BRRI ANNUAL REPORT

For July 2014-June 2015

Bangladesh Rice Research Institute (BRRI)
Gazipur 1701, Bangladesh

Preface

The present volume of BRRI Annual Report is a summary of research works carried out by 19 research divisions and nine regional stations of the institute during July 2014 to June 2015. This document consists of the significant portions of the research covering seven programme areas.

The programme areas, such as crop-soil-water management, rice farming systems, pest management, socio-economics and policy, technology transfer and farm mechanization, represent the broader conceptual frameworks of BRRI activities.

With a target to make Bangladesh a rice surplus country BRRI scientists have been engaged in developing different location specific, climate smart, stress tolerant rice varieties and some premium quality ones that can compete in the international market.

They dedicated their time and energy to develop and disseminate cost and resource-saving profitable technologies along with some management tools such as urea super granule (USG) applicator, rice transplanter, integrated crop management (ICM) practices, alternate wetting and drying (AWD) techniques, rice based farming systems and popularization of BRRI machinery.

Furthermore, BRRI developed high yielding rice varieties along with relevant crop management technologies were demonstrated in different agro-ecological zones of the country.

Above all, the present report includes various research results out of activities that attempted to minimize yield gap between research level and farmer's fields.

We acknowledge all the efforts that helped bring out the publication and special thanks for those who contributed with different capacities.

We expect that the report will be useful for the scientists, extension agents, related policy makers and other partners to be updated on rice research at BRRI.

(Dr Jiban Krishna Biswas)
Director General
BRRI

Research Personnel of the Plant Breeding Division, July 2014-June 2015

**Helal Uddin Ahmed, *PhD*
Chief Scientific Officer and Head
Tamal Lata Aditya, *PhD*
Chief Scientific Officer and Head
Khandakar Md. Iftekharuddaula, *PhD*
Principal Scientific Officer
Partha Sarathi Biswas, *PhD*
Principal Scientific Officer
Mohammad Akhlasur Rahman, *PhD*
Principal Scientific Officer
Mohammad Amir Hossain, *PhD*
Principal Scientific Officer
Mahmuda Khatun, *PhD*
Principal Scientific Officer
Md. Abdul Kader, *PhD*
Senior Scientific Officer
Md. Ruhul Amin Sarker, *PhD*
Senior Scientific Officer
*Sharmistha Ghosal, *MS*
Scientific Officer
*Md. Rafiqul Islam, MS
Scientific Officer
*Nirmal Sharma, *MS*
Scientific Officer
Ratna Rani Majumder, *MS*
Scientific Officer
Md. Anisuzzaman, *MS*
Scientific Officer
Hasina Khatun, *MS*
Scientific Officer
Tapas Kumer Hore, *MS*
Scientific Officer

*Deputation for PhD in abroad

** Transferred to BRRI, R/S, Comilla

SUMMARY

For developing improved rice varieties under different ecosystems, several crosses were made and a number of progenies and fixed lines were selected from F_2 to F_7 populations. A total of 487 crosses were made and 291 crosses were confirmed as true F_1. From segregating generations 26414 progenies were selected and 833 fixed lines were isolated. Five hundred and four entries from observational trial and 352 advanced lines were selected from yield trials. A total of 76 germplasm from different screening nurseries were selected for using in the breeding programme.

Three promising genotypes viz. BR7357-11-2-4-1-1 for exporting quality rice, IR82589-B-B-84-3 for drought tolerant rice and BR7528-2R-19-HR10 for high zinc rice during T. Aman, 2014-15 were evaluated by NSB team and have been recommended as variety. BR7357-11-2-4-1-1 (BRRI dhan70) showed 4.8-5.0 t/ha grain yield with 10 days earlier than BRRI dhan37. IR82589-B-B-84-3 (BRRI dhan71) having 5.05 t/ha grain yield with 111 days growth duration. BR7528-2R-19-HR10 (BRRI dhan72) showed 0.9 t/ha higher yield but matured one week later than BRRI dhan39. Two genotypes IR78767-B-SATB1-28-3-24 and IR78767-B-SATB1-28-3-26 were also evaluated by National Seed Board and IR78767-B-SATB1-28-3-24 released as salt tolerant variety BRRI dhan73 for T. Aman season. It can tolerate 8 dS/m water salinity in its whole life cycle. In Boro 2014-15, BR7671-37-2-2-3-7 produced 1.2 t/ha higher yield and 3-5 days earlier than BRRI dhan64. This line was recommended as BRRI dhan74 by the National Technical Committee of the NSB at its 81th meeting. The selected line IR83142-B-71-B-B performed in Proposed Variety Trial (PVT) and produced 0.7 t/ha higher grain yield with growth duration similar to BRRI dhan28 during Boro 2014-15.

Development of Upland Rice (Aus): Major thrust was given to develop varieties in combination of multiple traits viz: quick seedling emergence and vigorous growth, short growth duration (90-95 days), tolerance to lodging, drought and pre-harvest sprouting; medium bold to medium slender grains and good eating quality. In total, 20 crosses were made using 18 parents, 18 crosses were confirmed as true hybrid; 495 progenies and 43 fixed lines were selected from pedigree nurseries. Thirteen entries were selected from OT. Six advanced lines were selected from SYT. Three lines viz., BR6855-3B-12, BR6855-3B-13 and BR6848-3B-12 were selected from RYT for further evaluation. The proposed line, OM1490 with average growth duration of 99 days was selected and released as BRRI dhan65.

Development of Transplanted Aus Rice: The project was aimed at developing the genotypes having short duration (105-115 days), high yield potential, acceptable grain quality and tolerance to lodging, heat (high temperature) at reproductive phase and pre-harvest sprouting. In total, 16 crosses were made using 21 parents and 264 F_1 seeds were obtained, seven crosses were confirmed as true hybrid; 262 progenies and 88 fixed lines were selected from pedigree nurseries. Eleven genotypes from observational trial were selected on the basis of homogeneity with respect to plant height, phenotypic acceptability at vegetative and maturity stages. From PYT, two entries were selected for further evaluation based on phenotypic acceptability, grain yield and growth duration. One entry was selected from RYT-1 conducted over seven locations, while three

entries were selected from RYT-Somaclone showing better performance than check variety BRRI dhan48 with respect to grain yield with similar growth duration. From Advanced yield trial one promising line was selected from two genotypes.

Improvement of Rice varieties for Shallow Flooded Environment: The major objectives were to develop improved genotypes with slow elongation for shallow flooding condition (1.0 m flood depth). Fourteen crosses were made involving eight parents and 674 F_1 seeds were obtained. Nine crosses were confirmed as true hybrid. Totally 23 segregating populations were bulked. From PYT#1, two genotypes were promoted to SYT while from PYT#2, 3 genotypes were selected and promoted to SYT. Totally 10.3 kg seeds of local cultivars were increased and genetic purity was maintained.

Development of Rainfed Lowland Rice (RLR): Efforts were made for the development of genotypes superior to standard varieties and adaptable to rainfed lowland environment in T. Aman season. In the reporting year, 22 crosses were made, 16 crosses were confirmed and 259 plants were selected from two F_2 populations. From pedigree nursery 776 segregating progenies and 108 fixed lines were isolated. From OT, 88 genotypes were selected, 30 genotypes were selected from PYT, 07 genotypes were selected from SYT, 2 advanced lines were selected for retrial and 4 lines were selected from RYT and 1 advanced line was selected from ALART.

Development of Tidal Submergence Tolerant Rice (T. Aman): The project was aimed to develop high yielding varieties adaptable to tidal non-saline condition in the southern districts. In total, 10 crosses were made using 16 parents, 10 crosses were confirmed as true hybrid. Totally 388 progenies were selected from F_4 and F_5 generations. Forty one genotypes along with 58 plants were selected from 208 genotypes evaluated in observational trial. Thirteen lines were selected from 36 genotypes from two PYTs. Four promising lines were selected from RYT based on higher grain and acceptable growth duration compared to the check varieties.

Development of Salt Tolerant Rice: This program emphasized on the development of salt tolerant rice variety suitable for the saline prone areas of coastal districts in Aus, Aman and Boro seasons. Twenty-six and fifty eight crosses were made for Aman and Boro season, respectively. A total of 19 F_1's for Aman and 25 F_1's for Boro season were confirmed and selected. Twenty-five F_2 populations were grown and 358 progenies were selected and crosswise bulked, 1292 progenies and 34 fixed lines were selected from pedigree nurseries (F_3-F_6) in T. Aman season. Bulk progenies were selected from 25 F_2 populations, 798 progenies and 63 fixed lines were selected from pedigree nurseries (F_3-F_6) of Boro season. Nineteen advanced lines were selected from observational trial (OT), 7 entries were selected from PYTs. Four (IR77674-3B-8-2-2-14-2-AJY2, IR77674-3B-8-2-2-12-5-5-1, IR83484-3-B-7-1-1-1 and BR8131-24-1) genotypes were selected from SYTs. In three Participatory Variety Selection (PVS) trials, three genotypes (IR98066-102-B, BRRI dhan28-Saltol and IR86385-117-1-1-B) as well as BRRI dhan58 and BRRI dhan61 were selected by the farmers through PVS which showed consistency with the yield performances. The genotype BR7100-R-6-6 was released as salt tolerant variety, BRRI dhan67 for salt tolerant variety in Boro season.

IR78767-B-SATB1-28-3-24 and IR78767-B-SATB1-28-3-26 were evaluated (Table 1 & 2) by National Seed Board and IR78767-B-SATB1-28-3-24 was released as salt tolerant variety, BRRI dhan73 for T. Aman season. It can tolerate 8 dS/m water salinity in its whole life cycle (Fig. 1, 2 & 3). Five entries from INGER (IRSSTN) and eight entries from Salt Tolerant Breeding Nursery (STBN) were selected for future evaluation.

Table 1: Yield and agronomic performance of the proposed lines in the Proposed Variety Trial (PVT), T. Aman, 2014-15

Genotype	PH (cm)	GD (days)	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	Mean
IR78761-B-SATB1-28-3-24 (BRRI dhan73)	117	120	5.3	4.8	4.1	5.3	2.1	5.3	2.7	4.2	6.1	4.5	5.2	4.5
BRRI dhan53 (Ck)	109	123	4.6	4.3	3.6	4.7	1.8	4.5	2.4	3.7	5.4	3.7	4.5	3.9

L1=Satkhira Sadar, L2=Debhata, L3= Shymnagar, L4= Tala, L5=Assasuni, L6= Batiaghata, L7= Dumuria, L8= Sharankhola, L9= Kolapara, L10= Cox's Bazar Sadar (1), L11= Cox's Bazar Sadar (2)

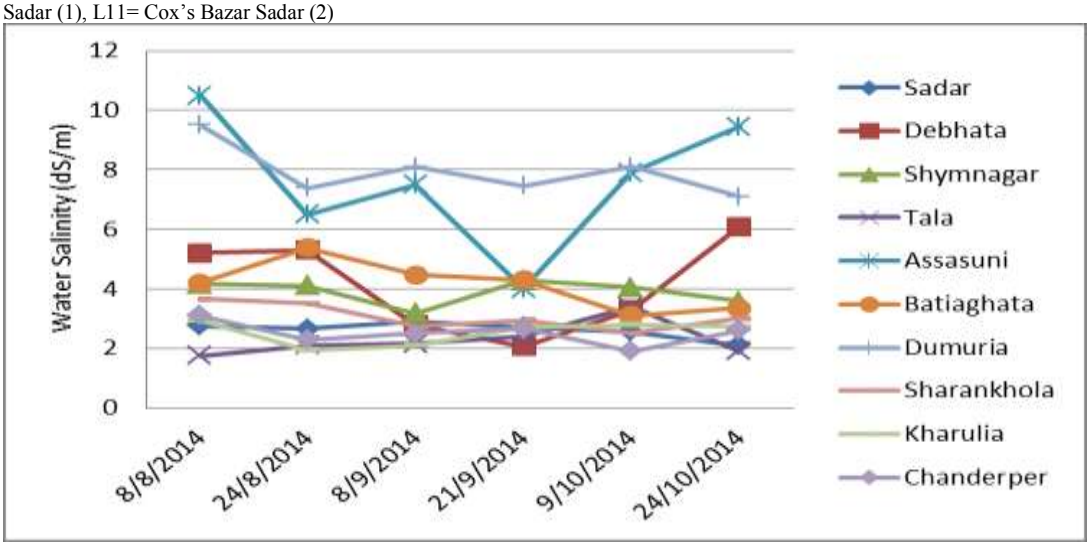


Fig 1: Water salinity (EC dS/m) levels of different experimental plots (PVT), T. Aman 2014-15

Table 2: Salt stress tolerance score (SES) and survivability (%) of proposed variety at EC of 12 dS/m at seedling stage, T. Aman, 2014-15

Proposed line with std. checks	Tolerance score (SES)	Survivability (%)
IR78761-B-SATB1-28-3-24 (Proposed)	6	66
BRRI dhan53 (Ck)	6	60
IRRI 154 (Sensitive Ck)	8	32

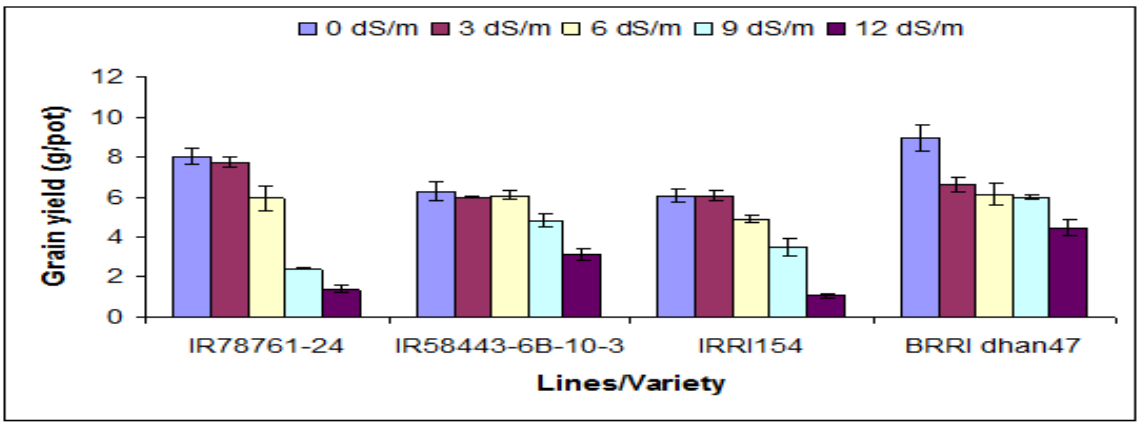


Fig 2: Yield (g/pot) of different rice genotypes as affected by different salinity levels under net house condition, BRRI, T. Aman 2014-15

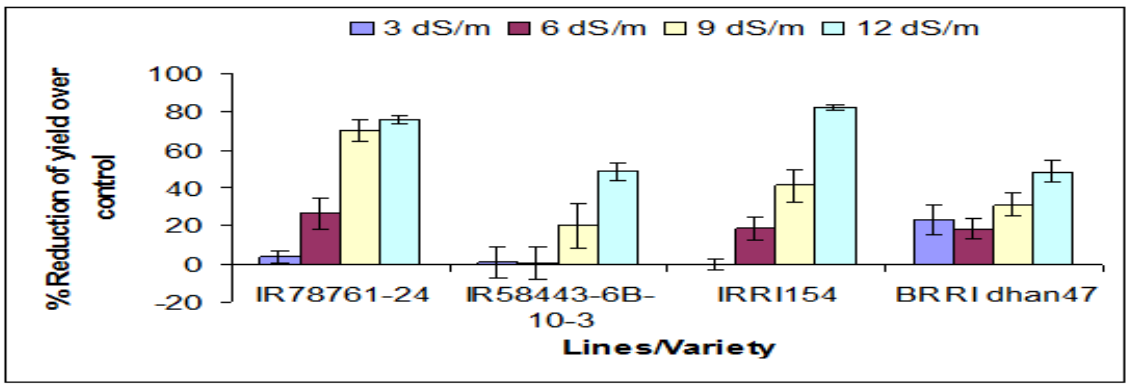


Fig 3: Reduction of yield over control (%) among the tested genotypes at saline condition. Error bar represents ±SE.

Development of Premium Quality Rice (PQR): Efforts were made to develop aromatic and non-aromatic fine quality rice with national (Kalizira/Chinigura type) and international (Basmati/Banglamati type) standards for domestic use and export. Experiments were conducted in T. Aman and Boro season. In T. Aman, total 22 crosses were made, 14 crosses were confirmed and 407 plants were selected from 7 F_2 populations. None of the materials was promoted to ALART from RYT. BR7357-11-2-4-1-1 performed well in PVT having 4.8-5.0 t/ha grain yield with 14 days earlier growth duration than BRRI dhan37 and National Seed Board has already released BR7357-11-2-4-1-1 as BRRI dhan70 for T. Aman season (Table 3).

In Boro, a total of 41 crosses were made, 18 crosses were confirmed and 2098 plants were selected from 19 F_2 populations. From pedigree nursery 2347 segregating progenies and 40 fixed lines were isolated. Fifteen genotypes were selected from OT, 10 genotypes were selected from PYT, none of the materials were selected from SYT and 3 genotypes were selected from RYT for promoting in ALART. None of the materials was found suitable for promoting to PVT from ALART except NERICA Mutant.

Table 3: Performance of the proposed variety for premium quality rice, T. Aman 2014-15

Designation	Plant height (cm)*	Growth duration (days)*	Grain yield (t/ha)*	Grain characteristics					
				Head rice yield (%)	L-B Ratio	Size and shape	Elongation Ratio	Protein (%)	Amylose (%)
BR7357-11-2-4-1-1 (BRRI dhan70)**	125	130	4.77	61.9	4.4	ELS	1.5	9.5	21.7
BRRI dhan37(Ck.)	125	144	3.39	64.9	3.2	MS	1.2	10.3	23.8

*Mean of 10 locations (Rajshahi, Rangpur, Kustia, Barisal, Feni, Comilla, Habiganj, Satkhira, Mymensingh and Gazipur)
**This proposed variety has already been released by NSB as BRRI dhan70 on 12 July, 2015.

Development of Rice Varieties for Favorable Boro Environment: The major objective of the project was to develop improved genotypes with high yield potential (≥8.0 t/ha), earliness (130-135 days) and acceptable grain quality for favorable irrigated ecosystem in Bangladesh. Sixteen crosses were made. Fourteen crosses were confirmed as true F_1. In total, 1736 superior individual plants were selected from F_2 populations based on phenotypic performance of each cross. From Pedigree nurseries, 1475 individual progenies were selected from 38 crosses of F_3- F_7 populations. Four out of 72 genotypes were selected from OT based on growth duration, yield, and homogeneity in other morpho-agronomic traits. From PYT-1, one genotypes, BR9209-

5-3 having 1.3 t/ha yield advantage over BRRI dhan28 was selected. From PYT-3, three genotypes viz. BR8609-2-B-8-3-B1, BR7671-37-2-2-3-7-3-P3 and BR7831-59-1-1-4-3-1-7 having 0.5 t/h yield advantage over BRRI dhan28 were selected. In SYT-1, 2 & 3, total 9 genotypes viz. BR7988-12-5-1-1-1, BR7988-12-3-4-3-1, BR7988-14-1-4-4-2, BR 8611-10-3-2-2, BR 8247-3-2-2-2, BR 8643-6-4-3, BR 8626-20-9-1-3, BR 8626-19-5-1-2 and BR 8626-19-4-1-1 had 0.6-.07 t/ha yield advantage over check varieties BRRI dhan28, BRRI dhan29 and BRRI dhan55. In RYT, BR7988-10-4-1 was the highest yielder across ten locations followed by BR7683-30-3-3-4 and BRRI dhan29-SC3-28-16-10-8-HR1 (Com).

Development of Cold Tolerant Rice: The major objective of the project was to develop high yielding rice varieties tolerant to cold injury. Thirty eight crosses were made. Thirty three crosses were confirmed as true F_1. In total 1757 individual plants were selected from F_2 population based on phenotypic performance. From Pedigree nursery, 1098 superior individual plants and 27 fixed lines were isolated from 20 crosses of F_3- F_7 populations. Twelve genotypes were selected from OT#1 and OT# 2 based on growth duration, yield, and homogeneity in other morpho-agronomic traits and superiority in one or more traits over the check variety. In PYT and SYT, no genotype was found superior than the check varieties, thus none was selected for further evaluation in advanced yield trial. Three genotypes were selected based on yield and growth duration from the International Temperate Rice Observational Nursery (IRTON).

Under IAPP cold program, two near isogenic lines of BRRI dhan29, IR90688-20-1-1-1-1-1 and IR90688-91-1-1-1-1 showed almost similar yield to check variety, BRRI dhan29 at both Gazipur and Rangpur. Since, these two lines were found cold tolerant at seedling stage in previous studies, they were selected as parents to use in hybridization program. From CS1 pedigree nurseries, 223 progenies tolerant to cold at seedling stage were selected considering leaf discoloration (LD) scores under artificial cold treatment and agronomic performance under field condition from 68 plant families. In a PVS baby trial, BR7812-19-1-6-1-P2 and BR7812-19-1-6-1-P4 gave comparatively higher yield (0.36 t/ha to 0.63t/ha) than check varieties with almost similar growth duration.

Three mapping populations, BR1×HbjBVI, BR1×BR18 and BRRI dhan28×HbjBVI were phenotyped for cold tolerance. Forty eight F_2- F_3 progenies were selected from two extreme trails of cold sensitivity as most susceptible and most tolerant progenies for genotyping to map QTL(s) confering cold tolerance at seedling stage.

Development of Low Amylose Rice: The project was aimed at developing high yielding (8.0t/ha) indica rice variety with low amylose content (18-22%) for domestic use particularly for ethnic people. In pedigree nursery, 75 individual progeny comprising18 from F_7 and 57 from F_8 generation and 31 bulk lines were selected .From observational trial, 3 genotypes were selected based on growth duration, yield, and homogeneity in other morpho-agronomic traits for preliminary yield trial. In PYT, no genotype was found superior than the check varieties, thus none was selected for further evaluation in advanced yield trial.

