9. There were eight treatments viz.  $T_1$ : Native fertility,  $T_2$ :  $N_{30}P_{20}K_{30}S_{20}Zn_{1.0}B_{1.0} \text{ kg ha}^{-1}$  (FRG 2018),  $T_3$ :  $N_{30}P_{20}K_{30}S_{20}Zn_{1.0}B_{1.0} \text{ kg ha}^{-1}$  + Vermicompost  $3 \text{ t ha}^{-1}$ ,  $T_4$ :  $P_{20}K_{30}S_{20}Zn_{1.0}B_{1.0}$  + Vermicompost  $3 \text{ t/ha}$  + *Rhizobium* (BARI Rhi-803),  $T_5$ :  $P_{20}K_{30}S_{20}Zn_{1.0}B_{1.0} \text{ kg ha}^{-1}$  + *Rhizobium*,  $T_6$ :  $N_{30}P_{20}K_{30}S_{20}Zn_{1.0}B_{1.0} \text{ kg ha}^{-1}$  + CD  $5 \text{ t/ha}$ ,  $T_7$ :  $P_{20}K_{30}S_{20}Zn_{1.0}B_{1.0} \text{ kg ha}^{-1}$  + CD  $5 \text{ t ha}^{-1}$  + *Rhizobium* which were replicated for four times. Different fertilizer combination had influence on yield and yield attributes of BARI Chinabadam-9. The highest seed yield ( $1.71 \text{ t ha}^{-1}$ ) was obtained from  $T_4$  treatment, where we used chemical fertilizer, vermicompost and *Rhizobium* fertilizer and it was statistically similar with  $T_2$  ( $1.47 \text{ t ha}^{-1}$ ) and  $T_7$  ( $1.53 \text{ t ha}^{-1}$ ) treatment. The highest number of nodule (67, 66 and 61) plant<sup>-1</sup> was found in those treatments where we used *Rhizobium* fertilizer.

### Validation trial of biofertilizer on soybean

M.S. Islam, M.M. Bashir, M.E. Ali and H.M. Naser

The experiment was conducted at the farmers' field at FSRD site, Noakhali during Rabi season, 2022-2023. There was no significant difference in any characters or seed yield. But numerically the



maximum seed yield  $1.63 \text{ t ha}^{-1}$  was obtained from  $T_2$  treatment and the minimum ( $1.48 \text{ t ha}^{-1}$ ) from  $T_1$  treatment. The highest gross return (Tk. 101875  $\text{ha}^{-1}$ ) and gross margin (Tk. 58875  $\text{ha}^{-1}$ ) were observed in  $T_2$  treatment due to its higher yield. The lowest gross return (Tk. 92500  $\text{ha}^{-1}$ ) and gross margin (Tk. 50500  $\text{ha}^{-1}$ ) were found from  $T_1$  treatment due to its lower yield.

#### Validation trial of biofertilizer on mungbean

M.S. Islam, M.M. Bashir, M.E. Ali and H.M Naser

The experiment was conducted at the farmers' field at Char Wapda, Noakhali during Rabi season, 2022-23 to popularize the *Rhizobium* biofertilizer technology for producing mungbean in the farmer's field. The maximum seed yield  $1.25 \text{ t ha}^{-1}$  was obtained from  $T_2$  treatment and the minimum ( $1.10 \text{ t ha}^{-1}$ ) from  $T_1$  treatment. The highest gross return (Tk. 112500  $\text{ha}^{-1}$ ) and gross margin (Tk. 80500  $\text{ha}^{-1}$ ) were observed in  $T_2$  treatment due to its higher yield. The lowest gross return (Tk. 99000  $\text{ha}^{-1}$ ) and gross margin (Tk. 65500  $\text{ha}^{-1}$ ) were found from  $T_1$  treatment due to its lower yield.

#### Validation trial of biofertilizer on groundnut

M.M. Rahman, A.K.M.Z.U. Noor, M.A. Rahman M.E. Ali and H.M Naser

The experiment was conducted in the farmers' field at Naovanghar Char, Jamalpur during Rabi season, 2022-23. The maximum yield of nut ( $2.05 \text{ t ha}^{-1}$ ) was found from  $T_2$  treatment and the minimum ( $1.87 \text{ t ha}^{-1}$ ) from  $T_1$  treatment. The higher gross return (Tk. 1, 64,000/-  $\text{ha}^{-1}$ ) and gross margin (Tk. 86,680/-  $\text{ha}^{-1}$ ) were observed from  $T_2$  treatment due to its higher yield. The lowest gross return (Tk. 1, 49,600/-  $\text{ha}^{-1}$ ) and gross margin (Tk. 73, 086/-  $\text{ha}^{-1}$ ) were found from  $T_1$  treatment due to its lower yield.

#### Validation trail of biofertilizer on lentil

M. Z. Hasan, M. Maniruzzaman, M. A. Suborna, M. A. Islam M.E. Ali and H.M Naser

The experiment was carried out at FSRD site, Gangarampur, Pabna during the Rabi season of 2022-23 to assess the effect of bio fertilizer on yield traits and yield of lentil (BARI Masur-8). The experiment was laid out in RCBD with three treatments and four replications. The treatments were:  $T_1 = \text{PKSZn}$ ,  $T_2 = \text{Rhizobium}$  inoculant +  $\text{PKSZn}$  and  $T_3 = \text{NPKSZn}$ . The highest grain ( $1.30 \text{ t ha}^{-1}$ ) and straw ( $1.80 \text{ t ha}^{-1}$ ) yields were found in  $\text{NPKSZn}$  applied treatment. Other two treatments

were almost similar in yield and yield contributing characters. The highest gross return (Tk. 125775  $\text{ha}^{-1}$ ) and gross margin (Tk. 69675  $\text{ha}^{-1}$ ) were also found in the  $\text{NPKSZn}$  fertilizer applied treatment. Therefore, *Rhizobium* was not found to have any effect on the yield of lentil.

### HRC Soil Science Section

#### Effect of foliar application of boron on growth, yield and quality of dragon fruit (*Hylocereus Costaricensis*)

M. Ataur Rahman, M. A. Quddus, M. J. Hossain and B. C. Sarker

Boron (B) is a key element directly involved in dragon fruit (*Hylocereus Costaricensis*) pollen viability and quality fruit development. Hence, a study was initiated at the research field of Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur in February, 2021. Five boron levels of 0, 0.1, 0.2, 0.3 and 0.4%, from boric acid were applied as foliar at 4 months interval starting from six month age of the plants. Each treatment was replicated thrice following randomized complete block design. The treatments of 0.3 and 0.4% B application gave equally better result in respect to vegetative growth and number of fruits/plant. Highest yield ( $13.8 \text{ t ha}^{-1}$ ) was recorded from 0.3% B application attributed to bigger fruit size and higher fruit yield 5.51 kg per plant. B application @ 0.3% is preferable under experimental B deficient soil condition.

#### Integrated Effect of Different Sources of Organic Manures and Chemical Fertilizers on Growth, Yield and Quality of Tomato

M. A. Quddus, M. Ataur Rahman, R. Ahmed, K.K. Sarker, M. A. Siddiky and M. S. Arfin

Tomato (*Lycopersicon esculentum* Mill.) is responsive to organic and inorganic fertilizers. Therefore, a field experiment was conducted during 2022-23 at Horticulture Research Centre, BARI, Gazipur to evaluate the effect of organic and inorganic fertilizers on productivity and quality of tomato. Eight treatments were  $T_1$  (Control),  $T_2$  ( $\text{N}_{140}\text{P}_{40}\text{K}_{90}\text{S}_{18}\text{Zn}_3\text{B}_2 \text{ kg ha}^{-1}$  as per FRG, 2018),  $T_3$  (3 t vermicompost  $\text{ha}^{-1}$  +  $T_2$  based on INM),  $T_4$  (3 t poultry manure  $\text{ha}^{-1}$  +  $T_2$  based on INM),  $T_5$  (5 t vermicompost  $\text{ha}^{-1}$  +  $T_2$  based on INM),  $T_6$  (5 t cowdung  $\text{ha}^{-1}$  +  $T_2$  based on INM),  $T_7$  (5 t poultry

manure  $\text{ha}^{-1}$  +  $\text{T}_2$  based on INM) and  $\text{T}_8$  (10 t cowdung  $\text{ha}^{-1}$  +  $\text{T}_2$  based on INM) including blanket dose 12 kg Mg  $\text{ha}^{-1}$ . The experiment was set up in a randomized complete block design with three replications. The result indicated that fruit yield was increased by 73.3% higher in treatment  $\text{T}_5$  over control. More vitamin C (45.1 mg/100g) and higher gross return (BDT 1094400) was achieved from  $\text{T}_5$  treatment. Application vermicompost @ 5 t  $\text{ha}^{-1}$  with INM basis recommended inorganic fertilizer can improve the yield and quality of tomato.

#### **Effect of Boron and Magnesium on Growth, Yield and Quality of Cauliflower**

M. A. Quddus, M. Ataur Rahman, K.K. Sarker, R. Ahmed and M. S. Arfin

Cauliflower (*Brassica oleracea* var. *botrytis* L.) is very responsive to applied boron and magnesium fertilizers when soil is deficit or minimum in boron and magnesium. Hence an experiment was conducted in winter season of 2022-23 to evaluate the effect of boron and magnesium application on yield and quality of cauliflower. The experiment was planned with 16 treatment combinations involving four levels each of boron (0, 1, 2 and 3 kg  $\text{ha}^{-1}$ ) and magnesium (0, 4, 8 and 12 kg  $\text{ha}^{-1}$ ) following factorial design with three replications. The result indicated that application of B @ 2 kg  $\text{ha}^{-1}$  and Mg @ 12 kg  $\text{ha}^{-1}$  produced higher fresh curd yield (24.9 t  $\text{ha}^{-1}$ ) with higher yield increase (57.6%) over control. The higher vitamin C contents (57.0 mg/100g) and curd firmness (1.53 kgf) in application of B @ 2 kg  $\text{ha}^{-1}$  and Mg @ 8 kg  $\text{ha}^{-1}$ . The interaction effect of boron and magnesium was superior to single effect. The result suggests that combined application of B 2 kg  $\text{ha}^{-1}$  and Mg 12 kg  $\text{ha}^{-1}$  can increase the curd yield of cauliflower. The present findings may have potential in improving the yield and production of cauliflower in the areas where soils are deficit in boron and magnesium.

#### **Effect of zinc and boron on growth, seed yield and quality of gypsophila (*Gypsophila paniculata* L.)**

M. A. Quddus, M. Ataur Rahman, R. Ahmed and K.K. Sarker

A field experiment was conducted in winter season of 2022-23 at Horticulture Research Centre, BARI, Gazipur to evaluate the effect of boron and magnesium on growth, yield traits and yields of

gypsophila. The experiment was planned with 16 treatment combinations involving four levels each of zinc (0, 2, 3 and 4 kg  $\text{ha}^{-1}$ ) and boron (0, 1, 2 and 3 kg  $\text{ha}^{-1}$ ) following factorial design with three replications. The result indicated that joint application of Zn 3 kg and B 2 kg  $\text{ha}^{-1}$  produced highest number of fruits (90.4) and highest seed yield (886 kg  $\text{ha}^{-1}$ ) with higher percent yield increment (47.9%) over control. The interaction effect of zinc and boron was superior to their single effect. The result suggests that combined application of Zn 3 kg and B 2 kg  $\text{ha}^{-1}$  can increase the seed yield of gypsophila. The present findings may have potential in improving the seed yield and production of gypsophila in the areas where soils are deficit in zinc and boron.

#### **Effect of boron and magnesium on growth, yield and quality of okra (*Abelmoschus esculentus* L.)**

M. A. Quddus, M. Ataur Rahman, R. Ahmed, K.K. Sarker, and M. S. Arfin

An experiment was conducted in summer season of 2023 at Horticulture Research Centre, BARI, Gazipur to evaluate the effect of boron and magnesium on growth, yield traits and yields of okra. The experiment was planned with 16 treatment combinations involving four levels each of boron (0, 1, 2 and 3 kg  $\text{ha}^{-1}$ ) and magnesium (0, 4, 8 and 12 kg  $\text{ha}^{-1}$ ) following factorial design with three replications. The result indicated that application of B 2 kg  $\text{ha}^{-1}$  and Mg 12 kg  $\text{ha}^{-1}$  produced higher number of fruits (25.2) and higher fruit yield (14.8 t  $\text{ha}^{-1}$ ) and vitamin C (37.8 mg/100g) with higher yield increase (69.3%) over control. The interaction effect of boron and magnesium was more positive their single effect. The result suggests that combined application of B 2 kg  $\text{ha}^{-1}$  and Mg 12 kg  $\text{ha}^{-1}$  can increase the fruit yield of okra. The present findings may have potential in improving the yield and production of okra in the areas where soils are deficit in boron and magnesium.

#### **RARS Jashore**

##### **Effect of foliar application of micronutrient on quality and yield of tomato**

NU Mahmud, N Salahin and KU Ahammad

A field experiment was conducted during 2022-23 at RARS, Jashore to find out the response of foliar application of zinc (Zn) and boron (B) on

vegetative and reproductive growth attributes of tomato. The treatments consisted of  $T_1$  = control,  $T_2$  = Zn @ 300 ppm,  $T_3$  = Zn @ 600 ppm,  $T_4$  = B @ 300 ppm,  $T_5$  = B @ 600 ppm,  $T_6$  = Zn @ 300 ppm + B @ 300 ppm,  $T_7$  = Zn @ 300 ppm + B @ 600 ppm,  $T_8$  = Zn @ 600 ppm + B @ 300 ppm,  $T_9$  = Zn @ 600 ppm + B @ 600 ppm. boron and zinc mixture of all and control. All the yield and yield attributes of tomato gave the best performance with combined application of zinc @ 600 ppm and boron @ 300 ppm ( $T_8$  treatment) than individual application.

#### **Effect of minimum tillage and crop residue retention on soil properties and crop yields under a rice-based cropping system**

N Salahin, Nu Mahmud and KU Ahammad

A field experiment was conducted during 2022-23 at RARS, Jashore. There were two tillage practices: (i) conventional tillage (CT) and (ii) minimum tillage (MT) were assigned in main plot and two levels of residue retention: (i) 30 cm crop residue retention/incorporation of wheat and rice and full amount of mungbean and (ii) removal of crop residue were allotted in sub-plot. The MT conserved more available soil water content at 20, 50 and 80 DAS in soils under wheat field. With this synergistic effect of minimum tillage, statistically higher wheat grain ( $4.41 \text{ t ha}^{-1}$ ) was found in MT over the CT practice ( $3.53 \text{ t ha}^{-1}$ ). In contrast, conventional system produced higher rice grain ( $5.84 \text{ t ha}^{-1}$ ) than minimum tillage ( $4.97 \text{ t ha}^{-1}$ ). Tillage practices and residue retention showed insignificant variations in REY. Conservation agriculture showed improvement of most of the plant nutrients over conventional agriculture system.

