

Research Highlights

2020-2021

Research Progress

Plant breeding division of BARI works on varietal improvement of barley, millets, sorghum, oat, quinoa and buckwheat. Crop improvement includes for collection and characterization of germplasm, hybridization and conformation of barley, evaluation of barley, millets, sorghum, oat, quinoa and buckwheat, population development with variation, breeder seed production and technology transfer to farmers. The endmost objective is to develop and improve varieties and fitting technologies for the development of these field crops to the benefit of the farmers in all around Bangladesh particularly in saline, char, barind and marginal areas. Therefore, development of stress tolerant (drought, salt and waterlogging) varieties have been strengthened. Emphasis is also given for location specific variety development. The urgency is given to popularize and disseminate released varieties and developed technologies among farmers and private agencies through demonstration, training, workshop, field days, publications, electronic media etc.

A. Barley Variety Development

Hybridization of barley

➤ Two sets of hybridization program were taken in barley at the research field of Bangladesh Agricultural Research Institute, Gazipur during rabi 2020-21 to develop early, drought and saline tolerant high yielding hull-less barley variety. In set-I, eight parental genotypes of barley including six advance lines, BHL-25 (P₁), BHL-27 (P₂), INBYT-18-E4 (P₃), INBYT-19-E5 (P₄), INBYT-18-E9 (P₅) and INBYT-20-E85 (P₆), and two released varieties (BARI Barley-7 (BB-7, P₇) and BARI Barley-9 (BB-9, P₈) were crossed following a 8×8 half diallel fashion. Additionally, a new line-112/21, early, short, waxy and medium yielder, was also included and crossed with P₇ and P₈. Among 30 cross combinations, 29 successfully produced 1352 seeds. On the other hand, in set-2, ten parents, IBON-HI-19 E3 (P₁), IBON-HI-19 E24 (P₂), IBON-HI-19 E43 (P₃), IBON-HI-19 E75 (P₄), IBON-HI-19 E100 (P₅), IBON-HI-19 E47 (P₆), IBON-HI-19 E20 (P₇), IBON-HI-19 E34 (P₈), BB-7 (P₉) and BB-9 (P₁₀) were crossed in 10×10 half diallel method. Among 45 cross combinations, 37 cross has successfully produced 1230 seeds. The seeds will be evaluated in next year confirmation trials.

Confirmation of F₁ generation

➤ Ten parents and their F₁ progenies were grown in single row in family block during rabi 2020-2021 to confirm F₁ population and identify the better cross combinations. Twelve early crosses with positive heterosis for yield were selected for next year experiment.

Advancing of fillial (F₂ – F₆) generation of barley

➤ In F₂, based on earliness, tillering and yield, 258 individual plants were selected. In F₃ generation, 140 plants, in F₄ generation 16 families, in F₅ generation 3 families and in F₆ generation, 9 families were selected for future breeding program.

Evaluation of barley

- Twelve hull-less barley lines along with three standard checks BARI Barley-7 (BB-7), BARI Barley-8 (BB-8) and BARI Barley-9 (BB-9) were evaluated to select early and high yielding hull-less barley lines. Considering earliness and yield, E111 (2.67 t/ha), E32 (2.39 t/ha) and E119 (2.39 t/ha) were selected for next year trial.
- Ten selected barley lines along with those three check varieties were evaluated for high yield. Four barley lines, E17 (3.06 t/ha), E7 (2.98 t/ha), E10 (2.96 t/ha) and E21 (2.93 t/ha), were selected for next year trial.
- Fourteen barley lines including nine BARI barley varieties and five promising barley lines were evaluated for dual purpose (grain and fodder) use. Considering yield and fodder production, four

BARI barley varieties, BB-9, BB-1, BB-7 and BB-5, and one promising line INBYT E9/18 were selected.

