BRRI Annual Report Summary 2012-13

Program Area: Varietal Development

Plant Breeding Division

SUMMARY

Development of Upland Rice (Aus): In total, 13 crosses were made using 13 parents, 430 progenies were selected from pedigree nurseries. Seventeen advanced lines were selected from PYT and SYT. Two lines viz. BR7587-2B-3 and BR7182-2B-1-2-HR4 were selected from RYT for further evaluation.

Development of Rainfed Lowland Rice (RLR): Fifteen crosses were made, 12 crosses were confirmed. A total of 252 plants from F2 populations, 655 progenies from pedigree nurseries and 98 fixed lines were selected from F3 and F7 generations. Fifteen genotypes from OT, 7 from two PYT, 5 entries from SYT and 7 from RYT were selected.

Development of Drought Tolerance Rice (STRASA): ***Rainfed Lowland Rice (RLR) Rainfed Lowland Rice (RLR) Ecosystem*****.** In total 4 crosses were made for T. Aman season and 275 crosses were confirmed. A total of 135 and 215 progenies were selected from F2 and F3 populations. Twenty lines were selected from OYT, 20 from AYT and 4 from PVS based on yield and other agronomic traits.

Development of drought tolerant rice (IAPP): In total 1162 progenies were selected from F2 population in T bAman. Three genotypes were selected from PVS in Rangpur region. A total of 451 kg seeds of promising lines were produced per each variety.

Irrigated Ecosystem. Twenty genotypes were selected from OYT based on yield under reproductive stage stress condition. Twenty one genotypes were selected from AYT ‘s based on yield under reproductive stage stress condition.

Evaluation of Exotic NERICA Genotypes: In T. Aman 2012, among the 13 genotypes 6 genotypes were selected based on yield, earliness, panicle length and other agronomic traits had been selected for further yield trials. 8 genotypes were selected from 13 genotypes in Boro season for further evaluation.

Development of Shallow Flood Tolerant Rice: A total of 1400 F1 seeds were produced from 13 crosses using 12 parents. Two crosses were confirmed. Six F3, 13 F4, 4 BC1F4, and 6 F5 crosses were bulked for further generation advancement. Ten genotypes were selected from OT, 3 genotypes were selected from AYT. A total of 6 local genotypes and 3 germplasm were selected depending mainly on elongation characters through screening.

Development of Submergence and Water Stagnation Tolerant Rice: In total, 11 crosses were made using 14 parents and 2538 F1 seeds were produced for combining submergence, medium stagnant water tolerance, earliness, strong photo-sensitivity, tall plant type and premium quality rice into the high yielding genetic background. A total of 18 crosses were confirmed (6 MAS & 12 conventional). BC1F1 seeds were produced from 7 crosses and F2 seeds were produced from 15 crosses. A total of 74 PS from F2 population, 52 PS from F3 generation, 167 PS from F4 generation, 3 PS and 7 bulks from F5 generation, 38 PS from F6 generation, 8 PS and 4 bulks from F7 generation, 4 bulks from F8 generation, 24 bulks from BC2F7 generation, 17 PS and 6 bulks from BC1F8 generation were selected and preserved.

Totally 3 BC4F3 plants having fixed Sub1 QTL from the BRRI dhan33*4/BRRI dhan52, 6 BC5F2 plants from BRRI dhan49*5/BRRI dhan52 and 41 BC5F2 plants from BRRI dhan44*5/BRRI dhan52 were selected through foreground and background selection. From two observational trials, 28 entries were selected. In PYT (submergence), 11 genotypes were selected based on survival percentage and higher grain yield under 16 days of complete submergence. In PYT (SFT), 13 genotypes were selected based on yield and growth duration. The genotype BR7937-28-1 was found promising as it gave around one ton higher yield than check variety BRRI dhan52 in SYT (submergence) & was selected for PVS trial. Two genotypes were also selected from SYT(both submergence & SFT). In PVS trial none of the entry was found out yielder than the check variety BRRI dhan52 irrespective of flooding. Importantly, mapping populations (F2:3) were developed using two Bangladeshi
v cultivars viz. Kalojoma and DG1-349 (new sources of submergence tolerance). A total of 12 genotypes were selected as submergence tolerant germplasm through screening.

Pyramiding Bacterial Blight Resistant Genes into the Genetic Background of BR11-Derived Submergence Tolerant Rice Lines (ID-179): In BC2F1 (BRRI dhan52/IRBB60//BRRI dhan52) one best plant (BR9163-90-17) was identified possessing both *SUB1* and Xa21 QTLs/genes. In BC2F2 populations (BR9163-90-17), 20 plants showing fixed recipient alleles of
BRRI dhan52 were selected. In BC4F1 generation ten plants were found heterozygous for ART5 marker in foreground selection. Out of these, 1 plant BR9163-1-30-1-9 was identified with both *SUB1* and *Xa21* QTLs. In background selection, out of 14 markers, 3 markers showed recipient fixed allele, 3 markers showed homozygous donor alleles, 8 markers were unidentified, hence will be repeated. Other nine plants were backcrossed with BRRI dhan52 to produce BC5F1 seeds.
In BC4F2 (BR9163-1-30-1-9) plant population, 4 plants with fixed BRRI dhan52 alleles were selected. Through conventional breeding a total of 42 plant progenies were selected from F5
generation and were transplanted as F6 generation in the field. Eighteen plant progenies as fixed lines were selected from F6 generation.
Development of Rice Varieties with Enhanced Submergence Tolerance Through Marker Assisted Breeding (BAS Submergence Project): In BC4F1 (BRRI dhan33*4/BRRI dhan52)
generation, one plant having fixed *SUB1* allele and having phenotypic resemblance close to BRRI dhan33 was self-pollinated to produce BC4F2 seeds. In BC4F2 generation, 47 microsatellite markers being polymorphic between donor and recurrent parent were used to select plants that have maximum
contribution from the recurrent parent genome (background selection). Four best plants were selected out of 94 plants which had fixed donor alleles. The percentage of recipient genome recovery in the best plant was 93.50%. Through conventional breeding a total of 50 and 26 desirable F4 plant progenies
were selected from BRRI dhan33/Chiherang-Sub1 and BRRI dhan33/IR64-Sub1 cross combinations.

Improvement of Rice Varieties/Breeding Lines for Low Water Availability: In
Observational trial 32 entries were selected from 76 genotypes. From RYT and validation trial (14 locations) the genotype PSBRC82 was selected having similar growth duration with check varieties BRRI dhan28 and BRRI dhan45 but gave 0.8-1.2 ton higher yield ranging from 6.4-8.2 t/ha in six locations however in other locations gave similar yield with the check varieties.

Development of Tidal Non-saline Tolerant Rice: Twelve crosses were made and 10 crossed were confirmed as true F1. A total of 107 progenies were selected and 81 were bulked from pedigree nursery. Due to uneven growth, 152 plant selection were done for further evaluation
from OT. On the basis of replications maximum yield potentiality, and seedling height, only 4 entries BR7941-1-1-2-1, BR7941-20-1-1-1-HR1, BR7941-20-1-1-1-HR2 and BR7941-30-1-1-1 were selected for further evaluation.

Development of rice varieties for favorable Boro environment: A total of 34 crosses were made and 12 crosses were confirmed. A total of 1198 individual plants were selected from 22 F2 populations and 2193 progenies and 68 fixed lines were selected from pedigree generations.

Seven uniform advanced breeding lines yield from 6.3 to 8.1 t/ha were selected from OT.

Twenty advanced breeding lines showing yield significantly higher yield than the check variety coupled with similar or shorter growth duration were selected for further evaluation. BR7800-63-
1-7-3 and BR7988-10-4-1 were selected from SYT based on their yield and growth duration.

Development of Cold Tolerant Rice: Forty four crosses were made and 26 crosses were confirmed as true F1s. A total of 656 individual plants were selected from 20 crosses of pedigree nursery subjected to natural cold temperature following standard protocol for screening against cold under natural chilling temperature. Seven genotypes were selected form OT based on growth duration, yield, and homogeneity in morpho-agronomic traits and superior in one or more traits over the check variety. Also, a total of 869 plants comprising 45 F3, 192 F4, 303 F5, 242 F6 and 87 F7 progenies were selected based on superior phenotype and seedling stage cold tolerance under vi artificial cold condition. In another study, BR8264-1-1-3B2-HR4 was found the most tolerant and others 10 genotypes were found medium tolerant at seedling stage under artificial cold condition. However, BR8427-2-3-2, BR8258-7-1-5-2B2 and BR17 were found cold tolerant at reproductive stage. In an observational trial of 25 cold tolerant panel at Gazipur and Rangpur, five genotypes viz. BR8445-54-6-7, BR8261-19-1-1-3, BR8261-19-5-2-4, BR8445-54-6-6 and BR8257-10-1-1-2 were found promising for further evaluation in replicated yield trial. BR7974- 3-1-3-P3 and BR794-1-3-1-P1 yielded 1.0-1.6 t/ha over BRRI dhan55 with similar growth duration in advanced yield trial. On the other hand, BR7974-3-1-3-P4, BR7812-19-1-6-1-P2 and BR7812-19-1-6-1-P4 showing almost similar growth duration to that of BRRI dhan28 gave yield advantage of 1.7, 1.5 and 1.3 t/, respectively. In a validation trial at 10 locations in Rangpur, Lalmonirhat, Kurigram and Nilphamari, two genotypes viz, IR77496-31-2-1-3-1 and IR2266-42-6-2 yielded almost similar to that of check variety BRRI dhan28 with 2-3 days late in growth duration. However in SYT in Gazipur, these two genotypes yielded 0.2-0.4 t/ha higher than BRRI dhan55 and 0.7-0.9 t/ha higher yield than BRRI dhan28. Interestingly, both the lines showed strong tolerance to cold stress at seedling stage (LD: 3±0.00 and 2.3±1.5) and better recovery percentage (51.2±3.8 and 47.7±6.1) than tolerant check varieties (38.7±6.3: BR18 and 37.1±15.9: Hbj.BVI).

Development of Beta Carotene Enriched Rice (Golden Rice): In glasshouse trial, theintrogression lines showed a wide range of variation in grain yield and other ancillary traits. Grain yield/plant ranged from 11.8 g to 38.7 g. Days to flowering was differed from 99 days to 110 days. Thirteen introgression lines were selected from screenhouse trial of 28 backcross introgression lines imported from IRRI considering growth traits and yield performance. The lines showing performance similar or very close to those of BRRI dhan29 were selected. In addition, a set of different generations of backcross progenies in BRRI dhan28, BRRI dhan55 and BRRI dhan52 background have been developed.

Hybrid Rice Division

Summary

Development of Parental materials

During T. Aman season 2012, fifty **(**50) test crosses and 75 (Ax R) crosses were made from source nursery. Fifty five testcrosses (F_1s) were evaluated for their pollen fertility status of which two entries have been shown complete sterile and it was immediately backcrossed with its corresponding male parent for conversion. Twenty seven (27) BC_6 generations were designated as new CMS lines and included into CMS maintenance & evaluation nursery. One hundred twelve CMS lines were maintained by hand crossing for seed increasing and genetic purity.

Twenty four **(**24) test crosses and 130 (A x R) crosses were made using 16 CMS lines during Boro season 2012-13 from source nursery. Twenty eight (28) testcrosses (F_1s) were evaluated for their pollen fertility status under test cross nursery of which three entry have been shown complete sterile and it was immediately back crossed with its corresponding male parent for conversion. Thirteen BC6 generations were stable in terms of pollen sterility and other desirable agronomic characteristics and shifted to CMS nursery as new CMS line in the background of corresponding elite maintainer lines. Other BC generations were advanced for next generations. One hundred twelve (112) CMS lines along with their respective maintainer lines were maintained by hand crossing.

Biotechnology Division

Summary

BRRI dhan29 was used for transformation with gene construct having *GlyI and GlyII*. Four (4) putative transgenic plants from BRRI dhan29 were confirmed by GUS test, hygromycin screening and PCR amplification.

BRRI dhan29 and BRRI dhan28 were used for transformation with gene construct *AeMDHAR* and five (5) putative transgenic plants were regenerated.

TPSP gene construct was used to transfer into BRRI dhan29 rice variety. Ten plants recovered from the hygromycime containing (50mg/l)) medium were transferred into the earthen pot.

A cross (BRRI dhan29/IRBB60) was made to pyramid two BB resistance genes (x*a13* and *Xa21*) in popular variety BRRI dhan29. After molecular confirmation in BC_5F_1 progenies, BB screening was carried out and 3 resistant lines were selected and bulked for further evaluation.

A cross between BRRI dhan44 and BRRI dhan52 was made to transfer *SUB1* gene in to BRRI dhan44. In BC_5F_1, background and foreground selection were done and selected 4 plants were selfed. Forty our homozygous plants for *SUB1* gene were selected from 405 plants in BC_5F_2 generation for further evaluation.