#### **Requirement of potassium fertilizer under conservation agriculture practice in wheat-mungbean-T. Aman cropping system**

N Salahin, NU Mahmud and KU Ahammad

An experiment was conducted during 2022-23 at RARS, Jashore 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 system productivity. Two crop establishment methods were: (i) conventional method and (ii) conservation agriculture whereas four K fertilizer rates were applied: (i) 75% of recommended rate of K (RDK),

(ii) 100% of RDK, (iii) 125% of RDK and (iv) 150% of RDK. The design of the experiment was split-plot. Higher rice grain was observed in conventionally puddled compared to CA. On the contrary, Conservation agriculture conserved more soil water in wheat field which resulted higher wheat grain. The highest rice and wheat grain as well as system productivity was obtained from 150% of RDK. After 3-years, SOM, TN and available K improved in the CA practice.

#### **Effect of long-term fertilization on crop productivity, soil properties and nutrient efficiency under conservation agriculture practice with mustard-Boro-T.Aman cropping pattern**

N Salahin, NU Mahmudand, KU Ahammad

An experiment was conducted during 2022-23 at RARS, Jashore. Two crop establishment methods: (i) conventional method and (ii) conservation agriculture whereas four nutrient packages were applied: (i) 75% Recommended dose of chem. fertilizers, (ii) 100% Recommended dose of chem. fertilizers, (iii) 125% 75% Recommended dose of chem. fertilizers and (iv) control. The design of the experiment was split-plot. Conventional system produced higher Boro and T. Aman rice yield compared to CA system whereas CA system produced higher seed yield of mustard than conventional system in dry condition. In addition, the response of to 25% higher nutrient dose was statistically different from all other nutrient packages. Higher SOM, TN and available K were recorded in CA plots after 4<sup>th</sup> crop harvest.

#### **RARS Ishurdi, Pabna**

##### **Nutrient management for sustaining soil fertility and performance of wheat-mungbean-t.aman cropping pattern**

M.S. Alam and M.M.Uddin

Soil fertility is being exhausted with the increase of cropping intensity; introducing high yielding varieties along with modern technologies. So, proper fertilizer management is very important considering the residual effect of the nutrients. Moreover, inclusion of a pulse crop in the cropping pattern would reduce the requirement of chemical fertilizer in next crop as well as maintain good soil health. Thus, a long term field experiment on



Wheat-Mungbean-T.aman cropping pattern was carried out in High Ganges River Floodplain Soils (AEZ-11) at Regional Agricultural Research Station, BARI, Ishurdi, Pabna during the period of 2022-2023 to i) find out sustainable fertilizer recommendations for Wheat-Mungbean-T.aman cropping pattern, ii) to monitor soil health after each cropping cycle and to estimate uptake of different nutrients and to make a balance sheet for each nutrient. The experiment was laid out in a RCB design with six treatments replicated three times. The experiment consisted of six different fertilizer doses were:  $T_1 = N_{120}P_{35}K_{75}S_{20}Zn_5 \text{ kg ha}^{-1}$  (Recommended dose)  $T_2 = N_0 P_{35}K_{75}S_{20}Zn_5 \text{ kg ha}^{-1}$ ,  $T_3 = N_{120}P_0K_{75}S_{20}Zn_5 \text{ kg ha}^{-1}$ ,  $T_4 = N_{120}P_{35}K_0S_{20}Zn_5 \text{ kg ha}^{-1}$ ,  $T_5 = N_{120}P_{35}K_{75}S_0Zn_5 \text{ kg ha}^{-1}$  and  $T_6 = N_{120}P_{35}K_{75}S_{20}Zn_0 \text{ kg ha}^{-1}$ . Result exhibited that higher system productivity ( $17.11 \text{ t ha}^{-1}$ ) was obtained in  $T_1$  followed by  $T_2$  while the lower system productivity ( $8.02 \text{ t ha}^{-1}$ ) was found in ( $T_6$ ). The pH of the soil reached near neutrality ranging from 7.1 to 7.3 after twenty years. The soil organic matter, PNSZn content was increasing due to biomass addition. But K nutrient was negative balance, it indicated that crop uptake more K. Therefore, the nutrient management for sustaining soil fertility of Wheat-Mungbean-T.aman rice cropping pattern performed better in  $T_1$  ( $N_{120}P_{35}K_{75}S_{20}Zn_5 \text{ kg ha}^{-1}$  Recommended dose).

#### **Nutrient management for sustaining soil fertility and performance of mustard-mungbean-T.aman cropping pattern**

M. S. Alam and M.M Uddin

Long term soil fertility monitoring under a specific cropping system would be of great help in determining a better soil fertility management

program for sustained productivity at high level. Intensive cropping system, sustainability of soil fertility may decline in the long run. As for, soil nutrient levels should be built to an optimum level and maintained. Considering the reason, a field trial was carried out at Regional Agricultural Research Station, Ishurdi, Pabna during the period of 2022-2023 in High Ganges River Floodplain Soils (AEZ-11) of Ishurdi to find out sustainable fertilizer doses for Mustard-Mungbean-T.aman cropping pattern, to monitor soil health and productivity of the cropping pattern. The experiment was laid out in RCB design with eight treatments and replicated four times. The experiment consisted of eight treatments of fertilizer like  $T_1 = N_{80} P_{36} K_{70} S_{40} Zn_3 B_1$ ,  $T_2 = N_{120} P_{36} K_{70} S_{40} Zn_3 B_1$ ,  $T_3 = N_{160} P_{36} K_{70} S_{40} Zn_3 B_1$ ,  $T_4 = N_{120} P_{18} K_{70} S_{40} Zn_3 B_1$ ,  $T_5 = N_{120} P_{54} K_{70} S_{40} Zn_3 B_1$ ,  $T_6 = N_{120} P_{36} K_{35} S_{40} Zn_3 B_1$ ,  $T_7 = N_{120} P_{36} K_{105} S_{40} Zn_3 B_1$  and  $T_8 = N_0 P_0 K_0 S_0 Zn_0 B_0$ . Result indicated that higher system productivity ( $11.83 \text{ t ha}^{-1}$ ) was obtained from ( $T_6$ ) followed by  $T_7$  while the lower system productivity ( $7.01 \text{ t ha}^{-1}$ ) was found in native fertility ( $T_8$ ). System productivity (REY) increased 40.74% over native fertility. After cropping cycles, the pH reached near neutrality ranging from 7.1 to 7.2. The soil OM, total N, P, S and Zn nutrient content was increased due to high amount of biomass was added; but K nutrient was negative balance, it indicated that crop uptake more K. The maximum additional income of Tk. 295717  $\text{ha}^{-1}$ , gross margin Tk. 265223  $\text{ha}^{-1}$  and marginal benefit cost ratio of Tk. 9.70 were recorded in  $T_6$ . Therefore, the nutrient management for sustaining soil fertility of Mustard-Mungbean-T.aman rice cropping pattern performed better in  $N_{120} P_{36} K_{35} S_{40} Zn_3 B_1$  ( $T_6$ ).

# ENTOMOLOGY

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## Integrated Pest Management

### Biorational based management of fruit borer in tomato

The experiment was carried out at the research field of Entomology Division, BARI during rabi season of 2022-23 to develop biorational based management package of fruit borer in tomato. The seedlings were transplanted in 19 November 2022. There were seven treatments, viz. T<sub>1</sub> = Colleciton and destruction of infested fruits; T<sub>2</sub> = Collection and destruction of infested fruits + spraying of Bt (Kurstaki) @ 1 g/litre of water; T<sub>3</sub> = Collection and destruction of infested fruits + spraying of *Celastrus angulatus* (Bio Chamak 1.0% EW) @ 2.5ml/L of water; T<sub>4</sub>= Collection and destruction of infested fruits + spraying of Minchu plus (Bt+ spinosad) @ 2 ml/ litre of water; T<sub>5</sub> = Collection and destruction of infested fruits + spraying of spinetoram (Delegate 11.7 SC) @ 1 ml/l of water; T<sub>6</sub> = Collection and destruction of infested fruits + Spraying of spinosad (Success 2.5 SC) 1.2 ml/L of water and T<sub>7</sub> = Untreated control. The experiment was laid out in RCBD with 3 replications. The number and weight of healthy and borer infested fruits were counted and recorded during each harvest.

The results indicated that T<sub>6</sub> (Collection and destruction of infested fruits + spraying of spinosad 2.5 SC @ 1.2 ml/L of water) offered significantly the lowest fruit infestation (3.23%). Similarly, T<sub>6</sub> offered highest fruit infestation reduction over control. The highest yield (46.92 t/ ha) was also obtained from this treatment which varied significantly with other treatments.

### Development of bio-rational management package against major insect pests attacking country bean

The study was conducted at the research field of Entomology Division, BARI, Gazipur during rabi

2022-23 cropping season. The country bean variety “BARI sheem 1” was grown following the recommended practices. The experiment was laid out in randomized block design with five treatments and three replications. The 5 treatments were as follows: T<sub>1</sub>=Yellow sticky trap @ 40 traps/ha + 10% sodium lauryl ether sulfate (Fizimite) @ 1.0 ml/L of water + spinosad (Success 2.5 SC) @ 1.2ml/L of water ; T<sub>2</sub>= Yellow sticky trap @ 40 traps/ha + d-Limonene 5% SL (Bio-clean) @ 1 ml of water + spinosad (Success 2.5 SC) @ 1.2ml/L of water; T<sub>3</sub>= Yellow sticky trap @ 40 traps/ha + matrine (Biotrin 0.5% AS ) @ 1.5 ml/L of water) + *Celastrus angulatus* 1.0% EW (Bio Chamak) @ 2.5ml/L of water ;T<sub>4</sub> = Farmers’ practice: Alternate spraying of emamectin benzoate (Proclaim 5 SG) @ 1 g/ L of water and imidacloprid 20 SL (Imitaf) @ 0.5/L of water;T<sub>5</sub>= Untreated control.

Results showed that, mean thrips population per inflorescence (2.29) was the lowest in T<sub>2</sub> (Yellow sticky trap + d-Limonene + spinosad). Similarly, the highest reduction (86.87 %) of thrips population over control was obtained from this treatment. It was also revealed that the lowest pod infestation (5.73 %) was obtained from the plots treated with T<sub>2</sub>, which was statistically at par with T<sub>1</sub> (6.61%) (yellow sticky trap + 10% sodium lauryl ether sulphate + spinosad). The highest pod infestation reduction over control (66.96 %) was similarly obtained from T<sub>2</sub>. It was revealed that, the highest (4.62) marginal benefit-cost ratio (MBCR) was calculated from T<sub>2</sub> followed by T<sub>1</sub>. So, considering MBCR, installing yellow sticky trap @ 40 traps/ha along with spraying of d-Limonene @ 1 ml of water and spinosad 2.5 SC @ 1.2 ml of water could be recommended for effective management of major insect pests attacking country bean.

## Biological Control

### Study on efficacy of predatory mite, *neoseiulus longispinosus* (evans) against two spotted spider mite, *tetranychus urticae* koch under field conditions

The study was conducted at research field of Entomology division, Bangladesh Agricultural Research Institute Gazipur during October 2022 to March 2023. The experiment was carried out in a Randomized Complete Block Design (RCBD) with six treatments and three replications. Treatments were assigned as follows: T<sub>1</sub>: predator and prey mite ratio=20:100, T<sub>2</sub>: predator and prey mite ratio=15:100, T<sub>3</sub>: predator and prey mite ratio=10:100, T<sub>4</sub>: predator and prey mite ratio=5:100, T<sub>5</sub>: Vertimac 1.8EC @1.2ml/L of water and T<sub>6</sub>: Control.

The results indicated that in micro plot conditions, the pre-treatment population was in the range of 31.39 to 40.60 mites per 2cm<sup>2</sup> leaf area. Results revealed that there was significant reduction in the number of mites on leaf bit which received 20 predators with the predator prey ratio of 20: 100. The prey population was reduced to 66.85, 56.46, 51.86 and 53.83 percent over control treatment with the proportion of 20:100, 15:100 and 10:100 and 5:100 predator: prey, respectively after 7 days of predatory mite release. The results also revealed that after first time release, the spider mite population reduced significantly up to seven days in all the treatments than untreated check. Among the predator prey ratios 20:100 was found to be more effective and recorded the lowest mean mite population of 13.34 in 2 cm<sup>2</sup> leaf area. The acaricide vertimac 1.8 EC (1.2 ml L<sup>-1</sup>) was superior to all other treatments and recorded highest mean mite reduction (75.55 %) after first time application. Although, acaricides were effective, but mite is difficult to control with acaricides because of rapid development of resistance to several chemical groups. The resistance development is favored by its high reproductive potential and extremely short life cycle.

### Mass rearing of common cutworm (*spodoptera litura*) under laboratory condition

Laboratory studies were carried out in IPM laboratory at Bangladesh Agricultural Research Institute Gazipur during October – December 2022

to determine the best food materials for common cutworm mass rearing in the laboratory condition. This study was conducted with two natural and one artificial diet to rear the larvae of common cutworm under laboratory condition (24±2°C, 60±5% RH and natural photoperiod). Three food materials/media viz. cube of potato, cut pieces of cabbage leaf and artificial diet were tested for mass rearing of common cutworm (*Spodoptera litura*). The study was set following complete randomized design (CRD) with three treatments and 15 replications. Fifteen (15) pot contained fungicide treated one cube of potato, 15 pot contained cut pieces of cabbage leaf and 15 pot contained cube (1×1×0.5 cm) of artificial diet. 4<sup>th</sup> instars (5 day-old) larvae of common cutworm were released at the rate of 1 larva per pot. Each pot was considered as one treatment replicate. The efficacies of the diets were compared based on the length, breadth and weight of the larvae, total period of development, percent pupation, and percent of larval mortality, adult emergence and fecundity. Data were recorded on survival, weight of full fed larvae, days to pupation, days to adult eclosion, sex, and fecundity.

The result indicated that tested food materials had positive impact on growth and development parameters and reproductive performance of *S. litura*. It was observed that potato/ cabbage leaf/ artificial diet were suitable for laboratory production of the *S. litura*. Female moth reared on cabbage laid the highest egg mass (3.8/female) with 84.05% hatchability.