Development of Micronutrient Enriched Rice (MER): The main objective of the program was to develop high yielding rice varieties with improved nutritional quality in term of high zinc content in polished grain. The experiments were conducted at both T. Aman and Boro season. In T Aman season, 55 single and fourteen back, top- and three-way crosses were made. A total of 47 crosses were confirmed as true F_1 comparing with their respective parents. Fourteen crosses were used to make back-, top- and crosses. From F_2 population, a total of 2208 progenies were selected from 27 crosses. A total of 1215 individual superior progenies comprising 728 from F_3 and 478 from F_4 generation were selected following pedigree method of selection. Eighty nine fixed progeny rows were bulked from F_7 and advanced generations. Also, 295 perior individual plants were selected from non-uniform entries of observation trial. From OT, a total of 38 uniform genotypes were selected considering initial yield advantage over the check varieties for further evaluation. Sixteen genotypes were selected from preliminary yield trial having yield advantage of at least 0.5 t/ha over the check varieties. Nine genotypes from SYT were selected for regional trial. Three genotypes in term of yield advantage (0.4 to 0.8 t/ha) with growth duration more or less similar to check variety were selected from RYT. The breeding lines, BR7528-2R-19-HR10 showing 0.4 t/ha yield advantage over BRRI dhan39 and 128 days growth duration in PVT was released as BRRI dhan72 for T. Aman season by the National Seed Board (Table 4). In Boro season, 68 single crosses and 13 back- and three-way crosses were made for developing breeding and pre-breeding materials. A total of 36 crosses were confirmed as true F_1. From F_2 population, a total of 1766 individual plants were selected from 34 crosses and bulk selection was performed from 2 crosses. A total of 3185 individual progenies comprising 155 from F_3, 125 from F_4, 1050 from F_5, 763 from F_6, 1054 from F_7, and 38 from F_8 generation were selected. Ninety two progeny rows were bulked from advanced generations. Also, 295 individual plants were selected from non-uniform entries of observation trial. From OT, a total of 80 uniform genotypes were selected based on yield advantage over check varieties for further evaluation. Thirteen genotypes were selected from preliminary yield trial considering yield advantage of at least 0.5 t/ha over the check varieties, growth duration and zinc content. Twelve genotypes from SYT were selected for regional trial. Nine genotypes in term of yield advantage (0.4 to 0.8 t/ha) with growth duration more or less similar to the check varieties were selected from RYT. Two genotypes showing 0.4 t/ha and 0.8 t/ha yield advantage with growth duration more or less similar to the check varieties were selected from RYT. In a proposed variety trial, BR7671-37-2-2-3-7 and BR7833-11-1-1-2-1-2B5 were tested and BR7671-37-2-2-3-7 was showing 1.2 t/ha higher yield with 3-5 days shorter growth duration than BRRI dhan64 (Table 5) was recommended as BRRI dhan74 by the National Technical Committee of the NSB at its 81th meeting.

Table 4: Performance of the proposed lines in the proposed variety trial, T. Aman 2014-15

Designation	Growth duration (days)	Yield (t/ha)	MY (%)	HRY (%)	Chalk	WGL (mm)	WRB (mm)	L/B ratio	Protein (%)	Amylose (%)	IR
BR7528-2R-19-HR10	128	5.7	72.7	59.5	Tr	6.9	2.5	2.7	8.9	26.0	3.5

BRRI dhan39(ck)	121	4.8	73.0	60.0	Tr	5.9	2.0	3.0	8.5	26.5	3.7

Tr = Translucence, MY = Milling yield, HRY = Head rice yield, WGL = Whole grain length, WRB = Whole grain breadth, IR = Imbibitional Ratio

Table 5: Performance of the proposed lines in the proposed variety trial,Boro 2014-15

Designation	Growth duration (days)	Yield (t/ha)	MY (%)	HRY (%)	GL (mm)	GB (mm)	L/B ratio	Size and shape	Protein (%)	Amylose (%)	Zinc (mg/kg)	ER	IR
BR7671-37-2-2-3-7	147	7.1	70.0	67.6	6.1	2.5	2.4	MB	8.3	28	24.2	1.5	4.6
BRRI dhan64(ck)	150	5.9	72.5	66.0	5.4	2.7	2.0	MB	7.2	26	24.0	1.4	4.3

MY = Milling yield, HRY = Head rice yield, GL= Grain length, GB = Grain breadth, IR = Imbibitional Ratio, ER = Elongation Ratio

Development of Insect Resistant Rice: The main thrust of the project was to develop varieties resistant to brown plant hopper (BPH), white backed plant hopper (WBPH) and gall midge (GM). Eighteen crosses for T. Aman and 45 crosses for Boro season were made. Four and 12 crosses were confirmed in T. Aman and Boro season, 434 progenies in T. Aman from F_2 populations, 790 progenies (907 for BPH & GM in T. Aman season and 609 for BPH & GM in Boro season) and 30 fixed lines for BPH & GM in T. Aman season were selected from pedigree nursery. Eighteen lines from OT, 8 lines from PYT, 6 lines from SYTs and 4 lines from AYT were selected showing resistance to BPH in T. Aman season. Twenty five lines from OT, 8 lines from PYT, 5 lines from SYT and 5 lines from AYT were selected in Boro season.

Development of Disease Resistant Rice: Efforts were made for developing varieties resistant to bacterial blight (BB), rice tungro virus (RTV) and blast diseases. Twenty four crosses for BB and 17 crosses for blast in T. Aman and 20 crosses for BB and 04 crosses for blast were made in Boro season. Twenty five crosses for BB and 1 for blast during T. Aman and twenty crosses for BB and 04 crosses for blast in Boro were confirmed as true F_1. Four hundred ninety seven resistant progenies for BB were selected in T. Aman season from F_2 population. Ninety two superior progenies from F_3 generation for BB, 96 for blast and 11 for RTV from F_3 generation were selected in T. Aman. A total of 201 progenies for BB and 162 for blast were selected from F_4 generation in T. Aman were as, 119 superior progenies from F_3-F_4 generations were selected for BB during Boro season. Fifteen fixed lines for BB, twelve for blast and 6 fixed lines for RTV were isolated during T. Aman season, while 47 fixed lines were isolated from F_5 generation for BB during Boro season. From OT, 11 homogenous lines for BB in T. Aman, while 5 entries for BB during Boro season showed better yield potential and agronomic performance over the check varieties. In SYT, BR8821-8-1 showed higher yield coupled with growth duration similar to check variety, BRRI dhan39 with. BR8821-10-2 also produced 1.0 t/ha higher yield than BRRI dhan49 with almost similar growth duration during T. Aman season. Two entries for BB were selected from SYT during Boro season. One genotype for BB were selected

from AYT during T. Aman season. Three lines such as BR7986-2-3, BR7986-7-4 and BR7986-29-4 were selected for BB from AYT during Boro, 2014-15.

Development of Submergence and Water Stagnation Tolerant Rice: The project was aimed for the development of high yielding rice varieties tolerant to submergence (flash flooding) and medium stagnant water (MSW) stresses in collaboration with IRRI as flash flooding and water stagnation are the major constraints in the rainfed lowland rice ecosystem in Bangladesh. In total, 20 single crosses were made using 14 parents and 2328 F_1 seeds were produced. Six crosses were selected and confirmed as true F_1s. Pedigree generations were grown under controlled submergence and medium stagnant water condition of BRRI, Rangpur and BRRI, Gazipur. A total of 333 progenies from F_2-F_8 and backcross generations were selected and preserved. Fourteen lines were selected for observational trial. In Marker-Assisted Selection, 6 BRRI dhan49-Sub1 isogenic lines and 10 recombinant lines, 15 BC_3F_1 plants from BRRI dhan22*2/BRRI dhan51 and 13 BC_4F_1 plants from BRRI dhan39*3/IR64-sub1 were selected through foreground and phenotypic selection approach. From two PYT's conducted under rainfed conditions, 09 genotypes were selected based on yield and growth duration. Only one entry was selected from two SYT's. In PVS (Early) trial conducted under flooded and non-flooded/rainfed conditions, totally three genotypes were selected based on grain yield and growth duration. In PVS (Late) trial conducted under both controlled submergence and natural flooded conditions, BR9158-19-9-6-9-9 and BR9159-8-5-49-1-2 genotypes were selected, respectively, based on grain yield and submergence tolerance. In 'Head to Head' trial, Sub1-varieties were tested over 8 locations. There was no significant difference between Sub1-varieties and original mega varieties with respect to grain yield, plant height and growth duration. Newly developed Pyramided (*Xa21* & *SUB1*) lines developed through backcross breeding were evaluated and five genotypes were selected from 8 entries based on grain yield and phenotypic acceptability. Adaptive trials were conducted with BRRI dhan49-Sub1 lines and BR9159-8-5-40-13-57 produced highest average grain yield (4.9 t/ha) at four locations of northern region under non-flooded condition. While from adaptive trials with BRRI dhan33-Sub1, BRRI dhan44-Sub1 and BRRI dhan49-Sub1 at BRRI Gazipur, 11 genotypes were selected.

Development of Drought Tolerance Rice: The project emphasizes for developing high yielding rice varieties tolerant to drought stresses in the rainfed lowland rice ecosystem in Bangladesh. Experiments were conducted in T. Aman eason. In total, 15 crosses were made, 23 crosses were confirmed and 491 plants were selected from 16 F_2 populations. From pedigree nursery 1566 segregating progenies were selected. In OYT, 25 genotypes performed better than the local and international check varieties in respect of yield under reproductive stage drought condition. From AYT, 11 genotypes were selected based on yield with 100-120 days growth duration. In PVS trial, 3 genotypes from 14 genotypes were identified as promising in Rajshahi and in Rangpur IR82589-B-B-84-3 and IR83377-B-B-93-3 were found superior according to farmers' choice. IR82589-B-B-84-3 and IR83377-B-B-93-3 both performed well in PVT. IR82589-B-B-84-3 having

5.05 t/ha grain yield with 111 days growth duration was approved by the National seed board to release as BRRI dhan71 for T. Aman season (Table 6).

Table 6. Performance of the proposed variety under drought prone area, T. Aman, 2014-15

Designation	Plant height (cm)*	Growth duration (days)*	Grain yield (t/ha)*	Grain characteristics					
				Head rice yield (%)	L-B Ratio	Size and shape	Elongation Ratio	Protein (%)	Amylose (%)
IR82589-B-B-84-3 (BRRI dhan71)**	108	111	5.05	63.6	2.8	MB	1.5	7.0	24.0
BRRI dhan56 (Ck)	110	106	4.40	59.5	2.8	MB	1.5	8.0	23.0

*Mean of 9 locations (Godagai, Paba, Tanore of Rajshahi, Nachole of Chapai Nawabganj, Rangpur, Lalmonirhat, Kustia, Jessore and Gazipur)

**This proposed variety has already been released by NSB as BRRI dhan71 on 12 July, 2015.

Development of water saving and aerobic rice varieties for low water environment: The objective of the project was to develop high yielding rice varieties suitable for low water environment. Thirteen crosses were made using 12 parents and 688 F_1 seeds were produced. Totally 180 progenies from F_3 generation received from IRRI were selected. Again, 26 entries were selected from four observational trials based on grain yield, growth duration and phenotypic acceptability. Validation trials of Boro varieties were conducted under late Boro condition (late February seeding) in four on-farm locations of greater Rangpur region. The grain yield of BRRI dhan48 was the highest having 4.71 t/ha yield with 107 days growth duration among nine BRRI and BINA varieties while BRRI dhan58 produced the second highest grain yield 4.62 t/ha with 115 days growth duration. On the other hand, at BRRI Gazipur, BRRI dhan58 produced the highest grain yield 4.49 t/ha with 121 days growth duration with early February seeding of the same validation trial. In PVT, the selected line IR83142-B-71-B-B produced 0.7 t/ha more grain yield compared to BRRI dhan28 and growth duration was similar to check during Boro 2014-15.

Screening and Testing of Improved Aus Rice Genotypes Suitable for Aerobic Soil Condition: In large portion of rainfed Aus areas of Bangladesh, rainfall is erratic and dry spells may occur during seedling stage (April to May) of Aus crop. Base line information indicated that there is scope to increase Aus areas through adapting short duration aerobic rice varieties under water saving direct seeding methods in Rajshahi and Sylhet regions. Under such situation, this coordinated project has been designed to develop aerobic rice varieties having short duration (100-105 days), high yielding and aerobic soil adaptability. During the reporting period, 3 separate advanced yield trials were conducted under aerobic soil condition in farmer's field in replicated yield trials to find out the best aerobic rice lines. Out of tested 19 lines, 4 top ranking varieties (IR91006-88-1-3-1, IR84788-40-3-3-1-1, IR90228-1-3-3-3-2 and IR92240-40-2-2-1) in respect of yield (3.60- 4.10 t/ha) and comparatively shorter growth duration (105-109 days) were selected. Further, Out of tested 12 lines, 5 top ranking varieties (BR7182-2B-1-HR4, BR7178-2B-19-10, BR6855-3B-12, BR6848-3B-12 and BI dhan-5) with respect to yield (3.55- 4.50 t/ha) and shorter growth duration (97-101 days) were selected.

Higher root length under water stress was used as criteria for selecting aerobic rice lines. IR90228-1-3-3-3-2 and IR91006-88-1-3-1 are the best aerobic rice genotypes with higher root length (55-58 cm) than others. During 2nd year, a set of diverse lines was used for marker assisted selection having deep rooting ability. One of two markers RM302 amplified a specific allele (112 bp) in all the aerobic rice genotypes, which showed different pattern in short rooted rice genotypes. Thus, RM302 marker on chromosome 1 could be used to differentiate between long and short rooted genotypes. IR92240-40-2-2-1 was best aerobic rice genotypes possessed deeper root system.

Development of Green Super Rice (GSR): The project was aimed for developing of less input but high yield potential genotypes with tolerance to different stresses rice. In T Aman season, total 26 genotypes were selected based on yield, plant type, grain quality, homogeneity in other agronomic traits from observational trial. From PYT(1 & 2), eight genotypes were selected. Considering drought 9 genotypes were selected from SYT#1 and 8 genotypes were selected for salinity from SYT#2. Therefore, all entries will be evaluated for regional yield trial in next season. One promising genotype (HUA565) has been approved for retrial in the proposed variety trial.

In Boro season, two fixed genotypes were selected based on phenotypic acceptability, yield, and homogeneity in other morpho-agronomic traits and superiority in one or more traits over the check variety. From PYT, 11 genotypes were selected based on yield and growth duration for secondary yield trial. In RYT, the genotypes HHZ15-DT4-DT1-Y1 (6.4 t/ha), HHZ6-SAL3-Y1SUB2 (6.7 t/ha) produced the highest average yield over 10 locations than BRRI dhan60 and growth duration was 4-6 days earlier than BRRI dhan29 (Table 7). Therefore, the two genotypes were selected in Boro season for conducting adaptive yield trials in farmers' field.

Table 7: Performance of genotypes in Regional Yield Trial, Boro 2014-15

Sl.	Designation	PH (cm)	GD (days)	Yield(t/ha)											Grain shape
				L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	Ave	
1	HHZ15-SAL13-Y1	89.9	154	5.1	4.1	6.3	7.2	6.6	6.7	6.3	6.9	6.1	7.2	6.2	S
2	HHZ23-DT16-DT1-DT1	89.9	156	5.9	4.9	7.9	6.4	6.8	6.3	6.6	7.5	6.8	7.2	6.6	S
3	HHZ15-DT4-DT1-Y1	85.4	153	5.7	4.6	8.0	6.9	6.5	6.7	6.4	6.3	6.4	6.9	6.4	S
4	HHZ11-DT7-SAL1-SAL1	84.0	150	4.1	4.5	8.6	6.5	6.4	6.0	5.9	6.4	6.2	6.8	6.2	MS
5	HHZ6-SAL3-Y1-SUB2	91.2	155	5.0	5.0	9.4	6.9	6.7	6.5	7.0	6.4	6.9	7.1	6.7	S
6	BRRI dhan29	96.1	159	5.9	4.1	7.6	7.6	6.4	6.9	6.1	6.7	7.6	6.6	6.5	
7	BRRI dhan60	86.8	147	4.9	4.5	7.1	6.1	6.6	5.4	5.7	5.8	5.1	5.4	5.7	

L1=Gazipur, L2=Sonagazi, L3=Rangpur, L4=Rajshahi, L5= Hobigonj, L6=Bhangha, L7=Sathkhira, L8=Comilla, L9=Kushtia and L10=Barisal

International Network for Genetic Evaluation of Rice (INGER): This programme focused on sharing germplasm and breeding lines through international platform for the acceleration of genetic improvement of rice

varieties. A total of 62 germplasm were selected from six INGER nursery sets in T. Aman 2014 season. While 28 germplasm were selected from four INGER nursery sets in Boro 2014-15 season for using in the breeding program either as parents or for directly using in the yield trials.

BANGLADESH RICE RESEARCH INSTITUTE
Biotechnology Division

SUMMARY

A total of 23 experiments were conducted under 4 projects during the reporting period. In total 45 green plantlets were regenerated from hybrid anther of four crosses. For developing modern rice variety through anther culture 34 different crosses were made and 4,911F_1 seeds were harvested from those cresses. A total of 341 plants were selected and 16 homozygous lines were bulked from 246 pedigree lines during T. Aman/2014. On the other hand, during Boro/14-15 season, 87 homozygous lines were bulked from169 pedigree lines for further evaluation. Twenty- nine anther culture derived doubled haploid lines were evaluated in two OTs with standard checks in T. Aman 2014. Among them 16 promising doubled haploid lines were selected for further evaluation as PYT. On the other hand 42 advanced homozygous lines were evaluated in two OTs during Boro 2014-15 with standard checks and 15 lines were selected for further evaluation as PYT. Twenty-nine advanced homozygous lines were evaluated in four PYTs in T. Aman 2014 and among them 20 lines were selected for further evaluation. On the other hand during Boro 2014-15 season, 41 lines were evaluated in three PYTs and 19 lines were selected further evaluation. Five advanced doubled haploid lines were evaluated at 10 BRRI regional stations during Boro 2014-15 and two lines were selected for ALART in Boro 2015-16. One advanced Rice-Wheat derived line (BR6158RWBC2-1-2-1-1) was also evaluated at 10 BRRI regional stations during Boro 2014-15. The line BR6158RWBC2-1-2-1-1 showed better performance than those checks and selected for ALART in Boro 2015-16. Seventeen BB resistant gene (*xa4* and *Xa21*) pyramided BRRI dhan29 lines were evaluated as OT during Boro 2014-15 with standard check. Among them 9 lines were selected depending on the phenotypic acceptability and yield. Genotyping of mapping population of BRRI dhan28/ *Oryza rufipogon* (Ac.no.105890) was completed for QTL analysis. From this mapping population two major QTL for yield and yield contributing traits were identified. BRRI dhan29 and BRRI dhan28 was used for developing salt tolerant transgenic rice with salt tolerant gene *AeMDHAR*. From this study 40 and 20 putative transgenic plants were obtained from BRRI dhan29 and BRRI dhan28, respectively. However, none of the putative transformants amplified by PCR with *AeMDHAR gene* specific primers. In another transgenic study, salt tolerant genes *Gly1* and *GlyII* were introduced into BRRI dhan29 to make it salt tolerant. From this study T_4 seeds were harvested for salinity screening.

DEVELOPMENT OF RICE VARIETY THROUGH TISSUE CULTURE

Development of rice variety through anther culture

Twenty four F_1s populations were grown in the net house under optimum management (Table 1). A total of 91418 hybrid anthers from 24 crosses were plated in KE amd M10 media for callus induction. Data were

taken on number of anther plated, number of calli produced, number of green and albino plant regenerated. A total of 808 calli were obtained from KE and M10 media (Table 1). The highest numbers of calli (167) were obtained from hybrid anthers of BRRI dhan29/ Kalizeera cross followed by 105 calli obtained from BR17/Kanaklata cross (Table 1). On the other hand, highest number of green plant regenerated (26) from hybrid anther of BRRI dhan29/Kalizeera cross (Fig.l) followed by 17 green plants regenerated from BRRI dhan29/FL478 cross. After hardening, green plantlets were transferred into the earthen pots and kept until maturity.

FIELD PERFORMANCE OF TISSUE CULTURE DERIVED LINES

Hybridization

Hybridization was done to generate F_1s for anther culture for developing doubled haploid. Thirty Four (34) crosses were made for developing aromatic, fine grain, high yield potential, salinity tolerance, cold tolerance, low GI and short duration rice variety. In total 4911 F_1 seeds were harvested from 34 different crosses (Table 2).

Progeny selection

Progeny selection was carried out to select the best progenies with high yield having desire traits. A total of 341 plants were selected and 16 homozygous lines were bulked from 246 pedigree lines during T. Aman/2014. On the other hand 87 homozygous lines were bulked from169 pedigree lines during Boro/14-15 for further evaluation.

Observational trial (OT)

During T. Aman/14, 29 anther culture derived doubled haploids lines were evaluated in two OTs with standards checks to select agronomically desirable and high yield potential materials. Among them 16 doubled haploids lines were selected depending on the duration and comparable yield with checks (Table 3 & 4). Forty two advanced homozygous lines were evaluated in two OTs with standard checks in Boro/14-15. Among them 15 lines were selected depending on the growth duration and comparable yield with checks (Table 5 & 6).

Preliminary yield trial (PYT)

Preliminary yield trial was carried out for initial evaluation of agronomically desirable and high yield potential advanced rice lines. During T. Aman 14, twenty nine (29) lines were evaluated with standard checks in 4 PYTs and among them 22 lines were selected for further evaluation (Table 7, 8, 9 & 10). During

Boro 14-15, forty one (41) materials were evaluated with standard checks in 3 PYTs and 19 lines were selected for further evaluation (Table 11, 12 & 13, Fig. 2 & 3).

