Research Highlights
2017-2018

Research progress

Plant breeding division of BARI works on varietal improvement of maize, barley, millets and sorghum. Maize improvement includes for collection and characterization of inbred lines, development and evaluation of inbred lines, hybridization, evaluation of experimental hybrids and maintenance and seed increase of parental lines and hybrid seed production of BARI released hybrids as well as open-pollinated varieties of maize. The endmost objective is to develop high yielding and quality maize varieties as well as minor cereal crop varieties (Barley, millets, sorghum). Development of stress tolerant (drought, heat, salt, waterlogged) varieties are also 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. Collection, characterization and maintenance of germplasm

- Thirty two inbred lines (17 Pro vitamin A enriched line and 15 locally developed line) were characterized and maintained through selfing by hand.
- One hundred and thirty five developed inbred lines of which 82 field corn lines and 53 popcorn lines were maintained and a total 24.2 kg selfed seeds were produced.

B. Development of source population and inbred lines

Development of base population: Eighty one commercial hybrids in two sets were random mated in isolation and 200 ears were selected separately based on dwarf with earliness and medium tall and high yield goal.

Generation Advancing:

S_0 - S_1: Two waxy field corn hybrids namely waxy corn 2008 and waxy corn 932 were advanced to S_1 and 77 selfed ears were harvested and preserved separately.

S_1 to S_2: Thirty S_1 lines of commercial field corn hybrid (IM8119) were advanced to S_2 and 85 selfed ears were harvested and kept separately.

S_2 to S_3: Forty S_2 sweet corn lines of Dream sweet 2 and Dream sweet 3 hybrids were advanced to S_3 and 232 selfed ears were selected for advancing them to S_4.

S_3 to S_4: Twenty S_3 baby corn lines of Baby star and twenty field corn lines of commercial hybrid IM8013 were advanced to S_4 and 229 selfed ears were harvested.

S_4 to S_5: Two hundred and seventy nine S_4 lines of field corn and 47 S_4 lines of popcorn were advanced to S_5 and total 45 kg selfed seeds were produced.

S_5 to S_6: Forty nine S_5 lines of field corn, 14 S_5 lines of popcorn and 36 S_5 lines of sweet corn were advanced to S_6 and total 15.1 kg selfed seed were harvested.

S_6 to S_7: Fifty S_6 lines of field corn were advanced to S_7 and 317 selfed ears were harvested from the lines and kept separately.

C. Evaluation of inbred lines

- Fifty two popcorn hybrids produced through line×tester method and were evaluated with check variety Khoibhutta 1. Four hybrids viz. SP/S_3-10×Thaipop-24 (6.95 t/ha), SP/S_3-15×Thaipop-24 (7.07 t/ha), SP/S_3-31×T_2 (6.98 t/ha) and SP/S_3-33×Thaipop-24 (7.05 t/ha) were selected on the basis of yield and popping quality like popping percentage and popping expansion.
- Twenty one hybrids produced through 7×7 diallel fashion were evaluated in three locations with three commercial hybrids. None of the crosses were selected.

- Twenty eight hybrids produced through 8×8 diallel fashion were evaluated. Four hybrids viz. E3×E4, E3×E7, E4×E6 and E6×E7 showed positive SCA and high mean yield (10.76-11.51 t/ha) were selected for further evaluation.

D. Evaluation of single cross hybrids

- Twenty one modified single crosses of field corn (9) and popcorn hybrids (12) in two sets were evaluated with check varieties namely BHM9, 981, Sunshine and BARI Khoi bhutta-1 at Gazipur, Jashore, Barishal, Ishurdi, Rangpur and Dinajpur. Among the field corn hybrids E-4 (11.84 t/ha) and popcorn hybrid E-7 (6.17 t/ha) were selected based on yield stability, earliness and low plant height.
- Two hundred fourteen single cross hybrids of which 186 field corn, 15 baby corn and 13 popcorn hybrids consisting of 14 sets experiments were evaluated with three check variety namely BHM9, 981, Sunshine (for field corn) Baby Star and MSC 001 (for baby corn) and BARI Khoibhutta1 (for popcorn) at Gazipur, Jamalpur, Jashore, Ishurdi, Hathazari, Barishal, Rangpur and Dinajpur. Considering yield and stability 29 field corn hybrids were found promising and yield ranged from 9.1 t/ha to 12.20 t/ha, for baby corn 4 hybrids showed high cob yielder (4 cob/plant) and high green fodder yield (654-758 g/plant) and for popcorn one hybrid (PCB15×T17) selected based on yield (5.4 t/ha) and shorter plant (170 cm) with low ear height (73 cm).