## Pesticide Residue Analysis

### Determination of pre harvest interval for lambda-cyhalothrin and chlorpyrifos in major vegetables

This laboratory study was carried out in Pesticide Analytical Laboratory (PAL) at Bangladesh Agricultural Research Institute. Certified Reference Materials (CRM) of lambda-cyhalothrin and chlorpyrifos were used in the present study having purity > 99.99 per cent were obtained from M/s Sigma Aldrich, Germany through SF Scientific, Dhaka. Analytical graded acetonitrile (MeCN), anhydrous MgSO<sub>4</sub>, Primary Secondary Amine (PSA) and NaCl manufactured by Scharlau were purchased from M/s Sigma Aldrich, Germany through SF Scientific, Dhaka. The



modified QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) method developed by Prodhon *et al.* 2015 was used to extract, separate and clean-up of samples. Marketable size of hyacinth bean were collected from three supervised field trials at 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 days after spray (DAS) which were sprayed with lambda-cyhalothrin @ 1 mL/L of water in hyacinth bean and red amaranth, but for chlorpyrifos in red amaranth it was @ 2 mL/L of water. The formulated product of chlorpyrifos was Dursban 20EC and lambda-cyhalothrin was Karate 2.5EC. The purity of formulated insecticides were tested in the pesticide analytical laboratory (ISO/IEC 17025:2017 accredited) and found to be 100% pure. Collected vegetable samples (1kg) were taken to the laboratory for the extraction, separation and clean-up procedures. The final concentrated extracts were subjected to analysis by GC-ECD to detect above mentioned pesticides. The method validation was done properly according to the standard document no. SANTE/2021(European commission, 2021).

From the analytical results, residue of lambda-cyhalothrin in hyacinth bean was detected up to 9 DAS. The detected quantities (4.815-0.426 mg/kg) were above MRL up to 7 DAS. So, the PHI of lambda-cyhalothrin for bean can be selected at 8 DAS. The left over residue of lambda-cyhalothrin in red amaranth was detected up to 9 DAS. The detected quantities were above MRL up to 8 DAS while sample of 9 DAS contain 0.028 mg/kg which was below MRL. So, the PHI of lambda-cyhalothrin for red amaranth can be selected at 9 DAS. Residue of chlorpyrifos could be detected up to 8 DAS. The detected quantities (3.536-0.241mg/kg) were above MRL up to 7 DAS. But the sample of 8 DAS had 0.013mg/kg chlorpyrifos residue which was below MRL. At 9 DAS, no residue was detected in red amaranth. So, the PHI of chlorpyrifos for red amaranth can be selected at 8 DAS. The MRLs which were used in this experiment were set by European Union.

#### **Quantification of pesticide residue load in major vegetables collected from different regions of Bangladesh**

The study was carried out in Pesticide Analytical Laboratory (PAL) at Bangladesh Agricultural Research Institute. Certified Reference Materials

(CRM) of lambda-cyhalothrin, fenvalerate, chlorpyrifos, cypermethrin, acetamiprid and deltamethrin were used in the present study having purity > 99.99 per cent were obtained from M/s Sigma Aldrich, Germany through SF Scientific, Dhaka. Analytical graded acetonitrile (MeCN), anhydrous MgSO<sub>4</sub> and NaCl manufactured by Scharlau were purchased from M/s Sigma Aldrich, Germany through SF Scientific, Dhaka. The modified QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) method developed by Prodhon *et al.* 2015 was used to extract, separate and clean-up of the samples. Sampling was performed by random collection from different markets namely Jashore, Rajshahi, Jamalpur, Patuakhali, Dhaka and Gazipur. Samples of vegetables (1 kg for each) were taken to the laboratory for the extraction, separation and clean-up procedures. Samples were then kept in refrigerator at -20<sup>o</sup> C until analysis. The final concentrated extracts were subjected to analysis by GC-ECD to detect above mentioned pesticides. The method validation was done properly according to the standard document no. SANTE/2021(European commission, 2021).

A total of 180 samples of cauliflower, yard long bean and okra were collected from Jashore, Rajshahi, Jamalpur, Patuakhali, Dhaka and Gazipur during July 2022-June 2023 and were analyzed for the quantification of pesticide residues. Among them, 36 samples (about 20% of the total number of samples) were contaminated with the residues of chlorpyrifos, fenvalerate, cypermethrin, acetamiprid and deltamethrin. Out of 36 contaminated samples, 19 samples (10.56% of the total number of samples) of cauliflower, yard long bean and okra contained residue above respective EU-MRLs. Among the tested vegetables yard long bean had higher residue load (13.33%) followed by cauliflower (10%) and okra (8.33%) which were above MRL. In addition, 60 samples of tomato and pointed gourd of each were also analyzed but no pesticide residue was detected. Pesticide residue exceeding MRL is very harmful to human that causes many diseases like birth defect, teratogenesis, ulcer, cancer, etc. So, more research is needed to include a large number of samples incorporating more vegetables collected from different regions of Bangladesh.

### Monitoring of multiple pesticide residues in fruits collected from different regions of Bangladesh

The study was carried out in Pesticide Analytical Laboratory (PAL) at Bangladesh Agricultural Research Institute. The reference standards of cypermethrin, deltamethrin, lambda-cyhalothrin, fenvalerate, acetamiprid, thiram and difenoconazole were obtained from Sigma-Aldrich (St Louis, MO, USA). Sodium chloride (NaCl) was purchased from Chem-Lab, anhydrous magnesium sulphate was from Panreac (Barcelona, Spain), and PSA was from Agilent (Santa Clara, CA, USA). Pesticide standard stock solutions of cypermethrin, deltamethrin, lambda-cyhalothrin, fenvalerate, acetamiprid, thiram and difenoconazole were prepared separately in acetonitrile (MeCN) at a concentration of 1000 mg/L and stored at -20°C until use. A mixed standard solution of 50 mg/L in MeCN containing all the aforementioned pesticides was prepared by adding the appropriate volume of each individual stock solution in a 50 ml volumetric flask and made to volume by addition of acetone. An intermediate mixed standard solution of 10 mg/L in MeCN was prepared from the mixed standard solution of 50 mg/L. Then working standard solutions of 0.1, 0.2, 0.5, 1.0, 2.0, 3.0, and 5.0 mg/L in MeCN were prepared by transferring the appropriate amount from 10 mg/L intermediate mixed standard solution into seven separate 10-mL volumetric flasks. All the standard solutions were kept in a freezer at -20°C until use. In this study, the QuEChERS extraction technique was used for the extraction and clean-up of samples which was modified by Prodhan *et al.* (2015).

A total of 50 samples were analyzed and 3 (6.0 % of the total number of samples) contained detectable residues and 27 samples (94.0 % of the total number of samples) contained no detectable residues of the sought pesticides. Out of 10 apple samples 1 had chlorpyrifos residue with a level above the EU-MRL. In case of grape, among the 10 analyzed samples, 1 had chlorpyrifos and acetamiprid residue, the level of chlorpyrifos residue was above EU-MRLs and the level of acetamiprid residue was below the EU-MRL. In case of 10 hog plum samples, 1 had chlorpyrifos residue with a level above the EU-MRL. However, none of the analyzed samples of dates fruit and dragon fruits were contaminated with the sought pesticides.

### Determination of multiple pesticide residues in capsicum, green chilli, lettuce leaf and coriander leaf collected from different markets of Bangladesh

This laboratory study was carried out in Pesticide Analytical Laboratory (PAL) at Bangladesh Agricultural Research Institute. The reference standards of cypermethrin, deltamethrin, lambda-cyhalothrin, fenvalerate, acetamiprid, thiram and difenoconazole were obtained from Sigma-Aldrich (St Louis, MO, USA). Sodium chloride (NaCl) was purchased from Chem-Lab, anhydrous magnesium sulphate was from Panreac (Barcelona, Spain), and PSA was from Agilent (Santa Clara, CA, USA). Pesticide standard stock solutions of cypermethrin, deltamethrin, lambda-cyhalothrin, fenvalerate, acetamiprid, thiram and difenoconazole were prepared separately in acetonitrile (MeCN) at a concentration of 1000 mg/L and stored at -20°C until use. A mixed standard solution of 50 mg/L in MeCN containing all the aforementioned pesticides was prepared by adding the appropriate volume of each individual stock solution in a 50 ml volumetric flask and made to volume by addition of acetone. An intermediate mixed standard solution of 10 mg/L in MeCN was prepared from the mixed standard solution of 50 mg/L. Then working standard solutions of 0.1, 0.2, 0.5, 1.0, 2.0, 3.0, and 5.0 mg/L in MeCN were prepared by transferring the appropriate amount from 10 mg/L intermediate mixed standard solution into seven separate 10-mL volumetric flasks. All the standard solutions were kept in a freezer at -20°C until use. In this study, the QuEChERS extraction technique was used for the extraction and clean-up of samples which was modified by Prodhan *et al.* (2015).

A total of 100 samples of capsicum, green chilli, lettuce leaf, and coriander leaf were analyzed. Among 100 analyzed samples, 7 (7.0 % of the total no. of samples) were contaminated with cypermethrin, lambda-cyhalothrin, acetamiprid and chlorpyrifos residues. Among 7 contaminated samples, 4 (4.0 % of the total no. of samples) contained residues above EU-MRLs. Among the 40 analyzed samples of capsicum, 4 (10%) had pesticide residues, 3 samples (7.5%) contained residues above EU-MRL. Among the 40 analyzed samples, 4 (10%) had pesticide residues, 3 samples (7.5%) contained residues above EU-MRL. Among 20 analyzed samples of green chili, 1 (5%) had pesticide residues, which contained residue above

EU-MRL. Among 20 analyzed samples of lettuce, 1 (5%) had pesticide residues, which contained residue below EU-MRL. Among 20 analyzed samples of coriander, 1 (5%) had pesticide residues, which contained residue below EU-MRL.

#### **Determination of pre harvest interval for acetamiprid in selected vegetables under supervised field trial**

The study was carried out in Pesticide Analytical Laboratory (PAL) at Bangladesh Agricultural Research Institute. The reference standard of acetamiprid was obtained from Sigma-Aldrich (St Louis, MO, USA), Sodium chloride (NaCl) was purchased from Chem-Lab, anhydrous magnesium sulphate was from Panreac (Barcelona, Spain), and PSA was from Agilent (Santa Clara, CA, USA). Pesticide standard stock solution of acetamiprid was prepared separately in acetonitrile (MeCN) at a concentration of 1000 mg/L and stored at -20°C until use. An intermediate standard solution of 10 mg/L in MeCN was prepared from the standard solution of 1000 mg/L. Then working standard solutions of 0.1, 0.2, 0.5, 1.0, 2.0, 3.0, and 5.0 mg/L in MeCN were prepared by transferring the appropriate amount from 10 mg/L intermediate mixed standard solution into seven separate 10-mL volumetric flasks. All the standard solutions were kept in a freezer at -20°C until use. In this study, the QuEChERS extraction technique was used for the extraction and clean-up of samples which was modified by Prodhon *et al.* (2015). The concentrated extracts of the selected matrices were analyzed by GC-2010 (Shimadzu) coupled with Electron Capture Detector (ECD). The capillary column was Rtx-CLPesticides2 (length was 30m, ID was 0.32 mm and film thickness was 0.2 µm). Nitrogen was used as carrier and make up gas for GC-ECD.

The analytical results revealed that, in case broccoli, the level of residue of acetamiprid was 6.29 mg/kg at 0 DAS and gradually the level of residues decreased and at 15 DAS (0.45 mg/kg), it was above the EU-MRL (0.04 mg/kg) and at 17 DAS the level of residue (0.38 mg/kg) was below EU-MRLs. Therefore, the PHI of actamiprid was determined at 17 DAS for broccoli. In case of lettuce, the level of residue of acetamiprid was 9.22 mg/kg at 0 DAS and gradually the level of residues decreased and at 7 DAS (3.61 mg/kg), it was above the EU-MRLs (1.5 mg/kg) and at 9 DAS the level

of residue (0.73 mg/kg) was below EU-MRLs. Therefore, the PHI of actamiprid was determined at 9 DAS for lettuce. In case of red amaranth, the level of residue of acetamiprid was 2.67 mg/kg at 0 DAS and gradually the level of residues decreased and at 7 DAS (0.76 mg/kg), it was above the EU-MRLs (0.6 mg/kg) and at 9 DAS the level of residue (0.51 mg/kg) was below EU-MRLs. Therefore, the PHI of actamiprid was determined at 9 DAS for red amaranth.

#### **Detection and quantification of different pesticide residues in dry fish and their associated health risk assessment**

The study was carried out in Pesticide Analytical Laboratory (PAL) at Bangladesh Agricultural Research Institute. Certified Reference Materials (CRM) of 19 organochlorine pesticides and chlorpyrifos were used in the present study having purity > 99.99 per cent and analytical graded acetonitrile (MeCN), anhydrous MgSO<sub>4</sub> and NaCl manufactured by Scharlau were purchased from M/s Sigma Aldrich, Germany through SF Scientific, Dhaka. The modified QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) method developed by Prodhon *et al.* (2015) was used to extract, separate and clean-up. Sampling was performed by random collection from different markets of Chattogram, Khulna, and Natore. Samples of dry fish (about 250g) were taken to the laboratory for the extraction, separation and clean-up procedures. The final concentrated extracts were subjected to analysis by GC-ECD to detect above mentioned pesticides. The method validation was done properly according to the standard document no. SANTE /11312/202 (European commission, 2021).

Satisfactory results were found in four levels of fortification, with recoveries between 70 and 120% and the relative standard deviation in case of repeatability (RSDr) were < 20%. The LOD, LOQ and co-efficient of determination ( $R^2$ ) of mentioned pesticides in dry fish matrix were 0.005 mg/kg, 0.01 mg/kg and 0.999, respectively. The LOQ was, in all cases, the lowest level of quantification that could achieve the required accuracy and precision, which indicates that the method used is valid for the determination of the mentioned pesticides in the dry fish matrix. Among 40 samples, 20% were contaminated with chlorpyrifos which were not hazardous for human consumption.



## RARS Jashore

### Development of management approach against tomato leaf miner *tuta absoluta*

M Anwarul Monim and K U Ahammad

The experiment was conducted at RARS, Jashore during 2022-23 cropping season for evaluating different management approaches against tomato leaf miner (*Tuta absoluta*) in tomato. There were six treatment viz. T<sub>1</sub> = Pheromone mass trapping @ 50/ha + Matrine 0.5% AS @ 1.5 ml/L of water + soil recharge @ 5 kg /ha, T<sub>2</sub> = Pheromone mass trapping @ 50/ha + Success 2.5SC @ 1.2ml/L of water + Bt (Kurstaki) @ 1 g/L of water, T<sub>3</sub> = Pheromone mass trapping @ 50/ha + Matrine 0.5% @ 1.5 ml/L of water) + Bio Chamak 1.0% EW @ 2.5 ml/L of water, T<sub>4</sub>= Pheromone mass trapping @ 15/ha + Antario 1.4% + Abamectin 0.1% @ 1 g/L of water + Soil recharge @ 5 Kg /ha, T<sub>5</sub>= Farmers' practice : Admire 200SL @ 0.5 ml/L of water + Ripcord 10 EC @ 1.0 ml/L of water and T<sub>6</sub> = Untreated control. The result indicates that the highest leaf infestation reduction (72.98%), fruit infestation reduction by number (92.31%) and fruit infestation reduction by weight (87.61%) over control was found in T<sub>3</sub> (Pheromone mass trapping + Matrine + *Celastrus angulatus* which was followed by T<sub>5</sub> = farmer's practice: Admire 200SL @ 0.5 ml/L of water + Ripcord 10 EC @ 1.0 ml/L of water (64.72%, 79.34% and 79.44%). The highest yield (71.18 t/ha), net income (331545 Tk/ha) and MBCR (12.80) obtained from T<sub>3</sub> (pheromone mass trapping (water trap) + Matrine + *Celastrus angulatus*) treated plots. It may be concluded that pheromone mass trapping and spraying with Matrine 0.5% AS @ 1.5 ml/L of water and Bio-Chamak 1.0% EW was more effective against tomato leaf miner (*Tuta absoluta*) in respect of reducing the leaf and fruit infestation with higher yield, net income and MBCR.