Three sets of mapping populations were developed to identify and introgress high yield QTLs for enhancing grain yield of elite Bangladeshi rice variety. Phenotypic data on yield and yield component of all the three populations was recorded. On the other hand, in total 101, 31and 22 polymorphic SSR markers were amplified for genotyping of 238, 209 and 208 progenies from BRRI dhan28/ *Oryza rufipogon* (Ac.no.105890), BRRI dhan28/ *Oryza rufipogon* (Ac.no.103404), and BRRI dhan29/*Oryza rufipogon* mapping populations (Ac.no.103404), respectively.

Eleven (11) polymorphic SSR markers were amplified for genotyping of F_2 population of BRRI dhan29/IR4630-22-2-5-1-3 to identify QTLs for salinity tolerance at seedling and reproductive stage.

Ten green plantlets were obtained from anther culture for salt tolerance and yield.

During T.Aman/2012, 18 plants were selected and 115 lines were bulked from 204 pedigree lines. In Boro/12-13, 624 pedigree lines were transplanted for further evaluation. 268 plants were selected and 27 lines were bulked.
Thirteen (13) and fourteen (14) anther culture derived advanced breeding materials were selected depending on the duration and comparable yield with standard checks during T. Aman/12 and Boro/12-13, respectively.
Four anther culture -derived advanced breeding lines for T. Aman and 25 lines for Boro were transferred to Plant Breeding Division for further evaluation and 40 advanced lines were given to Plant Physiology Division for salinity tolerance screening.

Genetic Resources and Seed Division

SUMMARY
A total of 40 rice germplasm in which 35 Jhum, 02 Aus and 03 Aman/Boro were collected from different districts of Bangladesh including hilly areas. A total of 270 germplasm including 20 geographical indication (GI) varieties were characterized with 45 morpho-agronomic characters during Aus, T. Aman and Boro seasons. Besides, 2149 germplasm accessions including 590 new collections were rejuvenated Apart from this, 267 new collections were registered as accession.
Molecular characterization was carried out for 164 germplasm including 20 GI varieties using SSR markers. Genebank database preparation is going on and about 100 accessions have been entered into the database with available information during the reporting year.
Genetic diversity was pronounced in 40 Boro rice germplasm and the varieties were grouped into five (5) clusters.
Three germplasm *viz*: Rajasail, Biruin (Tola) and Balam dhan (acc. no. 841) have allelopathic potentialities and more inhibitory character to suppress weeds in laboratory condition.
Among 120 germplasm, 40 genotypes found tolerant against sheath blight and 35 found moderately resistant against bacterial blight diseases. Besides, 16 aromatic germplasm provided the lowest mean cluster disease score against blast and also confirmed using molecular marker.
Among the tested (97) genotypes, three accessions (Acc. 4217, 4398, 4399) found tolerant at seedling stage under complete submergence and among the tested 65 genotypes, 23 materials found elongating type under medium water stagnation.
Among the tested 81 germplasm, 14 were found moderately tolerant against salinity.
Acc. no. 128 under net house and acc. no. 104 at field conditions found best tolerant to heat.
Acc. no. 114, acc. no. 177, acc. no. 197 and acc. no. 202 found best tolerant to cold.
A total of 55 BRRI developed and recommended varieties were maintained as nucleus stock.
A total of 190.42 tons of breeder seed of which 75.80 tons from 29 varieties in T. Aman and 114.62 tons from 11 varieties in Boro seasons were produced during 2012-13.
In T. Aman season, about 48.69 tons from 23 varieties, 93.12 tons from 11 varieties in Boro and 2.31 tons from 9 varieties in Aus seasons were distributed during 2012-13.
Around 3.17 tons truthfully labeled seeds (TLS) from 25 varieties of T. Aman and 2.92 tons TLS from 11 varieties of Boro were available for distribution. Around 3.03 tons seeds from 19 varieties of T.Aman, 2.90 tons seeds from 11 varieties of Boro and 98 kg from six varieties of Aus were distributed as quality seed (TLS) during the reporting year.
A total of 16 foundation seed producing farms were visited to monitor the varietal purity and performance. Two training programs entitled “Breeder seed production and preservation techniques of rice” were organized under breeder seed project for the scientists and scientific assistant of BRRI.
Five training programs entitled “Quality seed production and preservation techniques of rice” were organized under breeder seed project for the farmers.

A closing workshop on “Strengthening of rice breeder seed production and maintenance of nucleus stock project” was organized under the said project.

Grain Quality and Nutrition Division

Forty nine lines including 32 lines from the Plant Breeding Division and seventeen lines from Plant Physiology Division were evaluated for physicochemical properties. Most of them had acceptable physical, chemical and cooking qualities. Twenty six lines had high amylose content (>25.0%) , three lines had high protein content (>9.0%), twenty four lines had high volume expansion ratio (>4.0) and two lines had high elongation ratio (>1.5). Among the lines twenty two lines had more than (>70.0%) milling outturn and twenty four lines had more than (>85.0%) head rice outturn. Twenty two lines had more than (>6.0) mm length among the lines and twenty nine lines have shown translucent grain. There were no lines in less than 15 minutes cooking time. Most of the lines having the range of cooking time from 15-19 minutes and two lines had more than twenty (>20) minutes cooking time.
Puffed, popped and flattened rice were produced from seven modern rice varieties to evaluate the quality of products. Comparing few parameters with BR16, all of the varieties produce similar or better quality puffed rice, these varieties might be used for production of popped rice except BRRI dhan54. Among the varieties, BRRI dhan51, BRRI dhan52, BRRI dhan53, BRRI dhan56 and BRRI dhan58 produce similar/better quality flattened rice comparing with BR16.
Iron content ranged from 8.0 mg/kg (BRRI dhan49) to 10.40 mg/Kg (BRRI Hybrid3) incase of non-parboiled rice. While, on the other hand, Fe content in parboiled brown rice was the lowest (8.65 mg/kg) in BR11 and highest (11.80 mg/Kg) in BRRI dhan28. Iron content of parboiled brown rice of all the varieties were significantly higher than that of non-parboiled brown rice (LSD = 0.696 at $P<0.05$ level) except for two varieties namely,BRRI dhan47 and Swarna. Zn content ranged from 13.20 mg/kg in Swarna to 18.70 mg/Kg in BR16, in case of non-parboiled rice. On the other hand, Zn content in parboiled brown rice was the lowest of 14.30 mg/kg in Swarna and highest of 22.95 mg/kg in BR16.
Percent retention of Fe and Zn decreased with incresed degree of polishing and the decrease varied from variety to variety. Mean of 10 rice varieteis showed that 6-8% polishing retained 56-66% Fe and 60-66% Zn. In laboratory milling experiment it may be concluded that milling up to 6-8% degree of polishing retains about 60% Fe and Zn and the organoleptic quality is expected to be accepted by the consumers.

Both Fe and Zn content of brown rice slightly decreased at 12h, 24h and 36h but decreased by about 10% at 48h soaking. Similar trend was observed in case of 10% polishing but loss of Fe was about 26% and loss of Zn was about 25 % at 48h soaking.
Between 24 and 48 hours soaking time, the reduction in iron content was 16% and the reduction in zinc content was 8% in the 10% milled samples. Changing water at 12h interval in case of 24h, 36h and 48h soaking did not affect the Fe content much but Zn content decreased with increasing soaking time. Most lost occurred at 48h soaking for both brown (26%) and polished rice (24%). A shorter soaking time within a usual range 5 of soaking times with pre-steaming, the iron and zinc contents of open-steamed, 10% degree of milling samples, decreased by 4-8% and 3-7%, respectively between 3 and 9 hours of steaming. These losses were somewhat higher with the pressure parboiling, 10% milled samples, where iron and zinc contents decreased by 9-11% and 12-13%, Respectively There was some effect, but a less consistent trend, of pressure *vs* open parboiling on Fe and Zn content; pressure parboiling resulted in a lower Fe content in 10% polished samples but not brown rice samples, while pressure parboiling resulted in a lower Zn content in brown but not 10% polished samples. Fourteen germplasm cultivars were evaluated for protein digestibility. The

invitro protein digestibility (IVPD) of the rice flour of the different local rice cultivars ranged from 49% to 68%. The highest *invitro* protein digestibility was obtained in the flour of the local rice cultivar, Magoi balam 68% while it was the lowest in the cultivars Poushmorich 49% and Depa 49%. The range of protein loss from 14.5-8.6% during milling.

Fourteen germplasm cultivars were evaluated for cooked rice through protein loss. In case of cooking in excess water, Leda binni had shown the highest protein lost 20% whereas Dudh kalam and Karaila dhan had shown the lowest protein lost 4%. Highest cooked rice protein was 8.83% for Need and the lowest cooked rice protein was 5.74 for Kanai bansi. Rubber roll or polyurethane roll husker along with both abrasive and friction type polisher are the most appropriate machines for securing a higher milling yield, as well as head rice recovery depending on the variety. With the automated and semi automated rice mill it is possible to control the degree of polishing, from 3% and above. The head rice recovery of medium long grain (BRRI dhan29) under parboiled condition in small rice mill was 62% and under unparboiled condition was 53%. For short grain (BRRI dhan34) the head rice recovery was 60%, with a very negligible percentage broken at 1%. Moreover, an extra yield of 1.6 mt to 2.4 mt can be obtained if the degree of milling can set as 10% to 5%. The profit margin of the small-scale rice milling factory (1 t/hr) ranged from 25%-30%.

It was observed that an additional 1-3% yield of head rice could be secured by using an air blowing type of Engelberg rice mill rather than the traditional Engelberg rice mill, though this was dependent on the variety. With this type, one pass is enough to produce pure rice free from husk. Using the modified air blowing type rice mill, it is possible to control over degree of polishing from 7% and above. The capacity of the modified air blowing type Engelberg rice mill was increased by 300% compared to the traditional Engelberg rice mill. The machine efficiency is 99% and can save Tk 1300.00 per 1000 kg of paddy processing compared to traditional Engelberg milling.

Program Area: Crop Soil Water Management

Agronomy Division

It was possible to obtain sufficient tillers from BRRI dhan29 of the main plot, which was used to retransplant 3-4 times more area than main plot in 15 December and 30 January transplanting.

The highest grain yield was observed from 45days old seedlings with20x20 cm spacing plus four seedlings per hill, which is followed by 35-day-old seedlings with 20- × 20-cm spacing plus four seedlings per hill.

BR7474-60-5-3 produced higher grain yield in T. Aman season than BR11 (check variety) but it was statistically similar with the check and the percent heterosis was not satisfactory.

None of the tested entries produced higher grain yield than BRRI dhan28, BRRI dhan47, BRRI dhan50 and BRRI dhan55 (the check varieties) in Boro season.

About 22 - 27 percent urea could be saved in Aman and Boro seasons respectively without sacrifying grain yield if 2/3rd of urea was applied as top dress along with 2-3 percent urea spraying maintaining 3.5 percent urea solution instead of last top dress. The study needs further evaluation.

Among the treatments weed free and herbicide + 1HW treated plot produced higher grain yield irrespective of fertilizer doses. Though weed free treated plot showed higher grain yield but herbicide + 1HW treated plot is economically more viable.

Among the treatments, the highest grain yield was obtained from 25 x 15 cm spacing (6.63 t ha^{-1}) when USG was deep placed followed by 20 x 20 cm spacing (6.20 t ha^{-1}) than 20 x 15 cm spacing (6.16 t ha^{-1}).

Among the tests different time of USG deep placement, the highest grain yield was obtained from 15 DAT USG deep placement (6.77 t ha^{-1}) followed by 10 DAT USG deep placement (6.72 t ha^{-1}) than 5 DAT USG deep placement (6.36 t ha^{-1}).

Almost three ton yield advantage over control and 500 kg over recommended rate was obtained though the nutrient amount was less than recommended rate.

Water hyacinth allowed to grown in waste water for 20-30 days and then this water might be used for irrigation to obtain similar grain yield of fresh water treated pot.

Though nutrient manger based fertilizer use may save fertilizer cost but it depends on knowledge level of the users. It is difficult to collect correct information for nutrient manager right now. It requires further improvement.

Grain yield and fertilizer dose of nutrients across the farmers' fields showed spatial variability. The application of appropriate fertilizer dose NPK @ 147, 25, 50 kg ha^{-1} may increase rice yield and minimize cost in all fertility grades of soil to a certain level, which is possible with farmers' present knowledge level.

Among the treatments recommended doses of fertilizer with USG application prodeuced higher yield (4.66 t ha^{-1}) followed by recommended doses of fertilizer with 25% additional Gypsum application (4.52 t ha^{-1}) and recommended doses of fertilizer with LCC based nitrogen management(4.44 t ha^{-1}).