Regional Yield Trials

Five anther cultures derived doubled haploids advanced materials were evaluated at 10 regional levels during Boro 2014-15 as RYT 1. All the materials gave comparable yield and similar growth duration in comparison with the standard check BRRI dhan28 (Table 14 & 15). However, two lines were selected for ALARL trails. One Rice -Wheat derived tissue cultured advanced materials were evaluated at 10 regional levels during Boro 2014-15 as RYT 2. The line BR(BE)6158RWBC2-2-1-1 showed better performance than those of slandered checks (Table 16& 17, Fig. 4).

APPLICATION OF DNA MARKERS

Gene pyramiding for resistance to Bacterial Blight (BB)

Seventeen Bacterial Blight (BB) genes pyramid BRRI dhan29 rice lines having two BB resistant genes (*xa4* and *Xa21*) were evaluated as OT during Boro 2014-15 with standard checks. Among them 9 lines were selected depending on the phenotypic acceptability and yield performance (Table 18 and Fig. 5). These 9 lines were also confirmed by PCR with gene specific primers (Fig. 6).

Identification of yield enhancement QTLs

Crosses were made to identify and introgress high yield QTLs for enhancing grain yield of elite Bangladeshi rice varieties where BRRI dhan28 was used as recurrent parent and *Oryza rufipogon* (Acc.no.103404 & Acc.no.105890) were used as donor parents. Genotyping and phenotyping of mapping population of BRRI dhan28/ *Oryza rufipogon* (Acc.no.104303) was completed using 102 polymorphic markers. From this mapping population two major QTL for yield contributing traits were identified (Fig. 7). Genotyping of another mapping population (BRRI dhan28*3/ *O. rufipogon* (Ac. No. 105890) having population size 238 has been completed with 108 polymorphic marker (Fig. 8).

DEVELOPMENT OF TRANSGENIC RICE

Development of salt tolerant transgenic rice lines through transformation

BRRI dhan29 and BRRI dhan28 were used for developing salt tolerant transgenic rice with salt tolerant gene *AeMDHAR*. From this study 40 and 20 putative transgenic plants were obtained from BRRI dhan29 and BRRI dhan28, respectively. However, none of the putative transformants amplified by PCR with *AeMDHAR gene* specific primers. In another transgenic study, salt tolerant genes *Gly1* and *GlyII* were introduced into BRRI dhan29 to make it salt tolerant. From this study T_4 seeds were harvested for salinity screening.

Table 1. Callus induction and plant regeneration from hybrid anther of 24 crosses.

Cross combination	No. of anther plated	No. of calli obtained	No. of plant regenerated
BRRI dhan29 / FL478	5013	60	17 green plants
MR219/BR16	7162	55	One green plant
BR16*^{2}/Kanaklata	6247	29	
BR16/BRRI dhan28	3524	34	
BRRI dhan28/BR16	3147	71	
Kanaklata/BR16	802	09	
BR16/Kanaklata	5967	105	
MR219/Kanaklata	2043	22	
BRRI dhan28/Kanaklata	369	18	
BRRI dhan29/Kanaklata	9206	05	
BRRI dhan28 / FL478	5402	10	6 Albino plants
BRRI dhan29 / BRRI dhan61	2086	9	4 Albino plants
BRRI dhan61 / FL478	5660	2	
BRRI dhan50 / Tepiboro (Ac. No. 930)	3805	74	one green plant 57 Albino plants
BRRI dhan29 / Kalizeera	6335	167	26 green plants 78 Albino plants
BRRI dhan 49 /Kalizera	3438	37	12 Albino
BRRI dhan 28 /Tepiboro (Ac. No. 930)	3136	18	4 Albino
BRRI dhan29 /Bashful	731	2	
BRRI dhan29 /Tepiboro (Ac. No. 930)	2475	15	21 Albino
BRRI dhan 55 /Tepiboro (Ac. No. 930)	344	2	
BRRI dhan 50 /Bashful	3019	29	32 Albino
Chinigura/ BRRI dhan 28	1353	2	
NERICA7 /BRRI dhan55	5380	22	8 Albino
NERICA7/ BRRI dhan48	4774	11	1 Albino
Total	**91418**	**808**	**45 green plants**

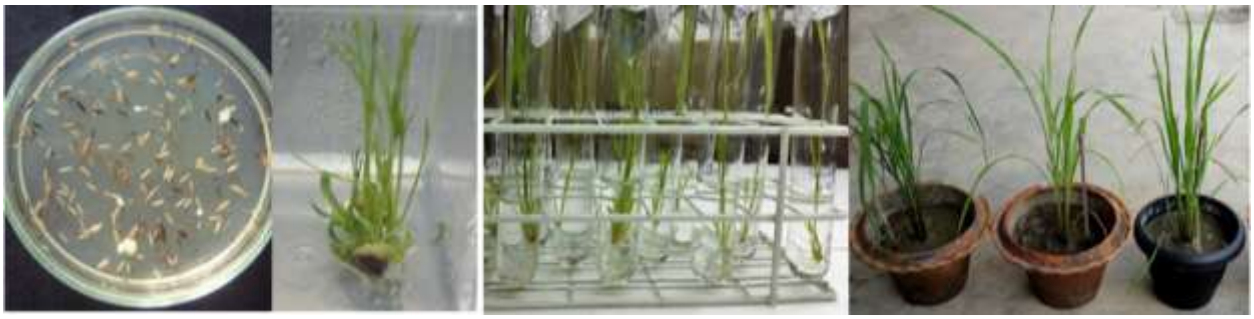


Fig. 1. Anther culture derived doubled haploid plants from BRRIdhan29/Kalizeera cross.

Table 2. List of crosses for anther culture.

Cross	No. of seeds
BRRI dhan29/Kanaklata	260
BR16/Kanaklata	116
BRRI dhan28/Kanaklata	108

MR219/Kanaklata	198
BRRI dhan28/BR16	143
MR219/BR16	190
BRRI dhan29/BR16	123
BR16/ BRRI dhan29	64
BR16/MR219	62
MR219/BR16	190
MR219/BR16*^{3}	22
BR16*^{3}/BRRI dhan28	108
MR219/BR16*^{2}	78
MR219/BR16*^{3}	135
BRRI dhan28*^{2}/Kanaklata	10
MR219*^{2}/BR16	94
MR219*$^{3/}$BR16	21
BRRIdhan29/ BRRIdhan 61	107
BRRIdhan 28/FL 478	166
BRRIdhan 61/FL478	620
BRRIdhan 28/ BRRIdhan 61	314
BRRIdhan 28/IR4630-22-2-5-1-3	48
BRRIdhan 29/IR4630 22-2-5-1-3	156
BRRI dhan29/Tepiboro (Ac. No. 930)	421
BRRI dhan28*^{2}/Tepiboro (Ac. No. 930)	24
BRRI dhan50*^{2}/Tepiboro (Ac. No. 930)	49
BRRI dhan28/Tepiboro (Ac. No. 930)	383
BRRI dhan50/Bashful	28
BRRI dhan29/Kalizeera	65
BRRI dhan49/Kalizeera	123
MR219\NERICA7	112
BRRI dhan28\NERICA7	129
BRRI dhan48\NERICA7	144
BR8072-AC5\NERICA7	100
Total	**4911**

Table 3. Agronomic characteristics of anther culture derived doubled haploid lines during T. Aman 2014(OT-1).

Designation	Plant ht (cm)	Growth duration (days)	Yield (t/ha)
BR8018-AC3-2-2-1	112	118	4.36*
BR8018- AC6-2-2-2	110	118	4.90*
BR8018- AC12-4-1-5	107	117	5.38*
BR8018- AC14-4-3-6	129	123	5.88*
BR8019- AC2-1-2-13	116	119	4.54*
BR8019- AC3-1-3-14	112	119	5.38*
BR8019- AC13-1-2-17	103	117	4.56*
BR8019- AC161-3-20	124	120	4.79*
BRRI dhan49 (ck)	105	131	4.45

Sixteen entries were evaluated and 8 entries were selected.

*= selected

Table 4. Agronomic characteristics of anther culture derived doubled lines during T. Aman 2014, (OT-2).

Designation	Plant ht (cm)	Growth duration (days)	Yield (t/ha)
BR8009-AC15	115	127	4.65*
BR8009-AC16	116	126	4.51*
BR8009-AC20	111	127	4.63*
BR8009-AC21	123	127	4.49*
BR8009-AC23	112	127	4.51*
BR8009-AC24	121	126	4.49*
BR8009-AC25	124	126	4.50*
BR8009-AC26	120	127	4.57*
BRRI dhan49(ck)	105	133	4.65

Thirteen entries were evaluated and 8 entries were selected
*= selected

Table 5. Agronomic characteristics of advanced lines during Boro 2014-15, (OT-1).

Designation	Plant ht (cm)	Growth duration (days)	Yield (t/ha)
BR9777-26-4-3	104	152	8.37*
BR9777-26-4-1	103	152	8.63*
BR9777-41-6-1	107	155	8.02*
BR9777-72-12-2	105	150	8.09*
BR9777-79-3-4	98	143	7.07*
BR9777-79-3-5	100	153	8.02*
BR9777-106-7-4	109	151	8.16*
BR9777-120-8-3	99	152	7.94*
BRRI dhan47 (ck)	95	147	6.83
BRRI dhan29 (ck)	112	157	7.93

Eighteen entries were evaluated and 8 entries were selected
*= selected

Table 6. Agronomic characteristics of advanced lines during Boro 2014-15 (OT-3).

Designation	Plant ht (cm)	Growth duration	Yield (t/ha)

		(days)	
BR9786-BC2-80-1-1	103	156	7.33*
BR9786-BC2-119-1-2	110	158	7.62*
BR9786-BC2-65-1-1	108	158	7.76*
BR9786-BC2-122-1-2	111	156	8.05*
BR9786-BC2-142-1-2	112	162	7.57*
BR9786-BC2-146-2-2	112	161	7.75*
BR9786-BC2-161-1-2	107	158	8.13*
BR9786-BC2-163-1-2	96	162	6.63*
BRRI dhan29 (ck)	103	158	6.87

Twenty four entries were evaluated and 7 entries were selected
*= selected

Table 7. Agronomic characteristics of anther culture derived lines during T. Aman 2014 (PYT-1).

Designation	Plant ht (cm)	Growth duration (days)	Yield (t/ha)
BR8018-AC2-2-2-1	128	122	5.12*
BR8019-AC4-1-1-3	107	126	5.55*
BR8019-AC5-1-2-1	117	124	5.35*
BR8019-AC8-1-2-2	105	123	5.25*
BR8019-AC9-3-3-1	106	123	5.31*
BR8032-AC3-4-1-3	101	121	4.65*
BR8032-AC4-1-2-2	109	124	4.78
BRRI dhan54 (ck)	118	133	5.15
CV	2.06	0.45	1.79
$LSD_{0.05}$	4.03	0.97	0.16

*= selected

Table 8. Agronomic characteristics of anther culture derived lines during T. Aman 2014 (PYT-2)

Designation	Plant ht (cm)	Growth duration (days)	Yield (t/ha)
BR8036-AC6-2-2-1	123	123	4.20*
BR8011-AC2-3-3-3	135	136	4.51*
BR8011-AC3-4-1-2	131	113	4.17*
BR8011-AC3-4-1-4	134	113	4.29*
BR8036-AC3-2-2-3	121	125	3.58
BR8036-AC2-1-2-1	126	128	3.23
BRRI dhan54(ck)	123	134	4.42
CV	2.65	0.45	3.19
$LSD_{0.05}$	6.08	0.97	0.24

*= selected

Table 9. Agronomic characteristics of advanced lines during T. Aman 2014(PYT-3).

Designation	Plant ht	Growth duration	Yield

	(cm)	(days)	(t/ha)
BR9786-BC2-124-1-2	114	120	4.34*
BR9786-BC2-119-1-1	119	124	4.30*
BR9786-BC2-98-1-2	117	116	3.79
BR9786-BC2-132-1-3	119	127	4.31*
BR9786-BC2-135-4-1	112	124	3.84
BR9786-BC2-117-2-2	112	127	4.09
BR9786-BC2-2-1-1	107	129	4.75*
BR9786-BC2-139-2-3	115	122	4.68*
BR9786-BC2-98-1-1	113	117	3.34
BR9786-BC2-124-1-5	120	120	4.37*
BRRI dhan49 (ck)	105	137	4.25
CV	2.78	0.29	13.91
$LSD_{0.05}$	5.37	0.63	0.96

Table 10. Agronomic characteristics of anther culture derived lines during T. Aman 2014 (PYT-4).

Designation	Plant ht (cm)	Growth duration (days)	Yield (t/ha)
BR8009-AC2-1-1-2	115	136	4.55*
BR8009-AC4-1-1-3	116	138	4.36*
BR8009-AC7-1-2-2	122	136	4.40*
BR8009-AC8-1-2-4	119	136	4.26
BR8009-AC9-1-3-1	120	138	4.40*
BR8009-AC11-1-5-2	121	136	4.26
BR11(ck)	116	136	4.26
CV	0.61	0.5	0.72
$LSD_{0.05}$	1.34	1.21	0.06

Table 11. Agronomic characteristics of wide crossed materials during Boro 2014-15, (PYT-1).

Designation	Plant ht (cm)	Growth duration (days)	Yield (t/ha)	Thousand grain wt. (g)
BR9787-BC2-63-2-2	87	143	6.49	18.11*
BR9787-BC2-63-2-4	82	143	6.58	18.24*
BR9787-BC2-102-1-4	87	150	6.89	19.76
BR9787-BC2-119-1-6	116	147	6.57	20.91*
BR9787-BC2-127-1-5	90	149	6.96	18.64
BR9787-BC2-173-1-3	90	145	6.87	19.44*
BR9787-BC2-203-1-3	92	152	7.10	19.58
BR9787-BC2-3-6-2	97	151	6.10	19.46
BR9787-BC2-8-7-1	97	153	6.59	17.14
BR9787-BC2-16-3-1	98	149	6.45	20.27*
BR9787-BC2-35-4-2	98	151	6.59	20.17
BR9787-BC2-41-3-2	97	154	6.72	19.16
BR9787-BC2-41-8-2	95	151	6.24	19.75
BR9787-BC2-43-6-1	86	146	6.07	17.52*

BR9787-BC2-44-7-1	96	153	6.45	17.71
BR9787-BC2-48-4-1	98	155	6.90	20.21
BR9787-BC2-51-9-1	95	155	7.21	18.22
BR9787-BC2-53-4-1	100	156	6.95	20.31
BRRI dhan28 (ck)	97	145	6.45	21.53
BRRI dhan58 (ck)	97	156	7.25	21.51
CV	0.97	0.40	3.56	0.28
LSD (0.05)	1.5	0.99	0.39	0.89

Fig. 2. Selected lines from PYT- 1 (BRRI dhan28 × *O. rufipogon* cross).

Table 12. Agronomic characteristics of wide crossed materials during Boro 2014-15) (PYT-2).

Designation	Plant ht (cm)	Growth duration (days)	Yield (t/ha)	Thousand grain wt. (g)
BR9786-BC2-122-1-3	108	158	8.45	24.58*
BR9786-BC2-2-1-1	97	163	7.12	21.62
BR9786-BC2-15-2-2	103	159	7.98	21.93*
BR9786-BC2-15-2-3	102	163	7.83	22.22*
BR9786-BC2-16-1-1	106	162	7.32	22.50
BR9786-BC2-16-1-2	106	165	7.49	22.81
BR9786-BC2-49-1-2	105	159	8.48	22.41*
BR9786-BC2-115-2-1	98	165	7.41	22.78
BR9786-BC2-127-2-3	106	163	6.59	23.16
BR9786-BC2-59-1-2	105	157	8.02	24.40*
BR9786-BC2-124-1-1	106	158	8.08	24.84*
BR9786-BC2-135-4-1	103	162	6.72	21.18
BR9786-BC2-135-4-3	104	162	6.24	20.99
BR9786-BC2-139-3-2	101	162	6.07	22.73
BR9786-BC2-142-1-1	108	161	8.26	23.50*
BRRI dhan58 (ck)	99	154	7.02	21.46
BRRI dhan29 (ck)	99	165	7.50	20.42
CV	2.03	-	2.74	0.78
LSD	0.84	-	0.34	0.28

Table 13. Agronomic characteristics of wide crossed materials during Boro 2014-15, (PYT-3).

Designation	Plant ht (cm)	Growth duration (days)	Yield (t/ha)	Thousand grain wt. (g)
BR9785-BC2-9-2-3	113	141	6.56	28.17
BR9785-BC2-6-2-2	102	138	6.91	23.53*
BR9785-BC2-19-3-1	100	141	6.95	21.36*
BR9785-BC2-20-1-3	99	142	6.48	23.10*
BR9785-BC2-27-1-1	123	147	7.14	23.89*
BR9785-BC2-19-3-5	100	144	6.48	21.16*
BR9785-BC2-62-2-2	99	142	6.70	21.38*
BR9785-BC2-110-1-3	99	146	7.15	23.01
BRRI dhan28 (ck)	98	141	6.33	21.58
BRRI dhan58 (ck)	99	154	7.01	21.96
CV	3.93	0.55	4.12	-
LSD	6.96	1.33	0.74	-

Fig. 3. Selected material from PYT- 3 (BRRI dhan28 X *O. rufipogon* cross).

Table 14. Agronomic characteristics of anther culture derived lines during Boro 2014-15 (RYT-1).

	Designation	Gaz	Bar	Bng	Sat	Kus	Rnp	Raj	Hbj	Son	Com	Avg
PH	**BR8072-AC5-4-2-1-2-1**	**85**	**85**	**87**	**84**	**93**	**76**	**83**	**84**	**77**	**85**	**84**
	BR8072-AC7-4-1-2-2-4	84	81	87	80	90	77	83	84	74	83	82
	BR8072-AC8-1-1-3-1-1	**86**	**80**	**84**	**85**	**92**	**79**	**84**	**86**	**75**	**84**	**84**
	BR8072-AC11-1-1-3-1-1	85	85	81	85	90	84	85	85	78	85	84
	BR4909-R1-R2	110	*	*	105	113	106	108	108	87	110	106
	BRRI dhan28(ck)	95	87	82	84	93	96	86	92	*	95	90
GD	**BR8072-AC5-4-2-1-2-1**	**139**	**139**	**146**	**139**	**139**	**149**	**141**	**151**	**144**	**144**	**143**
	BR8072-AC7-4-1-2-2-4	141	138	146	139	137	149	141	145	147	146	143
	BR8072-AC8-1-1-3-1-1	**141**	**138**	**144**	**139**	**138**	**149**	**141**	**146**	**140**	**143**	**142**

	BR8072-AC11-1-1-3-1-1	141	138	145	139	138	149	141	145	144	143	142
	BR4909-R1-R2	149	*	*	143	144	159	154	145	*	150	149
	BRRI dhan28(ck)	141	137	145	140	141	143	142	142	143	143	142
GY	**BR8072-AC5-4-2-1-2-1**	**5.66**	**4.81**	**5.18**	**5.68**	**5.80**	**4.3**	**5.23**	**7.1**	**4.87**	**5.2**	**5.38**
	BR8072-AC7-4-1-2-2-4	5.86	4.89	4.88	5.32	5.81	5.01	5.49	5.2	5.07	5.1	5.26
	BR8072-AC8-1-1-3-1-1	**6.48**	**4.28**	**5.55**	**5.46**	**6.57**	**5.12**	**5.63**	**5.7**	**5.01**	**4.8**	**5.46**
	BR8072-AC11-1-1-3-1-1	5.90	4.76	5.33	5.34	5.95	5.54	5.14	5.3	4.93	5.2	5.34
	BR4909-R1-R2	5.99	*	*	5.96	5.96	5.54	6.36	5.2	*	6.6	5.94
	BRRI dhan28(ck)	6.83	4.14	5.29	5.79	5.69	5.3	5.94	6.7	5.27	4.2	5.51

Gaz= Gazipur, Br= Barisal, Bng=Bhanga, Sat=Satkhira, Kus=Kustia, Rnp=Rangpur, Raj= Rajshahi, Hbj= Habijang, Sog= Sonagazi, Com= Comilla
*= Seedling shortage, GD= Growth duration (days), PH= Plant Height (cm), Grain Yield (t/ha)
Bold= Selected

Table 15. Physicochemical properties of anther culture derived lines during Boro 2014-15 (RYT-1).

Variety/Line	MO (%)	Ap	Ck	L (mm)	L/B ratio	SS	Aml (%)	P (%)	ER
BR8072-AC5-4-2-1-2-1	**72**	**V. good**	**Tr**	**6.5**	**3.2**	**LS**	**26.0**	**9.5**	**1.2***
BR8072-AC7-4-1-2-2-4	74	Good	Wc10-20	6.5	3.1	LS	23.2	9.8	1.2
BR8072-AC8-1-1-3-1-1	**74**	**Good**	**Wb 10-20**	**6.6**	**3.2**	**LS**	**25.0**	**9.2**	**1.2***
BR8072-AC11-1-1-3-1-1	73	Good	Tr/Wb5	6.5	3.2	LS	27.0	8.6	1.4
BR802-78-2-1-1(ck)	70	Good	Opaque/Tr	6.0	3.0	LS	23.1	8.2	1.2
BRRI dhan28 (ck)	72	Good	Wb10-20	6.0	3.8	LS	26.0	8.9	1.3
Niamat (ck)	72	Good	Wb>20	7.7	3.8	LS	25.7	9.5	1.4

MO= Milling outran, Ap= Appearance, Ck= Chalkiness, L= Length, L/B= Length/Breath, SS= Shape and size, LS= Long slender, Aml= Amylose, P= Protein, ER= Elongation ration
*= Selected

Table 16. Agronomic characteristics of Rice- Wheat derived materials during Boro 2014-15 (RYT-2).