### Development of bio-rational based management package(s) against common cutworm, *spodoptera litura* infesting cauliflower

M Anwarul Monim and K U Ahammad

The experiment was conducted during Rabi season 2022-23 at RARS, Jashore. The treatments were as follows: T<sub>1</sub>=hand picking + pheromone mass trapping, T<sub>2</sub> = hand picking + pheromone mass trapping + Antario @ 1.0 g/L of water, T<sub>3</sub> = hand picking + pheromone mass trapping + Matrine

0.5% @ 1.5 ml/L of water, T<sub>4</sub> = hand picking + pheromone mass trapping + Success 5 SC @ 1.2 ml/L of water, T<sub>5</sub> = hand picking + pheromone mass trapping + Bio-Chamak 1% EW @ 2.5 ml/L of water, T<sub>6</sub> = farmers' practice: Proclaim 5 SG @ 1.0 g/L of water and T<sub>7</sub> = untreated control. The lowest card infestation was recorded in T<sub>2</sub> hand picking + pheromone mass trapping + Antario @ 1.0 g/L of water (0.60%) and the highest in control plot (2.98%). On an average 3.25, 2.34, 3.65, 3.23 and 2.97 *Spodoptera litura* captured in sex pheromone trap on T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> per week. The results revealed the highest MBCR (13.05) was observed in T<sub>2</sub> hand picking + pheromone mass trapping + Antario @ 1 g/L of water treated plot. The highest yield (45.63 t/ha) was obtained from T<sub>2</sub> treated plot and the lowest in control plot (38.92 t/ha). It may be concluded that the treatment T<sub>2</sub> hand picking + pheromone mass trapping + Antario @ 1.0g/L of water was more effective against *Spodoptera litura* of cauliflower in respect of reducing card infestation and highest yield and marginal benefit cost ratio.

## RARS Ishurdi, Pabna

### Evaluation of new bio-rationals against sucking pests of brinjal

Md. Altaf Hossain and Md. Mohi Uddin

The experiment was conducted at Regional Agricultural Research Station, Ishurdi, Pabna, Bangladesh during rabi 2022-23 to evaluate the biorational based management approach against sucking insect pests of brinjal which will be environmentally safe and sustainable. All the tested bio-rationals significantly reduced sucking pests like- whitefly, aphid and jassid population in the leaves of brinjal. Among the bio-rationals, Bio-clean and Gladius reduced higher percentage of whitefly and aphid population in brinjal leaves compared to others. On the other Sefina reduced highest percentage of jassid population followed by Gladius. Yield of brinjal varied significantly with the level of sucking pest's infestation depending on the efficacy of different bio-pesticides and chemical insecticide. Significantly the highest yield was obtained from Sefina treated plots which was statistically at par with Farmers practice (spraying Actara), Gladius and Bio-clean followed by Fizimite. The lowest yield was recorded from untreated control plots which was statistically

similar to installing Blue & Yellow Sticky Trap. So, it can be concluded that considering environment friendliness- Sefina, Gladius and Bio-clean equally showed better performance in controlling sucking pests of brinjal with higher yield.

#### **Survey and documentation of insect pests and diseases of country bean and their management practices used by the farmers of Ishurdi areas**

Md. Altaf Hossain, Md. Sayedur Rahman and Md. Mohi Uddin

A survey was carried out in the country bean growing three blocks of Ishurdi Upazilla under Pabna district of Bangladesh during 2022-23 to document the insect pests and diseases attacked in country bean and also to finding out the pest management practices followed by the farmers in Ishurdi area. Randomly selected 36 country bean growing farmers were interviewed using objective oriented pre-designed questionnaires. The variety Auto-sheem was cultivated in this area which was previously collected from may be India. Fifteen insect pests, one mite pest, earth worm and snail were found to attack country bean in the farmer's field. To protect seedlings pests most of the farmers used Cabofuran. To control leaf feeding and sucking insect pests, majority of farmers used cypermethrin, chlorpyrifos, difenthiuron,

dimethoate and imidachloprid. For controlling flower and fruit borer, most of the farmers used Emamectin Benzoate, thiamethoxam (20%) + chlorantraniliprole (20%) and Fenvalerate. For the management of mite pests, most of the farmers used Abamectin. Diseases also cause a serious threat in country production. A total of 7 diseases infect the country bean and cause significant yield loss. To protect the crops against different diseases most of the farmers sprayed tebuconazole followed by propiconazole and Fluopyram (25%) + Trifloxystrobin (25%) like Luna Sensation 50 SC. Among the farmers, 6% of them did not know the name of any pesticides they used. Perception of pesticides application methods differed. About 70% farmers sprayed pesticides in cocktail form (i.e., mixed more than one pesticide) then sprayed. Frequency of pesticides application varied, more than 50% farmers sprayed 2 times per week and it might goes up to 4-5 times per week in early in the season. Majority of the farmers taken their decision to spray application consulting with pesticide dealers followed by Sub Assistant Agriculture Officer (SAAO). Highest 31% responding farmers cited that costing of pesticides application per bigha ranged >25000- 30000/- and profit per bigha is 50000- 110000/-.

# HILL AGRICULTURE

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## Evaluation of jackfruit germplasm in the hilly region

M. G. Rahman, M. A. A. Malek, M. R. Ahmad And M. A. Hossain

Ten jackfruit germplasm were evaluated at the fruit farm of HARS, Khagrachari during the year 2022-2023 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 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.

## Performance of green mango (*kanchamitha*) germplasm at hilly region

M. A. A. Malek, M. G. Rahman, M. R. Ahmad And M. A. Hossain

An experiment was conducted for the evaluation of one Kanchamitha mango germplasm (MI Kha 001) at Hill Agricultural Research Station, Khagrachari last three years. The full blooming period was and of January. The tree habit was spreading to intermediate type. Last three years Harvesting period was 02 to 19 May. Average total Soluble Solids (TSS) was recorded 9.77%. Average edible portion was found (78.28%). 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 used as unripe condition.

## Evaluation of indigenous ber germplasm at Khagrachari

M. A. A. Malek, M. G. Rahman, M. R. Mia, M. R. Ahmad And M. A. Hossain

A study was conducted at Hill Agricultural Research Station in Khagrachari hill district with thirty one local Ber genotypes during 2018 to March 2023. Average individual fruit weight ranged from 5.25g to 13.08 g. The genotype ZM Kha 013 produced the highest individual fruit weight (13.08g) and lowest in ZM Kha 005 (5.25g). Fruit weight (12 fruits) of different ber genotypes ranged from 63-157g. The genotype ZM Kha 013 produced the highest fruit weight (157g) and lowest (63g). Edible portion (%) ranged 68.34g (ZM Kha 008) to 79.12% (ZM Kha 023). % TSS of ber genotypes varied from 10.2% (ZM Kha 021%) to 25.0% (ZM Kha 024).

## Evaluation of sweet orange germplasm in the hilly region

M. G. Rahman, M. A. A. Malek, M. R. Ahmad And M. A. Hossain

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 (227) in BARI Malta-1 while the lowest (142) was in CS Kha-002. Individual fruit weight was also varying



from 131.67-168.33g. The biggest (168.33g) fruit were recorded in CS Kha 002 and the smallest (131.67) was observed in BARI Malta-1. Weight of fruits per plant was the highest (27.53 kg) in BARI Malta-1 while in case of CS Kha-001 it produces yield of 30.04 kg/plant and the lowest (23.87 kg) was in CS Kha-002. Number of seed ranges from 9-20. TSS ranges from 7.6 to 8.5 %. Fruit aroma was strong in all the germplasm.

#### **In-situ evaluation of year-round pummelo germplasm**

M. A. A. Malek, M. G. Rahman, M. R. Ahmad And M. A. Hossain

The study was conducted at the Hill Agricultural Research Station, BARI, Khagrachari during the year 2018-2019, 2019-2020, 2020-2021 & 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 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 (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.

#### **Effect of pruning on growth, yield and quality of coffee**

M. A. A. Malek, M. R. Ahmad And M. A. Hossain

The experiment was carried out at the existing plantation of Hill Agricultural Research Station at Khagrachari during 2021-22 to find out the pruning method for maintaining tree size and impact of pruning on yield and quality of coffee. *Coffea canephora* (syn. *Coffea robusta*) commonly known as robusta coffee from the existing coffee orchard of HARS, Khagrachari was selected for the study. All treatments produced higher yield than control treatments. Maximum yield was found in P<sub>3</sub> (9.14 kg/plant) followed by P<sub>5</sub> (8.86 kg/plant). On the other hand, control treatments produced lowest amount of coffee per plant. All treatments showed higher yield than control treatment. Yield increased maximum 49.7% found in P<sub>3</sub> treatment over control. In a nutshell the present finding shows that

pruning increase yield potentiality of old coffee orchard.

#### **Year round crops production under agroforestry system in the hill slope**

M A A Malek, B C Sarker, M Islam And M A Hossain

The experiment was carried out at hill agricultural research station khagrachari hill districts during 2021-2022 to scale up farm productivity throughout the year and farmer's income under fruit based agro forestry. Different high value vegetables crops such as Cabbage, Cauliflower, Radish, Broccoli, Amaranth and Red amaranth were selected for growing with mango orchard for year-round vegetables production technology. All treatments showed the highest fruit equivalent yield (t/ha) than sole mango.

#### **Production programme of mustard varieties in the hilly area of Khagrachari**

M A A Malek, J A Chowdury, A A Begum, S Skakon, M Z Ali, M R Karim And D A Chowdhury

This experiment was conducted at the hill valley of Hill Agricultural Research Station, Khagrachari during robi season 2022. Three mustard varieties were used for this experiment. Among the three varieties BARI Sharisha-17 showed highest yield (1602.3 kg/ha) in the hilly environment.

#### **Evaluation of promising cashew nut germplasm in hill tract**

S. M. Faisal And R. H. Nitol

Twenty promising cashew nut germplasm were evaluated at Hill Tracts Agricultural Research Station, Ramgarh during the year 2022-23. The line AORAM013 produced the maximum number of fruits (600/plant) while a bigger nut (7.33 g) was obtained from the line AORAM018 and AORAM049. The maximum nut yield (2196 g/plant) was obtained from line AORAM013 and the maximum edible portion of nut (37.5%) was recorded from line AORAM005.

#### **Evaluation and adaptability of promising coffee germplasm at Ramgarh**

S. M. Faisal And R. H. Nitol

The experiment was carried out at the existing plantation of HTARS, Ramgarh from 2022 to 2023 in order to release high-yielding, better-quality, and

adaptive to local environment coffee variety. Twenty-five genotypes of *Coffea canephora* were selected and evaluated randomly for the study. The line CCRAM075 has maximum yielding capacity i.e. 1320 g fruit/plant. CCRAM098 is recorded as an early-matured line with maximum hundred fruit and seed weight (115 g and 69 g respectively).

#### **Evaluation of colour fleshed jackfruit germplasm in hilly region**

S.M. Faisal

Three-color fleshed jackfruit germplasm has evaluated at HTARS, Ramgarh during the year 2021- '22. The highest plant height (8.90 m) was recorded from AH RAM 003. The maximum number of fruits per plant was obtained from AH RAM 002 (56) followed by AH RAM 003 (43) and the lowest in AH RAM 002 (35). Individual fruit weight was maximum in AH RAM 002 (9.08 kg) followed by AH RAM 001 (8.69 kg) and the minimum was in AH RAM 003 (8.22 kg). The highest yield per plant (508.48 kg) was observed in AH RAM 002 followed by AH RAM 003 (353.46 kg) and the lowest yield was recorded from AH RAM 001 (304.15 kg). Maximum TSS was obtained from AH RAM 002 (22.36 %) followed by AH RAM 001 (19.66 %).

#### **Evaluation of velvet bean at hilly region**

S.M. Faisal and R.H. Nitol

An investigation was carried out at HTARS, Ramgarh during the winter of last year. Three velvet bean germplasm, viz. MPRAM001, MPRAM002, and MPRAM003 were used to see their diversities. They took more or less similar time for harvest from flowering except the check variety BARI seem-8. No. of pods/plant and single pod weight was higher in BARI Sheem-8 (94.66) and MPRAM001 (35.10 3 gm) respectively. Wt. of pods/plot was the highest (5.46 kg) in MPRAM001 and the lowest in MPRAM002 (2.66 Kg). The line MPRAM001 gave the highest (6.06 t/ha) yield followed by MPRAM003 (4.60 t/ha).

#### **Effect of supporters for quality production and higher yield of black pepper in hilly region**

S. M. Faisal and R. H. Nitol

An experiment was conducted at Hill Tract Agricultural research station at Ramgarh, khagrachari in order to find out the impact of different support trees on black pepper production

in the hilly region. The highest dried fruit yield was recorded in case of jackfruit trees and it was 1.91 kg/plant followed by Mango (1.58 kg/plant) and Chapalish (1.57 kg/plant), although no significant difference was found. None of the parameters showed significant differences among the treatments studied.

#### **Evaluation of eggfruit (*Pouteria campechiana*) in hilly area**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment on the evaluation of eggfruit or tiesa in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. There were four different tiesa genotypes, such as PC Rai-001, PC Rai-002, PC Rai-003 and PC Rai-004, under study. Among those genotypes, the maximum number of fruits per plant (300), individual fruit weight (193 g), fruit size (85 mm × 68 mm), pulp thickness (1.5 cm), edible portion (80%) and yield (57.9 kg/plant) were obtained from PC Rai-001 and comparatively higher than other genotypes.

#### **Evaluation of jabuticaba (*Plinia cauliflora*) in hilly area**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment on the evaluation of jabuticaba in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. There were three genotypes, such as PC Rai-001, PC Rai-002 and PC Rai-003, under study. Among those three lines, the maximum number of fruits per plant (4000), individual fruit weight (7.2 g), fruit size (25.2 mm × 24.6 mm), yield (28.8 kg/tree) and edible portion (79.2%) was observed in PC Rai-001. It also had TSS 17% and was good in taste.

#### **Evaluation of star gooseberry (*Phyllanthus acidus* L.) germplasms**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment on the evaluation of star apple in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. There were four genotypes under study. Among those four lines, PA Rai-002 had maximum 10-fruit weight (40 gm), flesh thickness (6.23 mm), TSS (10%) and sweet in taste compared to other lines.