Soil test based (STB) fertilizer application produced the highest yield in Aman season.

Among the tested varieties/lines, Joli, Rangpuri (sada) and Mi-chocho have allelopathic potentials and more inhibitory character to suppress weeds in laboratory condition

Evaluation of herbicide with Pretilachlor, Butachlor, Pyrazosulfuran-ethyl, Mefenacet + Bensulfuran methyl, Bensulfuran methyl+ Acetachlor and Pyrazosulfuron ethyl 0.6%+ Pretilachlor 34.4% group control weed effectively in transplanted field.

On the basis of FGD, researchable issues were identified and accordingly adaptive trials and other related activities are in progress.

Soil Science Division

In Boro season, the estimated optimum N rate was 150 kg/ha for the tested lines BR7358-5-3-2-1, BR7358-30-3-1, BR7372-18-3-3 and BRRI dhan50. Along with them, the optimum rate of K for BRRI dhan51 and BRRI dhan54 was 100 kg/ha while it was 50 kg/ha for BRRI dhan52 and BRRI dhan53 in T. Aman season. In Boro 50 kg K/ha is enough to produce optimum rice yield for all the tested varieties (BRRI dhan28, BRRI dhan55, BRRI dhan57 and BRRI dhan58). Twenty-five percent higher N/NP/NK/PK fertilizers need to be applied with STB dose depending on location for obtaining optimum rice yield. Long term missing element trial in BRRI HQ, Gazipur revealed that omission of N or K from complete treatment (NPKSZn) significantly decreased yield in both Boro and T. Aman seasons. Higher yield decrease was observed in Boro than T. Aman season due to omission of P fertilizer. At both

BRRI RS Rangpur and Barisal the omission of N or K in Boro significantly lowered yield while in T. Aman only N omission produced such results. Thus, to get optimum yield fertilization of NPKSZn is necessary. Soil test based (STB) dose is a good option for obtaining higher rice yield either in double or triple rice cropping pattern. Straw surface mulch immediately after establishment of rice with minimum tillage builds up soil organic carbon compared to rice straw incorporation in soil with minimum tillage. Higher level of water arsenic (193 – 462 ppb) of shallow tube well was found at two unions (Alibabad and Korola) of Faridpur sadar upazila and two unions (Keragachi and Jalalabad) of Kolaroa upazila under Satkhira district. Urea deep placement in the form of USG or NPK briquette is a key factor for efficient utilization of N fertilizer and obtaining higher rice yield as well as reduces N loss which perhaps decreases N_2O emission in the atmosphere.

Irrigation and Water Management Division

Irrigation applied by AWD practice when water level up to 15cm below soil surface produced the highest yield (5.56 t/ha) followed by continuous standing water and 30 cm AWD (5.33 t/ha) respectively. Higher yield was obtained from non-protected plots compared to protected plots covered with polythene sheet in levee. Thus, 15 cm AWD is the best water management practice for irrigated Boro production.

Considering specific discharge, an engine speed within 1500-1600 RPM is optimum for earthen canal. For polyethylene pipe with five and four inches diameter, 1450 to 1550 RPM is the optimum and for polyethylene and cotton pipe, 1400-1500 RPM is the optimum.

USG in AWD method produced slightly higher yield compared to prilled urea for Boro production. But application of USG alone cannot maintain higher yield in longer duration Boro rice like BRRI dhan29. Therefore, BRRI recommended additional split of prilled urea as top dress should be incorporated in the USG treated plots for BRRI dhan29 cultivation.

Refinement of AWD experiment showed that irrigation (5-7 cm) application is economically more viable when water level goes below 15 cm from soil surface. It saved 20%-25 % water and Tk 4,931/ha compared to continuous standing water practice.

Short and long duration varieties like BRRI dhan33 and BR11 were tested to determine the drought sensitivity and to find optimum date of transplanting under climate change situation. Both short and long duration T. Aman varieties suffered less from drought and showed good yield when transplanted from 24 to 31 July. The early transplanting of T. Aman through supplemental irrigation showed effective mitigation of terminal drought at reproductive and vegetative stages in T. Aman production.

Among medium duration varieties, BRRI dhan31 and BRRI dhan49 were found less sensitive to drought stress. On the other hand, long duration varieties having growth duration between 153 and 155 days were found sensitive to drought stress.

In Sonazagi area a good water bearing aquifer existed at a depth from 155 m to 180 m (salinity level ranged from 0.30 to 0.57 dS/m). BRRI dhan28, BRRI dhan47 and BRRI dhan55 were grown during Boro season and yields were 5.52 t/ha, 5.27 t/ha and 5.70 t/ha respectively. All the varieties performed well in irrigated condition. Thus, mono-cropped saline area has been converted into a double cropped area which is a good news for the

coastal saline areas. The adjacent farmers have started installing tubewells for irrigating Boro rice. The findings may be disseminated to other areas where similar condition exists.

Rain water harvesting in a reservoir with 25 cm high embankment conserved more water than without embankment, which could increase irrigated Rabi crops area in the coastal region. Rainfed T. Aman (HYV) - Tomato with irrigation cropping sequence is more profitable than other cropping sequences. It was also evident that Rabi crop cultivation with pond water is also profitable in costal saline areas.

In hilly areas, rain water harvesting, ring well renovation, rubber dam or river cross dam in Chegi river and Myani river, hill water conservation from small hill stream by making creek dam could be the good source of surface water in this region. Cultivable land can be increased by proper management of surface water from those sources.

Among the BRRI regional stations (RS) the highest depth of groundwater level (30.16 m) was found in Gazipur during March/April and lowest (1.4 m) in Kushtia area during September to October. In Barind area, the highest groundwater level depth (32 m) was observed in Nachol area, followed by Godagari (23 m) and Nawabganj (20 m). The overall trend indicates the lowering of groundwater level. The main reason for this declination was excess withdrawal due to increased demand for both domestic use and irrigation;

BRRI dhan54 could be a good option in Aman season in the polder 30 area (Khulna) considering the water height in Aman season and higher yield potential than local variety (2.4 to 2.8 t/ha). In polder 43/2F (Barguna), establishment of Boro rice in early November might be affected due to cold stress but it can be recovered after temperature increase. It is possible to grow BRRI dhan28 having yield range of 4 to 6 t/ha in polder 30 and more than 6 t/ha in polder 43/2F;

Rabi crops can be grown in polder 43/2F (Barguna) under undrained or unmulched condition if sown in January. To achieve better establishment and better yield of mungbean it needs to be sown early and when the soil moisture is optimum. Therefore, all the Rabi crops can be established earlier with proper drainage, which needs further study for confirmation.

Irrigation cost for Boro production gradually increased over the last 15 years (1989 to 2003). It started to increase at faster rate from 2004 till 2011 with some exception in 2008. After 2011, the projected irrigation cost will increase gradually and it will reach to Tk 16,713/ha in 2031. Availability of irrigation water at the farm level is closely related to the crops grown. Therefore, steps should be taken to improve on farm water management practice. To ensure a regular water supply to crops, it requires an improved irrigation plan (ie, when to irrigate and how much water to apply). Thus, agricultural extension workers could assist in this regard. In general, policies should be taken to promote water management training to farmers for better understanding of on farm water management.

Plant Physiology Division

Summary of Findings

1. Salinity tolerance:

- Eight BRRI dhan28-*Saltol* NILs (NIL412, NIL434, NIL683, NIL618, NIL607, NIL448, NIL657 and NIL576) were selected as moderately tolerant at seedling stage; but 3 of them (NIL434, NIL657 and NIL683-R) was found better yield potential at reproductive stage salinity tolerance and selected for further evaluation.
- HB8, a BRAC hybrid variety was identified as tolerant at seedling stage and has good yield potential at reproductive stage salinity tolerance.
- F_2 segregating progenies from 47 crosses were screened for salinity tolerance at seedling stage; progenies from 6 crosses were identified as moderately tolerant (av. SES 5).
- One Green Super Rice (GSR) genotype (IR 83142-B-79-B) was found moderately tolerant (av. SES 5) at seedling stage salinity tolerance.
- Fourteen BRRI Gene Bank Accessions were identified moderately tolerant (av. SES 5) at seedling stage salinity tolerance.
- Six Anther derived and two breeding lines were identified tolerant to moderately tolerant at seedling stage; but the selected 8 showed very sensitive at reproductive stage, grain yield under stress is poorer than BRRI dhan28.
- Based on the superior yield performance over BRRI dhan47 at reproductive stage salinity tolerance, two advance lines BR7100-R-6-6 and IR59418-7B-21-3 were selected and proposed for future salinity tolerant Boro variety.
- Based on the results of 3 trials in 3 locations of Khulna and Satkhira, the upper limits of soil and irrigation water salinity for Boro rice cultivation is assume to ECe 8.6 dS/m and ECw 4.5 dS/m respectively; four genotype (G28, G32, G33 and G50) showed higher tolerance, good quality grains and improved phenotype compared to the currently available tolerant varieties like BRRI dhan47 and BINA dhan8.
- Out of 7 ALART-salinity trials, soil salinity of Paikgacha was found strongly saline while 2 locations from Barisal Division were non-saline but all 4 locations of Satkhira have slightly to moderately saline.

2. Submergence tolerance:

- Three genotypes namely SONGA TEPI (Acc. No. 4217), ATSHOTTI (Acc. No. 4398) and ATSHOTTI (Acc.no. 4399) showed apparently good with more than 80% survivality under submerged condition. Although both the result of submergence and water stagnation should be retested.

3. Drought tolerance:

- Considering grain yield none of the genotype could perform better than BRRI dhan56 under stress condition. Among the tested genotypes IR82589-B-B-84-3 performed better which may be attributed to the less tillering, longest root and highest root shoot ratio.

- Two genotypes namely IR83142-B-60-B and IR83141-17-B showed better regarding deep rooting ability which could be used for further breeding program.

4. Heat tolerance:

- From the two different experiment of heat tolerance, 12 genotypes were found more than 85% spikelet fertility in 1st experiment and 10 genotypes were found in another experiment.

5. Cold tolerance:

- Out of 87 rice germplasms only 10 genotypes (Acc no. 79, 102, 113, 114, 121, 127, 169, 177, 197, and 202) were selected through screening for cold tolerance at seedling stage.

- IR77496-31-2-1-3-1 and IR62266-42-6-2 apparently found cold tolerant both at the vegetative and reproductive phase.

- Maintaining 2-4 cm water layer in seedbed at night time for 12-hour was suitable for healthy seedling raising for avoiding cold injury. If water is not available or scarce, 24-hour covered seedbed with polyethylene sheet is preferred for avoiding cold injury.

6. Growth studies:

- The two advance breeding lines BR7105 and IR72579-B3-2-3-3 are 7 days earlier than and BRRI dhan55 and have fine grain but yield is slightly lower than BRRI dhan47. Among the tested genotypes BRRI dhan55 is the best yielder. The morpho-physiological reasons for higher grain yield are probably due to more panicles per unit area and better HI.

7. Crop weather information:
Manual Weather Station data

- Among the station the highest maximum temperature was observed in Joydebpur During April (35^{o}C) and the lowest minimum temperature recorded in Comilla during January. Annual highest total rainfall recorded in Comilla (2029.5mm) and the lowest in Joydebpur (1641.7mm). The highest solar radiation 403.9 Cal/cm^2/day was observed in Joydebpur during April and the lowest solar radiation was observed in Habiganj during December (185.6 Cal/cm^2/day). The highest mean daily hours of bright sunshine prevailed in February both at Joydebpur and Habiganj. The lowest mean sunshine prevailed in December at Habiganj but at Joydebpur it was in May. The relative humidity at 9am and 2 pm was low during the month of February 48.2% and 69.2% respectively at Joydebpur.

Automatic weather station data

- Six Automatic Weather Stations was established during February to December 2012 obtained from BRRI Climate Change Project. One station was set in BRRI HQ Gazipur and rests were set in 5 Regional Stations i.e. Rangpur, Rajshahi, Comilla, Barisal and Bhanga. The recent record of lowest temperature in Bangladesh 3.2-4.7

^{0}C prevailed from 8-11 January 2013 in Rangpur region recorded by our Automatic Weather Station (WatchDog 2900ET). But Rajshahi ranked next to Rangpur, the minimum temperature ranged 4.1-4.8 ^{0}C from 9-10 January 2013. The highest temperature was recorded in Rajshahi 40.3 ^{0}C in 13 April 2013 and Bhanga (39.4 ^{0}C in April 3, 2013) ranked next to Rajshahi. You can find detail weather information in the handouts.

Program Area: Pest Management

Entomology Division

SUMMARY

The rice fields and seed beds of BRRI farm, Gazipur harboured GLH, WLH and GHin high numbers. Spider, Dam. fly, LBB and CDB were the dominant predators in all the habitats. Stem borers, GH, LHC, RLF and WM damages were observed throughout the year in weekly 20 hill counts.