E. Nutritional maize

- Eighteen CIMMYT developed Pro-vitamin A enriched maize hybrids were evaluated with two commercial checks (BHM 9 and 981). Three hybrids HP1129-42 (10.4 t/ha), HP1129-44 (11.0 t/ha) and HP1129-45(10.3 t/ha) were selected considering yield and short stature plant.

F. Maize Biotechnology

- Three experiments were conducted on oxidative stress tolerance. The objective of the experiments was to identify stress inducible proteins as well as basic differences in enzymatic antioxidants between C_3 and C_4 crops. At the same time, role of Trehalose was studied in mitigating oxidative stress under salinity and low P stress. In first experiment, APX1 and APX2 were identified as stress inducible proteins under salinity while GPX2 for drought. In second experiment, barley has more possibility to have high oxidative damage than maize. Both SOD and GPX can play important role in ROS decomposition in maize. In third experiment, observation was, Trehalose has role in reducing oxidative damage as well as root and shoot growth.
- Seventeen maize lines are being studied for genetic diversity by using nine SSR markers. Marker umc2388 has been tested for polymorphism was found monomorphic for the studied genotypes.

G. Stress Breeding-Abiotic stress tolerant variety development

- Eighteen field corn hybrids were evaluated along with three checks BHM 9, 981 and Sunshine at three saline areas viz. Benerpota, Satkhira, Batiaghata, Khulna and Cox's Bazar. Salinity ranged from 7.5 to 9.05 dS/m. Two hybrids E4 (8.39 t/ha) and E6 (7.42 t/ha) were selected based on yield and stability.
- Eighteen hybrids were evaluated in haor areas, Nikli, Kishoregonj. Four entries (E2, E3, E4 and E8) perform better and selected based on yield (9.17-9.32 t/ha) and earliness (129-133 days).
- The experiment was conducted at haor area, Kishoregonj to observed the performance of transplanted maize in escaping early flash flood in haor area. Three treatments were (i) planting of 15 days seedling raised in poly bag (ii) planting of 12 days seedling raised in seed bed and (iii) farmer's practice. Transplanting of maize is one of the options to avoid natural hazard in haor areas and farmers can harvest their crop

earlier. Yield was highest in poly bag seedling (10.37 t/ha) and seed bed seedling (9.93 t/ha) than farmer's practice (8.2 t/ha). The experiment would be repeated.

- Seven hundred and ten maize hybrids received from CIMMYT under HTMA Project and evaluated under four sites under optimal (Gazipur and Baishal) and heat stress (Jashore and Ishurdi) in kharif season of 2017. Among them 27 hybrids were selected under optimal (yield range 6.05- 9.63 t/ha) and 17 hybrids were selected under heat stress (yield range 6.02- 9.59 t/ha)
- Nine hundred and ninety four maize hybrids received from CIMMYT under CRMA Project were evaluated at Gazipur, Ishurdi, Barishal and Dinajpur location under optimal and waterlogged condition in kharif season of 2018. Among them 79 hybrids were selected for waterlogged (3.06-6.7 t/ha) and 5.0-11.05 t/ha for optimal condition.

H. Production of new hybrid

- Forty five crosses of field corn were produced through line×tester method and 55.4 kg F_1 seeds obtained for evaluation.
- Forty nine crosses of field corn produced through diallel fashion and 17.3 kg F_1 seed obtained for testing in next rabi season.
- Selected 47 crosses of field corn, baby corn and popcorn were produced and 14.9 kg F_1 seed obtained for next year multilocation trials.

I. Maintenance and seed increase of parental/inbred lines

- Nineteen parental lines of different maize hybrids were maintained at Gazipur and 1.93 kg selfed seeds were produced.
- Nine parental lines of BARI hybrid maize (BIL28, BIL79, BIL106, BIL210, BIL211, BIL213, BIL216, BIL217, BIL20, BIL22, BIL157) were grown and 1833 kg breeder seeds were produced at Thakurgaon, Gazipur, Pahartali, Narsingdi, Rajbari, Dinajpur, Bogura (Seusgari and Shibgonj), Ishurdi, Burirhat, Faridpur, Kishoreganj and Barishal.