**Evaluation of star apple (*Chrysophyllum caimito* L.) germplasms**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment on the evaluation of star apple in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. There were three genotypes under study. Among those three lines, CC Rai-002 had maximum number of fruits per plant (175), individual fruit weight (190 g), fruit size (67.86 mm × 68.78 mm), pulp TSS (19%) and yield (33.4 kg/plant) compared to other two lines.

**Evaluation of bullock's heart (*Annona reticulata* l) germplasm**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment on the evaluation of Bullock's heart in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. There were eleven promising bullock's heart lines under study. Among those lines, the highest individual fruit weight (390 g), fruit size (118 mm × 90 mm), yield (5.85 kg/tree) and TSS were observed in AR Rai-011.

**Evaluation of exotic passion fruit (*Passiflora edulis*) germplasm**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment on the evaluation of passion fruit in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. The growth conditions of the passion fruit lines were promising, and BARI Passion fruit-1 started flowering as it was grown directly from vine while the other lines directly from seeds.

**Evaluation of para jam (*Antidesma acidum*) germplasm**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment on the evaluation of para jam in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. The fruit size, 100-fruit weight, TSS and yield of the AA Rai-001 were 4.81 mm × 4.50 mm, 3.68 g, 20% and 7.2 kg/tree, respectively.

**Performance of BARI developed mango varieties in chattogram hill tracts**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment was conducted with eleven 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, BARI Aam-9, BARI Aam-10 and BARI Aam-11 at hill valley of Hill Agricultural Research Station in Raikhali, Rangamati Hill District during 2022-23 on the existing fourteen years old mango orchard with an objective to verify their performance. Among the varieties, BARI Aam-7 performed better in terms of yield followed by BARI Aam-8 and BARI Aam-3. However, in terms of TSS BARI Aam-3 (23%), BARI Aam-4 (22%) and BARI Aam-9 (22%) were superior, and in terms of individual fruit weight BARI Aam-4 was the heaviest (385 g) followed by BARI Aam-5 (366 g).

**Evaluation of mango germplasm for green consumption at hill valley in Chattogram hill tracts**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment was conducted at hill valley of Hill Agricultural Research Station of Raikhali, Rangamati Hill District during 2022-23 to find out the best green mango germplasm. The highest number of fruits per plant (512) was found in MI Rai-008 and the lowest number of fruits per plant (32) was in MI Rai-009. The heaviest individual fruit weight (240 g) with edible portion (79.17%) were recorded in MI Rai-008 on the other hand lowest individual fruit weight (130 g) was found in MI Rai-009. The maximum TSS (11%) was found in germplasm MI Rai-008 and BARI Aam-9. Germplasm MIR008 and BARI Aam-9 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 superior among all other germplasms under study in Chattogram Hill Tracts.

**Evaluation of dwarf coconut in hilly area of Rangamati**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

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 2022-23. There were six lines from two different varieties, such as Xiem blue and Kerala hybrid under study. Among those lines, the highest number of fruits per plant (52) and number of inflorescence (16) were observed in CN Rai-010. The biggest fruit (18.6 cm × 13.8 cm), heaviest fruit (1512 g) and water volume (180 ml) were recorded in CN Rai-008.

#### **Evaluation of newly collected mango germplasm**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment on the evaluation of mango germplasm in hill valley was conducted at the fruit orchard of Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. The highest no. of fruits per plant (1500) in MI Rai-040 and lowest number of fruits per plant (10) in MI Rai-029. MI Rai-037 performed better in terms of overall performance like individual fruit weight (712 g), TSS (20%), edible portion (73%), and size and shape compared to other lines. However, MI Rai-040 and MI Rai-029 were also found superior in terms of early harvest and year-round production, respectively.

#### **Evaluation of pummelo in hilly region of Rangamati**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment with thirteen germplasms of pummelo was conducted at the existing fourteen years old orchard of pummelo plants collected from different parts of Chittagong Hill Tracts at hill valley of Hill Agricultural Research Station of Raikhali in Rangamati Hill District during the period of 2022-23 for the evaluation of superior pummelo genotypes in hilly region. The performance of the germplasm can be concluded after the harvest of the fruits.

#### **Evaluation of promising dragon fruit germplasm in Rangamati hilly area**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment with three germplasms of dragon fruits collected from different parts of the country were conducted at eight years old dragon fruit orchard of Hill Agricultural Research Station, Raikhali, Rangamati. HU Rai-003-2, a round shaped white flesh red skin dragon fruit line, had maximum fruit weight (494 g) and TSS (16%), and HU Rai-002, an oblong shaped red fleshed red

skin fruit line, had maximum number of fruits per pillar (47) and yield (30.98 t/ha), but BARI Dragon fruit-1, a round shaped red flesh red skin dragon fruit variety, had maximum edible portion (75%).

#### **Collection and evaluation of coffee germplasm**

S.P. Chakma, M.M. Hasan, 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 2022-23. The maximum 100-fresh berry weight (120.47 g), 100-dried filled seed weight (11.96 g), fresh berry yield (7.12 t/ha) and dried seed yield (1.20 t/ha) of *C. arabica* were obtained in CA Rai-012 the highest 100-fresh berry weight (150.65 g), 100-dried filled seed weight (12.88 g), fresh berry yield (4.60 t/ha) and dried seed yield (0.74 t/ha) of *C. canephora* were found in CC Rai-063.

#### **Collection and evaluation of cashew germplasm**

S.P. Chakma, M.M. Hasan, N.U. Ahmed And M.A. Hossain

An experiment on the evaluation of cashew nut in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. The higher cashew nut weight (9.71 g) and size (35.6 mm × 28.42 mm × 19.4 mm) were observed in AO Rai-024. The higher cashew kernel size was observed in AO Rai-037, AO Rai-032, AO Rai-030 and AO Rai-024, which were 2.95 g, 2.78 g, 2.74 g and 2.69 g, respectively. Based on nut weight and size, and kernel weight and size AO Rai-024, AO Rai-037, AO Rai-030, AO Rai-034, AO Rai-018, AO Rai-009, AO Rai-036, AO Rai-032, AO Rai-031 and AO Rai-002 were selected for further evaluation.

#### **Study on the performance of grafted cashew saplings**

S.P. Chakma, M.M. Hasan, N.U. Ahmed And M.A. Hossain

An experiment on the performance of grafted cashew saplings in hill valley was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. The growth performance of cashew saplings directly from seed was found to superior compared to cleft grafted saplings in terms of success survivability (96%).

**Evaluation of exotic french bean lines**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

An experiment for evaluation yield trial on French bean lines was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23 to find out the suitable flat French bean lines in order to release as a variety. BARI Jharsheem-2 was used as check variety. Among the four lines and control BARI Jhar sheem-2, PV Rai-097 was found superior in terms of pod number (31), pod size ( $20.5 \times 1.8 \times 0.7$  cm), pod weight (11 g) and pod yield (49.1 t/ha) compared to control.

**Evaluation of year round muskmelon lines at hill valley of Chattogram hill tracts**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

The experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23 to find out the suitable muskmelon lines which is year round in character to release as a variety and to utilize in future breeding program of muskmelon. According to fruit qualities and yield performance, among the three lines (CM Rai-009, CM Rai-013 and CM Rai-019), CM Rai-009 was found superior in terms of number of fruits per plant (6.7) and TSS (6%) with no crack on the fruit.

**Evaluation of exotic cherry tomato germplasm**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

The experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23 with six cherry tomato germplasms to find out the suitable cherry tomato lines to develop as a variety. The earliest flowering (55 DAT), earliest harvest (75 DAT), maximum number of fruits (198.5), pericarp thickness (3.71), number of fruit/truss (14.57), harvest duration (55 days), yield per plant (2.14 kg) and estimated yield (63.56 t/ha) were observed in SL Rai-002. Its average fruit weight was 10.8 g, TSS 5 % and red in color. This line was superior compared to other lines based on all the characters.

**Evaluation of cape gooseberry (*Physalis peruviana* L.) Germplasm**

S.P. Chakma, M.M. Hasan And N.U. Ahmed

The experiment was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23 with two *Physalis* spp. germplasms to find out the suitable cape gooseberry line to

develop as a variety. The 10-fruit weight (35.45 g), fruit size ( $17.89 \text{ mm} \times 17.65 \text{ mm}$ ), TSS (13%), no bitterness, and number of fruits per plant (700) were maximum in PP Rai-001 compared to check line.

**Research on Oilseed Crop****Adaptive trial on BARI sharisha-18 at hilly area**

N.U. Ahmed, S.P. Chakma, M.M. Hasan And M.M. Kadir

The adaptive trial of BARI Sharisha-18 was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. BARI Sharisha-18 were 160 cm tall containing 200 siliquea per plant, 28 seeds per siliquea,  $70.8 \text{ mm} \times 5.6 \text{ mm}$  siliquea size, 7 primary branches, 13 secondary branches, 4 tertiary branches and 2 t/ha yield.

**Research on Tuber Crops****Performance trial of BARI released potato varieties at hill valley**

N.U. Ahmed, S.P. Chakma, M.M. Hasan And M.A. Kawsar

The observation trial of BARI released potato varieties to understand the performance of suitable potato varieties for hill area was conducted at Hill Agricultural Research Station, Raikhali, Rangamati Hill District during 2022-23. Among 43 BARI released potato varieties, the maximum estimated yield (44.35 t/ha) was found in BARI Alu-37 followed by BARI Alu-82 (43.93 t/ha), BARI Alu-88 (34.13 t/ha), BARI Alu-87 (32.1 t/ha) and BARI Alu-56 (31.03 t/ha).

**On-farm trial of BARI developed winter country bean varieties in hilly areas of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar And M. F. Hossain

An on-farm trial was conducted at hill valleys of Bandarban sadar during the rabi season, 2022-23 to evaluate the performance of BARI developed winter Country bean varieties in farmers' field. The treatments were  $T_1$ = BARI Sheem-1,  $T_2$ = BARI Sheem-6,  $T_3$ = BARI Sheem-10 and  $T_4$ =Local variety as check. The experiment was laid out in RCB design with three dispersed replications.

BARI Sheem-1 took less time to harvest (66 days) than other varieties. BARI Sheem-10 gave the highest flower/plant, fruits/plant and individual fruit weight (23.98, 8.64 and 12.26 g) whereas BARI Sheem-6 gave the highest yield (18.36 t ha<sup>-1</sup>). Local variety gave the lowest pod length, individual fruit weight and yield (9.42 cm, 9.17 g and 12.66 t ha<sup>-1</sup>). From cost-return analysis it was found that highest gross return was found from BARI Sheem-6 (Tk.642600 ha<sup>-1</sup>) with BCR of 4.06 followed by BARI Sheem-10 (Tk.621600 ha<sup>-1</sup> and 3.93) and BARI Sheem-1 (Tk.541800 ha<sup>-1</sup> and 3.43). Lowest gross return (Tk.405120 ha<sup>-1</sup>) and BCR (2.56) was found from local sheem.

#### **On-farm trial of BARI released short duration mustard varieties in hilly areas of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar And M. F. Hossain

A varietal trial of mustard was conducted at farmer's field of Reicha of Bandarban district, during 2022-23 to evaluate the performance of BARI Mustard varieties. A total of four varieties viz. BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-17 and Local (as check) were tested in the farmer's field. The experiment was carried out in a randomized complete block design with three replications. Significant differences were found among the mustard varieties for number of branches plant<sup>-1</sup>, number of capsules plant<sup>-1</sup>, capsule length and seed yield. BARI Sarisha-14 produced the highest plant height (133.47 cm) number of branches plant<sup>-1</sup> (9.42), number of capsules plant<sup>-1</sup> (140.83), number of seeds capsule<sup>-1</sup> (40.76) and seed yield (1.64 t ha<sup>-1</sup>), followed by BARI Sarisha-15 (1.47 t ha<sup>-1</sup>). The seed yield of BARI Sarisha-15 and BARI Sarisha-17 was not differed significantly. The lowest seed yield was found in local (1.22 t ha<sup>-1</sup>). From cost-return analysis it was found that highest gross return was found from BARI Sarisha-14 (Tk.139400 ha<sup>-1</sup>) followed by BARI Sarisha-15 and BARI Sarisha-17 shared same amount of return (Tk.128350 ha<sup>-1</sup>) and lowest was found from local one (Tk.103700 ha<sup>-1</sup>).

#### **Intercropping of fenugreek with groundnut at sangu river bank of Bandarban hill district**

M. T. Islam, I. Hossain, M. M. Anowar And M. F. Hossain

The experiment was carried out at the farmers' field of On-Farm Research Division, Bangladesh Agricultural Research Institute (BARI), Bandarban during the rabi season, 2022-23 to find out the suitable intercropping system for increasing crop productivity and profitability of fenugreek with groundnut intercropping system. The treatments were T<sub>1</sub>=sole groundnut, T<sub>2</sub>= one row of fenugreek in between two rows of groundnut and T<sub>3</sub>= two rows of fenugreek in between two rows of groundnut T<sub>4</sub>=sole fenugreek. Treatments were arranged in a randomized complete block design with three replications. Between intercropped treatments, single row of fenugreek within paired rows of groundnut (T<sub>2</sub>) showed higher groundnut equivalent yield (3467.80 kg ha<sup>-1</sup>), highest land equivalent ratio (1.58), gross return (Tk. 277424 ha<sup>-1</sup>), net return (Tk. 218624 ha<sup>-1</sup>) and benefit cost ratio (4.72) over the respective sole groundnut crop (T<sub>1</sub>), sole fenugreek (T<sub>4</sub>) and Two rows of fenugreek in between two rows of groundnut (T<sub>3</sub>). The result showed that groundnut + fenugreek (single row) intercrop system was most productive and profitable than sole groundnut cultivation in Bandarban region.

#### **On-farm trial of BARI developed lemon varieties in the hilly areas of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar And M. F. Hossain

An on-farm trial was conducted at farmer's field of hill slopes of Bandarban sadar during 2021-22 and 2022-23 to evaluate the performance of BARI lemon varieties and suitable one in hill areas of Bandarban. Vegetative and yield data were collected immediate after planting, on 18 May, 2022 and on 8 May, 2023 to evaluate performance of the varieties. The investigation revealed that vegetative growth of lemon varieties varied significantly. Overall plant height, canopy development, tree volume, fruit length, fruit diameter, individual fruit weight and juice content were found high in BARI Lebu-1 (343.33 cm), (N-S: 317.67 cm) (E-W: 314 cm) and (18.15 m<sup>3</sup>), (12.63 cm), (7 cm), (358.67 g) and (83.33 ml) respectively. Thai seedless lebu showed the least results in terms of plant height, canopy development, tree volume, fruit length, fruit diameter, individual fruit weight and juice content (160.50 cm, N-S: 100 cm, E-W: 106.67 cm, 0.91 m<sup>3</sup>, 3.67 cm, 3 cm, 26 g and 4.48 ml respectively).