Highest incidence of GLH was observed at Gazipur HQ in light trap followed by Habiganj. Peak BPH incidence was found in November and YSB from September to December at Barisal. On the other hand, incidence of RLF, BPH, LHC was highest in October. Highest catch of the natural enemies in the light trap was recorded at Barisal which was almost similar to that of Gazipur. Peak incidence of BPH was observed from October to November in Washin, Betrashin and Aurongail of Sirajganj during the T. Aman season. During the Boro season highest planthoppers and natural enemies were observed in May. Longevity of both the sexes of *Trichogramma zahiri* decreased significantly when temperature increased from 18 to 34oC. No significant difference was found at temperature range from 18 to 26oC. Female longevity was always higher than the male longevity at all the temperatures. However, the differences were statistically insignificant.

Multiple parasitism was common in *T. zahiri*. After three hours of initial parasitization, percent single parasitism decreased and multiple parasitism increased to a high level.

Yellow stem borer, BPH, GLH, GMB and LBB showed different periodicity at different months owing to different climatic conditions.

Rice yield increased by 14.76% over the untreated control when insecticide was applied with double nozzle sprayer. Research managed plots yielded 11.47% higher than the farmers managed plots. Prophylactic application of insecticides at 15-day intervals failed to show any significant differences in yield both in Barisal and Rangpur region.

Among the tested T. Aman varieties, highest yield loss occurred in BRRI hybrid dhan4 (24.41%) and the lowest in BRRI dhan56 (4.29%). In Boro season 8.62% and 11.62% yield losses were observed in BRRI dhan55 and BRRI dhan58 respectively**.**

· A total of 155 insecticides were evaluated during the reporting period of which, 88 against BPH, five against rice hispa, three against rice leaf folder (showing more than 80% mortality) and 13 against yellow stemborer (reduced deadheart 80% or above) were found effective and recommended for registration by the Pesticide Technical Advisory Committee (PTASC).

· Out of the 34 breeding lines, no materials were found promising against BPH but one material of Boro was found promising against WBPH and GLH. Out of the 11 advance breeding lines, two were found promising against GLH. Out of the 12 genotypes four against BPH, one against WBPH and two against GLH were found promising.

Plant Pathology Division

SUMMARY
Least blast disease incidence and severity were observed in AEZ2 and AEZ20 irrespective of variety and season. While, highest disease incidence (50-70%) was recorded in AEZ1 and AEZ9.
In Boro, hybrid Jhalak was worsely infested by neck blast while in Aman, aromatic rice particularly Bagunbichi and BRRI dhan34 were severely infected by neck blast disease.
In Aman season, BR10, BR23 BRRI dhan30, Nayanmoni and Swarna were least infected by blast while in Boro hybrid rice Tia and Sonar bangla-6 was least infected.
Pathogenicity of blast isolates on MLs indicated that virulence genes of the isolates against resistant genes *Pia*, *Pib*, *Pit*, *Pik-s*, *Piz-t*, *Pi12(t)*, *Pi19(t)*, and *Pi20(t)* of MLs and avirulence genes of the isolates against *Pish*, *Pi9*, *Pita-2*, and *Pita* were distributed widely in fungus population in Bangladesh. These four genes *Pish*, *Pi9*, *Pita-2*, and *Pita* are the useful genes for developing durable blast resistant variety.
A set of twenty five standard differential reference isolates have been developed for blast resistance studies. Out of 536 blast isolates, 419 races were identified. Among the pathotypes, U, z and ta
were more diversified in rainfed low land ecosystem (T. Aman) while i, k, z pathotypes were in irrigated ecosystem (Boro). Pathotypes U63, z04 and ta403 were dominant in both the ecosystems and widely distributed in Bangladesh.
Cultural and molecular characterization of *Rhizoctonia oryzae sativae* isolates indicated the wide variation among this pathogen.
Among the tested advanced breeding lines, two lines BR7830-16-1-5-3 and BR7840-54-1-2-5 were found tolerant to ShB, BR7830-16-1-5-3 was tolerant to BB and three lines BR7976-11-11-3-1, BR7840-54-3-1 and BR7840-54-1-2-5 showed tolerant to false smut disease under natural condition.
Out of 28 materials, seven materials such as BR7840-54-3-2, BR7831-10-3-1-6, BR7831-78-2-1-2-1, BR7830-16-1-5-3, BR7673-14-2-1-7-1HR1, BR7671-37-2-2-3-7 and BR7830-16-1-5-3 were moderately resistance to rice blast.
Pish and *Pita*-2 genes were introgressed in the background of BRRI dhan29. The F1 plants were confirmed by molecular marker.
Out of 140 aromatic materials including MLs, 16 were found tolerant against blast. At least one of the genes either *Pish* or *Pita* or *Pi9* was detected using molecular marker of these materials.
Out of surveyed 19 primers against blast *R*-gene *Pita*, *Pita2*, *Pish*, *Pi9* and *Pib*, primer pita440, OSM89, AOL45, RM195 and Sub3-5 were produce specific bands to corresponding *R*-gene.
Among the 96 germplasms, 54 posses *Pita*, 54 having *Pita-2*, 33 having *Pish*, 1 having *Pi9* and 64 having *Pib* blast resistant gene.
MR genes *Pita*, *Pita-2*, *Pish* and *Pib* against blast were found in the same background of H13, H35, H49 and H58 germplasms. The *Pi9* gene was detected only in one local rice variety (H100) in which *Pita-2* and *Pib* genes were also detected.
Out of 50 BRRI varieties, *Pish* and *Pi9* genes were detected in 12 and 2 varieties, respectively. While, *Pib* gene were detected in all most all BRRI varieties.
Out of 120 aromatic materials, 40 materials found tolerant against ShB disease and 35 found moderately resistance to BB.
Out of 79 INGER materials, 11 found resistance against BB.
Ten new fungicides having Tricyclazole were recommended for blast disease control.
Five fungicides recommended for sheath blight disease control.
Blast disease management in Barisal and Rangpur region indicated that BRRI recommended practices were better than farmers' practice.

As a part of routine work, Plant Pathology Division provided advisory and clinical services around 200 farmers, DAE and NGO personnel.

Program Area: Rice Farming Systems

Rice Farming Systems Division

Kapasia, Gazipur. Higher income was associated with interventions of technologies, off-farmand non-farm activities. Improved mango production and rearing of layer and pigeon helped farmers increased their income. Mango trees were sprayed with fungicide both at flowering and pea-size stage of landless and small farmers. On an average each plant produced 37 kg and 47 kg which was 48% and 12% higher than non sprayed plants of the base year of landless and small farmers, respectively. Fertilized Jackfruit trees at FSR&D site, Kapasia gave higher return of landless farmers (378 Tk/plant) and small farmers (364 Tk/plant) than unfertilized trees. Rearing of goat increased the income of the landless farmers and about 462% cash benefit was found in 3 years. The increased average yield of BRRI dhan46 was 0.60 t/ha in T. Aman and that was 0.40 t/ha for BRRI dhan28 in Boro season. On an average 20.7 kg N/ha and 21.2 kg N/ha could be saved by LCC based N management practice in Aman and Boro season, respectively over the farmers' practice. Study revealed that cash earned by different farmers for growing different vegetables varied from Tk. 5130-10488. Turmeric and ginger produced an average yield of 32.3 kg and 4.8 kg with an average gross margin of Tk. 720.00 and 190.00 from a homestead area of 31.6 m2 and 5 m2 respectively. Rohu, Silver carp, Mrigal and Sorputi were released in three seasonal ponds in June, 2012. Total fish production was 315 kg and gross return was Tk 20160 from three ponds of 46 decimal. In a yield gap experiment at Kapasia it was found that the BRRI management practice, use of quality seed, LCC and USG contributed to higher yield. In wheat-Mungbean-DS Aman pattern, the higher grain yield of Wheat was (3.38 t/ha) produced by permanent beds with 100% crop residue retention. Moreover, an average wheat grain yield was better in different bed practices than conventional practices. Mungbean yield was higher in different bed practices than conventional practices. In Aman season, average grain yield of DS Aman was (4.46 t/ha) in different bed practices and in conventional practice was (3.39 t/ha). In evaluation of different cropping patterns in medium highland irrigated ecosystems indicated that highest REY was obtained from Potato-DT Boro-T Aman cropping pattern (19.02 t/ha) followed by Potato-T Aus-T Aman (17.76 t/ha) Boro-T Aus -T Aman (15.69 t/ha), Mustard –T Aus-T. Aman (12.49 t/ha) and the lowest from Boro-Fallow-T Aman (11.62 t/ha) cropping

pattern. Sesbania application and weed management in T Aman rice in Boro-Fallow-T. Aman cropping. pattern indicated that Sesbania incorporation before T Aman rice significantly influenced yield and yield contributing characters. Sesbania incorporation by applying herbicide 30 days after

seeding gave the highest yield (4.76 t/ha). Sole Maize-DS Aus with 2 hand weeding-DS Aman with herbicide followed by 1 hand weeding gave highest rice equivalent yield (10.42 t/ha) in intercropping of grasspea and Sesbania. Under late situation, double transplanting gave significantly higher grain yield than that of normal transplanting in both T Aman and Boro seasons. In long-term study with four cropping patterns, the Potato-Boro-T. Aman cropping pattern gave the highest REY and gross margin than Boro-Fallow-T Aman, Boro-T Aus- T Aman and Maize- Mungbean-T Aman in both Rangpur and Gazipur site. Among the six tested patterns Tomato-Mugbean-T. Aman gave the highest water productivity (8.83 kg/mm/ha). The pattern Wheat- Mugbean-T. Aman and Potato-T. Aus-T. Aman gave the water productivity of 4.94 and 5.25 kg/mm/ha, respectively. The pattern Lentil- T. Aus-T.

Aman, Chickpea- T. Aus-T. Aman and Boro-Fallow-T. Aman showed the water productivity of 4.02, 3.82 and 3.93 kg/mm/ha, respectively. All the tested pattern except Tomato-Mugbean-T. Aman showed similar water productivity and apparently the lower water productivity was observed in Chickpea- T. Aus-T. Aman. The pattern Tomato-DS Aus-T. Aman resulted significantly highest Rice Equivalent Yield (REY) of 30.40 t/ha among the four tested patterns. The yield of BRRI dhan28 was 5.7 t/ha, 5.6 t/ha, 5.6 t/ha, 5.7 t/ha and 5.2 t/ha under wet, dry, dapog, modified wet bed nursery-1 and modified wet bed nursery-2, respectively. In Aman season, the yield of BRRI dhan49 was 4.7 t/ha, 5.0 t/ha, 5.3 t/ha, 4.0 t/ha and 5.0 t/ha under wet, dry, dapog, modified wet bed nursery-1 and modified wet bed nursery-2, respectively. The grain yield of BRRI dhan49 was the highest (4.30 t/ha) followed by BRRI dhan39 and the lowest was in BRRI dhan57 irrespective of establishment methods. The grain yield in transplanting was the highest (4.59 t/ha) followed by dry-seeding with pre-germinated seed and the lowest was in dry seeded rice irrespective of varieties. BARI panikachu-3 and monosex tilapia in pond along with vegetables (sweet gourd and bottle gourd) and papaya on the pond bank was found to be an effective combination of vegetables, fruit and fish in a system. Five activities on validation and delivery of Farming Systems technologies were carried out in different location of the country. The activity included promotion of improved cropping pattern packages, demonstration of poultry manure as a source of phosphorus fertilizer, promotion of improved varieties of turmeric cultivation in the homestead and multilocation testing of BRRI dhan46/49-BRRI dhan29-Fallow cropping patterns. Under co-ordinated Sub-project on Farming Systems Research & Development for Farmers Livelihood Improvement twenty five activities on validation and delivery of Farming Systems technologies were carried out in Barisal and Habiganj.