	Designation	Gaz	Bar	Bng	Sat	Kus	Rnp	Raj	Hbj	Son	Com	Avg
GD	**BR (BE)6158RWBC2-1-2-1-1**	**161**	**157**	**157**	**142**	**154**	**161**	**164**	**159**	**145**	**157**	**156**
	BRRI dhan58 (ck)	154	146	146	142	149	159	153	156	143	149	150
	BRRI dhan2 9(ck)	164	154	154	155	154	167	165	161	158	161	159
PH	**BR(BE)6158RWBC2-1-2-1-1**	**111**	**108**	**103**	**104**	**116**	*****	**109**	**98**	**100**	**125**	**108**
	BRRI dhan58 (ck)	98	88	87	91	103	*	91	93	91	119	96
	BRRI dhan29 (ck)	99	85	106	92	103	*	97	98	92	123	99
GY	**BR(BE)6158RWBC2-1-2-1-1**	**8.08**	**6.69**	**6.83**	**6.42**	**7.9**	**5.75**	**9.23**	**7.9**	**5.83**	**8.3**	**7.29**
	BRRI dhan58 (ck)	7.22	6.32	5.32	5.82	7.24	5.62	7.34	7.6	5.96	5.8	6.42
	BRRI dhan29 (ck)	7.68	6.45	6.52	6.02	7.88	6.75	8.67	7.8	5.96	7.6	7.13

Gaz= Gazipur, Br= Barisal, Bng=Bhanga, Sat=Satkhira, Kus=Kustia, Rnp=Rangpur, Raj= Rajshahi, Hbj= Habijang, Sog= Sonagazi, Com= Comilla,
*= Seedling shortage, GD= Growth duration (days), PH= Plant Height (cm), Grain Yield (t/ha)
Bold= Selected

Table 17. Physicochemical properties of Rice- Wheat derived lines.

Variety/Line	MO (%)	Ck	L (mm)	L/B ratio	SS	Aml (%)	P (%)	ER
BR(BE)6158RWBC2-1-2-1-1	**72**	**Tr/Opaque**	**6.5**	**3.1**	**LS**	**26.0**	**7.5**	**1.4**
BRRI dhan28 (ck)	**72**	**Tr/Wc5**	**6.5**	**3.1**	**LS**	**27.0**	**8.4**	**1.4**
BRRI dhan29 (ck)	**70**	**Tr/Wc9**	**6.5**	**3.1**	**LS**	**26.0**	**7.1**	**1.3**

MO= Milling outran, Ck= Chalkiness, L= Length, L/B= Length/Breath, SS= Shape and size, LS= Long slender, Aml= Amylose, P= Protein, ER= Elongation ration

Fig. 4. Filed evaluation of BR (BE) 6158RWBEC2-1-2-1-1 during Boro 2014-15 (RYT-2).

Table 18. Agronomic characteristics of BB resistant gene (*xa4 and Xa21*) pyramided rice lines during Boro 2014-15 (OT-2).

Designation	Growth duration (day)	Average leaf area damage (%)	BB Score	Yield (t/ha)
BR8333-BC5-1-1	155	19.5	5	7.25*
BR8333- BC5-1-12	149	15.8	5	7.22*
BR8333- BC5-1-16	150	11.3	3	7.20*
BR8333- BC5-1-20	150	8.5	3	7.01*
BR8333- BC5-2-1	149	11.0	3	7.52*
BR8333- BC5-2-13	150	6.6	3	7.14*
BR8333- BC5-2-16	149	10.8	3	7.32*
BR8333- BC5-2-22	149	5.6	3	7.33*

BR8333- BC5-3-10	147	10.2	3	7.28*
BRRI dhan29 (ck)	154	86.9	9	7.28
Purbachi (ck)	-	95.3	9	-
IRBB60 (ck)	-	3.85	1	-

Seventeen entries were evaluated and 9 entries were selected

*= selected

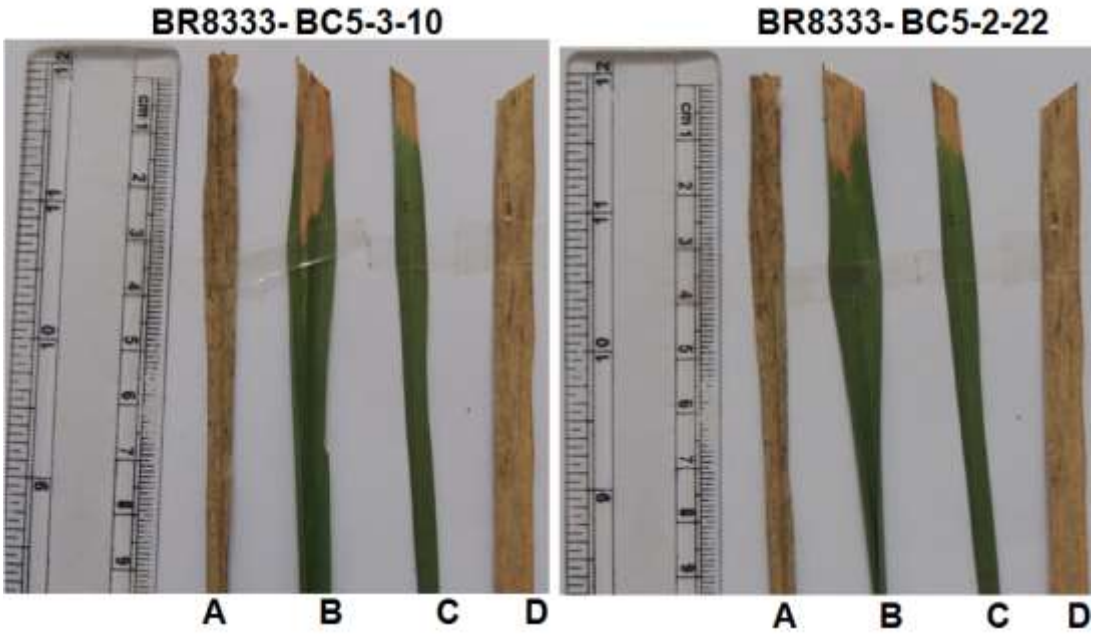
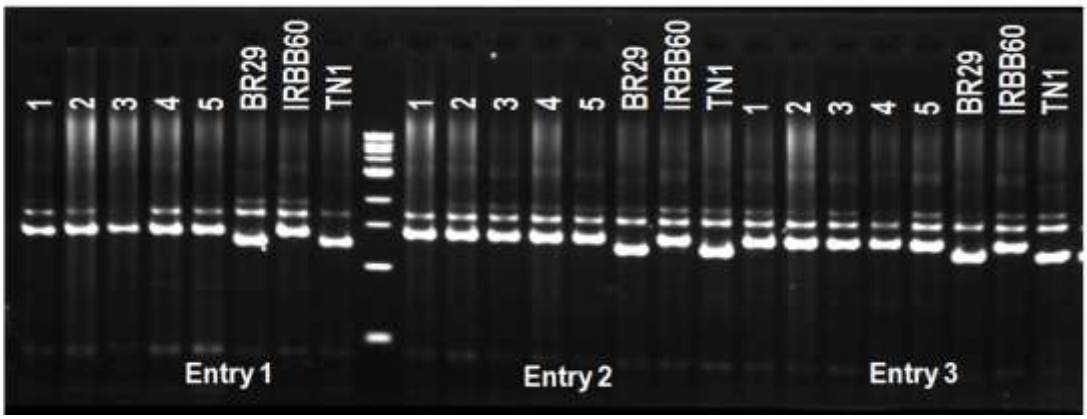


Fig. 5. BB Screening 15 days after inoculation with BXo9 isolate.

Legend: A= Purbachi, B= BB pyramided Line, C= IRBB60, D= BRRI dhan29



1, 2, 3, 4 and 5 = Sample from each entry

Fig. 6. BB pyramided BRRI dhan29 lines confirmed by PCR with *Xa21* gene specific primer.

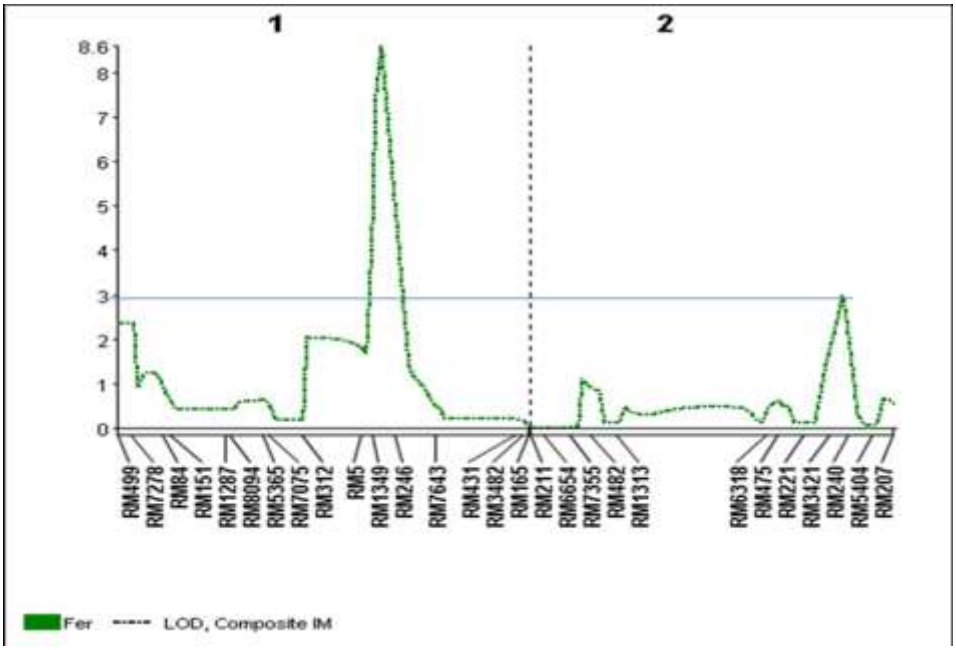


Fig. 7. Chromosomal locations of QTLs for fertility on chromosome 1 and 2 by Composite Interval Mapping (CIM)

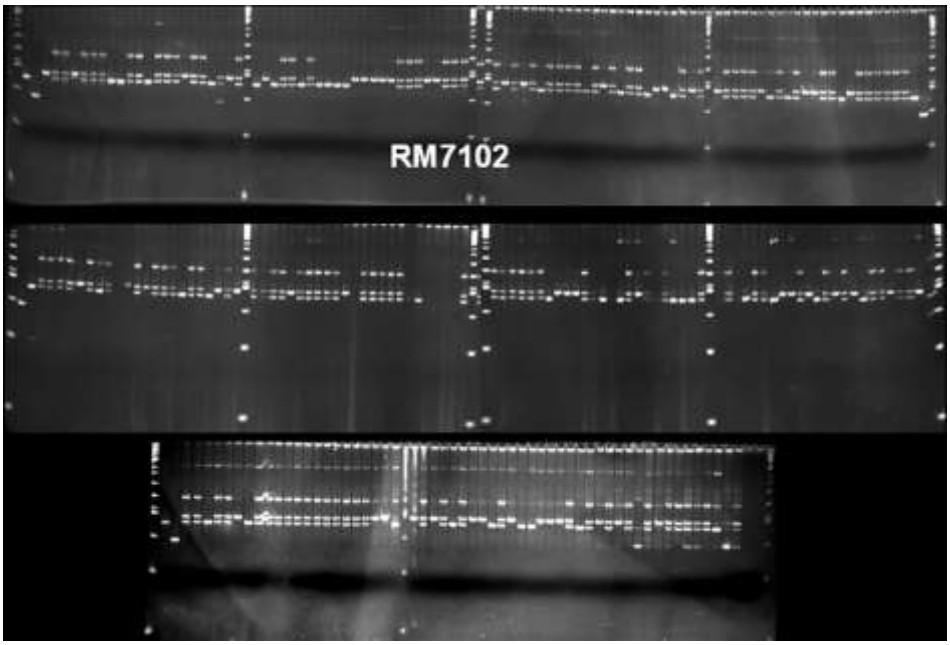


Fig. 8. Genotyping of BR28*3/ *O. rufipogon* (Ac. No. 105890) population with RM7102

Name and Designation

1. Md. Enamul Hoque, Ph D

Chief Scientific Officer (Additional Charge) & Head

2. Shahanaz Sultana, Ph D
   Senior Scientific Officer

3. Jannatul Ferdous, Ph D
   Senior Scientific Officer

4. Nilufar Yasmin Shaikh, Ph D
   Senior Scientific Officer

5. S.M. Hisam Al Rabbi, MS*
   Scientific Officer

6. Ripon Kumar Roy, MS
   Scientific Officer

7. Shampa Das Joya, MS
   Scientific Officer

8. Md Arafat Hossain, MS
   Scientific Officer

* = abroad for higher studies

BRRI ANNUAL REPORT
July 2014 - June 2015
Genetic Resources and Seed Division
Bangladesh Rice Research Institute, Gazipur-1701

CONTENTS

Mohammad Khalequzzaman, *PhD*
Chief Scientific Officer and Head
Mir Sharf Uddin Ahmed, *PhD*
Principle Scientific Officer
Ebna Syod Md. Harunur Rashid, *PhD*
Senior Scientific Officer
Md. Abubakar Siddique, *MS*
Senior Scientific Officer
Armin Bhuiya, *MS*
Scientific Officer
Hasina Begum, *PhD*
Scientific Officer
Mohammad Zahidul Islam, *PhD*
Scientific Officer
Md. Humayun Kabir Baktiar, *MS*
Scientific Officer

SUMMARY

During Aus, T. Aman and Boro 2014-15, 268 rice germplasm were collected from different districts of Bangladesh. Forty germplasm accessions in T. Aus, 49 in T. Aman and 47 in Boro seasons were characterized against 53 morpho-agronomic traits. Rejuvenation of 1756 accessions was performed during reporting year of which 572 accessions and 14 new collections in T. Aus, 603 accessions in T. Aman and 581 accessions in Boro. Again, 566 accessions in Aus, 603 in T. Aman and 581 in Boro were conserved in short term storage, while 200 and 176 accessions in Aus, 356 and 221 accessions in T. Aman and 329 and 398 accessions in Boro were conserved in medium and long term storages, respectively, during 2014-15. Apart from this, 60 new germplasm were registered as accession (from accession 7985 to 8044) in BRRI Genebank. Genetic diversity was pronounced in 54 Biroin rice germplasm and 31 BRRI developed boro rice varieties on the basis of fourteen morpho-agronomic and yield contributing characters and the varieties were grouped into six and five clusters, respectively. Moreover, 2529 samples of rice germplasm and BRRI developed rice varieties were supplied to different users.

Nucleus stock of 66 BRRI developed and recommended rice varieties were maintained. In total, 116.98 tons of breeder seed of which 37.17 tons from 31 varieties in T. Aman and 79.81 tons from 14 varieties in Boro were produced. Besides, 106.13 tons of breeder seed of which 31.03 tons from 24 varieties in T. Aman, 71.34 tons from 14 varieties in Boro and 3.76 tons from 10 varieties in Aus were distributed among the 'Rice Seed Network' partners. The number of the network partners (GO, NGO and PS) reached to >700 on 2015. Again, 1604 kg seeds of T. Aman, 3047 kg of Boro and 282 kg of Aus varieties were also distributed as quality seed (QS) during the reporting year. However, breeder and foundation seed producing plots and farms were also visited to monitor the varietal purity and performance of respective seed.

RICE GERMPLASM CONSERVATION AND MANAGEMENT

Germplasm Collection and Acquisition. Five collection missions were made during the reporting year and 268 rice germplasm of which 47 in Aus, 204 in T. Aman and 17 in Boro were collected from different districts of Bangladesh.

Germplasm Rejuvenation for Storage. Rice germplasm was rejuvenated to increase the seed for safe storage in the Genebank. The accessions which possessed less than 80% germination and stored before 2010 were used in the experiment. The experiment was carried out under transplant conditions using single row of 5.4 m long per accession with a spacing of 20 × 20 cm between rows and plants, respectively. Fertilizers were applied @ 60:20:40 kg NPK/ha in T. Aus and T. Aman and @ 80:20:40 kg NPK/ha in Boro seasons.

A total of 1,756 germplasm of which 572 accessions and 14 new collections in T. Aus, 603 accessions in T. Aman and 581 accessions in Boro 2014-15 were rejuvenated in field for getting fresh seed and on an average 500 g of seed were produced per accession.

Characterization and Documentation of Germplasm Accessions. Three experiments were conducted to characterize rice germplasm in Aus, Aman and Boro using 53 morpho-agronomic traits. The experiments were conducted in BRRI Gazipur using a single row of 5.4 m long for each entry/accession with a spacing of 25 x 20 cm between rows and plants respectively. One hundred and thirty six (136) accessions of which 40 in T. Aus, 49 in T. Aman and 47 in Boro were used for characterization. Fertilizers were applied @ 60:20:40 kg NPK/ha in T. Aus and T. Aman and @ 80:20:40 kg NPK/ha in Boro.

In Aus 2014, 15 varieties had medium (100-120 days) and 25 varieties had long (>120 days) growth duration (Table 1). Twelve germplasm were found with short (<90 cm) and 28 with moderate (90-125 cm) plant height. Two germplasm were found with very long (>30 cm), 17 with long (26-30 cm), 19 with medium (21-25 cm) and the rest (01) with short (<20 cm) panicle length. Maximum (24) varieties possessed low (<6) number of effective tillers, whereas 12 varieties possessed intermediate (6-10) and three had many (>10) effective tillers. Considering grain length breadth ratio, maximum varieties (19) were found with medium (2.1-2.5) type, 11 were bold (<1.5), eight were medium slender (2.6-3.0) and only one variety was slender (>3.0) type. For 1000-grain weight (TGW), fifteen varieties had very low (<15 g), 16 with low (16-19) and eight varieties had medium (20-23 g). Eight varieties/accessions had higher (>10 g) yield/hill which may be used in future breeding programme if other characters satisfy the breeding objective.

The shortest growth duration (107 days) was observed in Panbira (acc. 50) and Hasikalmi (acc. 30) and the longest (149 days) in Sada galon (acc. 7699). Also the shortest plant height (71.66 cm) was observed in Sada galon (acc. 7699) and the longest (115.4 cm) in Kumari (acc. 1936). The highest number of effective tillers (13.60) was observed in Tokday (acc. 7247) and the lowest (1.0) in Dharial (acc. 18). The highest grain length breadth ratio (3.06) was observed in Chhuri dhan (acc. 7697) and the lowest (1.54) in Paspai (acc. 51). Three varieties having accession number 7756 (Majoaishe), 56 (Pusur) and 51 (Paspai) had the lowest (10 g) and the accession number 7249 (Mongthong) had the highest (22 g) TGW. The highest yield per hill (19.8 g) was observed in Dang mese (acc. 7772) and the lowest (3.0 g) in Kaisha pajra (acc. 4228).

In T. Aman 2014, one accession had short growth duration (<120 days), 11 had medium (120-130 days) and 37 had long (>130 days) growth duration (Table 1). Four germplasm were found with short (<110 cm), 2 with moderate (110-130 cm) and the rest (43) with long (>130 cm) plant height. Twenty eight germplasm were found with long (26-30 cm), 19 with medium (21-25 cm), one had very long (>30 cm) and the rest (1) with short (<20 cm) panicle length. Twenty nine varieties possessed intermediate (6-10), 14 varieties possessed many (>10) and six varieties possessed few (<6) number of effective tillers. Considering grain length breadth ratio, twenty five varieties were found with bold (<1.5) type, 17 with medium (2.1-2.5), four

with medium slender (2.6-3.0) and only two varieties were slender (>3.0) type. TGW of nine varieties were found having very low (<15 g), 11 varieties with low (16-19 g), 18 were with medium (20-23), eight were with high (24-27 g) and the rest (three) of the varieties/accessions with very high (>27 g). Four varieties possessed low (<5 g), 20 varieties moderate (5-10 g) and rest (25) of the varieties/accessions had higher (>10 g) yield/hill.

The shortest growth duration (110 days) was observed in China irri and the longest (159 days) in 6 varieties. The shortest plant height (77.2 cm) was observed in China irri and the longest (170.2 cm) in Kumra gota. Kuri agrahani was found with the highest number of effective tillers (16) and Natpasha with the lowest (4). The highest grain length breadth ratio (3.6) was observed in Nizer sail and the lowest (1.6) in Moynamoti. TGW of Kalojira and China irri had the lowest (7.3 g) and the Kumra gota had the highest (30.1 g). The highest yield per hill (31.3 g) was observed in Lal Joyna and the lowest (2.3 g) in Khoiya motor digha.

Table 1. Some important features of characterized germplasm during T. Aus 2014, T Aman 2014 and Boro 2014-15.