Highest number of fruits/plant was found from BARI Lebu-4 (40.33) followed by Chaina-3 Seedless Lebu (39.33) and lowest was found from Thai Seedless Lebu (8.00). Further reproductive and yield data will be collected as progress.

#### **Performance of BARI mango varieties in the hilly areas of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar And M. F. Hossain

A trial was conducted at farmer's field of hill slopes of Bandarban sadar during 2021-22 and 2022-23 to evaluate the performance of BARI mango varieties along with other popular commercial varieties to find out the suitable one in 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 18 May, 2022 and on 8 May, 2023 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 Govidavog Aam throughout the year (5.33 m<sup>3</sup>) followed by Himsagor Aam (3.82 m<sup>3</sup>) whereas BARI Aam-10 showed the least tree volume (0.35 m<sup>3</sup>) in second year. Highest increment percentage in plant height, stem girth and canopy were observed in BARI Aam-2 (127.1%), BARI Aam-1 (364%) and BARI Aam-11 (417.7% in N-S) and BARI Aam-4 (421.7% in E-W direction) respectively. Reproductive and yield data will be collected from the following year.

#### **On-farm trial of BARI potato varieties in hill valleys of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar And M. F. Hossain

A varietal trial of potato was conducted at farmer's field of Reicha and Sharnamondir in Bandarban district, during 2022-23 to evaluate the performance of BARI Potato varieties. A total of ten varieties viz. BARI Alu-7, BARI Alu-25, BARI Alu-36, BARI Alu-37, BARI Alu-40, BARI Alu-41, BARI Alu-48, BARI Alu-56, BARI Alu-62 and BARI Alu-79 were tested in the farmer's field. The experiment was carried out in a randomized complete block design with three replications. Significant differences were found among the potato varieties for tuber length, tuber diameter, tuber weight, yield hill<sup>-1</sup> and yield ha<sup>-1</sup>. BARI Alu-

62 produced the maximum yield hill<sup>-1</sup> and yield ha<sup>-1</sup> (0.46 kg and 30.67 t). The yield of BARI Alu-36 and BARI Alu-48 (0.45 kg, 30 t and 0.45 kg, 30 t ha<sup>-1</sup> respectively) was not differed significantly. The lowest yield hill<sup>-1</sup> and yield ha<sup>-1</sup> was found in BARI Alu-25 (0.33 kg and 22 t).

#### **Pilot production of sweet gourd and red amaranth intercropping system in hill valleys of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar And M. F. Hossain

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 the rabi season of 2020-21 and 2021-22 to evaluate the performance of sweet gourd production, to increase land use efficiency and to find out best intercrop combination with sweet gourd. From that experiment, among all the intercrops, red amaranth performed better in terms of yield and economic returns. That is why this pilot production program was taken to popularize this technology among the farmers. Two farmers field were selected for piloting this intercropping system. The results indicating that sweet gourd equivalent yield (SEY) was 38.83 t/ha. Gross return from sweet gourd + red amaranth intercropping system was 776600 Tk. ha<sup>-1</sup> while net return was 580100 Tk. ha<sup>-1</sup> with BCR of 3.95. That is the indication of the suitability of this intercropping system due to higher crop productivity, better land and time utilization as well as economic return for the hilly areas of Bandarban.

#### **Pilot production program of BARI lau-4 in hill valleys of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar And M. F. Hossain

Two farmers field were selected for piloting of BARI Lau-4 at Bikricchara and Harinmara in hill valleys of Bandarban during the rabi season of 2022-23 to popularize this variety in hilly areas. Prior to this pilot production program, the performance of 03 BARI bottle gourd Varieties were evaluated in farmers' field during two consecutive years 2020-21 and 2021-22. Among those varieties, BARI Lau-4 performed better in terms of yield and economic returns. That is why, this variety was selected for pilot production

program so that farmers can get high profit. In 2022-23, BARI Lau-4 performed good like before and highest fruit length, fruit diameter, single fruit weight and fruit plant<sup>-1</sup> and yield were 39.72 cm, 15.53 cm, 2.05 kg and 8.57 and 29.27 t ha<sup>-1</sup> respectively. Gross return from BARI Lau-4 was 439050 Tk. ha<sup>-1</sup> where net return was 334050 Tk. ha<sup>-1</sup> with BCR of 4.18. Farmers were very happy to have an excellent variety like BARI Lau-4.

#### **Pilot production program of BARI hybrid summer tomato in hill valleys of Bandarban**

M. T. Islam, i. Hossain, m. M. Anowar and m. F. Hossain

Pilot Production Program was conducted at three different location of hill valleys of Bandarban Sadar (Sualock, Reicha and Sharnamondir) during the summer season, 2022 to evaluate the performance of BARI Hybrid summer tomato-8 variety under farmers' field conditions and to popularize it among the farmers. The average yield of BARI Hybrid summer tomato-8 variety was 41.24 t ha<sup>-1</sup>, which was highly appreciated and accepted by the farmers. From the cost and return analysis it was revealed that the gross return was found as Tk.3505400 ha<sup>-1</sup> which resulted in gross margin of Tk. 2565800 ha<sup>-1</sup> with 2.84 BCR. Comparison between two production technologies (poly tunnel and poly mulch) were performed at Sualock hill valleys which showed that, yield of poly tunnel tomato (47.51 t ha<sup>-1</sup>) was higher than poly much tomato (44.30 t ha<sup>-1</sup>) though gross return was high in poly mulching tomato (3800800 Tk. ha<sup>-1</sup>) because of less production cost.

#### **Pilot production program of BARI sarisha-18 in hill valleys of Bandarban**

M. T. Islam, I. Hossain, M. M. Anowar And M. F. Hossain

A pilot production program of BARI Sarisha-18 was conducted at Ratnapur village of Reicha in hill valleys of Bandarban during the rabi season of 2022-23 to evaluate the yield potentiality and popularize this variety in hilly areas. Cultivation of mustard is not an old practice except some scattered production of local cultivar. But in recent times, high yielding BARI released mustard varieties are being cultivated in hill valleys of Bandarban. In hilly areas, aman rice harvest becomes late and most of the land has water scarcity where rabi crops cannot thrive. Targeting

this areas, long duration BARI Sarisha-18 was introduced which can be sown slightly late. Plant height, Number of branches plant<sup>-1</sup>, number of capsules plant<sup>-1</sup>, capsule length, seeds capsule<sup>-1</sup> and seed yield of BARI Sarisha-18 was 160.1 cm, 6.13, 129.57, 7.17 cm, 29.82 and 1.93 t ha<sup>-1</sup>. Mustard oil and oil cake yield per hectare were 752.7 liter and 1061.5 kg respectively. Gross return from BARI Sarisha-18 was 318740 Tk. ha<sup>-1</sup> where net return was 233050 Tk. ha<sup>-1</sup> with BCR of 3.72. Farmers were very happy to have an excellent variety like BARI Sarisha-18.

#### **Adaptive trial of robusta and arabica coffee in Bandarban hill district**

M. T. Islam, F. Arshad, I. Hossain And A. Hossain

This study investigated the adaptive performance of coffee robusta and coffee arabica in seven upazila of Bandarban Hill District, Bangladesh. The study was conducted over two cultivation years, 2021-2022 and 2022-2023. The results showed that coffee robusta had a higher average plant height increment than coffee arabica in all seven upazila. The highest average plant height increment from 2021 to 2023 for coffee robusta was in Alikadam Upazila (88.01%), and for coffee arabica was in Ruma Upazila (83.67%). The highest average trunk girth increment for coffee robusta was in Rowangchhari Upazila (80.93%), and for coffee arabica was in Thanchi Upazila (91.33%). The highest average tree volume increment for coffee robusta was in Thanchi Upazila (516.23%), and for coffee arabica was in Alikadam Upazila (520.42%). The study is ongoing, the vegetative and yield data for coffee robusta and coffee arabica will be recorded and analyzed in the upcoming year for better understanding the performances among them throughout the Upazila of Bandarban district.

#### **Maximizing the yield of existing cashew nut garden through improved management practices in Chittagong hill tracts**

M. T. Islam, F. Arshad, I. Hossain And A. Hossain

A trial was conducted at farmer's field of Dolupara hill valleys of Bandarban sadar during the season, 2021-22 and 2022-23 to develop improved management technologies for increasing the yield of existing cashew nut garden in chittagong hill tracts. For the year 2022-2023, among five treatments, Treatment T<sub>0</sub> = Control (No management) showed the highest annual height

increment (21.08%) over other treatments followed by  $T_1 = T_0 + \text{Fertilization (2 times, pre-rainy season and post rainy season)}$  (15.83%) and lowest increment observed in  $T_4 = T_3 + \text{pesticide application (after pruning, pre-flowering and at nut set)}$  (7.32%). Most girth increment found at Treatment  $T_1 = T_0 + \text{Fertilization (2 times, pre-rainy season and post rainy season)}$  (5.87%) where lowest was found from  $T_0 = \text{Control (No management)}$  (3.56%). Treatment  $T_3 = T_2 + \text{Pruning (1 time after harvesting)}$  developed more Canopy (N-S) (16.52%) and  $T_2 = T_1 + \text{Mulch (before winter)}$  express highest canopy in (E-W) direction (13.75%). Overall tree volume rises more in

Treatment  $T_2 = T_1 + \text{Mulch (before winter)}$  express highest tree volume (51.69%) followed by treatment  $T_4 = T_3 + \text{pesticide application (after pruning, pre-flowering and at nut set)}$  (39.09%). Among the all treatments,  $T_4 = T_3 + \text{pesticide application (after pruning, pre-flowering and at nut set)}$  treatment performed better in all yield attributing parameters viz. panicle length (23.59 cm), panicle/m<sup>2</sup> (38), nut/m<sup>2</sup> (13.17), apple weight (40.63 g), nut length (2.75 cm), nut breadth (1.82 cm), single nut weight (5.26 g), thousand nut weight (510 g) and mean nut yield/tree (0.73 kg) because of improved management practices.



# 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**

M. Mukhlesur Rahman, M. G. Mahboob, AFM Tariqul Islam, M. H. Ahmmed, M. H. Rashid, S. M. Khan and Suman Biswas

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 the cropping patterns and availability of natural resources on the ground and allocate them to the judiciary for SI in agriculture. Hence, 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 project period (2018-2023), a total of seven extensive surveys were 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. Sentinel-2A images were collected through Google Earth Engine during the dry months (Oct-Mar) of each cropping season. Although the cloud was masked out, these images were filtered to ensure the 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 the area covered by rice, 22253.46 ha (45.17%), was relatively better than other classified crop fields initially during 2020-21 cropping season, but over time it gradually dropped and replaced with significant portion of the maize field which occupied 2296.02 ha (9.31%), 6033 ha (12.38%), and 13247 ha (26.89%) during 2020-21, 2021-22, 2022-23 cropping season accordingly. Concerning the reference data, the overall accuracy and Kappa coefficient of the classified map were found to be around 86%, 91% and 89%, and 0.81, 0.89, and 0.86 during the 2020-21, 2021-22, 2022-23 cropping season accordingly 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 each cropping season. Besides, a set of agro-environmental resources geodatabase was developed including the digital elevation model, slope map, aspect map, soil map, topsoil texture, soil reaction, 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. To obtain sustainable cropping pattern, crops suitability analysis for major rabi crops by integrating Analytic Hierarchy Process (AHP) and geographic information system

(GIS) technique with multiple factors, which are initially developed for geo-database development. The highest two crops that occupied S1 (Highly Suitable) class were Wheat with 5243.6 ha (10.67 %) and Potato with 4389.25 ha (8.9%) of the study area. In S2 (Moderately Suitable) class, Wheat with 30304.16 ha (61.71%) and Lentils with 29654.53 ha (60.39%) of the total study area occupied respectively. The lowest suitability areas in the study areas N (Not Suitable) class were occupied by mustard and potatoes, with 8128.52 ha (16.55%) and 6534.55 ha (13.30%), respectively. The results revealed that the integration of Remote sensing, geospatial modeling for crop type mapping, and crop suitability analysis made an appropriate approach for the evaluation of suitable cropping patterns of this area for optimized land use planning.

#### **Forecasting onion yield by using satellite-based remote sensing technique in Bangladesh**

Nur Mohammad, M. Mukhlesur Rahman, Istiak Ahmed, M. Rasel, and M. A. Monayem Miah

Onion is one of the major vegetables as well as spices crops with the largest production worldwide. Onion plays a major contribution as spices crop which is used in daily meal in Bangladesh. Therefore, it is imperative to do research aimed at forecasting the yield of onion crops. Pre-harvest prediction of a crop yield may prevent a disastrous situation and help decision-makers to apply more reliable and accurate strategies regarding food security. Remote sensing can be used for yield estimation prior to harvest at the field level to provide helpful information for agricultural decision making. Remote sensing images are capable of identifying crop health, as well as predicting its yield. Vegetation indices (VIs), such as the normalized difference vegetation index (NDVI) calculated from remotely sensed data have been widely used to predict crop yield. Yield prediction models based on a time series of satellite images and high-density yield data, and to indicate the best phenological stage of onion crop to obtain satellite images for this purpose. The study used 16-day (~ 30 m) Landsat 8 OLI (Operational Land Imager) high resolution reflectance data for the first year 2022-2023 at three different locations viz. Sujanagar, Pabna; Baliakandi, Rajbari and Durgapur, Rajshahi in Bangladesh. The single date of cloud free image acquisition based on maximum

NDVI for Landsat 8 OLI satellite image was used for 2022-2023 onion growing period to develop the yield prediction model. Regression model was performed between NDVI values and 35 farmers filed level onion yields for all locations. The yield vs. NDVI relationship for Landsat 8 image exposed that the multiple determination of coefficient ( $R^2$ ) which is highest (84.1%) for Baliakandi, Rajbari followed by  $R^2=83.8\%$  for Sujanagar, Pabna and  $R^2=72.3\%$  for Durgapur, Rajshahi for first year onion growing season i.e., 2022-2023.

#### **Yield prediction of mustard crop by using satellite based remote sensing technique in Bangladesh**

M. Mukhlesur Rahman, Nur Mohammad, Istiak Ahmed, M. A. Monayem Miah and Suman Biswas

Mustard (*Brassica spp.*) is one of the important oilseed crops which has potential demand as the preferred edible oil for the majority of people of Bangladesh. The accurate estimation of both harvested area and yield of mustard are equally important in ensuring the accurate determination of their product. The traditional measurement of these statistics is time-consuming, tedious, and costly. Whereas remote sensing techniques are being used to easily measure these statistics at high spatial and temporal resolutions. Therefore, an attempt was made to predict the mustard yield through satellite-based remote sensing techniques before its harvesting. To get this done, the high spatial-temporal resolution Satellite imageries of Sentinel 2A (~10m) and Landsat 8 (~30m) were acquired for the three study locations after setting the experiment in a farmer's field for three consecutive mustard growing seasons of 2022-23, 2023-24 and 2024-25. The mean Normalized Difference Vegetation Index (NDVI) was extracted from the maximum NDVI-produced temporal satellite imageries within the growing season from 20 farmer's mustard fields of each study location. The first year's results revealed that in most cases the yield was maximum for the field where the NDVI values were not maximum and vice-versa. However, the relationships of the extracted mean NDVI and yields will be established using the classical linear regression model where the model will be developed using the first two years' data and will be validated using the data of the last study period.