Program Area: Farm Mechanization

Farm Machinery and Postharvest technology Division

BRRI prilled urea applicator was designed and fabricated considering line to line spacing 20 cm in the research workshop in view of deep placement of prilled urea between two rows plant. Fertilizer rate could be adjusted according to different rice season demands. The performance of BRRI prilled urea applicator was evaluated and compared with BRRI USG applicator and hand broadcasting of prilled urea. The field capacity of the applicator was 32 decimal/h. Urea placements by the prilled urea applicator, USG applicator and manual broadcasting gave insignificant effect on grain yield. BRRI prilled urea applicator saved 30 - 35% of prilled urea without sacrificing yield. A manual carrier (rickshaw-vans) was modified to improve the performance of the existing traditional rickshaw van, enhance the labor productivity and reduce the drudgery in farming work. The designed prototypes were two speed and four-speed change gear rickshaw-van involved with changeable gears, modified hubs with enlarged width, two free wheel sprockets, UC pillow block bearing, suspension springs, and wooden foot brake. The safe load of the developed prototype was found to be 350 kg. About 46% of safe loading capacity was increased in the developed prototype compared to the existing manual carrier. The developed manual carrier can be stopped instantly with 3 – 4 feet distance in any emergency conditions, pass any obstacle easily and make the drive and transportation easier and more comfortable. developing an adjustable and hill dispensing type seeder for paddy. The field test and evaluation was performed at BRRI research plot. The fuel consumption was found to be highest for the Korean cultivator (14.0 l/ha) followed by the Korean (12.0 l/ha) power tiller and then the Chinese (11.2 l/ha) power tiller. The hill-to-hill distance was found to be highest (19.5) for the Chinese power tiller and lowest (17.63) for the Korean cultivator, while it was 18.67 for the Korean power tiller. The number of plants per hill was more (8.43) with the Korean power tiller and less (5.567) with the Chinese power tiller. The seed rate was 44 kg/ha, 36 kg/ha and 40 kg/ha for Korean

cultivator, Korean power tiller and Chinese power tiller, respectively. The field capacity of Korean power tiller, Korean cultivator and Chinese power tiller were 0.189, 0.150 and 0.214 ha/hr, respectively. The seeder attached with Korean cultivator performed better in all aspects compared to the Chinese and Korean power tiller. with adjustable mechanism in Bangladesh condition. Five weeding technology were used in the study namely Korean Multi-rows Power weeder (KMPW), Developed Multi-rows power weeder (DMPW), Korean Single rows power weeder (KSPW), BRRI Weeder (BW) and Manual weeding. Korean multi-rows power weeder was modified for 18/20/22 cm line spacing. Modified power weeder was evaluated at BRRI research field, Gazipur and farmer's field at Kumarkhali, Kushtia in comparison with other weeding technology. It was observed that the average field capacity was 935, 1336, 540, 384 and 100 m2/hr for DMPW, KMPW, KSPW, BW and Manual weeding respectively. The average weeding efficiency was found 87.4, 86.6, 82.6 and 74.4 percent for DMPW, KMPW, KSPW and BW respectively. Weeding efficiency was observed more for manual weeding. Average field efficiency was found 68.9, 67.7, 67.2 and 85.6 percent for DMPW, KMPW, KSPW and BW respectively. Field efficiency of the technologies varied with the variation of total turning time loss. Turning loss was observed minimum in BW. For this reason, the field efficiency of BW was found highest followed by DMPW and KMPW. The modified weeder was suitable to operate in the line transplanted field with adjustable facility of 18/20/22 cm spacing. Un-puddled transplanting (bed planting, strip tillage and no-tillage) saved fuel remarkably compared to puddle transplanting. Mechanical transplanting reduced drudgery of the farmers and ensured timely operation. Transplanting time was higher in unpuddled than puddle plot. Floating hill was also higher in unpuddled plot due to increase in soil hardness and unable to provide proper anchorage and gripping force to seedlings. Grain yield of unpuddled transplanting was similar to puddled transplanting. Water productivity was the lowest in unpuddled than puddled transplanting. Input cost was higher in conventional puddling than unpuddled transplanting. Mechanical transplanting overcome the constraints of manual transplanting in unpuddled condition. It might be an effective technology in rice production with limited seedling floating (10-15%) in sandy loam soil. A study was conducted during Aman/2012 season on mechanical rice transplanter to evaluate the field performance in both puddle and un-puddle conditions in three different location. Walking type 4 rows mechanical rice transplanter was used to conduct the study. Mechanical rice transplanter was found suitable to operate in un-puddle condition with some pre-requisite management. In puddle field, average plant to plant distance was found 14.42 cm whereas it was 14.85 cm in un-puddle field. However, average total missing hills considering picker missing, floating, buried and damaged hills was found 3.60 and 4.92 hills/m2 in puddle and un-puddle fields respectively. Floating hills was observed more in un-puddle field though buried hills was more in puddle hills. Moreover, percent of missing hills in puddle and un-puddle conditions were 14.94 and 21.04% respectively. Average filed capacity was found 0.14 and 0.13 ha/hr in puddle and un-puddle conditions respectively. Average yield of the BRRI dhan49 was 5.1 and 4.87 t/ha whereas 4.92 and 4.89 t/ha for BINA dhan7 in puddle and un-puddle field respectively which was not varied significantly. BCR of rice production under puddle and un-puddle conditions, transplanting by mechanical transplanter, was gave 1.49 and 1.56 respectively. The study was conducted during Aman and Boro 2012-13 to know the harvesting and postharvest loss status in Bangladesh. A survey was done by the structured questioner to know the mechanization status and machinery used in harvesting operation and a comparative study was conducted between manual harvesting, reaper and combine harvester. Farmers expressed that harvesting is labor-intensive and time-consuming work by manual sickle harvesting. Farmers were not familiar with the performance of modern harvesting machinery. Every farmer used mechanical thresher for threshing the paddy either in the field or in the home yard. Only kula was commonly used for winnowing the crop. The theoretical field capacity (ha/h) and field efficiency (%) of combine harvester was 0.64 and

60.12 respectively. The labor requirement per unit area (man-h/ha) was 278.0, 238.1 and 9.87 for method 1, method 2 and method 3 respectively. Here, method 1 and method 2 required 28.2 and 24.1 times more labor compared to method 3. So the use of combine harvester was more effective than traditional reaping, transportation and threshing. The overall harvesting (cutting, transport, threshing, winnowing) cost of method 2 was Tk/ha 10481 and method 1 was Tk/ha 10965. The operating cost for method 1, method 2 and combine harvester was Tk/ha 10,965, 10,481 and 11,592 respectively. The total loss estimates for field operation (cutting to threshing) was 3.09, 2.94 and 1.25% for method 1 (sickle cutting - man transportation - open drum threshing- winnower), method 2 (sickle cutting - man transportation - close drum threshing - winnower) and method 3 (combine harvester), respectively. The loss in the combine process is lower than in either method 1 or method 2. Overall, the adoption of combine harvester use should be the highest priority for reducing post harvest loss. Demonstration is one of the most powerful tools to disseminate any technology to the end users. Field demonstration was arranged to the farmers' field to show the usefulness of BRRI farm machinery. The awareness among the farmers on the benefit of using BRRI farm machinery was created through the demonstration cum training programme. Nowadays, more farmers have been using BRRI machines including weeder, thresher and winnower. As a result, the use of agricultural machinery has been increasing day by day. As the price of the farm machinery was higher, therefore adequate subsidy should be provided to the farmers' for effective dissemination. Skillness among the operators of BRRI farm machinery was created through the training programme, Now-a-days, more farmers have been using BRRI machines including weeder and thresher. As a result, the use of agricultural machinery has been increasing day by day. This type
of training was found useful for the operators. Many workshop around the country manufactured different types of farm machinery. The quality of the machine could not satisfy the farmers demand. Five-day-long training programme on the fabrication of farm machinery was conducted to the machinery manufacturer. Through the training programme, the skillness among the manufacturer was created about manufacturing of BRRI developed machinery. Participants gained knowledge on the fabrication procedure of BRRI machine. They have learnt the step by step procedure to manufacture machine parts and assembled the machinery. They also learnt to prepare jig and fixture to manufacture the parts in large scale. This type of training was found useful for the manufacturers. Adaptive trial seedling raising technique (both mat type and tray type), Mechanical rice transplanter, BRRI USG applicator, BRRI power weeder, BRRI weeder, BRRI rice wheat thresher, BRRI winnower was conducted in different location of Barisal, Patuakhali, and Rangpur district during aus 2013 season. The yield of mechanically transplanted rice was higher than manually transplanted rice. Also the yield of USG applied plot was higher in manually placement of prilled urea plot. The farmers were satisfied about the performance of farm machines. BRRI rice-wheat thresher was provided to the farmers for long-term use of the machine. Farmers threshed 15 ton of rice these machine. Cleaning mechanism of the machine impressed the farmers very much. The study was conducted in three districts named Jhinaidah, Kustia and Chuadanga to investigate the maintenance practices of small diesel engine used in agricultural operation. The information was collected from 30 diesel engine owner and 10 power tiller owner from six villages. Most of the respondents' did not maintained bed testing before use the diesel engine due to lack of knowledge on the benefit of bed testing of new engine. Every operator checked fuel, oil and water before starting the engine. Most of the farmers did not clean the diesel filter, diesel tank, oil sump, diesel pipe line and mobile filter. Every respondent changed the compression spring and injector pipe within 2 to 3 month. Moreover, maximum respondents changed the gasket, fuel filter and pushrod. Farmers changed the v-belt and radiator as well as head assembly after one year. The study revealed that the maximum machine owner or

operators did not follow the proper maintenance schedule due to lack of knowledge about proper maintenance schedule.

Workshop Machinery and Maintenance Division

Several field tests were conducted to evaluate the overall performance of the BRRI developed self-propelled reaper comparing with imported self-propelled reaper under DDMISRMT project. In this test BRRI dhan-28 were harvested at Rangpur and Rajshahi Regional station of BRRI and wheat was harvested in Jhenaidha in Boro 2012-13 and T.Aman 2010-11 seasons respectively. During the field operation of the reaper with 1.2m head, the average field capacity of imported reaper were found 0.185 ha/hr (45.60 decimal/hr) and 0.222 ha/hr (54.82 decimal/hr) of BRRI dhan-28 cutting in Rangpur and Rajshahi respectively. On the other hand, the average field capacity of BRRI developed self-propelled reaper was found 0.278 ha/hr (68.66 decimal/hr) in 2011-12 Boro season. Imported self-propelled reaper was also tested for wheat harvesting. In this test the field capacity was found 0.231 ha/hr (57 decimal/hr) in Jhenaidha district. The average fuel consumption of imported reaper and BRRI developed self-propelled reaper were 0.733 l/hr and 0.825 l/hr respectively. The purchase price of imported reaper is almost double of BRRI dhan-28 cutting in Rangpur and Rajshahi respectively. On the other hand, the average field capacity of BRRI developed self-propelled reaper was found 0.278 ha/hr (68.66 decimal/hr) in 2011-12 Boro season. Imported self-propelled reaper was also tested for wheat harvesting. In this test the field capacity was found 0.231 ha/hr (57 decimal/hr) in Jhenaidha district. The average fuel consumption of imported reaper and BRRI developed self-propelled reaper were 0.733 l/hr and 0.825 l/hr respectively. The purchase price of imported reaper is almost double of BRRI developed self-propelled reaper. According to the analysis, it is clear that the overall performance of the BRRI developed self-propelled reaper was better than that of imported reaper in Bangladesh contest. machinery in farmers' field. We have collected data from 30 mechanics, 30 machine operator cum mechanics and 30 machine operators from Harinakundu and Shailakupa Upazilla of Jhenidah District. All PT, Thresher, STW owner believe that timely maintenance of farm machinery will increase engine life, reduce maintenance cost, but only 5-10% owner maintain proper maintenance. After 100 hr use, air cleaner, valve clearance, chain tension, tyre pressure should be checked. Only 12% people do it. Nobody check valve clearance before 6 month. After 200 hr use, diesel and lubricant filter, water should be changed. Only 25-35% people do it. Diesel tank inner, engine sum must be cleaned every 500 hr use. 45-65% people do it. Overhauling should be done after using 500 hr. Only one person found in survey area who does it. We provided 2 training programme on Farm Machinery maintenance in the study area. A study on adoption level of agricultural machinery in farmers' field was conducted in Jhenidah district. We have collected data from Harinakundu and Shailakupa Upazilla of Jhenidah District. Paddy areas have higher intensity of Farm Machinery whereas vegetables areas have less intensity of Farm Machinery. Betel leaf areas have few amount of Farm Machinery. In electrified area, almost all farmers are using Stand Fan to winnow. There are no any mechanical weeder, reaper, combine harvester, transplanter etc. So there is a scope to introduce of those machinery in this area. Data were collected for feasibility study of solar energy use in agricultural machinery. Less power (0.5 hp) is required to drive BRRI winnower among the farm machinery. The study was conducted preliminary on solar energy use in BRRI Winnower. To operate BRRI winnower, 0.5 kw solar photovoltaic system consists of photovoltaic module, energy storage, converter, charge controller and Balance-Of-System (BOS) components is required. Average solar radiation was found 4-7 watt-hr/m2 in December 2013 at BRRI. Solar panel fixed with winnower is appropriate in sunshiny weather but it is not feasible in cloudy weather. A battery is used to store electrical energy during sunshine which will be used in winnower off time.Repair and maintenance works of

transport/vehicles and different farm machineries of BRRI were repaired and maintained under WMM Division. There were 29 vehicles (4-wheeler), 76 motor cycles, 2 tractors with accessories (one scrapper, three harrows, five rotaries, three discs and three scissors), 21power tillers, 7 hydro-tillers, one reaper, one BRRI field mower, 18 pumps, one open drum threshers, two engines, and other farm machineries were repaired and changed of spare parts under major and moderate/minor repair and maintenance work. The total cost of major and moderate/minor repair and maintenance was Tk. 42, 29,506 from July 2012 to June 2013. Among these major repair andmaintenance cost was Tk. 35, 72,494 and, moderate/minor repair and maintenance cost was Tk. 6,57,010. The major repair and maintenance work was done by direct cash purchase, direct contracting through work order, RFQ (Request for Quotation) and OTM (Open Tender Method) but the moderate/minor repair and maintenance work was done only by revolving fund.