- Twenty nine barley lines were screened under 8 dS/m salinity under laboratory and green house condition. Four genotypes, BHL-25, BHL-27, BB-7 and BHL-32 performed better under salinity in germination stage.
- Seventeen barley genotypes along with the two check varieties BB-5 and BB-7 were evaluated under irrigated and non-irrigated conditions. Considering yield potentiality, three genotypes BHL-24 (0.96 t/ha), BHL-29 (0.654 t/ha) and BHL-28 (0.59 t/ha) performed better in non-irrigated condition.
- Six genotypes of barley along with two check varieties (BB-7 and BB-9) were evaluated in a preliminary yield trial at Gazipur, Jamalpur and Rangpur. Two genotypes IBON-HI- 19 E100 (2.69 t/ha) and IBON-HI- 19 E24 (2.68 t/ha) were selected.
- Eight lines and two checks viz. BB-8 and BB-9 were evaluated at Gazipur, Jamalpur and Burirhut in an advanced yield trial, and two lines BHL-30 and E-53 were selected. At Gazipur and Jamalpur, BHL-30 gave highest yield (2.38 and 2.28 t/ha, respectively) and E-53 (2.44 t/ha) at Burirhut.
- Eight genotypes of barley along with two check varieties (BB-7 and BB-8) were assessed for high and stable yield at Gazipur, Jamalpur and Rangpur. Three lines, BHL 26 (1.92 t/ha) and BHL 34 (2.16 t/ha) were selected.
- Twenty four barley lines along with one standard check BB-9 were to select early, dwarf and high yielding barley lines. Considering short stature and yield, two lines ISB-21018 (3.33 t/ha) and ISB-21011 (3.14 t/ha) were selected.
- One hundred and seventy one (171) barley lines with one check BB-9 were evaluated at BARI, Gazipur. Considering yield, yield contributing traits and earliness five lines, (ISB-20294 (3.12 t/ha), ISB-20283 (3.10 t/ha), ISB-20229 (3.06 t/ha), ISB-20292 (3.04 t/ha) and ISB-20282 (2.76 t/ha) were selected.
- One hundred and forty (140) from (IBON-HI) barley lines including one check BB-9 were evaluated at Gazipur. Considering yield, 12 lines, ISB-21140 E96, ISB-21113 E69, ISB-21072 E28, ISB-21096 E53, ISB-21048 E4, ISB-21092 E48, ISB-21075 E31, ISB-21066 E22, ISB-21052 E8, ISB-21128 E84, ISB-21110 E66 and ISB-21059 E15 (yield ranging 2.04-2.92 t/ha) were selected for further breeding program.

B: Millets and Sorghum Variety Development

- Evaluation of twenty five (25) proso millet germplasm were evaluated at BARI, Gazipur. Four lines, BD 1419 (1.85 t/ha), BD 1426 (1.77 t/ha), BD 1417 (1.76 t/ha) and BD 1406 (1.73 t/ha) were selected considering yield, and will be used in future breeding program.
- Nineteen (19) foxtail millet genotypes along with 4 check varieties BARI Kaon-1 (BK-1), BARI Kaon-2 (BK-2), BARI Kaon-3 (BK-3) and BARI Kaon-4 (BK-4) were evaluated in irrigated and non-irrigated conditions in observation trial at BARI, Gazipur. Considering yield potentiality and yield contributing characters, genotype BD-1284 (2.70, 0.117 t/ha in irrigated and non-irrigated condition, respectively) and BD-1114 (1.68, 0.261 t/, respectively) were found promising and selected for irrigated and non-irrigated condition respectively for future breeding program.
- Twelve foxtail millet lines (12) with two check varieties Bk-2 and BK-4 were evaluated at Gazipur and Burirhat in a preliminary yield trial to select early, dwarf and high yielding foxtail millet lines. Six lines (6), BD-1105 (3.33 t/ha), BD-922 (3.18 t/ha), BD-862 (3.15 t/ha), BD-1116 (3.15 t/ha), BD-1041 (3.10 t/ha) and BD-1063 (3.03 t/ha) were selected for next year regional trial.
- Twelve (12) pearl millet genotypes were evaluated and screened under irrigated and non-irrigated conditions in BARI, Gazipur. Considering yield potentiality, three genotypes ICMH-1201 (2.51 t/ha), ICMV-05555 (2.29 t/ha) and ICMH-1301 (2.28 t/ha) were selected for irrigated condition and the genotype ICMV-05222 (0.56 t/ha) was selected for non-irrigated condition for future trials.