J. Seed production of hybrids

- Five BARI hybrid maize (BHM 7, BHM 9, BHM 12, BHM 13 and BHM 14) were grown and produced 3265 kg hybrid seeds at Bogura, Jashore, Gazipur, Jamalpur, Panchagor (Debigonj), Ishurdi (Pabna), Dinajpur (Rajbari) and Rangpur (Burirhat).

K. Maintenance and seed production of open pollinated varieties

- One composite variety (Khoibhutta 1) produced 221 kg seeds at Gazipur.

L. Technology transfer activities

- Two varieties have been released in 2018

  BARI hybrids maize 16

  - Yield is about 11.57 t/ha in rabi season and in saline areas (8-9 ds/m) 7.06 t/ha.
  - Plant and leaves remain stay green at maturity stage.
  - Tolerant to lodging and medium tall plants.

  BARI Barley 8

  - Saline tolerant (4.8-10.0 ds/m), hull less, six row, medium tall (73 cm) and high yielding (2.2-2.51 t/ha).
  - The variety takes about 95 days to mature.
- Training: Nine program on maize, barley and kaon were conducted for scientist, seed company, NGOs' and DAE personnel (210 participants), SAAO, SSA, SA, LA (150 participants) and farmers (1500 participants).
- Field days: Eleven field days of maize (550 participants) and four field days of minor cereals (220 participants) were conducted.

M. Collaborative program

- Eight BARI hybrid maize varieties and one advance line were evaluated with three check varieties (NK- 40, DON 111 and Super shine 2760) at the farmer's field of Bogura, Rajbari and Faridpur. Among the locations Bogura showed the highest yield for BHM 9 (11.9 t/ha) over other BARI hybrid varieties and one check variety NK 40 (11.8 t/ha).
- Two drought tolerant white grain maize varieties (BHM 12 and BHM 13) were evaluated along with a commercial check NK 40 at four locations viz. Tangail, Jamalpur, Faridpur and Rajshahi Among the four locations BHM 12 (9.55 t/ha) showed the highest yield in Tangail and BHM 13 (7.8 t/ha) gave the significantly highest grain yield in Rajshahi.
- Two BARI released heat tolerant hybrid maize (BHM 14 and BHM 15) and two heat tolerant advance line were evaluated with two commercial check variety (NK 40 and BHM 9) at the MLT site Dumuria, Khulna. BHM 15 (10.3 t/ha) and BHM 9 (9.5 t/ha) performed better among the tested entries.
- BHM 9 and one commercial check variety NK 40 were considered in the up-scaling program to evaluate their yield performance in farmer's field. BHM 9 (10.9 t/ha) produced the highest grain yield over NK 40 (9.5 t/ha) at Cumilla.

Barley

Hybridization of barley

- Hybridization is one of the major techniques to create variability and to integrate one or more desirable characters from donor sources (e.g. wild relatives, local cultivars) into an individual existing popular variety. Eight selected genotypes (variety and advanced lines) were crossed in half diallel (8×8) fashion to develop early, dwarf and high yielding hull-less barley variety. Total 21 cross combinations produced seeds.

Confirmation of F_1 generation

- Among the 27 crosses, 9 combinations were selected for better heterosis of yield and yield contributing traits.

Evaluation

- Twenty six individual plants/family were selected from 14 crosses/families of three different filial generations (F2, F4, F5).
- Twenty seven hull-less barley lines were evaluated and among them 5 lines viz. INBON L37, INBON L61, IBON-HI L3, IBON-HI L107 and IBON-HI L108 were found promising on overall performance and yield (695 to 915g /plot).
- Five hull-less advance barley lines were evaluated with BARI Barley 7 at Gazipur, Jamalpur and Ishurdi. Line E3/16 gave the highest yield (2.03 t/ha), but was location specific. BB 7 (1.98 t/ha) and BHL-25 (1.88 t/ha) were stable over environments.
- Four hull-less advance barley lines were tested with check BARI Barley 7 at Gazipur, Jamalpur and Ishurdi. Entry IBON-L-21/15 (2.12 t/ha) produced highest yield but location specific and Atalapha-/12 (1.76 t/ha) was low yielding but stable entry.
- Two hundred and sixteen barley lines received from ICARDA were evaluated with two check varieties (BARI Barley 6 and BARI Barley 7). Among them 23 lines were selected based on yield, overall performance and earliness.