Season	Growth duration		Plant height		Panicle length		No. of tiller		No. of effective tiller		Grain LB ratio		1000-grain wt.		Yield/hill	
	Range	No. of entries	Range (cm)	No. of entries	Range (cm)	No. of entries	Range	No. of entries	Range	No of entries	Range	No of entries	Range (g)	No of entries	Range (g)	No. of entries
	<100 days	0	<90	12	<20	1	<10	29	<6	24	<1.5	0	<15	15	<5	11
	100-120 days	15	90-125	28	21-25	19	10-15	11	6-10	12	1.5-2.0	11	16-19	16	5-10	21
	>120 days	25	>125	0	26-30	17	>15	0	>10	3	2.1-2.5	19	20-23	8	>10	8
					>30	2					2.6-3.0	8	24-27	0		
											>3.0	1	>27	0		
T. Aus 2014	Shortest (107 days)	Acc. 50 (Panbira) Acc. 30 (Hasikalmi)	Shortest (66)	Acc.7699 (Sada galon)	Shortest (20)	Acc. No. 4228 (Kaisa pajra)	Lowest (3.25)	Acc. 7762 (Kapaning dhan)	Lowest (1.00)	Acc. No 18 (Dharial)	Lowest (1.54)	Acc. 51 (Paspai)	Lowest (10.00)	Acc. No. 7756 (Majoaishe), 56(Pusur), 51(Paspai)	Lowest (3.02)	Acc.4228 (Kaisha pajra)
	Longest (149 days)	Acc. 7699 (Sada galon)	Longest (115.4)	Acc. 1936 (Kumari)	Longest (31.25)	Acc. 7762 (Kapaning dhan)	Highest (14.80)	Acc. 7247 (Tokday)	Highest (13.60)	Acc. 7247 (Tokday)	Highest (3.06)	Acc. 7697 (Chhuri dhan)	Highest (22.00)	Acc. 7249 (Mongthong)	Highest (19.83)	Acc. 7772 (Dang mese)
	Mean	124.90				24.76		8.22		5.44		2.24		16.07		7.92
	Std. Dev.	11.29				2.83		2.80		3.11		0.38		3.66		4.02
	CV	9.04				11.41		34.03		57.25		17.13		22.78		50.75
	LSD	3.50				0.88		0.87		0.96		0.12		1.13		1.24
	<120 days	1	<110	4	<20	1	<10	23	<6	6	<1.5	0	<15	9	<5	4
	120-130 days	11	110-130	2	21-25	19	10-15	23	6-10	29	1.5-2.0	25	16-19	11	5-10	20
	>130 days	37	>130	43	26-30	28	>15	3	>10	14	2.1-2.5	17	20-23	18	>10	25
T.A man 2014					>30	1					2.6-3.0	4	24-27	8		
											>3.0	2	>27	3		
	Shortest (110 days)	China irri	Shortest (77.2)	China irri	Shortest (19.4)	China irri	Lowest (5.6)	Natpasha	Lowest (4.2)	Natpasha	Lowest (1.639)	Moynamoti	Lowest (7.3)	Kalijira, China irri	Lowest (2.28)	Khoiya motor digha
	Longest (159 days)	6 Varieties	Longest (170.2)	Kumra gota	Longest (31.2)	Kalojira	highest (17)	Chapalaish	Highest (15.4)	Kuri agrahani	Highest (3.621)	Nizer sail	Highest (30.1)	Kumra gota	Highest (31.25)	Lal joyna
	Mean	138				25.24		10.30		8.94		2.18		20.09		11.58
	Std. Dev.	10.90				4.13		2.59		2.39		0.38		5.55		6.15
	CV	7.89				16.36		25.20		26.70		17.82		27.68		53.12
	LSD	3.05				1.15		0.72		0.67		0.10		1.55		1.72
Boro 2014-	<135 days	0	<100	12	<20	4	<10	18	<6	6	<1.5	0	<15	2	<5	37
	135-150 days	17	100-120	19	21-25	35	10-15	24	6-10	25	1.5-2.0	1	16-19	15	5-10	10

15	>150 days	30	>120	16	26-30	7	>15	5	>10	16	2.1-2.5	20	20-23	19	>10	0
					>30	1					2.6-3.0	16	24-27	10		
											>3.0	10	>27	1		

Table 1. Some important features of characterized germplasm during T. Aus 2014, T Aman 2014 and Boro 2014-15 (continued).

Season	**Growth duration**		**Plant height**		**Panicle length**		**No. of tiller**		**No. of effective tiller**		**Grain LB ratio**		**1000-grain wt.**		**Yield/hill**	
	Range	No. of entries	Range (cm)	No. of entries	Range (cm)	No. of entries	Range	No. of entries	Range	No of entries	Range	No of entries	Range (g)	No of entries	Range (g)	No. of entries
	Shortest (147 days)	Acc. 72 (Tupa boro)	Shortest (64.2)	Acc. 1795 (Dud saita)	Shortest (16.4)	Acc. 1795 (Dud saita)	Lowest (5)	Acc. 9 (Boro HY dhan)	Lowest (4)	Acc. 1795 (Dud saita)	Lowest (1.72)	Acc. 2189 (Kali boro)	Lowest (11.6)	Acc.1794 (Saita)	Lowest (2.00)	Acc.2272 (Zhong-HUA09)
	Longest (173 days)	Acc. 3803 Varieties (BR1083 -49-2-3-1)	Longest (140.4)	Acc. 2238 (Boro734)	Longest (32.2)	Acc. 5671 (Lal chikon)	Highest (28)	Acc.938 (Boro deshi)	Highest (25)	Acc.938 (Boro deshi)	Highest (4.66)	Acc. 5671 (Lal chikon)	Highest (29.2)	Acc. 1050 (Sonar geye)	Highest (6.29)	Acc. 257 (Kumri boro)
	Mean	123.14				23.23		10.94		9.56		2.79		21.32		3.94
	Std. Dev.	5.83				2.93		3.94		3.57		0.52		3.78		1.08
	CV	4.74				12.62		35.94		37.34		18.68		17.73		27.58
	LSD	0.94				0.47		0.63		0.57		0.08		0.61		

In Boro 2014-15, 17 had medium (135-150 days) and 30 had long (>150 days) growth duration (Table 1). Twelve germplasm were found with short (<100 cm), 19 with moderate (100-120 cm) and the rest (16) with long (>120 cm) plant height. Four germplasm were found with short (<20 cm), 35 with medium (21-25 cm), seven with long (26-30 cm) and the rest (one) with very long (>30 cm) panicle length. Six varieties possessed low (<6), 25 varieties possessed intermediate (6-10) and 16 varieties possessed high (>10) number of effective tillers. Grains of ten varieties were slender (>3.0) type, 16 were medium slender (2.6-3.0), 20 were medium (2.1-2.5) and the rest one was bold type revealed from grain length breadth ratio. Considering TGW, two varieties had very low (<15 g), 15 varieties had low (16-19 g), 19 with medium (20-23 g), 10 with high (24-27 g) and one had very high (>27 g). Thirty-seven varieties possessed low (<5 g/hill) and 10 varieties possessed moderate (5-10 g/hill) yield.

The shortest growth duration (147 days) was observed in Tupa boro (acc. 62) and the longest (173 days) was observed in BR1083-49-2-3-1 (acc. 3803). The shortest plant height (64.2 cm) was observed in Dud saita (acc. 1795) and the longest (140.4 cm) in Badal Boro734 (acc. 2238). The highest number of effective tillers (25) was observed in Boro deshi (acc. 938) and the lowest (4) in Dud saita (acc. 1795). Accession number 1794 (Saita) has the lowest (11.6 g) and the accession number 1050 (Sonar geye) has the highest (29.2 g) TGW. The highest yield per hill (6.29 g) was observed in Kumri boro (acc. 257) and the lowest (2.0 g) in Zhong-HUA-no. 09 (acc. 2272). The variety having higher yield would be utilized in crossing programme, if other characters satisfy the breeder's objectives.

Germplasm Processing, Registration and Storage. One thousand seven hundred and fifty six (1756) germplasm were processed to conserve with respective accession number in different storages of Genebank. The germplasm were cleaned and dried with a seed moisture content of less than 9%.

Out of 1756 germplasm, 566 accessions in Aus, 603 in T. Aman and 581 in Boro 2014-15 were processed and stored in short term storage. Similarly, 200 and 176 accessions in Aus, 356 and 221 accessions in T. Aman and 329 and 398 accessions in Boro were stored in medium and long term storages, respectively. On the other hand, 60 germplasm were registered in accession book as new accession of which eight in Aus (from accession number 7985 to 7992) and 52 in T. Aman (from accession number 7993 to 8044).

Viability Testing, Periodic Evaluation and Routine Monitoring of Stored Germplasm. One hundred accessions in Aus, 150 in T. Aman and 125 in Boro seasons were checked randomly for viability (germination %) test in short term storage during 2014-15. Five tester varieties namely Dharial (acc. 649), Hashikalmi (3575), Purbachi (6207), Nizersail (1229) and Patnai-23 (52) were used as testers in the medium and long term storages and their viability were measured on six month interval usually on October and March of each year to predict the viability of germplasm in respective storages. Before storage of rice germplasm in the genebank, viability of the seed was also monitored.

Among the randomly selected 375 stored germplasm, 262 had viability between 80-90% and 35 had viability above 90%. The germplasm accessions stored during 2014-15 in short term storage were also found with more than 90% germination. Only 95 germplasm possessed less than 80% germination which will be grown in the following season. On the other hand, the range of germination percentages of the five test samples/testers in the medium and long term storages conducted in October 2014 and March 2015 were 76-96% and 72-97%, respectively which indicate the viability condition of stored germplasm in mid and long term storages.

Rice Germplasm Distribution/Exchange. A total of 2,529 samples of rice germplasm as well as BRRI developed rice varieties in Aus, Aman and Boro seasons were supplied to different users. Among the samples, 1759 germplasm samples were supplied for research purpose and 770 samples of BRRI varieties were supplied to Department of Agricultural Extension (DAE) personnel and university students for research, demonstration as well as other purposes during reporting year.

SEED PRODUCTION AND VARIETY MAINTENANCE

Variety maintenance: Using panicle to row method, eighty (80) BRRI developed and recommended rice varieties including 14 local improved varieties (LIV) were maintained (Table 2).

Nucleus Seed Production: A total of 45 modern varieties (MV's) of which 31 in T. Aman and 14 in Boro were grown as nucleus stock to maintain genetic purity and homogeneity of morphological characteristics of BRRI developed and recommended rice varieties and to keep as the source of breeder seed. These nucleus seeds would be used for Breeder seed production in the following seasons.

‘Panicle to row’ method was used to maintain nucleus stocks, where intact panicles were sown instead of threshed seeds. Off-type plants were identified and rogued out in each growth stage. At maturity, panicles from true to type plants of all the varieties were harvested and stored in controlled temperature (20°C with 40% RH).

Table 2. List of BRRI developed and recommended rice varieties maintained as nucleus stock.

Season	Type	Number	Variety name
T.	MV	33	BR4, BR5, BR10, BR11, BR21, BR22, BR23, BR24, BR25, BRRI dhan27, BRRI dhan30, BRRI dhan31, BRRI dhan32, BRRI dhan33, BRRI dhan34, BRRI dhan37, BRRI dhan38, BRRI dhan39, BRRI dhan40, BRRI dhan41, BRRI dhan42, BRRI dhan43, BRRI dhan44, BRRI dhan46, BRRI dhan48, BRRI dhan49, BRRI dhan51, BRRI dhan52, BRRI dhan53, BRRI dhan54, BRRI dhan56, BRRI dhan57, BRRI dhan 62
	LIV	8	Nizersail, Latisail, Rajasail, Kalijira, Kataribhog, Basmati-D, Patnai23, Tilockkachari
Bor	MV	33	BR1, BR2, BR3, BR6, BR7, BR8, BR9, BR12, BR14, BR15, BR16, BR17, BR18, BR19, BR26, BRRI dhan28, BRRI dhan29, BRRI dhan35, BRRI dhan36, BRRI dhan45, BRRI dhan47, BRRI dhan50, BRRI dhan55, BRRI dhan58, BRRI dhan59, BRRI dhan60, BRRI dhan61, BRRI dhan63, BRRI dhan64, BRRI dhan65, BRRI dhan67, BRRI dhan68, BRRI dhan69
	LIV	6	Hbj Boro II, Hbj Boro IV, Hbj Boro VI, Hbj Boro VIII, Purbachi, IR8

Breeder Seed Production and Distribution. GRSD, Farm Management Division and eight regional stations of BRRI were engaged in breeder seed production as per national demand during 2014-15. The BS plots were visited to monitor the varietal purity and performances. Off-type plants were identified and rogued out in each growth stage. After harvesting of each variety, the seeds were separately threshed, dried, cleaned and stored in controlled temperature (20^0C with about 40% RH) at BRRI HQ, Gazipur. The harvested seeds then offered as lot for getting ‘tag’ from SCA for distribution.

A total of 116.98 tons of breeder seed, of which 37.17 tons from 31 varieties in T. Aman and 79.81 tons from 14 varieties in Boro were produced during 2014-15 (Table 3). On the other hand, 106.13 tons of breeder seed, of which 71.34 tons from 14 varieties in Boro and 3.76 tons from 10 varieties in Aus and 31.03

tons from 24 varieties in T. Aman were distributed among the 'Rice Seed Network' partners (Tables 4, 5 and 6). Besides, 1604 kg seeds from 18 varieties of T. Aman, 3047 kg from seven varieties of Boro and 282 kg from eight varieties of Aus were also distributed as quality seed (QS) during 2014-15.

Monitoring Seed Production Plots/Farms. Breeder seed production plots of BRRI R/Ss Rajshahi, Rangpur, Habiganj, Comilla and Satkhira and foundation seed production farms of ACI (Rangpur), BRAC (Rangpur and Sirajganj) and BADC (Madhupur) were visited to monitor the varietal purity and performances of breeder and foundation seed. During the inspection, no major insect-pest damage was noticed in the visited plots. Varietal purity (%) was observed as an average of more than 99% in all the varieties except BRRI dhan48 in Madhupur BADC farm during Aus. The crops were found almost free from weeds. In maximum cases, isolation distance was properly maintained. Foundation Seed (FS) producers were advised to discard three meters boarder lines, where isolation distance was not maintained. Overall crop conditions and management was satisfactory. The seed producers were also advised for thorough rouging by themselves for one more time before harvesting.

Table 3. Production of breeder seed in 2014-15.

Variety	Production (kg)										
	GRS Division	Farm Division	BRRI RS Rangpur	BRRI RS Rajshahi	BRRI RS Habiganj	BRRI RS Comilla	BRRI RS Bhanga	BRRI RS Sonagazi	BRRI RS Barisal	BRRI RS Satkhira	Total
T. Aman											
BR10	140					1120					1260
BR11	520			2040							2560
BR21	140										140
BR22	140	1000									1140
BR23	160								520		680
BR24	70										70
BR25	120										120
BRRI dhan27	100								340		440
BRRI dhan30	480										480

BRRI dhan31	100										100
BRRI dhan32	140							720			860
BRRI dhan33	220			2120							2340
BRRI dhan34	120			1520				440			2080
BRRI dhan37	120										120
BRRI dhan38	100										100
BRRI dhan39	140										140
BRRI dhan40	140										140
BRRI dhan41	140								400		540
BRRI dhan42	250										250
BRRI dhan43	150										150
BRRI dhan44	280							400			680
BRRI dhan48	170				600	720			130		1620
BRRI dhan49	360	2600				3680				3200	9840
BRRI dhan51	800										800
BRRI dhan52	720		1000		2440				1480		5640
BRRI dhan53	140									400	540
BRRI dhan54	240										240
BRRI dhan56	380		880	400							1660
BRRI dhan57	120		760			400					1280
BRRI dhan62	200		840								1040
Nizersail	120										120
Sub total	7020	3600	3480	6080	3040	5920		1560	2350	3600	37170
Boro											
BR3	360										360
BR14	520							720			1240
BR16	440				960			1000			2400
BR26	200										200
BRRI dhan28	2400	3240	1440	3680	5720	5880	6120	1000	4280	4580	38340
BRRI dhan29	800		840	4120	840	10680	3680	1160	800	1720	24640
BRRI dhan36	720										720
BRRI dhan45	440										440
BRRI dhan47	240								1960		2200
BRRI dhan50	880					960					1840

BRRI dhan55	2040										2040
BRRI dhan58	680		1000			840				2400	4920
BRRI dhan59	250										250
BRRI dhan61	220										220
Sub total	10190	3240	3280	7800	7520	18360	9800	3880	7040	8700	79810
Grand total	**116,980**										

Table 4. Distribution of breeder seed in Boro 2014-15.

Type of the Organization	Number of the Organizations	Variety and quantity (in kg)														Total
		BR3	BR14	BR16	BR26	BRRI dhan28	BRRI dhan29	BRRI dhan36	BRRI dhan45	BRRI dhan47	BRRI dhan50	BRRI dhan55	BRRI dhan58	BRRI dhan59	BRRI dhan61	
GO	**5**	140	110	50	160	6800	4340	0	0	700	30	30	430	50	60	12900
NGO	**13**	0	60	80	0	2100	880	0	0	10	80	0	230	20	10	3470
PS	**673**	0	230	1450	0	28780	18360	130	110	130	1655	470	3540	40	80	54975
Total	**691**	140	400	1580	160	37680	23580	130	110	840	1765	500	4200	110	150	71345

Table 5. Distribution of breeder seed in Aus 2014-15.

Type of the Organization	Number of the Organizations	Variety and quantity (in kg)										Total
		BR3	BR14	BR16	BR21	BR24	BRRI dhan27	BRRI dhan42	BRRI dhan43	BRRI dhan48	BRRI dhan55	

GO	**3**	260	60	90	140	70	440	250	150	1150	390	3000
PS	**12**	0	0	0	0	0	0	0	0	580	180	460
Total	**15**	260	60	90	140	70	440	250	150	1730	570	3760

Table 6. Distribution of breeder seed in T. Aman 2014-15.

Type of the Organization	**Number of the Organizations**	**Variety and quantity (in kg)**																								**Total**
		BR10	**BR11**	**BR22**	**BR23**	**BR25**	**BRRI dhan30**	**BRRI dhan31**	**BRRI dhan32**	**BRRI dhan33**	**BRRI dhan34**	**BRRI dhan38**	**BRRI dhan39**	**BRRI dhan40**	**BRRI dhan41**	**BRRI dhan44**	**BRRI dhan49**	**BRRI dhan51**	**BRRI dhan52**	**BRRI dhan53**	**BRRI dhan54**	**BRRI dhan56**	**BRRI dhan57**	**BRRI dhan62**	**Nizersail**	
GO	**8**	1820	540	100	250		450	10	300	1000	150	50	140	100	200	60	4610	570	1330	350	240	880	780	840	50	13820
NGO	**9**	20	230	60	140	0	0	0	0	20	20	0	0	10	70	0	260	10	260	30	0	140	40	0	0	1310
PS	**241**	360	1730	710	370	110	60	50	520	1230	1670	40	20	30	270	220	4730	200	2640	0	0	490	220	200	30	15900
Total	**258**	120	2500	870	760	110	510	60	820	225	184	90	160	140	540	280	9600	780	4230	380	240	1510	1040	1040	80	3100

0	0	0	0	0	0	0	3 0

EXPLORATORY AND GENETIC STUDIES

Selection Criteria and Genetic Diversity of T. Aman Germplasm. Fifty-four Biroin accessions were grown under rainfed condition with three replications for diversity analysis with 14 morpho-agronomic characters. Based on D^2 analysis, the varieties/germplasm were grouped into six clusters. Maximum genotypes (20) were clubbed in cluster V and minimum (one) in cluster II (Table 7). The intra-cluster and inter-cluster distances ranged from 0.00 to 0.92 and 2.93 to 19.14, respectively, (Table 8) which clearly indicated the presence of variability in the germplasm of different clusters. Principal component analysis (PCA) scores also indicate a high degree of genetic diversity among the genotypes. The highest cluster means for grain yield hill^{-1} along with panicle length, grain length and grain LB ratio were obtained from cluster IV (Table 9) and the shortest growth duration, the highest flag leaf length and plant height were obtained from cluster III, whereas the highest effective tiller number and filled grain number panicle^{-1} were observed in cluster VI which also produced higher inter cluster-values over other clusters. Therefore, the genotypes of cluster between III & IV, and cluster III & VI can be used in hybridization programme to produce higher yielding genotypes as they are more distant.

Table 7. Distribution of 54 Biroin rice germplasm for 14 agro-morphological characters.

Cluster	No. of genotypes	Name of genotypes (acc. no.)
I	9	Boron (90), Boron (91), Boruin (831), Boroin (Hawai)(836), Makri Boroin (838), Kachra Boron (1339), Boron (3313), Biron (3449), Kalo Birion (5700)
II	1	Makri Boroin (862)
III	3	Kalaboron (1158), Biron (1972), Dharia Boron (3707)
IV	9	Boron Dhan (394), Boruin (833), Dulaiboron (1193), Holud Boron (3265), Boron (3637), Biran (4104), Aikka Birion (5697), Hati Birion (5705), Kaika Biruin (7589)
V	20	Boroi (241), Biron (670), Boroin (Kalamur) (834), Boroin (Makri)(835), Boroin (Habai)(837), Boron (1257), Boron (4142), Mou Birion (5698), Mou Birion (5699), Push Birion (5701), Paich Birion (5702), Biruin (7357), Lakhai Biruin (7508), Sada Biruin (7530), Mekli Biruin (7539), Modhu Biruin(7545), Pak Biruin (7555), Deshi Biruin (7571), Munshi Biruin (7576), Kala Biruin(7590)

VI	12	Boron (Taramukut)(497), Boruisail (832), Boroi Dhan (861), Birui Dhan (5108), Brani Dhan (5281), Khara Birion (5703), Lal Birion (5704), Sada Birion (5706), Kalo Biruin (7532), Kala Biruin (7536), Mikal Biruin (7556), Boaincha Biruin (7573)

Table 8. Average intra-(bold) and inter-cluster distances (D^2) for 54 Biroin rice germplasm.

Clusters	I	II	III	IV	V	VI
I	**0.84**					
II	11.48	**0.00**				
III	8.45	19.14	**0.92**			
IV	5.64	9.39	13.86	**0.72**		
V	3.52	8.02	11.75	4.07	**0.68**	
VI	6.39	6.48	14.82	2.93	3.25	**0.86**

Table 9. Cluster means of 54 Biroin rice germplasm for 14 agro-morphological characters.