- Four (4) pearl millet genotypes were evaluated at three locations viz. Gazipur, Jamalpur and Rangpur in a regional yield trial. Considering yield and other yield contributing characters, two genotypes IP5711 (2.11 t/ha) and IP3706 (2.10 t/ha) were selected.
- Balanced bulk seeds obtained from seventy germplasm were planted for random mating at BARI, Gazipur for developing of source populations in sorghum. Seeds of 7.15 kg (for short statured), 4.95 kg (medium height) and 4.43 kg (tall) were harvested separately from selected panicles, and they will be grown in isolation for random mating in coming rabi season for next breeding cycle.
- Four (4) sorghum genotypes were screened for salinity tolerance in pots containing three treatments (control, 8.0 and 12 dS/m) of NaCl solution at green house of Plant Breeding Division in BARI, Gazipur. Considering fresh and dry weight, leaf area, shoot and root length, sorghum line IS-2867 and variety BS-1 were found tolerant to salinity (12dS/m) which can be used for further breeding program.
- Four (4) genotypes were screened against waterlogging stress at field lab of Plant Breeding Division, BARI, Gazipur. Genotypes were imposed waterlogging condition for twenty days at seedling stage. All four genotypes were turned yellow and gradually reached a senescence state. However, all genotypes were recovered when waterlog stress was turned off. The revive ability of four genotypes after waterlogging state suggests that the waterlogging at vegetative stages maybe not a big concern for sorghum.
- Three (3) sorghum lines with one check BARI Sorghum-1 (BS-1) were evaluated at Gazipur, Jamalpur and Burirhat in a large plot yield trial to find out the suitable genotype(s). Considering the yield and yield contributing traits, IS-29464 (2.67 t/ha) line was selected for further breeding program.

C: Buckwheat and Oat Variety Development

- Four (4) genotypes along with one local check variety Bog-1 of buckwheat were assessed at three different locations Gazipur, Debiganj and Jamalpur for genotype environment interaction (GEI) and stability to select the best buckwheat lines. The genotype E3 (1092 kg/ha) was selected for high yielding and more stable to environments.
- Four (4) oat genotypes were characterized to estimate the extent of variation for morphological traits. Observations were recorded for the different agro-morphological characters viz., growth habit, hairiness of leaf sheath, hairiness of leaf margin, angle of flag leaf to culm, angle of leaves to culm (other than flag leaf), rigidity of flag leaf, rigidity of leaves, shape of panicle, erectness of panicle, angle of panicle branches to the main axis, erectness of spikelet, waxiness of panicle, number of tillers, number of fertile tillers/plant, days to 50% flowering, plant height, days to maturity, number of tiller, number of fertile tiller/plant, seed yield/plot and yield. Among the four lines both qualitative and quantitative morphological variation were found. In crop improvement program this variability could be used. The highest yield was found in BOL-2 (1.2 t/ha).
- Two (2) oat genotypes (BOL-1 and BOL-2) were irradiated (Gamma radiation) and chemically treated with Ethyl methane sulphonate (EMS) and combinely (Gamma radiation+ EMS) to induce variability. The irradiation treatments were carried out at the laboratory of Institute of Food and Radiation Biology, Ganakbari, Savar. The lower doses of gamma radiation, combination treatments and EMS treatments alone have been proved to be more efficient for most of the characters in M₁ generation. There are some mutagenic effects showed in some of the treatment i.e. short plant height, early to late flowering, and highest number of seed per plant. M₂ seeds of different treatments were harvested and kept separately for future breeding program.
- Four (4) oat genotypes namely BOL-1, BOL-2, BOL-3 and BOL-4 were evaluated in preliminary yield trial at BARI, Gazipur for grain yield and other agronomic traits. BOL-1 (1.2 t/ha), BOL-2 (1.4 t/ha) and BOL-4 (1.5 t/ha) were selected for next year advance yield trial.