Program Area: Socio-economics Policy

Agricultural Economics Division

Summary
BRRI dhan28 and BRRI dhan29 were the most popular varieties in Boro season. BR11 is still the dominant variety in T. Aman season covering about 22 percent of the total T. Aman area. In Aus season, the area coverage of BRRI dhan28 was the highest (12 percent) followed by BR2 (7 percent). Among different BRRI varieties, BRRI dhan29 was the top yielder in both Boro (5.43 t/ha) and Aus (4.96 t/ha) seasons. BRRI dhan32 ranked top in terms of per unit yield (5.21 t/ha) in T. Aman season. Recently some Hybrid varieties are being adopted as replacement of other MVs in Aus and Boro seasons due to higher yield performance.
Rice farmers used more seed than the recommended dose irrespective of cropping seasons. They applied comparatively lower amount of TSP and MP fertilizer due to their ignorance. MV Boro growers obtained higher yield due to better cropping environment, good management practices and use of better genotypes. However, the net return or profit was higher in Aman production due to lower per unit costs of production compared to that of Aus and Boro respectively
Rice varietal development remains to be skewed in favor of Aman season as 46 percent of the 72 MVs released up to 2010 were Aman, while it was 25 percent for Boro; although, it covered 41 percent of total rice area and 56 percent share in total rice production. So, farmers who are able to grow only Aman rice have more varietal choices. Aside from high-yielding traits, farmers prefer varieties with the traits like good eating quality, insect/disease resistance, short duration, high milling recovery and high grain weight, etc.
To evaluate the impacts of climatic changes on supply of and demand for rice in Bangladesh a simulation model was developed incorporating climate variables like; temperature, rainfall and solar radiation. It revealed from the baseline analysis that production of modern Aus, Aman and Boro are increasing. As the total rice production of the country is increasing; as a whole, quantity of imports is decreasing in one hand and on the other, the bulk of stock is increasing gradually. Higher level of per capita income growth along with negative elasticity of demand leads to the diversification of consumers' food habit. However, total demand of rice will increase eventually; as population increasing.
At the higher level of income, households substitute leisure for labour and supply less labour in the market. This redistribution affects the employment of higher to lower-income groups. Even the poor supply less labour in the market as income increases with technological progress. As a result, the demand for agricultural labour goes up because of the higher labour intensity of MVs, putting an upward pressure on the wage rate. These forces in the labour

market may operate, by promoting rural-rural migration, to redistribute some employment and income from technologically developed to under developed areas.

Agricultural Statistics Division

Summary

In the reporting period, BR11, BR22, BRRI dhan23, BRRI dhan32, and BRRI dhan41 were found as the most stable in T. Aman season, while BR3, BR4, BRRI dhan25, BRRI dhan51 BRRI dhan51, BRRI dhan52, BRRI dhan53, BRRI dhan54, BRRI dhan56 and BRRI dhan57 appeared to be unstable among the non-aromatic rice. In case of aromatic rice, BRRI dhan37 and BRRI dhan38 appeared to be the most stable varieties.

BRRI dhan28 and BRRI dhan29 was the only most stable variety and BR1, BR2, BR6, BR8 and BR18 appeared to be unstable in Boro season. In case of fine rice BRRI dhan50 appeared to be below average stable in Boro season.

BR11, BR22 and BRRI dhan32, BR16, BRRI dhan28 and BRRI dhan29, BR9, BR16 and BR20 were found to be more preferable and cultivable varieties due to higher yield in T. Aman, Boro and Aus season respectively among the producers and producer cum consumers. Pure consumers were found to prefer rice varieties on the basis of tastiness, fine rice and availability of the varieties. Although, BRRI variety contributes about 90% of total production but it does not reflect in field label because of BRRI variety sale in different brand name, namely BRRI dhan28 sale as Nizersail and BRRI dhan29 as Jhingasail and Miniket etc.

Three mathematical models have been developed for consumer and producer preference to rice varieties by using four locations/districts farmers' data of Bangladesh in terms of rice deficit" and rice surplus area. These three models uses to determine factors affecting producers' decision on varieties for rice cultivation and can provide an indication of the factors affecting consumers' preference to rice varieties.

Combining the total As of grain and water (drinking water and water for rice cooked) more than 800 and 700 ppb, respectively in command area level and upazila level consumed per person per day. Which may accumulate at least a small amount of As in human body. Thus, consumption of rice containing a small amount of As per day may lead to accumulation of large amount of As in human body in the long run.

In North-Eastern and South-Eastern regions of Bangladesh Aman production is proportional to rainfall and inversely proportional to average maximum temperature which indicate, the rainfall and temperature effect the rice production prominently. So, other parameters are less prominent to effect the production in this region. In South-Western region the Aman production decreased though rainfall but temperature does not show significant change. This scenario indicates rice productions in this region are less depends on rainfall and average maximum temperature. There may other factors are more prominent in this region. We know that most the area of the region is situated under tidal effect which may be the cause of production decrease. But most noticeable that, in North-Western region Aman production

increased though rainfall decreased so significantly also average maximum temperature was high in this region.

A model have been developed for forecast the production of Aus rice in Bangladesh using ARIMA methodology. By which total cropped area of Aus can be increase in future, if land reclamation and conservation measures are adopted.

A total of 106 different analyses were performed during the reporting year. Besides, a number of maps were prepared using GIS and supplied to the scientists of other divisions whenever required.

Farm Management Division

3. SUMMARY

This experiment was conducted at the West Byde of BRRI farm, Gazipur during boro'12-13 season to determine the relative profitability of different sources of N (PU and USG) and weed control methods (Herbicide Refit, Herbicide Super clean and Hand weeding) in relation to labour utilization for rice cultivation. The treatments were arranged in a Randomized Complete Block design with three replications. BRRI dhan29 was used for experimental purpose. All the parameters were significantly affected by the interaction effect of N-fertilizers and weed control methods except 1000-grain weight and straw yield. In PU applied plots, hand weeding produced the highest number tiller m^{-2} and grain $panicle^{-1}$. Super clean gave the highest number $panicle^{-1}$. Weeding method had no significant effect on grain yield. All the parameters were higher in USG applied plots than PU applied plots. USG applied plots required higher number (7%) of labor than PU applied plots. Application of super clean instead of refit gave Tk. 4010 ha^{-1} more profit but Application of super clean instead of hand weeding gave Tk. 10210 ha^{-1} more profit. However, application of refit instead of hand weeding the more profit was Tk. 6200 ha^{-1} and application of USG instead of PU the more profit was Tk. 3875 ha^{-1}.

An experiment was conducted at BRRI Gazipur farm during Boro season of 2012-13 to observe the effect of quality seed and farmers' seed for seed production and yield gap between them. BRRI dhan28, BRRI dhan29 and BRRI dhan47 were used as test varieties. The farmers' seed were collected from different locations of Cox's Bazar, Satkhira, Chittagong and Barisal. Breeder seed and truthfully labeled seed (TLS) were collected from BRRI, GRS division. It was observed that breeder seed used plot produced the highest grain yield followed by TLS and lowest in farmers' seed used plot. In case of BRRI dhan 28, the yield gap between breeder seed and farmers' seed was 1.9 tha^{-1} and between TLS and farmers' seed about 1.0 tha^{-1}. In case of BRRI dhan 29, the yield gap between breeder seed and farmers' seed was 1.8 tha^{-1} and between TLS and farmers' seed about 1.2 tha^{-1}. In case of BRRI dhan 47, the yield gap between breeder seed and farmers' seed was 1.4 tha^{-1} and between TLS and farmers' seed about 0.6 tha^{-1}

An experiment was conducted during aus'12, T.aman'12 and boro'12-13 seasons at the West Byde of the BRRI Farm, Gazipur to determine the cost and return of HYV rice cultivation in existing situation. The rice varieties BR26, BRRI dhan41 and BRRI dhan29 were tested in aus, aman and boro season, respectively. Rice cultivation in one hectare of land in aus, aman and boro season, requirement of total labor was 270, 271 and 273 md ha^{-1} respectively. The total variable cost, gross return and gross margin was highest in boro season followed by aman and lowest in aus season but the cost of production of per kg of rice was highest in aus season (Tk 23.4) followed by aman (Tk 16.9) and boro season (Tk 16.5). The BCR was 1.29, 1.71 and 1.72 in aus, aman and boro seasons, respectively

An experiment was conducted during T. aman season at the West Byde of BRRI Farm, Gazipur to find out the effect of different period of direct supervision on labor efficiency. The treatments were different period of direct supervision such as 100 %, 80%, 60%, 40 %, 20% and no direct supervision. Labor requirements for different operations such as seedling uprooting, transplanting, weeding, harvesting and post harvest operation were taken. It was observed that 100% supervision required less number of labors and the labor number increased with the decreasing of supervision period. It was highest in no supervision treatment. Therefore, to increase the labor efficiency supervision must be confirmed.

Survey and monitoring of laborers' wage rate at different locations around BRRI HQ such as Joydebpur, Chowrasta, Salna, Board Bazar, Konabari, Tongi were conducted throughout the year. The average wage rate day^{-1} varies from Tk. 335 to 350. The wage rate day^{-1}during the peak periods of the year Tk. 470 to 480 in May, Tk. 285 to 340 in July-August and Tk. 330 to 420 in December -January were existed.

The wage rate varied between Tk. 200-300, 200-300, 200-300, 250-300, 250-300, 300-400, 300-400 and 350-400 at Habiganj, Rangpur, Rajshahi, Barisal, Sonagazi, Comilla Satkhira and Khulna, repectively.

Program Area: Technology Transfer

Adaptive Research Division

Technology Validation

Advanced Line Adaptive Research Trial (ALART)

Advanced Line Adaptive Research Trial (ALART), GSR, T. Aman, 2012

Among the entries HUA 565 gave the highest grain yield in 6 locations out of 9 locations having average yield of 4.69 t/ha. Yield performance of two entries, IR83140-B-11-B and ZHONGZU 14 were also good having average yield of 4.27 t/ha. Regarding growth duration, HUA 565 was found the shortest (110 days). Based on the growth duration, grain yield, grain quality and farmers' opinion, HUA 565 may be considered for Proposed Variety Trial (PVT).

Advanced Line Adaptive Research Trial (ALART), Drought, T. Aman, 2012

In all locations, the trials escaped drought stress because of sufficient rainfall at the sensetive growth stages. Among the 5 advanced lines, IR82635-B-B-75-2 and IR83377-B-B-93-3 showed stable and slightly better yield performance (around 5.0 t/ha) in most locations than the other lines having almost similar growth durations (around 110 days). The trial should be repeated to evaluate the lines under drought stress. However under favourable rainfed condition and based on the growth duration, grain yield, grain quality and farmers' opinion, IR83377-B-B-93-3 and IR82635-B-B-75-2 may be considered for Proposed Variety Trial (PVT).

Advanced Line Adaptive Research Trial (ALART), RLR, T. Aman, 2012

Among the tested entries BR7611-31-5-3-2 gave the higher yield in most locations (average yield of 5.04 t/ha) which was similar to that (5.02 t/ha) of check variety BRRI dhan44. Another check variety, BR11 gave the lowest average yield (4.81 t/ha). Growth duration of all tested lines including checks were very similar. Based on grain yield and farmers' opinion, BR7611-31-5-3-2 may be considered for Proposed Variety Trial (PVT).

Advanced Line Adaptive Research Trial (ALART), Standard, Boro 2013

Among the tested entries, weed tolerant rice gave the highest grain yield (6.31 t/ha) which was higher than the standard check BRRI dhan28 (5.96 t/ha). Mean growth duration of all the tested entries varied from 148-150 days wherease it was 145 days for the standard check BRRI dhan28. Based on grain yield, growth duration, shorter plant type, lodging tolerance

and farmers' opinion, Weed tolerant rice and ZHONGZU 14 may be considered for Proposed Variety Trial (PVT).