Cluster	Seedling height (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Days to 50% flowering	Effective tiller number per hill	Plant height (cm)	Days to maturity	Panicle length (cm)	Filled grain number per panicle	Un-filled grain number per panicle	Grain length (mm)	Grain LB ratio	1000-grain weight (g)	Grain yield per hill (g)
I	60	39.5	1.39	103	8.5	132	134	27.0	89.7	34.5	8.55	2.73	24.0	11.20
II	62	38.4	1.43	139	8.9	113	168	25.5	112.9	21.7	8.36	2.58	26.1	12.15
III	56	45.4	1.33	86	6.1	108	118	22.2	52.1	19.2	8.17	2.65	20.0	8.42
IV	63	39.6	1.56	104	7.6	138	135	27.8	135.7	22.5	8.71	2.96	22.3	13.96
V	60	42.7	1.40	109	8.9	122	139	27.5	107.5	18.0	8.73	2.93	21.9	11.58

VI	58	43.1	1.42	108	9.4	117	139	26.9	143.1	21.3	8.16	2.95	19.1	11.23

Selection Criteria and Genetic Diversity of *Boro* Germplasm. Thirty-one BRRI developed *Boro* rice varieties were grown under irrigated condition with three replications for diversity analysis with 13 morpho-agronomic characters. Based on D^2 analysis, the varieties were grouped into five clusters. Maximum genotypes (13) were clubbed in cluster V and minimum (2) in cluster I (Table 10). The intra- and inter-cluster distances ranged from 0.60 to 0.76 and 4.18 to 13.82, respectively (Table 11). Principal component analysis (PCA) scores also indicate a high degree of genetic diversity among the genotypes. The highest cluster means for yield hill^{-1} along with seedling height, flag leaf width, panicle length and 1000-grain weight were obtained from cluster III (Table 12) and the shortest growth duration and the longest grain length from cluster IV, whereas the highest flag leaf length, effective tiller number hill^{-1} and the lowest un-filled grain number panicle^{-1} were obtained from cluster I which also generated higher inter cluster-values over other clusters. Therefore, the genotypes of cluster between IV & I and cluster III & I can be used in hybridization programme to produce high yielding genotypes as they are more distant.

Table 10. Distribution of 31 BRRI developed *Boro* rice varieties into five clusters.

Cluster	No. of genotypes	Name of genotypes (acc. no.)
I	2	BR2, BR7
II	4	BR15, BR16, BRRI dhan29, BRRI dhan35
III	5	BR8, BR9, BR17, BR18, BR19
IV	7	BRRI dhan45, BRRI dhan47, BRRI dhan50, BRRI dhan55, BRRI dhan60, BRRI dhan68, BRRI dhan69
V	13	BR1, BR3, BR6, BR12, BR14, BRRI dhan28, BRRI dhan36, BRRI dhan56, BRRI dhan58, BRRI dhan59, BRRI dhan61, BRRI dhan63, BRRI dhan64

Table 11. Intra-(bold) and inter-cluster distances (D^2) for 31 BRRI developed *Boro* rice.

Clusters	I	II	III	IV	V
I	**0.60**				

II	6.72	**0.66**			
III	10.29	6.21	**0.72**		
IV	10.46	5.40	7.06	**0.76**	
V	13.82	8.24	8.14	4.18	**0.73**

Table 12. Cluster means of 13 agro-morphological characters for 31 *Boro* rice.

Cluster	Seedling height (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Effective tiller number per hill	Plant height (cm)	Days to maturity	Panicle length (cm)	Filled grain number per panicle	Un-filled grain number per panicle	Grain length (mm)	Grain LB ratio	1000-grain weight (g)	Grain yield per hill (g)
I	22	35.0	1.38	11.6	102.2	171	25.3	165.0	21.1	7.69	2.90	23.15	8.89
II	20	29.4	1.32	11.6	89.1	171	25.3	125.4	22.5	8.81	3.33	22.00	7.85
III	25	30.7	1.39	9.7	110.9	174	26.9	112.0	18.7	8.62	3.13	25.28	9.20
IV	22	29.0	1.18	10.1	78.5	162	23.8	102.1	12.0	9.05	3.59	23.99	9.19
V	22	27.6	1.16	10.5	74.9	165	23.1	73.7	14.7	8.79	3.30	23.97	9.07

Pure Seed Multiplication of Popular Rice Germplasm of Southern Region. To purify the popular rice germplasm of southern region and for delivering seed to the farmers, 35 popular rice germplasm in which eight from *Sadamota* (acc. no. 961, 1040, 1576, 5331, 7501, 7787, 7788, 7923), six from *Lalmota* (acc. no. 1039, 1583, 1584, 7295, 7889, 7890), four from *Jesso-Balam* (acc. no. 2454, 2464, 2465, 2477), three from *Khajur Jhupi* (acc. no. 40, 2551 and 2552), two from *Khejur Chhori* (acc. no. 4246 and 4247) and 12 from *Bashful* (acc. no. 72, 466, 1300, 1471, 1508, 3852, 3954, 3996, 4010, 4215, 5318 and 7418) groups were grown during T. Aman 2014, using a single row of 5.4 m long per entry and with a spacing of 20 x 20 cm between rows and plants respectively. Fertilizers were applied @ 60:20:40 kg NPK/ha. Intensive/rigorous roguing was done at each growth stage of the crop.

On the basis of the agro-morphological characters, four genotypes of *Sadamota* (acc. no. 1040, 1576, 7788 and 7923), three of *Lalmota* (acc. no. 1583, 1584 and 7889), one of *Jesso-Balam* (acc. no. 2464), three of *Khejur Jhupi* (acc. no. 40, 2551 and 2552), one of *Khejur Chhori* (acc. no. 4246) and four of *Bashful* (acc. no. 466, 1300, 3996 and 4010) germplasm were selected for next T. Aman 2015 season (Table 13). In addition with these 16 selected germplasm, seven accessions of *Balam* (acc. no. 516, 720, 1013, 1011, 3643, 4836 and 4838) and six accessions of *Jesso-Balam* (acc. no. 2456, 2459, 2473, 2469, 2472 and 2480) have also been selected for growing on T. Aman 2015 taken from accessions list of BRRI Genebank on the basis of their previous performance records.

Table 13. Mean performance of *Sadamota*, *Lalamota, Balam*, *Khejur jhupi, Khejur chhori* and *Bashful* landraces during T. Aman 2014.

Sl. No.	Variety Name	Acc. No	Seedling height (cm)	Leaf area (cm^2)	Effective tiller number	Culm length (cm)	Days to maturity	Panicle length (cm)	Fill grain per panicle	Grain length (mm)	Grain LB ratio	1000 grain weight (g)	Grain yield per hill (g)	Grain yield per ha (ton)
1	**Sadamota**	961	36.0	33.8	10	65.4	122	24.2	58.8	6.62	2.50	2.8	7.79	3.1
2	**Sadamota**	1040	63.7	48.4	8.4	118.4	139	31.4	108.2	6.03	2.61	2.7	17.60	7.0
3	**Sadamota**	1576	58.2	46.8	6.4	122.6	131	28.6	102.8	5.74	2.35	2.8	13.74	5.5
4	**Sadamota**	5331	47.4	40.5	9	107.0	139	27.4	100.8	5.90	2.08	2.5	9.68	3.9
5	**Sadamota**	7501	60.2	40.4	8.6	112.8	154	26.4	104.4	6.85	2.30	3.4	8.38	3.4
6	**Sadamota**	7787	53.2	57.1	7	93.8	119	29.2	86.4	5.87	2.48	2.6	5.21	2.1
7	**Sadamota**	7788	56.6	38.9	12.4	111.2	151	24.4	107.8	6.41	2.04	2.9	10.76	4.3
8	**Sadamota**	7923	54.8	34.3	10	120.0	151	26.0	84.6	6.09	1.98	3.0	10.00	4.0
9	**Lalmota**	1039	58.8	28.9	9.6	130.0	151	24.2	72.0	6.35	2.02	3.0	5.93	2.4
10	**Lalmota**	1583	55.2	84.0	9.4	121.6	147	24.2	70.6	6.16	1.91	4.9	9.15	3.7
11	**Lalmota**	1584	56.4	36.8	9.6	110.8	147	25.0	91.4	6.52	2.17	3.4	9.33	3.7
12	**Lalmota**	7295	44.0	42.9	6.6	71.8	112	22.2	71.8	6.80	2.74	2.7	5.51	2.2
13	**Lalmota**	7889	51.8	33.0	6.6	113.2	151	25.8	87.4	5.96	2.01	3.0	8.25	3.3
14	**Lalmota**	7890	54.8	36.6	10.6	107.2	151	27.8	106.0	6.02	1.98	3.2	7.27	2.9
15	***Jesso balam***	2454	49.0	33.06	8.4	100.8	136	27.8	189.0	4.44	2.00	11.50	8.00	3.2
16	***Jesso balam***	2464	52.0	40.85	9.2	104.4	140	24.8	146.0	6.82	2.63	24.70	7.03	2.8
17	***Jesso balam***	2465	51.6	35.18	9	104.2	147	24.8	109.6	6.65	3.00	24.00	7.48	3.0
18	***Jesso balam***	2477	41.4	44.28	8.6	98.6	137	25.4	147.0	6.16	1.97	21.60	9.89	4.0
19	**Khiraijali**	40	43.2	40.57	8.6	129.8	142	30.0	96.2	5.91	2.10	21.20	6.72	2.7
20	**Khejur jhupi**	2551	47.8	48.55	5	119.8	145	19.8	101.8	6.37	2.26	25.50	6.12	2.4
21	**Khejur jhupi**	2552	50.4	52.65	5.4	124.2	145	21.0	101.6	5.82	2.06	24.40	7.21	2.9
22	**Khejur Chhori**	4246	50.2	53.21	7	111.4	143	28.2	119.4	6.55	2.86	26.60	8.20	3.3
23	**Khejur Chhori**	4247	29.2	33.26	7.6	53.2	121	23.0	71.4	5.85	2.76	23.50	2.95	1.2
24	**Bashful**	466	52.4	37.80	9.8	92.6	123	27.2	129.6	6.42	2.49	19.50	11.22	4.5
25	**Bashful**	72	47.2	32.87	6.8	108.8	144	25.4	91.2	6.23	2.62	20.90	5.43	2.2
26	**Bashful**	1300	51.6	37.67	7.4	119.8	126	27.0	142.8	6.46	2.21	27.10	10.58	4.2
27	**Bashful**	1471	46.4	33.66	6.6	93.8	113	24.6	91.8	5.16	1.96	18.90	2.77	1.1
28	**Bashful**	1508	45.0	36.58	8.8	106.4	146	25.2	147.6	6.30	2.67	19.30	6.30	2.5

29	**Bashful**	3852	49.8	54.03	11.4	106.8	144	22.0	130.6	6.65	2.88	17.20	6.28	2.5
30	**Bashful**	3954	39.4	38.40	7	103.2	120	23.6	127.2	3.62	1.47	14.10	3.93	1.6
31	**Bashful**	3996	51.0	35.70	12.2	107.4	123	25.0	86.8	5.90	2.45	22.60	9.59	3.8
32	**Bashful**	4010	35.8	55.92	5.6	102.2	133	26.4	141.8	6.50	2.26	32.70	9.74	3.9
33	**Bashful**	4215	52.8	43.04	10.2	95.4	120	25.6	102.4	5.82	2.41	22.40	8.52	3.4
34	**Bashful**	5318	49.0	38.88	10.8	127.8	144	25.6	102.8	6.51	2.63	27.30	8.69	3.5
35	**Bashful**	7418	41.0	42.84	10	95.6	131	23.4	110.6	6.92	2.97	22.60	6.20	2.5
Minimum/Lowest			**29.2**	**28.9**	**5**	**53.2**	**112**	**19.8**	**58.8**	**3.62**	**1.47**	**2.5**	**2.77**	**1.1**
Maximum/Highest			**63.7**	**84**	**12.4**	**130**	**154**	**31.4**	**189**	**6.92**	**3**	**32.7**	**17.6**	**7**

SUMMARY

Excessive free radicals trigger oxidative stress, which implicates the pathogenesis of various physiological disorders. Maintenance of oxidative balance in the brain is tightly regulated by antioxidants. An overall antioxidant status can be evaluated by clinical parameters like TIBC, transferrin, iron, uric acid and albumin in blood serum. Based on different level of TPC, FRAC and TAC, four HYV rice like BR5, BR16, BRRI dhan28 and BRRI dhan29 were selected to investigate the effect of dietary administration of these rice varieties in improving the antioxidant status in rat model. Different levels of antioxidant enriched HYV rice varieties like BR5, BR16, BRRI dhan28 and BRRI dhan29 were systematically fed to Long Evan rats for four weeks under clinical experiment and data reveal that antioxidant status measuring parameters like serum TIBC, transferrin, uric acid and albumin persisted the most elevated level in BR5 rice treatment among other rice varieties, which positively correlate healthy antioxidant status in rat blood serum. Thus we conclude that antioxidant enriched rice in dietary pattern improve the antioxidant status in rat. Being rich in nutritional value and food functionality, pre-germinated brown rice has added advantage over polished milled rice or brown rice considering physiological, clinical and nutritional aspects. Important amino acids like GABA, Glutamic acid, Methionine, Lysine, Histidine and Arginine were analyzed for rice varieties including both traditional and HYVs in Bangladesh in different conditions like brown rice and pre-germinated brown rice. Our data reveal that BRRI dhan31 possess the elevated content of GABA among ten selected HYV and local traditional rice varieties. Since GABA has nutritionally potential to mediate recovery to many disorders like diabetics, hypertension, alzheimer's disease so dietary administration of BRRI dhan31 at pre-germinated brown rice condition might be supportive to get a better healthy lifestyle. In addition, we have produced PGBR rice byproduct like GABA rice ball, GABA plain cake and GABA biscuit to popularize GABA rice byproduct for attaining value added foods in Bangladesh.

Nutritional Quality Assessment of Rice

Exp.1: Title: Estimation of antioxidant status in BRRI rice varieties using experimental rat model in 2015.

PI: Habibul Bari Shozib (HBS) CI: Muhammad Ali Siddiquee (MAS)

Introduction: Free radicals have been implicated in the progression of numerous conditions including cancer, diabetes, cardiovascular disease, ageing and neurological disorders. Human body has three levels of defense against free radical attack. Preventative antioxidants are to inhibit the formation of free radicals e.g. metal binding proteins like Ceruloplasmin, Metallothionine, Albumin, Transferrin, Ferritin and Myoglobin. Scavenging antioxidants are to remove any reactive species once formed. e.g. Superoxide Dismutase, Glutathione Peroxidase, Catalase and small molecules such as Ascorbate, Tocopherol, Bilirubin, Uric Acid, Carotenoids and Flavonoids. Finally repair enzymes has to correct the damaged biomolecules e.g. DNA repair enzymes. Rice has the potential to promote human health, due to its content of phenolic compounds that are able to inhibit the formation or reduction of the concentrations of reactive cell-damaging free radicals, thereby reducing the risk of coronary heart disease and cancer (Victor et al, 2009 and Wahle et al, 2010) and preventing oxidative damage of lipid and low-density lipoproteins (Vauzour et al, 2010). Alak et al (2012) reported that BR5 rice contained the highest Total Phenolic Content (TPC), Ferric Reducing Antioxidant Power (FRAP) and Total Antioxidant Capacity (TAC), BRRI dhan28 and BRRI dhan29 had intermediate level and BR16 had the lowest among all the tested HYV rice varieties. Bangladesh Rice Research Institute (BRRI) has developed about 72 high yielding variety (HYV) but have not yet tested its' antioxidant effects although rice is the staple food in Bangladesh and in some Asian countries. In the present study, we have selected BR5, BR16, BRRI dhan28 and BRRI dhan29 among the HYV rice developed by BRRI to test the effect of antioxidant properties in mammalian host like rat. Our study resembled the potential impact of antioxidant properties in the studied rice varieties on the improvement of mammalian immunity.

Objective: To evaluate the dietary administration of rice in improving the antioxidant status in vivo by a rat model of Long-Evan rat.

Materials and Methods: Twenty-three adult male Long-Evans rats from the stock colony of our Grain Quality and Nutrition (GQN) laboratory, BRRI, Gazipur (Collected mating rats from Bangladesh University of Health Sciences, Mirpur, Dhaka, Breeding at GQN laboratory under controlled condition), three months old (~12 weeks), weighing 150 ± 2g, were used in this study. Animals were housed individually in cages in a room maintained at 22–24°C with a controlled 12 hrs light–dark cycle, and had free access to tap water and cooked rice feed. Four rice BR5, BRRI dhan28, BRRI dhan29, BR16 samples were

cleaned and milled on a Satake test mill (Satake Corporation, Japan) for separating into bran and brown rice fraction. Brown rice was then polished 10% as milled rice. These milled rice were subjected to feed individual rat group for four weeks' time at twice meal per day as per requirement (0.89g cooked rice per meal for each rat equivalent to 5.94 gKg^{-1} body weight of rat). Following two week acclimatization with BRRI dhan29 at twice a day, the rats were allocated randomly to three groups of five animals each, ensuring the groups were balanced for body weight. After one week of interval for washout the effect of BRRI dhan29, commercial rat food were served. Then after Group1, Group2 and Group3 were fed BR5, BRRI dhan28 and BR16 respectively. Feeding of the experimental diets to rats lasted four weeks at twice meal a day. Unhemolyzed serum or heparinized or EDTA plasma was needed for clinical analysis. Thus, we anesthetized the rat(s) by using Diethyl ether and collected blood from jugular vein. Then blood samples were centrifuge at 6000 rpm for 15 minutes to get serum. Serum was stored at 4°C in a refrigerator until analysis. Serum Albumin, Uric acid and Iron were measured at 623 nm, 550 nm, 546 nm wavelength respectively and individual methodology describes the manual procedure to use the BioMed-Albumin kit (ALB100240), BioMed-Uric acid L.S kit (UA119100) and BioMed-IRON kit respectively. In quantitation of Serum TIBC and Transferrin, Excess ferric iron ($FeCl_3$) was added to rat serum specimen to saturate the transferrin. Remaining ferric iron was absorbed on $MgCO_3$. Bound iron in the supernatant is termed as TIBC, and assayed by Iron detection procedure of BioMed-IRON kit by Ferrozine method. Duncan's multiple range test (DMRT) was applied on Iron, TIBC, Transferrin, Uric acid and Albumin parameter for statistical analysis using SPSS, version 20.0.

Results and discussion: We fed our rats with BRRI dhan29 as a control for 14 days to accustom with food habit (only cooked rice) and controlled conditioned environment in a rat room of GQN laboratory, BRRI, Gazipur. Then we had use eight healthy rats to established normal range of different clinical parameters like Albumin, Uric acid, TIBC and Transferrin in rat serum for our laboratory. Clinical data explains the normal range of Albumin, Uric acid, TIBC and Transferrin in Lang Evan rat by 2.59±0.18 g dL^{-1}, 2.32±0.29 mg dL^{-1}, 257.59±16.36 µg dL^{-1} and 214.66±13.63 µg dL^{-1} (Fig1, n=8, All data are not shown graphically) respectively. After one week of interval for washout the effect of BRRI dhan29, commercial rat food were served. Then after cooked BR5 rice was fed for 28 days twice meal per day in group1 rats (n=5),

Fig 1: Normal values of TIBC and Transferrin in rat blood serum.

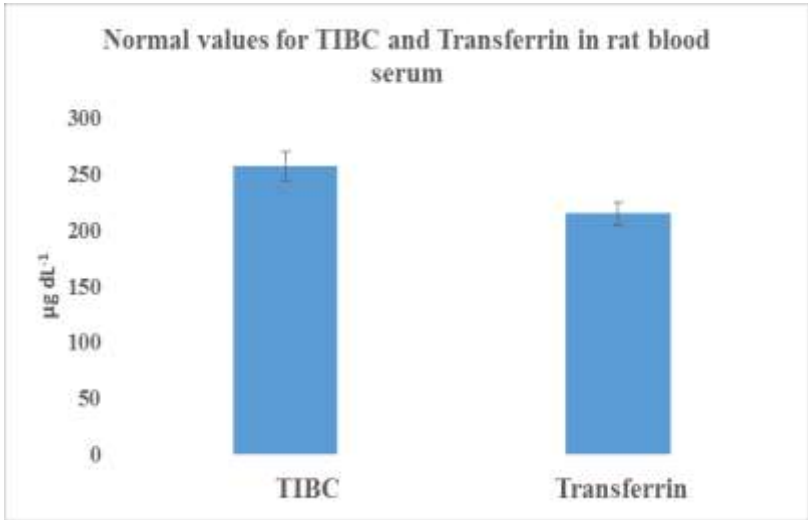


Table 1: Clinical parameters (Iron, TIBC, Transferrin, Uric acid and Albumin) of measuring Antioxidant status in rat serum (n=5 rats for each group).

Group /Variety	Iron ($\mu g\ dL^{-1}$)	TIBC ($\mu g\ dL^{-1}$)	Transferrin ($mg\ dL^{-1}$)	Uric Acid ($mg\ dL^{-1}$)	Albumin ($g\ dL^{-1}$)
Group 1 (BR 5)	53.75^{a}	311.23^{a}	259.36^{a}	3.23^{a}	3.36^{a}
Group 2(BRRI dhan28)	88.79^{b}	266.38^{b}	221.99^{b}	2.86^{b}	3.06^{b}
Group 3 (BR16)	103.74^{c}	161.26^{c}	134.39^{c}	2.40^{c}	3.01^{c}
Any two means having common letter (s) are not statistically different at a $P< 0.05$, as measured by the Duncan Multiple Range Test (DMRT).					