### Change and instability analysis in area and production of major pulses in Bangladesh

K. Saidur Rahman, J. K. Prioty and M. A. Monayem Miah

Instability is a crucial characteristic of agriculture. Since agriculture is dependent on weather conditions, the area, production, and yield of the crops are subject to significant variations over time. Pulses are not only a vital ingredient of the human diet; they are equally important to the health of humans and agricultural soils as well. This study examined the changes in area, production, and yield of major pulses in Bangladesh through growth rate and instability analysis based on secondary data for the last 40 years (1981-2020). The entire period was divided into three sub-periods: 1981-1990, 1991-2000, and 2001-2010 for analysis through different statistical tools. Growth rates were calculated by fitting an exponential growth function, and instability was analyzed by generating the Cuddy-Della Valle index for the six major pulses of Bangladesh and pulses as a whole. The analysis revealed that the area and production of pulses were not increased satisfactorily. Though the pulses yields were increased significantly, the rate of growth is slow, and it is insufficient to meet our country's demand. The analysis also revealed that the area, production, and yield of pulses were not stable during the study period.

### Potato yield forecasting using satellite images and crop simulation model under changing climate

Istiaq Ahmed, Suman Biswas, AFM Tariquul Islam, M. G. Mahboob, A. K. Choudhury and M. A. Monayem Miah

Traditional methods of yield estimation often rely on laborious field surveys and manual data collection, which can be time-consuming and resource-intensive. This study presents a comprehensive investigation into forecasting potato yield using satellite imagery and the AquaCrop model, with a specific focus on the utilization of the Normalized Difference Vegetation Index (NDVI) as a vital indicator of vegetation health and productivity. The research aims to address the challenges posed by climate variability in agriculture and offers valuable insights into crop dynamics, yield estimation, and the potential benefits of remote sensing and machine learning techniques. To achieve these objectives, nine

Sentinel-2 satellite images were analyzed during the ingestion period between December 2022 and February 2023. Five images with less than 40% cloud cover were selected for further analysis. The research demonstrated the effectiveness of machine learning approaches, specifically Support Vector Machine (SVM) and Random Forest (RF) models, for yield prediction. The exploratory data analysis (EDA) revealed a significant correlation between potato yield and the NDVI, particularly during the full vegetative stage observed in February. The AquaCrop simulated yield of potato showed an increasing trend over time, aligning with the mean yield during the harvesting period. Notably, as the crop approached maturity, AquaCrop outperformed machine learning models in yield estimation. The study serves as a stepping stone towards enhancing crop productivity and resilience, empowering farmers, agronomists, and policymakers to make informed decisions for a sustainable agricultural future.

### Bioinformatic analysis of *dicer-like (DCL)*, *argonaute (AGO)*, and *rna-dependent rna polymerase (RDR)* genes and their associated regulatory elements in brassica species (*brassica rapa L.*)

Zobaer Akond, Sheikh Hasna Habib, Nurul Haque Mollah

RNA interference (RNAi) or gene silencing in eukaryotes is a commonly occurring mechanism. It is controlled by the three main gene families called Dicer-like (DCL), Argonaute (AGO), and RNA-dependent RNA polymerase (RDR). They control gene expression at the transcriptional or post-transcriptional level and often maintain plant growth and development. They also play the important role to regulate gene expression in response to different biotic and abiotic factors. This mechanism is actually maintained by the 19-24 nt non-coding small RNA molecules (miRNA and siRNA). But how these genes function and their structures and the associated regulatory elements have not been analyzed in detail. Our analysis identified 4 *BrDCL*, 13 *BrAGO*, and 6 *BrRDR* RNAi-related genes from the *Brassica rapa* genome. Motif structure analysis showed that the predicted proteins conserve similar motif characteristics similar to their paralog RNAi genes of *Arabidopsis*. Moreover, sequence logo and relative frequency analysis showed that Lysine (K),



Serine(S), Valine(V), Leucine(L), and Glutamic acid(E) were the prevalent amino acids of the predicted motifs in the identified proteins. The trans-regulatory analysis showed that the top-ranked 10 TF families (Dof, bZIP, C2H2, ERF, BBR-BPC, MICK-MADS, MYB, TCP, WRKY, and AP2) consisted of 393 (78%) regulators of which Dof 115(23%), bZIP 58(11.55%), C2H2 49(9.76%), ERF 30(6%), BBR-BPC 29(5.77%), MICK-MADS 23(4.58%), MYB, TCP and WRKY

each 23 (4.58%) and AP2 regulate 21(4.18%) TFs. RNAi genes-TFs network analysis illustrated that eight key TF families were highly connected with the identified RNAi genes in *B.rapa* with some exception of ERF, MYB, TCP and ,WRKY. 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.

### Information on Right to Information: RTI of BARI

#### Designated Officer

Officer's name : Dr. Md. Abdul Monayem Miah  
ড. মো. আব্দুল মোনায়েম মিয়া  
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Office : ASICT Division, Bangladesh Agricultural Research Institute (BARI). Gazipur-1701

#### Designated Officer (Alternative)

Officer's name : Dr. Md. Shawquat Ali Khan  
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#### Designated Officer (Appeal)

Officer's name : Wahida Akter  
ওয়াহিদা আক্তার  
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Mobile : 01316105955  
Email : secreatary@moa.gov.bd  
Website : www.moi.gov.bd  
Office : Building # 04, Ministry of Agriculture, Bangladesh Secretariat, Dhaka

**Table. Citizen's access to information in 2022-23**

Sn	Name of the Authority	No. of application received as of the format of Right to Information Act, 2009	No. 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	02	02	-	-	-	-	-	-

# Training & Communication Wing

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## Training & Communication

During 2022-23, 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 2022-23 on different aspect of agricultural Knowledge share to achieve the goal of Annual Performance Agreement (APA). A total of 1472 participants of BARI and other national research organization were actively participated in these seminars and workshops.

## MoU signed

During the period 2022-23, 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 86,523 collections are existed till 2022-2023 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.

**Table 1. Existing collections of BARI Central Library: 86,523**

Items	Quantity
Books, Reports, Proceedings, etc.	46,849
Archival collection	2,670
Thesis	919
Periodicals (bound in book form)	4,247
Journal	24,606
Newsletter	671
Bulletin	164
Pamphlets & Booklets	962
Reprint	518
Leaflets	4,917

**Table 1 a. List of Books, Reports, Proceedings etc. and Thesis: 136**

Items	Purchased	Exchanged	Gift / Complimentary	Total
Books	39	01	26	66
Research reports, project reports & proceedings	-	04	40	44
Thesis (MS & Ph.D)	-	-	26	26

**Table 1 b. List of Journal, newsletters and bulleting published :64**

Items	Purchase	Exchange	Gift / Complimentary	Total
Journals	-	26	25	51
Newsletters	-	03	05	08
Bulletins	-	-	01	01
Booklet	-	-	04	04

**Table 2. List of documentation service processed.**

SI No.	Procured material processed	No.
01	Document Accessioned	187
02	Catalogued & Classified and pasted with call numbers, book pockets and due slips	136
Total		323

**Table 3. Services provided to users .**

SI No.	Services provided to the Scientists	Number
1.	Documents Charged/Discharges	116
2.	Users Referenced	563
3.	Photocopies	1117
4.	Publication Distributed (Journal, Newsletter & Report) in Exchange & Complimentary)	167
5.	Correspondence made	62
Total		2,025

**Complementary Online Journal**  
(<https://www.research4life.org/>)

#### **AGORA**

<http://www.aginternetwork.org>  
ID: ag-bgd026

**Password: WQ23pm7**

#### **HINARI**

<http://www.who.int/hinari>  
ID: BAN053  
Password: 70555

**BARI Digital Library:** BARI Central library has launched “BARI Digital Library” which is associated with both digital and automated library system. Now this digital library is available for user access through internet from anywhere. The web address is [www.barilibrary.org](http://www.barilibrary.org). Here SLiMS library software has used.

**Table 4: Type of resources uploaded for BARI Digital Library during 2022-2023.**

Sl. No.	Icons	Document uploaded (no.)
1.	BARI Publications	263
2.	Bengali Books	1962
3.	Reference	5580
4.	Booklet	64
5.	Fiction	12
6.	Center's Publication	275
7.	Divisional Publications	161
8.	Newsletter	45
9.	Report	63
10.	Journal	1088
11.	Thesis – MS	336
12.	Thesis –Ph.D	421
13.	Leaflet	304
14.	Personal Publications	167
<b>Total</b>		<b>10,741</b>

## 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 2022-2023. Among of them 25,800 were still photograph, 17,400 were photo editing and 19 were video recording are presented in Table 41.

**Table 1. Total activities of photography section during 2022-2023**

Sl. No	Activities	Number
1	Photograph exposed in Digital Camera	25,800 above
2	Photo Editing	17,400 above
3	Video Recording program	19 above

# Planning & Evaluation Wing

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## Introduction

The Planning and Evaluation Wing of the Bangladesh Agricultural Research Institute (BARI) plays a pivotal role in steering the nation's agricultural development towards sustainable and innovative pathways. As the foundation upon which BARI's strategic initiatives are built, this wing serves as the compass for agricultural research and policy formulation in Bangladesh. Its multifaceted responsibilities encompass meticulous planning, rigorous evaluation, and the alignment of research activities with the ever-evolving needs of the agricultural sector.

## Activities of the Planning and Evaluation Wing

Planning and Evaluation Wing playing is a pivotal role for BARI. Planning is a process of deciding in advance what we want to get (our goal) and how we will get it. Evaluation enables us to assess how well we are doing and to learn from this. The activities of planning & evaluation wing of BARI are:

- 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
<b>Officer</b>		
Director	1	1
Chief Scientific Officer	1	1
Principal Scientific Officer	3	1
Senior Scientific Officer	2	2
Scientific Officer	3	2

Designation	Organogram	Existing
Scientific Officer (Coffee and Cashew Nut Project)	-	1
<b>Sub total</b>	<b>10</b>	<b>8</b>
<b>Staff</b>		
Steno-Typist	1	0
UDA	1	2
Computer Operator	2	1
LDA cum Typist	4	2
MLSS	2	1
<b>Sub total</b>	<b>10</b>	<b>6</b>
<b>Total:</b>	<b>20</b>	<b>14</b>

**Table 2: Development projects implemented during 2022-23 (In lakh Tk.)**

Sl. no.	Name of the Projects (Implementation period)	Total Project Cost	Allocation of 2022-23	Expenditure up to June 2023 & % of allocation		Cumulative Progress upto June 2023
				Financial	Physical (%)	
1.	Research, Extension and Popularize of Vegetables and Spices Cultivation on Floating Bed (2nd Revised) (July 2017 to June 2023)	3913.03	566.00	479.60	84.73%	3700.00 (95.00%)
2.	Strengthening of Spices Crop Research in Bangladesh (1st Revised) (October 2017 to March 2023)	10040.00	1530.00	1529.51	99.97%	10039.00 (99.99%)
3.	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	3594.00	3594.00	100.00%	14493.00 (99.00%)
4.	Smallholder Agricultural Competitiveness Project (SACP) (BARI Part) (July 2018 to June 2024)	1457.97	158.00	147.05	93.07%	954.00 (65.00%)
5.	Upgrading Regional Horticulture Research Station, Cumilla to Regional Agricultural Research Station (1st Revised) (July 2018 to June 2023)	3727.52	1768.00	1768.00	100.00%	3514.00 (94.00%)
6.	Farm Machinery Technology Development for Profitable Crop Production (July, 2020- June, 2025)	5600.00	1584.00	1568.40	99.02%	2882.00 (51.00%)

Sl. no.	Name of the Projects (Implementation period)	Total Project Cost	Allocation of 2022-23	Expenditure up to June 2023 & % of allocation		Cumulative Progress upto June 2023
				Financial	Physical (%)	
7.	Enhance Production of Oil Crops Project (BARI Part) (July, 2020- June, 2025)	2044.17	402.00	341.70	85.00%	937.00 (46.00%)
8.	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	84.00	71.40	85.00%	188.00 (91.00%)
9.	Research, Development & Extension of Cashew nut and Coffee (BARI Part) (January, 2021- December, 2025)	5330.75	1727.00	1452.65	84.11%	2796.00 (41.00%)
10.	Strengthening Regional Pulse Research Station, Madaripur and increase production of pulse crops at greater Barishal, Faridpur Region (July, 2021- June, 2026)	16800.00	11956.00	10152.61	84.92%	10381.00 (62.00%)
	<b>Total:</b>	<b>68563.63</b>	<b>23369.00</b>	<b>21104.92</b>	<b>90%</b>	<b>49884.00 (74.39%)</b>

**Table 3: On going projects during 2023-24 (In Lakh)**

Sl.no.	Name of the Projects (Implementation period)	Total Project Cost	Allocation 2023-24	Status
1.	Research, Extension and Popularize of Vegetables and Spices Cultivation on Floating Bed (2nd Revised) (July 2017 to June 2024)	3913.03	126.00	6 <sup>th</sup> year
2.	Smallholder Agricultural Competitiveness Project (SACP) (BARI Part) (July 2018 to June 2024)	1457.97	300.00	5 <sup>th</sup> year
3.	Farm Machinery Technology Development for Profitable Crop Production (July, 2020- June, 2025)	5600.00	1156.00	3 <sup>rd</sup> year
4.	Enhance Production of Oil Crops Project (BARI Part) (July, 2020- June, 2025)	2044.17	503.00	3 <sup>rd</sup> year
5.	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	5.00	3 <sup>rd</sup> year
6.	Research, Development & Extension of Cashew nut and Coffee (BARI Part) (January, 2021- December, 2025)	5330.75	2198.00	2 <sup>st</sup> year
7.	Strengthening Regional Pulse Research Station, Madaripur and increase production of pulse crops at greater Barishal, Faridpur Region (July, 2021- June, 2026)	16800.00	3041.00	1 <sup>st</sup> year
8.	Program on Agricultural and Rural Transformation for Nutrition, Entrepreneurship and Resilience in Bangladesh (PARTNER, P176374) BARI Component	61286.55	7403.00	1 <sup>st</sup> year
	<b>Total</b>	<b>96639.27</b>	<b>14732.00</b>	<b>-</b>