Advanced Line Adaptive Research Trial (ALART), Micronutrient, Boro 2013

The tested entry BR7830-16-1-5-3 gave the highest grain yield in 5 locations out of 10 locations having average yield of 5.8 t/ha. The another entry IR83294-9-1-3-2-3-Gaz1 produced the highest yield in 3 locations having average yield of 5.6 t/ha which was statistically similar to that of standard check BRRI dhan28. Regarding growth duration, BR7830-16-1-5-3 and IR83294-9-1-3-2-3-Gaz1 matured in 149 days which was 3 days longer than the check variety BRRI dhan28. Based on the growth duration, grain yield and farmers' opinion, micronutrient dense BR7830-16-1-5-3 and IR83294-9-1-3-2-3-Gaz1 may be considered for Proposed Variety Trial (PVT).

Advanced Line Adaptive Research Trial (ALART), Salinity, Boro 2013

Overall yield performance of the tested genotypes was good in different saline areas, but there was no consistency of yield level in different locations. The tested entry IR59418-7B-21-3 gave the highest grain yield in 3 locations out of 7 locations having average highest yield of 6.39 t/ha, followed by IR78794-B-Sat 29-1 (6.19 t/ha). The 1st and 2nd highest yielder IR59418-7B-21-3 and IR78794-B-Sat 29-1 were found to be matured in 143 and 147 days respectively, which were 9 and 5 days earlier than the check variety BRRI dhan47. Based on grain yield, growth duration, salt tolerance, non-shattering character, grain quality and farmers' opinion, IR59418-7B-21-3 and IR78794-B-Sat 29-1 may be considered for Proposed Variety Trial (PVT).

Training Division

The Training Division has conducted 86 training programme in the reporting period with course duration from 1-day to 1-week depending on their nature and requirement. A total of 1,853 participants from different government and non-government organizations and farmers were trained through these courses. Need base course curriculum was developed for these courses. The highest number of participants was from the Department of Agricultural Extension (DAE) followed by farmers. The overall improvement of knowledge for extension personnel through 1-week rice production training (RPT) varied widely and ranged from 173 to 429%. The improvement results indicated a need for rice production training (RPT) of extension personnel to improve their knowledge. The updated training information from 1974 to June 2012 showed that BRRI completed 2,751 training programmes through which 76,089 participants were trained on different aspects of rice production technologies. Effectiveness of imparted trainings was determined on the basis of feedback remarks on different aspect. Most of the trainees gave positive views about the course content and method of training. However, participants of all courses, specially the 1-week course, suggested for increasing duration of the course from 1-week to at least 2-3 weeks. Most of the BRRI's speakers' performance was very good to excellent. Training Division also conducted seven training prgramme and two workshops on development and utilization of Bangladesh Rice Knowledge Bank (BRKB).

Regional Station

BRRI RS, Barisal

A total of 397 progenies and 22 fixed lines were selected from F_4 and F_5 generations from the pedigree nursery (F_4 – F_6 generation) with emphasis on height, tolerance to tidal

submergence, earliness, plant type, grain type and high yield potential. From long-term missing element trial, it may be concluded that BRRI RS, Barisal farm needed complete (NPKSZn) fertilization to obtain maximum yield. Omission of any one nutrient element from complete treatment decrease yield and the extend of yield decrease depends on each nutrient missing. IRBB60, IRBB65 and IRBB66 performed best against BB pathogen in Barisal regions. About 4-5 number of irrigation could be saved by using AWD technology, which was also increased water productivity in Barisal regions.

BRRI RS, Comilla

Fifteen crosses and eighteen crosses were made in T. Aman season and in Boro season respectively. A total of 8 crosses in T. Aman and 9 crosses in Boro seasons were confirmed.526 and 466 plant progenies were selected from F2 generations in T. Aman and Boro seasons, respectively. In T. Aman, 278 and 102 plant progenies were selected from F3 and F5 generations respectively. In Boro, 128 and 109 plant progenies were selected from F3 and F4 respectively. 12 homozygous lines were bulked in T.Aman from F5 & F6 generation respectively and 31 homozygous lines were bulked in Boro season from F5 & F6 generation respectively. In OT eighteen genotypes were selected for T. Aman season and twenty genotypes were selected for Boro season. For T. Aman, in PYT#1 (RLR) genotype BR7966-33-1-1 (Com) and BR747216-2-1-2-2 (Com) were selected for higher yield and earliness. Considering the yield performance and earliness it could be better for evaluating these two genotypes in SYT during next T. Aman season. For Boro, in PYT#2 (Comilla), genotype BR7372-18-3-3-HR1 (Com) wasselected for its higher yield and earliness as compared with BRRI dhan50. In PYT#3 (Comilla), genotype BR7781-10-2-3-2 –HR2 (Com) was selected for its high yield potentiality (6.7 t/ha) as compared with standard check BRRI dhan28. For T. Aman, in RYT#1, two genotypes BR7472-16-2-1-2-3 and BR7622-5-1-1-1 were selected for their high yield potentiality and earliness as compared with check variety BRRI dhan39. In RYT#2, none of the varieties yielded better than check variety BRRI dhan49 although it was susceptible to false smut disease. In RYT#4, four genotypes IR82635-B-B-75-2, IR82589-B-B-145-1, IR82635-B-B84-3 and IR83383-B-B-129-4 were selected for better yield performance. In RYT#5, genotype BI dhan3 was selected for earliness (4-5 weeks earliness as compared with all standard checks). In RYT#6 (Disease), genotype BRC245-419-2-1 performed similar yield potential to standard check BR11 (Sus.) with less disease. On the other hand, genotype BRC250-1-3-1-1 gave 0.5 t/ha higher yield than BRRI dhan49 but it showed bacterial leaf blight (BLB) infestation (disease score 3). For Boro, in RYT#1 genotype BR7372-30-1-1-1 was selected for its higher yield potentiality and earliness as compared with standard checks. In RYT#3, three genotypes PSBRC82, IR83140-B-32-B-B and IR83142-B-71-B-B were selected for better yield and similar growth duration as compared with standard check BRRI dhan28. In RYT#4, all genotypes obtained 0.7-1.5 t/ha yield advantage but showed 5-9 days longer growth duration as compared with standard check BRRI dhan28. So, considering the yield potentiality all genotypes were selected. In Boro season, from AYT-Comilla, genotype BR7358-56-2-2-1-HR7 (Com) was selected for higher yield (7.6 t/ha) and earliness than BRRI dhan50 (7.0). On the other hand, although genotype BR7372-18-2-1-HR1-HR6 (Com) showed almost similar yield potential of BRRI dhan50 with one week earliness. Importantly, this above genotype was selected for extra-long slender grain and long panicle. In addition, genotype, BRRIdhan29-SC3-28-16-10-8-HR1 (Com) was selected for similar yield potential and growth duration of BRRI dhan28 and for lodging tolerance which is lack in BRRI dhan28. For Boro season, from multi location trail for high zinc rice, considering the yield potential. and growth duration genotypes BR7840-54-3-1, BR7840-54-1-25and

BR7840-54-2-5-1 were selected. In PVT-PQR-T.Aman, genotype BR7465-1-4-1 was recommended by field evaluation team of NSB for its higher yield and earliness than check variety BRRI dhan37. On the other hand, proposed genotype BR7875-*5(NIL)-52-HR1 was rejected because it showed highly susceptible to false smut disease. In PVT (RLR-T.Aman), proposed genotype BR7465-1-2-4 and check variety BRRI dhan32 were completely damaged by rat. In PVT-PQR-Boro proposed genotype BR7358-30-3-1 was recommended by field evaluation team of NSB for giving 0.5 t/ha high yield and 7 days earliness than standard check BRRI dhan50. On the other hand, although proposed genotype BR7358-5-3-2-1 rejected for giving 0.4 t/ha lower yield than BRRI dhan50 although it showed 14 days earliness than BRRI dhan50. In PVT-High Zinc-Boro, proposed genotype BR7840-54-1-25 gave lower yieldthan standard check BRRI dhan55 and similar yield to standard check BRRI dhan28. Its growth duration was almost similar to BRRI dhan55 and 3 days longer than BRRI dhan28. On the other hand, proposed genotype BR7840-54-3-1 obtained almost 1.0 t/ha lower yield than the standard check BRRI dhan55 and0.4 t/ha lower yield than the standard check BRRI dhan28. It showed similar growth duration as compared with BRRI dhan55 and 4 days longer than BRRI dhan28. Field evaluation team of NSB has sent the result to SCA (HQ) for further process. In Boro, from PYT- Somaclone (Comilla), genotypes BRRI dhan29-SC3-28-1610-6-HR6, BRRI dhan29-SC3-28-16-10-4-HR3, BRRI dhan29-SC3-28-16-10-8, BRRI dhan29-SC3-28-16-10-2-HR3-HR6, BRRI dhan29-SC3-28-16-10-2-HR3HR9 and BRRI dhan29-SC3-28-16-10-2-HR6-HR9 were selected for giving high yield potential ranges from 7.2-7.6 t/ha and 10-14 days earliness as comparedwith standard check BRRI dhan28 (7.1 t/ha and 144 days). On the other hand genotypes BRRI dhan29-SC3-28-16-10-6-HR10 was also selected for showing similar yield potentiality (7.1 t/ha) and similar growth duration (142 days) as compared with standard check BRRI dhan28 (7.1 t/ha and 144 days). Since amylose content of these above selected genotypes is low (17-22%), these material could be evaluated under the project of “Breeding for low amylose content” in BRRI, Gazipur. In T. Aman, 7000 kg BRRI dhan49, 1152 kg BRRI dhan52, 300 kg BRRI dhan56 and 1012 kg BRRI dhan57 breeder seeds were produced. In Boro, 14245 kg BRRIdhan28, 2716 kg BRRI dhan50 and 3124 kg BRRI dhan58 breeder seeds were produced.

BRRI RS, Habiganj

Varietal Development: In B. Aman season, forty seven desirable homozygous plants of DWR were selected. In RYT, all the tested entries yielded higher than check Hbj. Aman IV. In Boro season, 42 plants from 11 F7 populations, 34 F7 plants from 7 F7populations and 13 F6 plants from 5 F5 populations were selected with desirable characters for the development of varieties suitable for Haor Areas. Two tested entries, yielded higher than BRRI dhan28 (6.7 tha-1) with longer growth duration in PYT. In SYT, PR26703-3B-PJ25 yielded (7.5 tha-1) higher than both the check varieties BR14 and BRRI dhan28. In AYT one of the tested entry, BR7742-79-24L22

(6.7 tha-1) yielded higher and 5 days earlier than BR19 (6.3 tha-1). In RYT#1, twotested entries, BR7358-36-2-2-1 (5.8 tha-1) and BR7358-19-3-1-1 (5.9 tha-1) yielded higher than BRRI dhan28 (5.2 tha-1) with similar growth duration. In RYT#2 none of the entries yielded over BRRI dhan29 (7.2 tha-1) and BRRI dhan55 (7.0 tha-1). In RYT#3 and RYT#4 all the tested lines out yielded BRRI dhan28 (5.6 tha-1) with longer growth duration. In RYT#5 All the tested lines showed higher yield than local check T27A (3.6 tha-1) and IR71604-4-1-4-7-10-2-1-3 (5.5 tha-1) and BR7803-16-10(5.6 tha-1) yielded closed to BRRI dhan28 (5.7 tha-1) with 3-4 days longer growth duration. In an observational trial six entries viz. NERICA L-1 (6.6 tha-1), NERICA L- (6.3 tha-1), NERICA L-33 (7.2 tha-1), NERICA L-34 (6.9 tha-1),

NERICA L-36 (7.4 tha-1) and NERICA L-32 (7.6 tha-1) yielded higher than BRRI dhan28 (6.2 tha-1) with almost similar growth duration.

Crop-Soil-Water Management: Balanced fertilization with complete treatment significantly increased the grain yield of rice. The highest rice yield (8.33 tha-1) was obtained with complet fertilizer dose of NPKS and lowest rice yield (5.37 tha-1) was obtained with all missing treatment.