We found the lowest level of iron content 53.75 µg dL^{-1} but very elevated level of TIBC 311.23 µg dL^{-1}, Transferrin 259.36 µg dL^{-1} Uric acid 3.23 mg dL^{-1} and Albumin 3.36 g dL^{-1}in rat blood serum of group1 (Table 1). On the other hand in group3 where BR16 cooked rice were fed, we found the highest level of iron content 103.74 µg dL-^{1}but the lowest amount of TIBC 161.26 µg dL^{-1}, Transferrin 134.39 µg dL-^{1}, Uric acid 2.40 mg dL^{-1} and Albumin 3.01 g dL^{-1} in rat blood serum (Table 1). In Group 2 rats revealed intermediate range of values for iron 88.79 µg dL-^{1}, TIBC 266.38 µg dL-^{1}, Transferrin 221.99 mg dL^{-1}, Uric acid 2.86 mg $dL^{-1}$and Albumin 3.06 g dL^{-1} in rat blood serum (Table 1). Oxidative stress occurs when the body is unable to eliminate the free radicals which are implicated in the pathogenesis of various neurological as well as physiological disorders. Maintenance of oxidative balance in the brain is tightly regulated by antioxidants (Becker, 1993). Free radicals are generated largely during the production of ATP in mitochondria. During this process, radicals leaking from the mitochondria form reactive oxygen species such as the superoxide anion and hydroxyl radicals. These species lead to the production of hydrogen peroxide from which further hydroxyl radicals are generated in a reaction that appear to depend on the presence of iron ions. These radicals have both beneficial and harmful actions in biological tissues. They are known to have a crucial role in stimulation of phagocytosis, induction of drug detoxification pathways and stimulation of signal transduction pathways (Droge 2002, Salganik 2001). However, these same radicals can be potentially dangerous products of cellular metabolism in that they can directly influence cell growth and development, cell survival and likely increase the pathogenesis of atherosclerosis, cancer, aging and several other conditions, including inflammatory disease. Uric acid is the antioxidant present in the highest concentration in human blood (Bindu et al, 2014). It functions as a paradox as it acts as an antioxidant in plasma or pro-oxidant within the cell (Enomoto, 2005 and Sautin, 2008). It measurements are used in the diagnosis and treatment of numerous renal and metabolic disorders including renal failure, gout, leukemia and psoriasis. Uric acid is a potent antioxidant contributing to around half the antioxidant capacity of blood plasma. It is a scavenging antioxidant that acts by inactivating free radicals such as HO^{-} and HOCI. Total Iron Binding Capacity (TIBC) measures the blood's capacity to bind iron with transferrin and is therefore an indirect measurement of transferrin. Iron is capable of stimulating the production of harmful free radicals. Plasma levels of transferrin are regulated by the availability of iron and increase when plasma levels of iron are low. Transferrin can be described as a preventative antioxidant and acts by binding iron in a redox inactive form. This process is extremely important as free iron is capable of stimulating the production of harmful free radicals. Albumin represents a very abundant and important circulating antioxidant. Albumin is the most abundant protein in serum representing 55-65% of the total protein. Its' main biological functions are to maintain the water balance in serum and plasma and to transport and store a wide variety of ligands e.g. fatty acids, calcium, bilirubin and hormones such as thyroxine. Recent

evidence suggests albumin may exert antioxidant properties by functioning as a serum peroxidase in the presence of reduced glutathione and it has an important role in ligand binding and free radical-trapping activities

Fig 2: TPC content of HYV varieties.

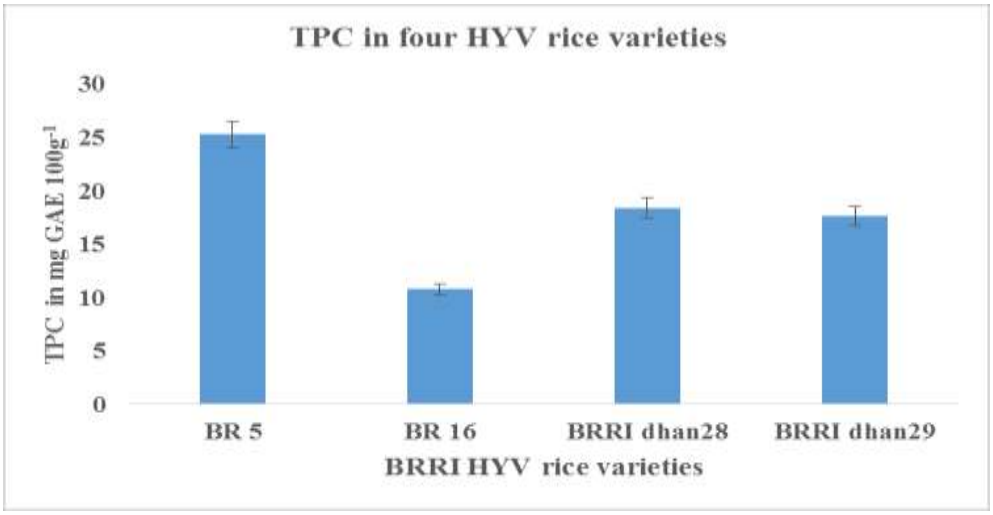
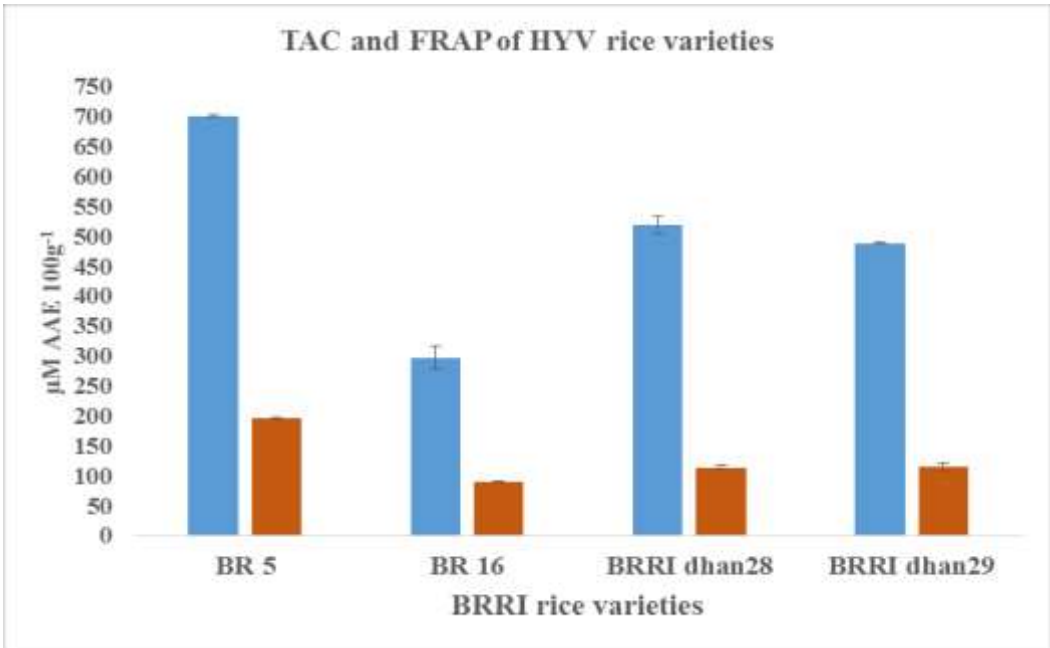


Fig 3: TAC and FRAP content of HYV rice varieties.



(Marjolaine, 2008). In Bangladesh, BRRI dhan28 and BRRI dhan29 are two mega high yielding rice varieties which covers most of the rice production area during boro season. On the other hand, BR5 is a popular aromatic rice with strong fragrance and BR16 is a low glycemic rice (Howlader, 2009). In 2012, Alak et al. in a comparative study on antioxidant properties of ten high yielding rice varieties of Bangladesh, reported that TPC was the highest in BR5 (25.30±0.52 mg GAE $100g^{-1}$) and the lowest was in BR16 (10.78±0.70 mg GAE $100g^{-1}$) among all ten tested varieties (Fig. 2). BRRI dhan28 and BRRI dhan29 had an intermediate score of 18.42±0.45 mg GAE $100g^{-1}$and 17.67±0.08 mg GAE $100g^{-1}$ respectively (Fig.2). Both antioxidant parameters like FRAP and TAC of these rice varieties were positively correlated with TPC (Fig 3). We have selected these varieties in this experiment. Since there were three deferent groups having three treatments, so Duncan's multiple range test (DMRT) was applied on Iron, TIBC, Transferrin, Uric acid and Albumin parameter for statistical analysis using SPSS, version 20.0. Our data revealed that high antioxidant enriched rice BR5 showed the lowest iron content 53.75 µg dL^{-1}among other rice varieties BR16 and BRRI dhan28. Since plasma levels of transferrin are regulated by the availability of iron and increase when plasma levels of iron are low, we found the content of transferrin in group 1 (rats) was a mean of 259.36 µg dL^{-1}. Mean values of TIBC, Uric acid and Albumin were elevated in group 1 compare to group2 and group3. Group3 had the highest free iron content of 103.74 µg dL^{-1} and lowest level of TIBC, Transferrin, Uric acid and Albumin among three groups (Table 1).

Conclusion: Comparative analysis of antioxidant status for dietary administration of high, intermediate and low antioxidant enrich HYV rice varieties of BR5, BRRI dhan28 and BR16 in rat model significantly correlate between the content of antioxidant properties of rice and antioxidant status in rat blood serum. Thus, we concluded that dietary administration of antioxidant enriched rice in improving the antioxidant status in rat blood serum has a significant impact indeed.

Commercial Rice Based Products

Exp.2: Title: Identification of γ-Aminobutyric acid (GABA) in rice and its health benefits as a value added food.

PI: Muhammad Ali Siddiquee (MAS) CI: Habibul Bari Shozib (HBS)

Introduction: Pre-germinated brown Rice (PGBR) alias germinated brown rice (GBR) or sprouted brown rice (SBR) enhances the bio-availability of nutrients by neutralizing phytic acid during germination process. Consumption of unsprouted grains can lead to poor absorption to nutrients in the grain. The incompletely digested proteins can irritate the intestines, leading to inflammation and allergic reactions. Neutralizing the phytic acid, releasing the proteins, vitamins, and enzymes allow these important nutrients to be absorbed during digestion. Brown rice (BR) can be soaked in water at 30°C for specified hours for germination to get PGBR. Soaking for 3 h and sprouting for 21 h has been found to be optimum for getting the highest GABA content in PGBR, which is the main reason behind the popularity of PGBR (Swati, 2011). During the process of germination, nutrients in the brown rice (BR) change drastically. Kayahara et al, (2001) showed that, not only existing nutrients are increased but new components are also released from the inner change due to germination. The nutrients which have increased significantly include GABA, Lysine, vitamin E, dietary fiber, niacin, magnesium, vitamin B_1, and vitamin B_6 (Kayahara, 2001, Kayahara, 2001). BR contains more nutritional components than ordinary white rice. PGBR has been reported to exhibit many physiological effects, including anti-hyperlipidemia, anti-hypertension, and the reduction in the risk of some chronic diseases, such as cancer, diabetes, cardiovascular disease, and Alzheimer's disease (Swati, 2011, Wu, 2013). Therefore, it is likely that PGBR will become a popular health food in Bangladesh. As the protein supply for ever increasing world population becomes limiting, the need for accurate data on the amino acids of major foods, such as rice becomes more critical. In this experiment we investigated the potentiality of our both Bangladeshi HYV and local rice varieties for the preparation of PGBR as well as quantitation of some selective amino acids, such as GABA, Glutamic acid, Methionine, Lysine, Histidine and Arginine in these tested rice varieties. Our present study might widen the scopes of developing of new food from rice and rice by-products based on the available content of beneficial amino acids specially GABA.

Methods and materials: Grains of ten Bangladeshi rice varieties including 5 traditional like Ghungshe, Kajalsail, Monteshor, Moulata, Sadamota and 5 BRRI HYV like BR22, BR23, BRRI dhan31, BRRI dhan40, BRRI dhan41 were subjected to determine the protein content, apparent amylose content (AAC) and amino acid content of Glutamic acid, GABA, Methionine, Histidine, Lysine and Arginine at both PBR and PGBR condition.

Estimation of Apparent Amylose Content (AAC): Amylose in starch is released by treatment with dilute alkali. By the addition of tri-iodide ion, amylose produces blue color. Then the absorbance of blue color produced in aqueous solution was measured (Juliano, 1971). Hundred

(100) mg of rice powder was accurately taken into a 100 mL volumetric flask and 1 mL (95%) ethanol and 9 mL NaOH (1N) were added carefully. Then the flask was incubated overnight at room temperature to gelatinize the starch and then made the volume up to the mark with distilled water. About 5 mL portion of the starch solution was pipette into another 100 mL volumetric flask and 1 mL (1N) glacial acetic acid, 2 mL of iodine solution were added and made the volume up to the mark with distilled water. Shake the mixture and after waiting 20 minutes, absorbance was measured at 620 nm in a spectrophotometer.

Calculation: Amylose (%) = $\frac{\text{Absorbance} \times \text{slope} \times \text{dilution factor} \times 100}{\text{Weight of sample (mg)}}$

Estimation of protein: In Protein estimation, Standard micro Kjeldahl procedure of AOAC (1995) was used for the determination of nitrogen and crude protein was estimated by multiplying the nitrogen content by a factor 5.95. Nitrogen present in the sample was converted to ammonium sulphate by digestion at 380°C with sulphuric acid in presence of a catalyst mixture. Ammonia liberated by distilling the digest with sodium hydroxide solution is absorbed by boric acid and titrated with HCl for quantitative estimation (AOAC, 1995). About 0.2 g rice grain sample was taken into 100 mL Micro Kjeldahl flasks and then about 0.5-0.6 g of the catalyst mixture (for digestion) and 5.0 mL concentrated H_2SO_4 were added. Then the micro Kjeldahl digestion flask was heated for about 1 hour until the mixture becomes clear. After cooling the digested mixture, a minimum amount of water was added to the flask to dissolve the solids. Then the flask was connected to the distillation set-up, placing a 250 mL Erlenmeyer flask containing 25 mL of 4% boric acid solution plus one drop of the mixed indicator under the condenser with the tip of the condenser extending below the surface of the solution. Then 9 mL NaOH solution (40%) was slowly added to the digested solution. The distillation flask was connected to a steam source to distill the solution until about 75 mL distillate was collected (within 10-12 minutes). The tip of the condenser was washed with distilled water into the receiver. The distillated solution was immediately titrated with standard HCl solution to the first appearance of the violet reddish color. A blank was simultaneously run to calculate the percent N in the sample.

Calculation: Nitrogen (%) = $\frac{\{(\text{mL HCl for sample - mL HCl for blank}) \times N_{HCl} \times 0.014\} \times 100}{\text{Weight of sample (g)}}$

where, N_{HCl} = Normality of HCl. Protein (%) = Nitrogen (%) × 5.95

Analysis of amino acid: The amino acid was estimated by the method of Moore and Stein (1963) using amino acid analyzer. For amino acid analysis, 0.5 g of sample was weighed and makes a fine pest by mortar pestle with adding about 50 mL HCl (6N). Then pest was transferred into a 250 mL round joint bottle flask and was placed on Heating Mantle at 110°C for 24 hours. Afterwards, the acid was evaporated on a water bath and the solution was concentrated up to 10 mL. Then the solution was filtered through Whatman filter paper No. 42 into a 25 mL volumetric flask and the

volume was made up to the mark with HCl (0.1N). The solution was ready for analysis and run through the Shimadzu amino acids analyzer (Shimadzu Corporation, Kyoto, Japan). Standard amino acids mixtures were also run under identical conditions to identify the compounds. Compound retention times and areas (peak) for samples and standard amino acids were automatically recorded. By comparing the two peak areas, the amount of amino acids were calculated.

Calculation: Amino acid (mg g^{-1} Protein)

$$= \frac{\text{Peak area of sample} \times 2 \times \text{Concentration of standard x } 100}{\text{Peak area of standard} \times \text{Protein (\%)}}$$

Statistical analysis: The SPSS, version 20 was applied for statistical analysis of the experimental data. Analysis of variance (ANOVA) followed by Duncan's multiple range test (DMRT) was applied on changing fold data of amino acid content parameters from PBR to PGBR condition at table 4. The level of significance was set at $p < 0.05$.

Results and discussion: In protein analysis, it is clearly revealed that protein content increased in PGBR compare to BR in all tested varieties ranges from 13.73 % to 46.86 % (Table 1). Ghungshe, BRRI dhan41 and BR23 showed maximum increased in protein content in PGBR stage compare to PBR. In Amylose content assay, all tested varieties showed decreasing AAC in PGBR compare to PBR and PMR (Table 2). In Amino acid analysis (Table 3a), we found that in quantitation of glutamic acid content, BR23 has the lowest content of 1.40±0.35 mg 100^{-1}g at PGBR and all tested varieties has a decreasing trends from BR towards PGBR except BRRI dhan41 (table 3a). In GABA quantitation, BRRI dhan31 has the highest content of 12.00±0.50 mg 100^{-1}g at PGBR among all varieties and it showed an increasing trends from BR towards PGBR for all varieties (table 3a). In case of Histidide quantitation, Ghungshe has the lowest content of 0.60±0.01 mg 100^{-1}g and BRRI dhan31 has the highest content of 2.34±0.06 mg 100^{-1}g. All the varieties showed increasing trend from BR towards PGBR except Ghungshe and Kajalsail (table 3a). In quantitation of Methionine, Ghungshe has the lowest content of 0.9±0.02 mg 100^{-1}g and BR22 has the highest content of 2.43±0.15 mg 100^{-1}g among all varieties. All varieties showed increasing trends from BR toward PGBR except Kajalsail, Montesshor and BRRI dhan40 (table 3b).

Table 1: Protein content of traditional and HYV of rice.

Varieties	Protein (N x 5.95) content (g $100g^{-1}$)				
	PMR	PBR		PGBR	
		Content	Increased	Content	Increased
Ghungshe	7.75	9.00	16.13	11.38	46.84
Kajalsail	8.32	9.18	10.34	10.5	26.20
Monteshor	8.29	9.74	17.49	9.87	19.06
Moulata	8.57	9.23	7.70	10.36	20.89

Sadamota	8.3	9.38	13.01	9.44	13.73
BR-22	8.56	9.13	6.66	9.96	16.36
BR-23	7.5	8.76	16.80	10.51	40.13
BRRI dhan31	8.34	8.85	6.12	10.47	25.54
BRRI dhan40	8.19	9.11	11.23	10.01	22.22
BRRI dhan41	7.32	8.77	19.81	10.75	46.86
PMR; Parboiled Milled Rice, PBR; Parboiled Brown Rice, PGBR; Pre-Germinated Brown Rice.					

Table 2: Amylose content (g 100^{-1}g) of traditional and HYV of rice.

Varieties	PMR	PBR	PGBR
Ghungshe	23.05	22.6	21.32
Kajalsail	25.65	24.41	23.46
Monteshor	22.33	20.94	23.46
Moulata	25.34	24.42	21.9
Sadamota	25.56	23.68	22.7
BR-22	26.24	25.16	23.07
BR-23	27.86	25.47	22.5
BRRI dhan31	26.97	26.22	23.5
BRRI dhan40	26.67	25.62	22.49
BRRI dhan41	27.12	26.07	23.46
PMR; Parboiled Milled Rice, PBR; Parboiled Brown Rice, PGBR; Pre-Germinated Brown Rice			

Table 3a: Amino acid (Glutamic acid, GABA, Histidine) content of traditional and HYV rice in BR and PGBR Stage.

Amino acid content of traditional and HYV rice varieties in BR and PGBR(mg 100^{-1}g) stage						
Rice	**Glutamic acid**		**GABA**		**Histidine**	
Varieties	**BR**	**PGBR**	**BR**	**PGBR**	**BR**	**PGBR**
Ghungshe	8.4±0.2	3.70±0.07	0.36±0.12	7.46±0.15	1.03±0.06	0.6±0.01
Kajalsail	7.4±0.3	2.50±0.40	0.8±0.20	7.60±0.17	1.44±0.08	1.33±0.13
Monteshor	11.5±0.3	4.60±0.30	1.66±0.15	8.43±0.21	0.84±0.09	1.40±0.16
Moulata	6.9±0.1	4.70±0.26	0.6±0.10	9.46±0.21	1.03±0.08	1.91±0.20

Sadamota	8.1±0.1	4.60±0.36	2.6±0.10	8.33±0.21	0.64±0.05	2.01±0.12
BR22	2.8±0.2	1.60±0.17	0.76±0.06	9.66±0.76	0.93±0.27	1.91±0.03
BR23	6±1.0	1.40±0.35	1.56±0.06	11.10±0.40	0.70±0.05	1.54±0.12
BRRI dhan31	9.3±0.3	3.10±0.10	0.85±0.10	12.00±0.50	0.70±0.14	2.34±0.06
BRRI dhan40	7.5±0.2	2.00±0.20	1±0.10	10.60±0.20	0.80±0.02	1.40±0.12
BRRI dhan41	4.7±0.2	4.90±0.10	1.53±0.06	7.53±0.12	0.80±0.05	1.64±0.13

Table 3b: Amino acid (Methionine, Lysine, Arginine) content of traditional and HYV rice in BR and PGBR Stage.