Molecular characterization

- Seven BARI Barley variety and seven advanced lines were characterized using 11 SSR markers. The study is still ongoing. Among the SSR's only Bmac0040 has been tested for polymorphism and rest of the SSRs will be tested soon. The SSR Bmac0040 did not show polymorphism for the tested lines.

Adaptive trial

- Two sets of experiment consists of seven BARI barley varieties evaluated in Noakhali, Khulna and Tangail and three advance lines (BHL-10, BHL-19 and BHL-29) were

evaluated at the farmer's field of Rajshahi. BARI Barley 7 (2.19 t/ha) and BARI Barley 6 (2.07 t/ha) produced highest yield in Khulna and BHL-29 (2.22 t/ha) and BHL-19 (2.08 t/ha) produced significantly highest yield in Rajshahi over the check.

Breeder seed production

- Total 683 kg breeder seed were produced from seven barley varieties viz. BARI Barley 1, BARI Barley 2, BARI Barley 3, BARI Barley 4, BARI Barley 5, BARI Barley 6 and BARI Barley 7 at six different locations namely Gazipur, Jamalpur, Bogura, Burirhat, Ishurdi and Debigonj for next year use.

Millets

Finger millet

- Seven finger millet genotypes were evaluated under advance yield trial and two genotypes IE-3392 (4.26 t/ha) and IE-2043 (3.84 t/ha) gave the highest yield and were selected for regional trial.

Pearl millet

- Nine pearl millet germplasm were evaluated and two genotypes IP13523 (6.5 t/ha) and IP5711 (5.6 t/ha) produced high yield and were selected for further evaluation.

Proso millet

- Nineteen proso millets genotypes were evaluated under advance yield trial at Rangpur, Gazipur and Jamalpur. Nine genotypes (BD1411, BD777, BD1447, BD764, BD762, BD767, BD768, BD772 and BD780) were selected based on yield (2.88 to 2.33 t/ha).
- One hundred and sixteen proso millets lines were evaluated under observation trial. Twenty lines (BD-1405, BD-1398, BD-793, BD-1446, BD-791, BD-1400, BD-1399, BD-1408, BD-1403, BD-771, BD-1454, BD-1447, BD-1459, BD-1456, BD-781, BD-768, BD-1378, BD-1461, BD-1492 and BD-1437) were selected and their yield/plot ranged from 110 to 1071 g.

Upscaling

- Three varieties of Kaon viz., BARI Kaon 1, BARI Kaon 2 and BARI Kaon 3 were evaluated to test their performance in charlands of Tangail and Munshiganj, drought prone Barind tract Godagari, Rajshahi and hill valleys of Bandarban. BARI Kaon 2 (1.74-2.92 t/ha) produced the highest yield in all locations.

Seed production:

- Total 467 kg breeder seed were produced from four millet varieties viz. BARI Kaon 1, BARI Kaon 2, BARI Kaon 3, and BARI Cheena 1 were produced at four different locations. Besides, 160 kg truthfully level seed (TLS) of BARI Kaon 2 were collected from farmer's of Munshigonj.

Sorghum and others Minor cereals

Sorghum

- Seven sorghum lines were evaluated under large plot trial at four locations viz. Gazipur, Khulna, Shatkhira and Jamalpur. Five lines IS-264, IS-3158, IS-9745, IS-29468 and IS-19153 were selected and their yield ranged from 2.88 to 3.75 t/ha in over locations.

Oat

- One oat line BD-4271 was maintained and seed increased and total 2.0 kg seed was produced and preserved for next year evaluation.

Buckwheat

- In Bangladesh, buckwheat is locally known as "Dhemsi"and nutritionally enriched minor pseudo cereals. Five buckwheat germplasm viz. BD-10460, BD-4272, BD-4273, BD-4274, BD-4275 were characterized and maintained through control pollination and 385g

seed was produced for next year evaluation. BD-4272 and BD-4275 produced higher grain yield/plot (400-450g).