Rice Farming System: The recommended patterns (BRRI dhan46-BRRI dhan29-Fallow) gave 14% higher grain yield and gross margin over existing farmers' patterns (BR22-BRRI dhan28Fallow).The recommended cropping pattern gave the yield of 11.65 t/ha and gross margin of Tk. 2,21,350/ha. In Boro season, normal transplanting gave significantly higher grain yield than the DT and delay planting. The highest grain yield was obtained from normal planting (T1=8.47 t/ha and T2=8.38 t/ha) and lowest grain yield was observed from delayed transplanting of 75days old seedlings (5.69 t/ha). DT gave significantly higher grain yield (7.06 t/ha) than the delay planting. In double transplanted crop the growth duration was one week shorter than delay planting and three days longer than normal transplanting

BRRI RS, Kushtia

Regional Yield Trial (RYT): To evaluate specific and general adaptability of the genotypes in on-station. Here there are four regional yield trials. In first regional yield trial there are seven genotypes and two checks variety, second regional yield trial there are five genotypes and three checks variety, third regional yield trial there are five genotypes and one check variety and forth regional yield trial there are five genotypes and three checks variety. First regional yield trial based on the yield performance genotype BR7372-30-1-1-1 may be selected for further trial. Second regional yield trial based on the yield performance genotypes BR7671-37-2-2-3-7, BR7840-54-3-2, BR7840-54-3-3 and BR8427-2-3-2 may be selected for further trial. Third regional yield trial based on the yield performance IR83141-B-18-B-B and IR83142-B-71-B-B may be selected for further trial. Forth regional yield trial based on the yield performance genotypes IR83140-B-11-B, SAGC-06, ZHONGZU14, Weed tolerant rice, HUA565 may be selected for further trial. BRRI dhan40 and BRRI dhan46 in Aman season, BRRI dhan58 in Boro season performed better under stability program at BRRI Barisal. From long-term missing element trial, complete fertilization (NPKSZn) is the demand at BRRI Barisal farm to achieve the maximum yield. Omission of any one nutrient element from complete treatment decrease the yield level and the extend of yield decrease depends on each nutrient missing. Under minimizing rice yield gap project, BRRI dhan44 performed better in three demonstrated upazilas of Barisal district. In Boro season, BRRI dhan47 is a popular variety in Barisal District for bold grain and high yield. The average yield gap was higher in T. Aman season (14.8%) than Boro season (10.67%). Framers' field days and training programs create awareness for adopting the BRRI rice production technologies and to accelerate the dissemination rate of BRRI varieties. And confidently increase the farmers' income as well as improve the livelihood through practicing the farming systems approach. According to the validation trial conducted in Barisal region, BRRI dhan52 gave higher yield in Patuakhali district in Aman season where BRRI dhan55 gave maximum yield in Barguna and Jhalokathi district. Inclusion of Mustard or Mung bean in single T.Aman pattern increased the yield level at more than 160%. About 20% yield advantage was found through including HYV in T.Aman season in Boro-T.Aman cropping pattern. And HYV Boro rice increased 30% of rice grain yield in Boro- (local)-T.Aman (local) cropping pattern. Boro (HYV) followed by Fish cultivation increased 465% REY over single Boro pattern. The stakeholders improved their vegetable production system as well as increased home consumption. They are also capable to spend the money getting from

vegetable selling to full-fill their daily necessity, family needs and finally improve their livelihood. Awareness is grown-up to the participatory farmers' for tree plantation. Successful mass vaccination and de-warming programs reduced the mortality rate of poultry birds and pet animals as well as ensured their healthy growth. Small scale of poultry and pigeon rearing, fish cultivation in seasonal and perennial ponds increased the household income and improved in house protein consumption.

BRRI RS, Rangpur

Sixteen varieties/lines were used in the hybridization block at three dates with an interval of 7 days to synchronize flowering for cross combinations to develop of standard Boro varieties for Northern region. . Eight crosses were made and mature F1 seeds were harvested and stored. A total of 38 entries were grown along with two standard checks in two PYT. Six and seven genotypes were selected from PYT#01 and PYT#02. In PYT#1, only BR784116-2-6-2-1 showed higher yield than BRRI dhan29 with similar growth duration. In PYT#2, all selected genotypes showed higher yield than BRRI dhan28 but only BR86251-3-5 than BRRI dha29. All selected genotypes can also be considered for further evaluation. Five advanced genotypes were evaluated against two checks in RYT#1. BR747216-2-1-2-3 performed better with the 0.69 and 0.46 t/ha yields advantages over the BRRI dhan31 and BRRIdhan39, respectively. In RYT#2, four advanced genotypes were evaluated against three checks BR11, BRRI dhan31 and BRRI dhan49. None of the tested advanced breeding genotypes performed better than the check varieties. Three advanced genotypes were evaluated against two checks BR11 and BRRI dhan44 in RYT#3. All the tested materials showed better performance over the check variety BRRI dhan44 but only BR7611-9-3-2-1 genotype showed higher yield (0.56 t/ha) than the BR11. Seven advanced genotypes were evaluated against the check variety BRRI dhan56 in RYT#4. All the tested materials showed better performance over the check variety BRRI dhan56. IR83377-B-B-93-3 and IR82635-B-B-75-2 showed 1.18t/ha and 1.06 t/ha yield advantage over the check variety respectively. Six advanced genotypes were evaluated against the check varieties BRRI dhan34, BRRI dhan37 and BRRI dhan38. None of the tested materials performed better than the check varieties in RYT#5. Three advanced genotypes were evaluated against the check variety BRRI dhan44 in RYT#6. ZHONGZU 14 performed better than the check variety BRRI dhan44 and showed 0.54 t/ha yield advantage with 19days less growth duration. Seven advanced genotypes were evaluated against the check variety BRRI dhan44. None of the tested materials performed better than the check varieties in RYT#7. Three advanced genotypes were evaluated against the check variety BRRI dhan44 in RYT#8. BRC245-4-19-2-1 performed better than the check varieties. 1.23t/ha and 1.17 t/ha yield advantage over BR11 and BRRI dhan49 respectively. In RYT#9 six advanced genotypes were evaluated against the check varieties BR11, BRRI dhan33, BRRI dhan39 and BRRI dhan49. AL-103 performed better than the check variety BRRI dhan33 and 0.68t/ha yields advantage with similar growth duration. Seven advanced genotypes were evaluated against the check varieties BRRI dhan28 and BRRI dhan50 to develop of premium quality of Boro rice in RYT#1. BR7358-35-2-1-1 and BR7358-35-3-2-1 performed better than the both check variety and 0.68t/ha yield advantage with similar growth duration. To develop of micronutrient enriched rice in Boro season four advanced genotypes were evaluated against the check varieties BRRI dhan28, BRRI dhan55 and BRRI dhan29 in RYT#2. BR7671-37-2-2-3-7 performed better than the check varieties and 1.81t/ha yields advantage over BRRI dhan29 with less 06 days growth duration. BR8427-2-3-2 showed higher yield than BRRI dhan28 but it segregated. Four advanced genotypes were evaluated against the check varieties PSBRC82 and BRRI dhan28 in RYT#3. IR83142-B-71-B-B gave higher yield than the check varieties and 0.93t/ha yield advantage over the popular variety BRRI dhan28. Four advanced genotypes were evaluated against the popular check

variety BRRI dhan28. All the tested genotypes were exceeded the yield than the popular mega variety BRRI dhan28. Among the tested genotypes Weed Tolerant Rice was performed best over the check variety along with 1.08t/ha yield advantage. Weed tolerant line may be advanced for further evaluation.Three advanced genotypes were evaluated against the popular check variety BRRI dhan28. IR71604-4-1-4-7-10-2-1-3 performed better than the standard check variety BRRI dhan28 and alongside obtained 0.67t/ha yield advantage. A total of 52 PS from F3 generation, 77 PS from F4 generation, 3 PS and 7 bulks from F5 generation, 8 PS from F6 generation, 8 PS and 2 bulks from F7 generation, 4bulks from F8 generation, 24 bulks from BC2F7 generation, 17 PS and 6 bulks from BC1F8 generation were selected from screening of pedigree generation for submergence and medium stagnant water tolerant progenies. Twenty genotypes of IRRI origin were selected from observational trials along with one check variety were evaluated in this study to identify entries tolerant to stagnant flooding in PYT. A total of 13 genotypes were selected among 21 genotypes based on yield and growth duration. Yield under stagnant condition were ranged from 2.27 t/ha to 3.61 t/ha and growth duration were ranged from 121 days to 158 days. The genotype IR 09F177 gave the highest yield (4.02 t/ha). Six submergence and medium stagnant water tolerant high yielding genotypes along with two standard check varieties were evaluated in PVS trial under rainfed and controlled submergence conditions. No entry out yielded the check varieties. PVS function were arranged on-farm PVS Mother trial of Sub1 entries at Gangachara, Alambiditor, Gangachara, Rangpur for preference analysis during Aman 2012. No entry out yielded the two check varieties BRRI dhan51 and BRRI dhan52. Across these three on-farm mother trials, the yield of the entries ranged from 2.17 t/ha to 5.26t/ha with growth duration from 138-152 days.

BRRI RS, Satkhira

dhan28 and BRRI dhan50. In the trial of RYT-2, BR7671-37-2-2-3-7 entry yielded the highest (6.64 t ha-1) among the tested entries. On the contrary, BR7840-54-3-2 entry gave the lowest yield (4.83 t ha-1). In case of RYT-3, IR80416-B-32-3 entry performed the highest yield (7.92 t ha1) though BRRI dhan28 yielded 8.37 t ha-1. In PVS trial the highest vote from the farmers was went for BRRI dhan53 followed by IR78761-B-SATB1-28-3-26 because of their yield performance and better appearance. • Additional Director (DAE, Jessore region) leading committee selected BR735830-3-1 genotypes for proposed variety, which yielded (6.47 t ha-1) higher than others and also have premium quality. Omission of N from complete treatment (NPKSZn) gave significantly lower yield. So for obtaining desired yield, balance fertilization of NPKSZn is necessary. • Among the tested five genotypes including standard check BRRI dhan28 and BRRI dhan55, BR7840-54-1-2-5 entry yielded (6.4 t ha-1) higher than other genotypes. Among the tested varieties for stability analysis the highest yield was obtained from BR3 and most of the varieties yielded more than 6 t ha-1 at BRRI R/S Satkhira A total of 16.10 tons breeder seed was produced. BRRI dhan28 was 12.50 tons in Boro 2013 and 2.60 tons breeder seed of BRRI dhan34 and BRRI dhan 49 produced in T. Aman 2012 at BRRI Regional station, Satkhira. A total of 16.10 tons breeder seed was produced. BRRI dhan28 was 12.50 tons in Boro 2013 and 2.60 tons breeder seed of BRRI dhan34 and BRRI dhan 49 produced in T. Aman 2012 at BRRI Regional station, Satkhira.

BRRI RS, Sonagazi

Bangladesh Rice Research Institute, Regional Station, Sonagazi is located at the southeastern part of Bangladesh and about 26.5 km south from Feni district head quarters. It is situated about 16 km away from the coast of the Bay of Bengal. In this coastal charland areas mainly

Aus and T. Aman rice have been growing as rainfed, facing crop vulnerability to occasional tides and natural calamities like 'Sidr', 'Aila', 'Resmi', Mohasen etc. Sometimes the effect of tides or natural calamities damaged rice crops. In last Aus season (2013), the BRRI-Sonagazi farm was affected by the Mohasen" and submerged for several days by tidal saline water (about 20.0 dS/m) and as a result, most of the crops (30-50%) were damaged. Besides these, this charland area also considered as the harbor of many insect pest (specially stem borer) and the resultant effect farmers getting poor yield. The entomologist can play their knowledge to dig out good information regarding rice insect management aspect for greater interest of rice cultivating farmers.

BRRI RS, Bhanga

Varietal development A total of 720 progeny lines were bulked based on uniformity of flowering and maturity and 993 individual plant progenies were selected for further evaluation from multiple-cross populations. Fifty six plants were selected from 8 RGA derived F4 populations; 141progeny lines were bulked 742 individual plant progenies were selected for further evaluation from introduced high zinc populations. Seventeen advanced breeding lines were selected from Observational mtrial. Out of 2500 selected Germplasm, 651 were found fairly higher (>30mg/kg) amount of Zn in the grain(Table 1.3). But the variation in iron content not was not so high. Out of nine promising high Zn breeding lines, BR7830-16-1-5-3 gave the highest grain yield (8.12t/ha) but 5 days earlier than BRRI dhan29. BR7840-54-3-1 had intermediate growth duration with higher Zn content in the grain. Another set of eight promising breeding lines were tested under AWD condition. All the entries under consideration gave lower grain yield and longer growth duration than BRRI dhan28 but PSBRC 82 gave similar phenotypic acceptance score in reproductive stage. Eleven exotic rice entries were evaluated out of that PR-113 gave the highest grain yield (6.82 t/ha) than BRRI dhan29 (6.81 t/ha) with similar growth duration (149-150 days) and BRRI dhan28 gave 6.70 t/ha. The International Network for Genetic Evaluation of Rice (INGER) gave 80 germplasm with four check of INGER out of that PANT DHAN19 gave the highest grain yield (9.64 t/ha) followed by UPR 3199-464-1-2 (9.59 t/ha), MTU-1119 (9.57 t/ha) and BRRI dhan29 (9.54 t/ha) with 157-160 days to maturity. Twenty-four Boro varieties were evaluated at BRRI, Bhanga farm to determine the stability index. BR15 and IR64 gave the highest grain yield (7.90 t/ha) followed by BR14 (7.78 t/ha) and BRRI dhan47 (7.29 t/ha).