**Table 4: List of new projects under process**

Sl.No.	Name of the Projects (Implementation period)	Total Project Cost (In Lakh Tk.)
1.	Establishment of Floriculture Research Centre (July, 2023- June, 2028)	25420.00
2.	Strengthening Research Facilities and Research Activities of Bangladesh Agricultural Research Institute (July 2023- December 2028)	64000.00
3.	Tuber Crops Research Strengthening Project (TCRSP) (July, 2023- June, 2028)	96500.00
4.	Horticultural Crops Research Strengthening Project (2 <sup>nd</sup> Phase) (July 2023- June 2028)	66912.00
5.	Upgrading of On-Farm Research Division to On-Farm Research Centre of BARI through Strengthening of Location Specific Technology Development and Transfer Project (July 2023- June 2028)	99839.00
6.	Sorjan based integrated farming systems research and dissemination of technology in submerged and saline areas of southern Bangladesh (July -2023 June 2028)	16538.00
7.	Establishment of Regional Agricultural Research Station under BARI in Meherpur Sadar and Strengthening Research activities suitable for South-West Region Project (July 2023-June 2028)	32700.00
8.	Development and expansion of bio-rational based integrated pest management of vegetables, fruits and betel leaf (2 <sup>nd</sup> Phase) (July 2023- June 2028)	6000.00
9.	Strengthening of Spices Crop Research in Bangladesh (2 <sup>nd</sup> Phase) (July 2023- June 2028)	30000.00
10.	Establishment of agricultural research station for agricultural development in Kishoreganj District (November 2022- June 2027)	19637.82
11.	Improvement of vapour heat treatment system for producing quality mango for profitable export (July 2022- June 2026)	4650.00
12.	Hill agricultural research strengthening project) (July 2022- June 2026)	48963.00
13.	Upgrading Regional Horticulture Research Station, Narsingdi to Regional Agricultural Research Station (July 2022-June 2026)	27500.00
14.	Strengthening Citrus Research and Technology Dissemination Project (July 2022-June 2026)	10422.36
15.	Integrated Agricultural Development in Chattogram Hill Tract Project (BARI Part) (July 2022- June 2026)	3597.00
16.	Climate Resilient Crop Production Technology Generation and Development Project (July 2023- June 2027)	36600.50
17.	Strengthening of Coconut Research and Diversification of Its Use (BARI Part) (July 2023-June 2027)	10573.26
18.	(Strengthening of Postharvest Technological Research Project) (July 2023- June 2027)	13648.00



Sl.No.	Name of the Projects (Implementation period)	Total Project Cost (In Lakh Tk.)
19.	Strengthening of Agricultural Research at Coastal Saline Regions Project (July 2023- June 2027)	29045.00
20.	Achievement of nutritional security and increasing income of poor farmers through establishing homestead garden (July 2023-June 2027)	21618.00
21.	Establishment of Agricultural Research Station of BARI in Pirojpur District and Strengthening Agricultural Research in Coastal Tidal Flood Plain Region (July 2023- June 2027)	20279.65
22.	Intensification and diversification of rice-based cropping systems with pulse crops for food and nutritional security, sustainable production systems and improved livelihoods of small-holder farmers in Bangladesh (January 2023-December 2027)	7022.55
23.	Strengthening of human resource development and technology transfer activities of BARI (July 2023- June 2027)	20738.00
24.	Identification, Collection, Conservation and Evaluation on Endangered and Rare Species of Indigenous Fruits and other Climate Smart Germplasm (July 2023- June 2027)	1500.00

**Table 5: Scheme implemented by BARI during 2022-23**

Sl No.	Title and Duration	Estimated cost	Cumulative progress upto June' 2023 (%)
1.	Adaptive trial, development of production technology and community based pilot production program of summer tomato in Bangladesh. (July 2020- June 2023)	500.55	490.48 (97.99%)
2.	Strengthening of food and nutrition security program through gene pool enrichment, research, technology development and improved variety dissemination of Aroids. (July 2021 - June 2024)	652.35	392.37 (60.15%)
3.	Development of Canola type rapeseed variety for cultivation between T. Aman and Boro Rice. (July 2021 - June 2024)	750.00	515.38 (68.72%)
4.	Year round bulb production, reduction of post-harvest losses and storage technologies development of summer onion and its dissemination. . (July 2022 - June 2025)	250.00	0.50 (0.20%)
5.	Production of micro-propagated sapling of BARI Kola-1, BARI Kola-5 and G-9 banana varieties through tissue culture technique & its dissemination. (July 2022- June 2025)	175.00	2.50 (1.43%)
<b>Total</b>		<b>2327.90</b>	<b>1401.23 (73.00%)</b>

**Table 6: On going Scheme during 2023-24**

Sl. No.	Title and Duration	Estimated cost
1.	Strengthening of food and nutrition security program through gene pool enrichment, research, technology development and improved variety dissemination of Aroids. (July 2021 - June 2024)	652.35
2.	Development of Canola type rapeseed variety for cultivation between T. Aman and Boro Rice. (July 2021 - June 2024)	750.00
3.	Production of micro-propagated sapling of BARI Kola-1, BARI Kola-5 and G-9 banana varieties through tissue culture technique & its dissemination (July 2022- June 2025)	175.00
4.	Year round bulb production, reduction of post-harvest losses and storage technologies development of summer onion and its dissemination	250.00
<b>Total</b>		<b>1827.35</b>

**List of Future Projects in Related to SDGs (2021-2030) & 8th FYP**

- Expansion of homestead gardening, school gardening commercial fruit gardening as a source of nutritional security all year round.
- Expansion of appropriate post harvest management technologies (Processing, preservation & packaging) to reduce production loss and develop market linkage among the producer and consumer.
- Production & distribution of good quality seed
- Increase agricultural productivity or production through modern technology transfer, minimizing yield gap, crop diversification & intensification with high value crop production.
- Extension of appropriate post harvest management technologies through training and demonstration
- 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.
- Introduction of renewable energy to provide irrigation.
- Integrated Agricultural Research & Development Project in South West part of Bangladesh
- Soil management through organic and inorganic amendments
- Development of climate smart crop varieties and Seed

- Development of stress tolerant (Salinity, drought, water submergence, cold, heat, etc and diseases, insect resistant) high yielding major crop varieties.
- Seed production and supply of climate resilient crop varieties.
- Collection, preservation and maintenance of plant genetic resources for food and agriculture for medium or long-term conservation.
- Morphological and molecular characterization of the collected genetics resources.
- Enhancement of pulse research and extension at greater Faridpur and southern region of Bangladesh
- Established value chain development for vegetables, fruits by encouraging public-private partnership (PPP)
- Biotechnological and hybrid research capacity development.
- Development of Nutrient enriched and Biotic stress tolerant crop varieties
- Manpower development (PhD, MS, Short/long duration training, etc)
- Strengthening of ICT for effective and rapid technology transfer.

**Projects beyond 8th FYP Period (2020-2025) aligning with SDGs**

- Development and extension of cereals, vegetables, fruits, pulses, oilseed and tuber crops with nutrient enriched varieties.
- 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.



# BUDGET

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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 2022-2023 (in lakh Tk.)**

Total	GOB Head			Project Aid (PA/RPA)	Expenditure		Total
	ADP	Revenue	Total		ADP	Revenue	
53725.05	22125.16	31514.89	53640.05	85.00	22128.98	30821.37	52950.35

**Table-2: Development Budget (Annual Development Programs) of BARI for 2022-2023 (in lakh Tk.)**

No.	Name of Projects & Programs	Total	GOB		PA/ RPA	Expenditure		Total
			Revenue	Capital		Revenue	Capital	
	<b>A. Development Projects</b>							
1.	Research, Extension and Popularize of Vegetables and Spices Cultivation on Floating Bed	<b>479.60</b>	479.60	0	0	479.60	0	<b>479.60</b>
2.	Establishment of Agriculture Research Station, BARI, Gopalganj and eco-friendly agricultural development project in south-western part through strengthening of research	<b>3594.02</b>	818.02	2776.00	0	818.02	2776.00	<b>3594.02</b>
3.	Strengthening of Spices Crop Research in Bangladesh	<b>1529.51</b>	650.00	879.51	0	650.00	879.51	<b>1529.51</b>
4.	Upgrading Regional Horticulture Research Station, Cumilla to Regional Agricultural Research Station	<b>1768.00</b>	213.00	1555.00	0	213.00	1555.00	<b>1768.00</b>
5.	Smallholder Agricultural Competitiveness Project (SACP) (BARI Part)	<b>147.05</b>	62.05	0	85.00	147.05	0	<b>147.05</b>

No.	Name of Projects & Programs	Total	GOB		PA/ RPA	Expenditure		Total
			Revenue	Capital		Revenue	Capital	
	<b>A. Development Projects</b>							
6.	Farm Machinery Technology Development for Profitable Crop Production	<b>1568.40</b>	880.00	688.40	0	880.00	688.40	<b>1568.40</b>
7.	Enhance Production of Oil Crops Project (BARI Part)	<b>341.70</b>	339.70	2.00	0	339.70	2.00	<b>341.70</b>
8.	Conservation of Ground Water and Raising it's Use Efficiency and Productivity in Irrigated Agriculture in Bangladesh (BARI Part)	<b>71.40</b>	71.40	0	0	71.40	0	<b>71.40</b>
9.	Research, Development & Extension of Cashew nut and Coffee(BARI Part)	<b>1467.95</b>	470.40	997.55	0	461.95	987.98	<b>1449.93</b>
10.	Strengthening Regional Pulse Research Station, Madaripur and increase production of pulse crops at greater Barishal, Faridpur Region.	<b>10152.61</b>	304.00	9848.61	0	304.00	9785.45	<b>10089.45</b>
<b>Sub-Total -A Development Projects:</b>		<b>21120.24</b>	<b>4288.17</b>	<b>16747.07</b>	<b>85.00</b>	<b>4364.72</b>	<b>16674.34</b>	<b>21039.06</b>

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**Table-3: Development Budget (Annual Programs) of BARI for 2022-2023 (in lakh Tk.)**

No.	Name of Projects & Programs	Total	GOB		PA	Expenditure		Total
			Revenue	Capital		Revenue	Capital	
	<b>B. Programs</b>							
1.	Adaptive trial, development of production technology and community based pilot production program of summer tomato in Bangladesh	<b>260.56</b>	260.56	0	0	260.56	0	<b>260.56</b>
2.	Development of Canola Type Rapeseed Variety for Cultivation between T.Aman and Boro Rice	<b>466.44</b>	447.94	18.50	0	447.94	18.50	<b>466.44</b>
3.	Strengthening of Food and Nutrition Security program Through Gene Pool Enrichment, Research, Technology Development and Improved Variety Dissemination of Aroids.	<b>359.92</b>	178.95	180.97	0	178.95	180.97	<b>359.92</b>
4.	Year round bulb production, reduction of post-harvest losses and storage technologies development of summer onion and its dissemination.	<b>0.50</b>	0.50	0	0	0.50	0	<b>0.50</b>
5.	Production of micro-propagated sapling of BARI Kola-1, BARI Kola-5 and G-9 banana varieties through tissue culture technique & its dissemination.	<b>2.50</b>	2.50	0	0	2.50	0	<b>2.50</b>
<b>Sub-Total -B Programs:</b>		<b>1089.92</b>	<b>890.45</b>	<b>199.47</b>	<b>0</b>	<b>890.45</b>	<b>199.47</b>	<b>1089.92</b>
<b>Grand Total (A+B):</b>		<b>22210.16</b>	<b>5178.62</b>	<b>16946.54</b>	<b>85.00</b>	<b>5255.17</b>	<b>16873.81</b>	<b>22128.98</b>



# INFORMATION REPORT

## (As per Information Commission Requirements)

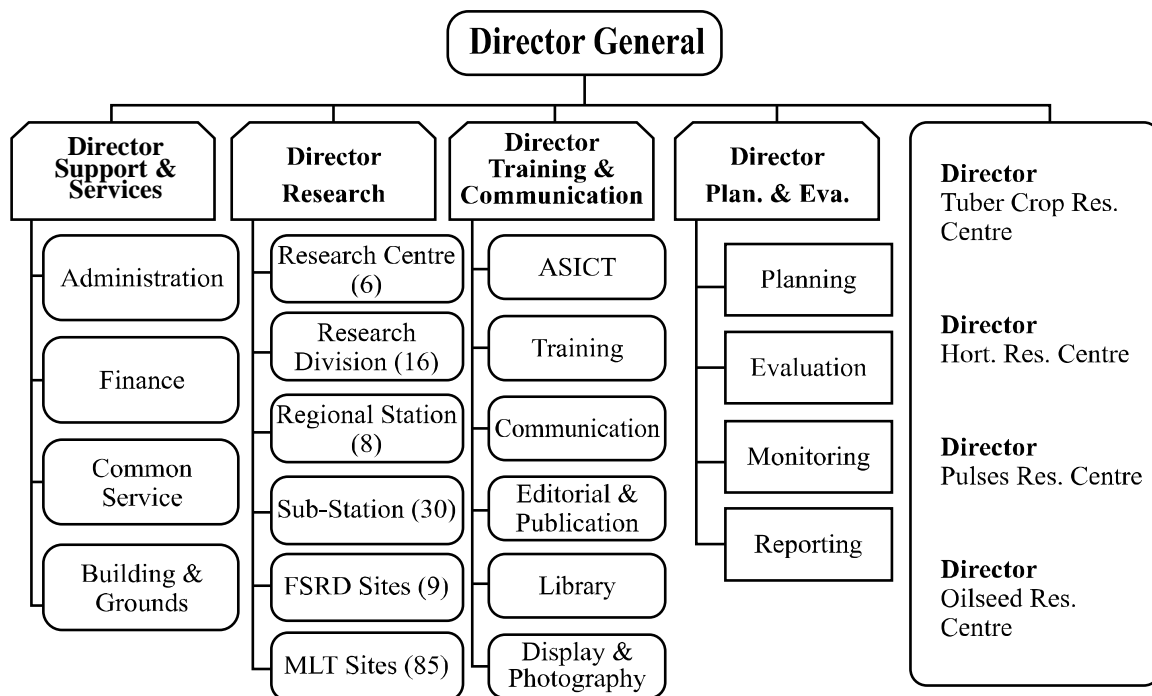
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### **Institutional information:**

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 abroad also fall within his responsibilities.

Director (Planning & Evaluation) is responsible for developing, executing, monitoring, evaluation of different projects under development budgets and Programmes (Karmosuchi) under revenue budget of GoB with the help of crop centers, sub-centers, divisions, Regional Agricultural Research Station (RARS) and Agricultural Research Station (ARS). Also involves in financial management, procurement activities, infrastructure development and arrange meetings like Project Implementation Committee (PIC), Project Evaluation Committee (PEC) of different projects and Planning & Development Committee (P&DC) meeting of the institute.

Each research division is headed by a Chief Scientific Officer (CSO) who is also designated as divisional head whereas a research center is headed by a Director/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**

<b>Designated Officer</b>	
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	No. 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. of 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.







## Bangladesh Agricultural Research Institute

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