D: Seed Production

- A Total of 760 g breeder seed of five buckwheat (Bog-1, 4275, 4274, 4273 and 4272) germplasm produced at BARI, Gazipur and stored for further use.
- To maintain the purity of the released barley varieties, total 1,168 kg breeder seeds of 9 barley varieties(BARI Barley-1, BARI Barley-2, BARI Barley-3, BARI Barley-4, BARI Barley-5, BARI Barley-6, BARI Barley-7, BARI Barley-8, and BARI Barley-9) were produced at Gazipur, Burirhat, Debigonj and Ishwardi.
- A total 848 kg seeds of BARI Kaon-1, BARI Kaon-2, BARI Kaon-3, BARI Kaon-4, BARI Cheena-1 and BARI Sorghum-1 were produced at Gazipur, Jamalpur, Burirhat and Ishwardi which were collected and stored for further use.
- Total 89.5 kg seeds were produced from 4 selected finger millets lines (IE-501, IE-2034, IE-2619 and IE-3392)at BARI, Gazipur and RARS Jamalpur for next year trial.
- Total 63.7kg seeds were produced from 7 selected proso millets lines at BARI, Gazipur for next year trial.

E: Minor Cereals Biotechnology: Molecular Biology

- Eleven (11) simple sequence repeats (SSRs) markers were used to characterize BARI developed 9 barley varieties and 13 advanced lines. Optimum PCR profile for Amplification of SSRs loci are being standardizing now to find out highly polymorphic one(s). Two markers have been completed; remaining will be done in next year. Diverged advance lines would be selected for hybridization.
- Comparative study of C₃ (barley) and C₄ (sorghum) under drought in the context of antioxidants response was conducted at green house and lab of PBD, BARI, Gazipur. Water relation and enzymes of ascorbate-glutathione (ASA-GSH) cycle were studied. Higher loss of water was found in drought in C₃ barley than C₄ sorghum, which was resulted from higher Gs. Ci was very low in barley. In ASA-GSH cycle, comparatively higher GR and MDHAR activities were the advantages in C₄, sorghum. However, higher DHAR activity can be important for prolong drought in C₃, barley. Loss of GSH and ASA was also slower in C₄ crop, and played important role to confer tolerance to sorghum in prolong drought.
- Forty five (45) F₁s from a 10×10 diallel cross of barley were screened hydroponically against 8 dS/m equivalent salinity in Hoagland media to select saline tolerance F₂ generation for further advancing. Among which, 12 were eliminated due to poor germination or poor growth. Remaining 33 crosses were evaluated based on grain setting, K⁺/Na⁺, root volume, ROS and their scavenging enzymes and stay grain. Based on the criteria, 14 genotypes selected as tolerant, 7 as medium tolerant and 12 as susceptible. The seeds will be used for F₂ advancing. On the other hand, 31 genotypes of F₂ generation were grown on 8 dS/m saline soil in green house and advanced for F₃ generation. Thirty-nine plants were selected for next generation advancing.

F: Technology transfer activities

One variety, BARI Oat-1 has been released as in July 2021

Salient feature:

- Yield: 1.0 - 1.2 t/ha
 - 10-14 erect panicle per plant
 - Grains are long and brown in color
 - Plant height: 110-115 cm
 - Maturity: 125-130 days
- Training: Five (05) training program on minor cereals were conducted for farmers (750 participants).
 - Field days: Four (04) field days of minor cereals were conducted.

- Demonstration/adaptive trial: Thirty six (36) demonstration and adaptive trial were conducted in collaboration of OFRD.
- One (01) seminar workshop was executed.
- One (01) annual report and 1 leaflet on BARI sorghum-1 were published.