Amino acid content of traditional and HYV rice varieties in BR and PGBR(mg 100^{-1}g) stage						
Rice	**Methionine**		**Lysine**		**Arginine**	
Varieties	**BR**	**PGBR**	**BR**	**PGBR**	**BR**	**PGBR**
Ghungshe	0.6±0.10	0.9±0.02	1.20±0.12	1.00±0.22	1.20±0.12	1.52±0.12
Kajalsail	1.05±0.07	0.11±0.01	1.50±0.27	1.30±0.15	1.11±0.08	1.31±0.12
Monteshor	1.50±0.20	0.90±0.06	1.30±0.15	2.01±0.12	1.81±0.09	1.21±0.06
Moulata	0.09±0.01	1.37±0.15	0.80±0.20	1.60±0.08	2.13±0.07	3.25±0.16
Sadamota	0.42±0.17	0.67±0.15	0.90±0.01	2.30±0.03	2.20±0.09	4.02±0.51
BR22	1.11±0.23	2.43±0.15	0.61±0.08	1.20±0.12	1.00±0.22	0.09±0.00
BR23	0.63±0.12	1.68±0.13	0.60±0.10	0.51±0.09	2.01±0.12	0.30±0.01
BRRI dhan31	0.49±0.05	1.22±0.11	1.30±0.15	0.50±0.08	1.91±0.16	0.71±0.06
BRRI dhan40	1.13±0.15	0.91±0.11	1.01±0.05	0.42±0.03	0.50±0.08	0.31±0.07
BRRI dhan41	0.60±0.16	2.16±0.12	1.00±0.22	3.40±0.11	1.50±0.03	1.80±0.10

In case of Lysine quantitation, BRRI dhan40 has the lowest content of 0.42±0.030 mg 100^{-1}g and BRRI dhan41 has the highest content of 3.40±0.11 mg 100^{-1}g among all varieties at PGBR (table 3b). Finally, in Arginine quantitation, BR22 has the lowest content of 0.09±0.01 mg 100^{-1}g and Sadamota has the highest content of 4.02±0.51 mg 100^{-1}g among all varieties at PGBR condition (table 3b). In analyzing of changing folds of amino acid content from BR to PGBR, Ghungshe has increased the maximum folds of 22.51 for GABA, Moulata has 14.11 folds for Methionine, BRRI dhan31 has 3.40 folds for Histidine, BRRI dhan41 has 3.51 folds for Lysine and Sadamota has 1.82 folds for Arginine, compare to other traditional an HYV rice varieties (table 4).

Table 4: Changing folds of amino acid content in traditional and HYV of rice varieties from BR to PGBR.

PGBR could be acceptable to consumers and food industry as a promising foodstuff that contains more nutritional proteins, amino acid and bio-functional components than ordinary rice products for malnourished children and aged population who have been suffering from different chronic disease. PGBR and rice bread may be cited as two promising rice based products that hold much more nutrition over milled rice and ordinary brown rice. Improve food security in food shortage regions can be attained by consumption of PGBR. PGBR can be a dietary food for health improvement. The reason behind the popularity of PGBR among health-conscious consumers and bio-techno-scientists is the significant increase in GABA and its extensive bio-functional properties to maintain a good human health. PGBR has potential to become innovative rice by preserving all nutrients in the rice grain for human consumption in order to create the highest value from rice. The PGBR technology can be transferred for empowerment of rural people, by transforming them into a successful entrepreneurs by starting their own food (PGBR) processing units and to contribute in the national development of health and nutritional security and improvement in the living standards in Bangladesh. In our experiment, we concluded that Ghungshe, seems the most suitable rice varieties among the tested varieties in order to possess highest protein and BRRI dhan31 has the highest GABA content of 12.00±0.50 mg 100^{-1}g (table 3a, Fig1) at PGBR stage. These findings can be an important information to our rice based agro food industries in Bangladesh. Lathyrism is due to absolute methionine deficiency. It is apparent that the low nutritive value of lentil protein is due to methionine deficiency instead of cystine deficiency and the better quality of rice protein is due to the higher methionine content (Rudra, 1950). In this case, BR22 which has the highest content of methionine 2.43±0.15 mg 100^{-1}g among all varieties, could be beneficial for rice consumer who have tendency of lathyrism related disorders. Histidine is utilized by our body to develop and maintain healthy tissues. It is especially important in the myelin sheath that coat nervous cells to ensure the transmission of messages from our brain to organs throughout our body. Adequate Histidine levels are essential to good mental and physical health. Histidine may be implicated in the

Variety	Glutamic acid	GABA	Methionine	Histidine	Lysine	Arginine
Ghungshe	0.44^{d}	22.51^{a}	1.53^{de}	0.58^{c}	0.82^{d}	1.27^{bc}
Kajalsail	0.33^{e}	0.99^{de}	0.10^{f}	0.90^{c}	0.89^{d}	1.17^{bc}
Monteshor	0.40^{de}	5.09^{f}	0.60^{ef}	1.68^{b}	1.55^{c}	1.02^{c}
Moulata	0.68^{b}	16.11^{b}	14.11^{a}	1.8^{b}	2.11^{bc}	1.52^{ab}
Sadamota	0.56^{c}	3.21^{f}	1.80^{cd}	3.10^{a}	2.56^{b}	1.82^{a}
BR22	0.57^{c}	12.61^{bcd}	2.22^{cd}	2.10^{b}	2.01^{bc}	0.09^{e}
BR23	0.23^{g}	7.091^{ef}	2.70^{c}	2.10^{b}	0.86^{d}	0.14^{e}
BRRI dhan31	0.33^{ef}	14.27^{bc}	2.49^{cd}	3.40^{a}	0.38^{d}	0.37^{de}
BRRI dhan40	0.26^{g}	10.65^{cde}	0.81^{ef}	1.70^{b}	0.41^{d}	0.60^{d}
BRRI dhan41	1.04^{a}	4.91^{f}	3.72^{b}	2.00^{b}	3.51^{a}	1.19^{bc}
Duncan's multiple range test; Within column means followed by same letter(s) did not differ significantly at $P<0.05$.						

treatment of mental disorders, sexual dysfunction and play a role in protecting the body from radiation damage and prevent the onset of AIDS. This is due to its

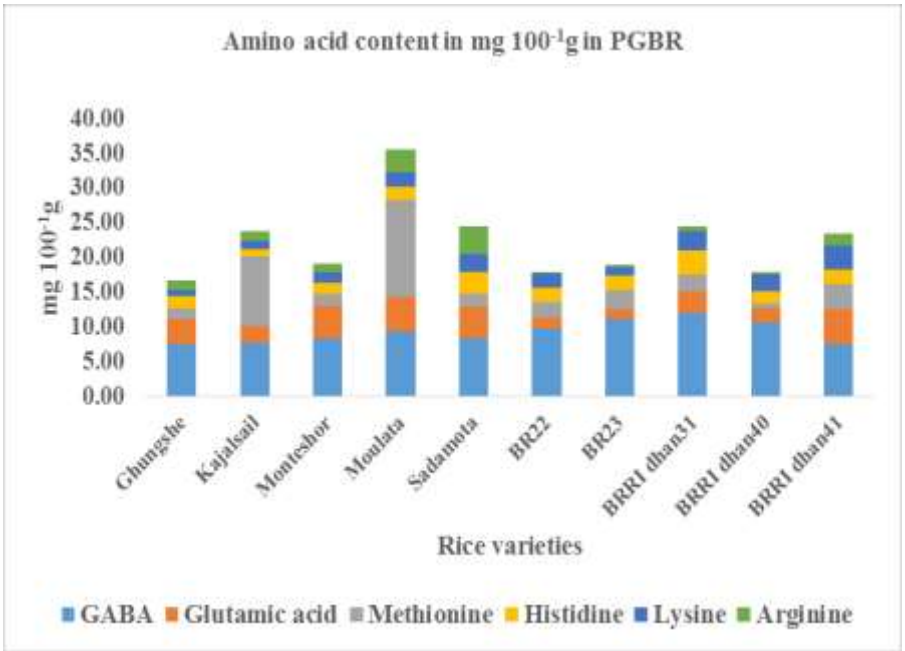


Fig 1: Amino acid content in mg 100^{-1}g of ten rice varieties.

ability to naturally detoxify the body and produce both red and white blood cells. Histidine, similar to other amino acids, is found primarily in high-protein foods. Meat, poultry, fish, dairy and some grain products including rice, wheat and rye are therefore histidine-containing foods. Two Rice Authentic Histidine Phosphotransfer Proteins, OsAHP1 and OsAHP2, mediate cytokinin signaling and stress responses in rice (Lijing, 2014). Histidine reduces the weight of stool and the frequency of stool output in cholera and could be a useful and safe adjunct treatment that will increase the success rate of ORS and antibiotic therapy in cholera. Antidiarrheal effects of l-Histidine–supplemented rice-based oral rehydration solution in the treatment of adults with severe cholera in Bangladesh (Golam, 2005). Since BRRI dhan31 has the highest Histidine content of 2.34±0.06 mg 100^{-1}g (table 3a, Fig1) among all varieties, it could be a good carbohydrate source for Histidine-supplemented rice based oral rehydration solution for Bangladesh.

In this present study we have prepared some value added GABA rice byproducts like GABA rice ball, GABA plain cake and GABA biscuit. We used BRRI dhan31 to produce PGBR and then grind to powder to get GABA enriched flour for preparing different cookies like cake and biscuit. In GQN, division, we have prepared a healthy rice ball from PGBR which contain around 393 calories per 100 g serving (fig.2). For protein source we can use egg, chicken, beef, mutton, fish instead of shrimp. We can keep this product at 4°C in refrigerator for several days.

Fig 2: Fact sheet of GABA rice ball (Shrimp)

Shrimp Rice Ball (393 calories 100 $^{-1}$g)		
Ingredient	**Amount (g)**	**Energy (Calories)**
Carbohydrate/ GABA rice	70	280
Sugar	5	20
Salt	3	0

Protein (Shrimp)	12	48
Fat (Edible oil)	5	45
Onion	2	0
Acetic acid	2	0
Black Cumin	1	0
Net weight & Energy	**100**	**393**

Fig 3: Fact sheet of GABA Plain Cake.

GABA Plain Cake (465 calories 100 $^{-1}$g)		
Ingredient	**Amount (g)**	**Energy (Calories)**
Carbohydrate/GABA rice flour	155	620
Sugar	190	760
Protein (Egg)	215	860
Fat (Edible oil)	90	810
Powder milk	11.5	44
Backing powder	1.5	0
Vanila scent	2	0
Net weight & Energy	**665**	**3094**
Mix well with 75 mL water and bake at 180°C for 35 mins		

Fig 4: Fact sheet of GABA biscuit.

GABA Biscuit (479 calories 100 $^{-1}$g)		
Ingredient	**Amount (g)**	**Energy (Calories)**
Carbohydrate/GABA rice flour	100	400
Sugar	125	600
Protein (Egg)	110	440
Edible oil	50	450
Butter	10	90
Powder milk	75	287
Backing powder	1	0
Vanila scent	2	0
Net weight & Energy	**473**	**2267**
Bake at 180°C for 20 mins	**Keep it at room temperature**	

GABA plain cake contain around 465 calories per 100 g serving (fig.3) and it was prepared from PGBR flour. GABA biscuit contain around 479 calories per 100 g serving (fig.4) and it was also prepared from PGBR flour. Details cooking protocols of the above rice byproducts are available in GQN division, BRRI, Gazipur.

Conclusion: Our research findings reveals that BRRI dhan31 generates elevated level of bio-active component, γ-aminobutyric acid (GABA) at pre-germinated brown rice condition and in conclusion we are hopeful that GABA enrich rice could widen the scopes of developing of new rice based value added quality as well as nutritional food products in Bangladesh in coming future.

BRRI Annual Report for
July 2014-June 2015

Program Area-I: Varietal Development Program
Hybrid Rice Division

Bangladesh Rice Research Institute
Gazipur 1701
BRRI Annual Research Review for July 2014-June 2015

List of scientific personnel

Md. Jamil Hasan, PhD
Principal Scientific Officer & Head
Ashish Kumar Paul, MScAg
Senior Scientific Officer
Priya Lal Biswas, MS*
Senior Scientific Officer
Md. Kamal Hossain, MS*
Senior Scientific Officer
Mosammat Umma Kulsum, MS**
Scientific Officer
Afsana Ansari, MS*
Scientific Officer
Anowara Akter, MS
Scientific Officer
Md. Hafizar Rahman, MS
Scientific Officer
Laila Ferdousi Lipi, MS
Scientific Officer

**** Abroad for higher studies***

***** Deputation for in-country PhD program***

Hybrid Rice Division

Summary

Development of Parental lines and Hybrids

Evaluation of Parental lines and Hybrids

Seed Production of Parental lines and Hybrids

Summary

During T. Aman season 2014, fifty nine (59) test crosses and 56 (Ax R) crosses were made from source nursery. A total of two hundred forty two (242) testcrosses (F_1s) were evaluated for their pollen fertility status of which nine entries have been found heterotic over check varieties. Pollen parents of those combinations were regarded as suspected restorers and selected for fertility restoration ability with other CMS lines in the next season. Nineteen entries were found completely sterile and their corresponding male parents were regarded as suspected maintainer lines. All the backcross generations were stable in terms of pollen sterility with other desirable agronomic traits and advanced for next generation. One hundred eighteen (118) CMS lines along with their respective maintainer lines were maintained by hand crossing. A total of 120 BB resistant parental lines were selected from pedigree nursery and advanced as F_4 generations.

One hundred eight (108) test crosses and 130 (A x R) crosses were made using 7 CMS lines during Boro season 2014-15. Eighty six (86) testcrosses (F_1s) were evaluated for their pollen fertility status. Among them seven entries showed complete sterility and immediately backcrossed with their corresponding male parents for conversion. On the other hand, three entries have been selected for their high yielding ability compared with check varieties. One BC_6 generation was found stable in pollen sterility and other desirable agronomic characteristics and designated as new CMS lines in the background of their corresponding male parents. Other generations were advanced as BC_5 and BC_2 generations except two entries due to fluctuation in pollen sterility. Sixty six (66) CMS lines along with their respective maintainer lines were maintained by hand crossing.

During T. Aman, out of 142 test hybrids under observational trials three (3) hybrid combinations were selected based on yield, duration and grain type and produced more than 15-20% yield advantage over check variety BR11 and BRRI dhan49 with two to three week shorter growth duration. Out of 123 test hybrids 10 hybrid combinations were selected based on yield, duration and grain type and showed yield advantage ranging from 16-31% over BRRI dhan28 and 8-22% over BRRI dhan29 in Boro 2014-15. Under preliminary yield trials three hybrids out of nine gave 14 to 20% yield advantage over BR11 and BRRI dhan49 respectively during T Aman 2014 and during Boro season 2014-15, Two combinations IR75608A/BRRI31R and IR75608A/BAU521R gave 1.01 t/ha and 1.49 t/ha yield advantage over BRRI dhan28 with similar growth duration. On the other hand, BRRI33A/BRRI31R, IR79156A/BRRI20R and BRRI33A/BAU521R gave 2.12 t/ha, 1.66 t/ha and 1.45 t/ha yield advantage over BRRI dhan28 and BRRI33A/BRRI31R and IR79156A/BRRI20R gave 1.54 t/ha and 1.12 t/ha yield advantage over BRRI dhan29. National hybrid rice yield trials were conducted through SCA during T Aman 2014 and Boro 2014-15 which included 16 and 50 hybrids. Results were compiled by SCA.

Seed yield of 70 kg/plot (1.5 t/ha), 75 kg/plot (1.6 t/ha) and 18 kg/plot (1.1 t/ha) were obtained from BRRI10A, BRRI11A line and IR58025A, respectively in T. Aman season. On the other hand, during Boro 2014-15 seasons, CMS seed yield of 110 kg (2.20 t/ha), 130 kg (2.35 t/ha)

and 90 kg (1.72 t/ha) were obtained from BRRI10A/B, BRRI11A/B and IR58025A/B, respectively. A total of 115 kg (1.5 t/ha), 50 kg (1.45 t/ha) and 22 kg (1.2 t/ha) hybrid seeds were produced from BRRI11A/BRRI15R, BRRI10A/BRRI10R and IR58025A/BRRI10R respectively during T. Aman season of 2014. During Boro 2014-15 seasons, F_1 seeds of released hybrids were obtained 110 kg (2.2 t/ha) from BRRI hybrid dhan2, 130 kg (2.35 t/ha) from BRRI hybrid dhan3 and 90 kg (1.7.2 t/ha) from BRRI hybrid dhan4.

During the last reporting year, hybrid rice division supplied a total of 1238 kg of parental lines and F_1 seeds among 36 farmers, 7 seed companies, scientists & staffs of BRRI and BADC. A total of 30150 kg F_1 seed was produced during Boro season 2014-15 with the technical assistance from BRRI under four seed companies and regional stations of BRRI.

DEVELOPMENT OF PARENTAL MATERIALS

Source Nursery

A total of fifty nine **(**59) test crosses and 56 (A x R) crosses were made using 8 CMS lines during T. Aman season 2014. One hundred eight **(**108) test crosses and 130 (A x R) crosses were made using 7 CMS lines during Boro season 2014-15.

Test cross Nursery

During T. Aman season 2014, out of 242 testcrosses (F_1s) nine entries have been found heterotic over check varieties and nineteen entries were found completely sterile**.** Pollen parents heterotic combinations were regarded as suspected restorers and pollen parents of completely sterile combinations were regarded as suspected maintainer lines. During Boro season 2014-15, out of eighty six (86) testcrosses (F_1s), seven tested entries showed complete sterility and immediately backcrossed with their corresponding male parents for conversion. On the other hand, three entries have been selected for their high yielding ability compared with check variety.

Back cross nursery

In T. Aman season 2014, all the backcross generations were stable in terms of pollen sterility and advanced for next generation. In Boro season 2014-15, tested BC_6 generation was found stable in pollen sterility and other desirable agronomic characteristics and designated as new CMS lines in the background of their corresponding male parents. Other generations were advanced as BC_5 and BC_2 generations except two entries due to fluctuation in pollen sterility (Table 1).

Table 1. Performance of Backcross entries during Boro seasons of 2014-2015

SL. No.	BC gen	Designation	Sterility status	DFF	D50%F	DTM	Grain type	Base color	Remarks
01.	BC_4	BRRI53A/BR7873-5-(NILS)-51-HR6	CS	108	111	137	Slender	Base green	Advanced as BC_5 generation
02.	BC_1	BRRI60A/EL140	CS	110	113	139	Slender	Base green	Advanced as BC_2 generation
03.	BC_1	BRRI28A/EL140	CS	108	111	137	Slender	Mixed	Advanced as BC_2 generation
04.	BC_1	BRRI60A/EL135	CS	97	100	126	Medium	Base purple	Advanced as BC_2 generation
05.	BC_1	IR77803A/EL135	CS	99	103	129	Medium bold	Base purple	Advanced as BC_2 generation
06.	BC_1	BRRI60A/EL110	CS	109	112	138	Slender	Base purple	Advanced as BC_2 generation
07.	BC_1	D. ShanA /EL109	S	104	107	133	Slender	Base purple	Discarded
08.	BC_1	PMS8A/EL30	CS	101	105	131	Medium bold	Base purple	Advanced as BC_2 generation
09.	BC_1	BRRI7A/EL116	CS	114	117	142	Slender	Base purple	Advanced as BC_2 gen, little awn
10.	BC_1	BRRI7A/EL125	CS	115	118	143	Slender	Base purple	Advanced as BC_2 generation
11.	BC_1	BRRI7A/EL145	CS	111	114	140	Slender	Mixed	Advanced as BC_2 generation
SL. No.	BC gen	Designation	Sterility status	DFF	D50%F	DTM	Grain type	Base color	Remarks
12.	BC_1	BRRI28A/EL256	CS	111	114	140	Slender	Base purple	Advanced as BC_2 generation
13.	BC_1	BRRI71A/EL70	CS	99	102	128	Medium slender	Base purple	Advanced as BC_2 generation

14.	BC_1	BRRI7A/EL211	CS	116	119	144	Medium slender	Base purple	Advanced as BC_2 generation
15.	BC_1	BRRI7A/EL211	CS	116	119	144	Medium slender	Base purple	Advanced as BC_2 generation
16.	BC_1	BRRI7A/EL210	CS	115	118	143	Medium slender	Base green	Advanced as BC_2 gen, little awn
17.	BC_1	BRRI7A/EL207	CS	118	121	144	Medium slender	Mixed	Advanced as BC_2 generation
18.	BC_1	BRRI7A/EL196	CS	118	121	144	Medium slender	Mixed	Advanced as BC_2 generation
19.	BC_1	BRRI7A/EL50	CS	113	116	141	Medium slender	Base purple	Advanced as BC_2 generation
20.	BC_1	BRRI7A/EL184	S	118	122	147	Medium	Mixed	Discarded
21.	BC_1	BRRI7A/EL195	CS	116	119	144	Medium slender	Base purple	Advanced as BC_2 generation
22.	BC_1	BRRI56A/EL23	CS	102	105	131	Medium	Base purple	Advanced as BC_2 generation
23.	BC_1	BRRI32A/EL36	CS	105	109	135	Medium slender	Base purple	Advanced as BC_2 generation

D/S: P_1 =02.12.14; P_2/F_1=05.12.14 P_3 =08.12.14 D/T: 08.01.15; CS = completely sterile, S = sterile

CMS Maintenance and Evaluation Nursery

One hundred eighteen (118) CMS lines were maintained by hand crossing for seed increase and genetic purity during T. Aman 2014 and during Boro 2014-15, sixty six (66) CMS lines were maintained through hand crossing for seed increase and genetic purity.

Pedigree nursery for development of BB resistance parental lines of hybrid rice

A total of 120 BB resistant parental lines were selected from pedigree nursery and advanced as F_4 generations during T. Aman 2014 and a total of 169 progenies were selected from the seven F_4 populations as F_5 generation from Boro 2014-15**.**

Evaluation of experimental hybrids

Out of 142 hybrids 3 hybrid combinations were selected based on yield, duration and grain type during T. Aman 2014 (Table 2). Around 15 to 20 % yield advantage was observed of the selected hybrids over inbred check variety.

During Boro 2014-15, out of 123 hybrids 10 hybrid combinations were selected based on yield, duration and grain type (Table 3). Upon commercial seed production feasibility of these selected hybrid combinations advance lines adaptive research trials (ALART) will be conducted and based on satisfactory yield advantage over check, hybrid combination will be submitted to SCA trials.

Table 2. List of experimental hybrids found heterotic over check variety during T. Aman, 2014

Entry	Designation	PHT (cm)	E/T	DFF	SF (%)	DTM	Yld (t/ha)	Grain type	Yld adv over cks		
									CK-1	CK-2	CK-3
01	IR79156A/ PL-1	105.8	13	93	84.2	120	8.15	S	18.12	19.68	4.49

02	BRRI21A/ BasmatiR	111.6	11	88	81.0	117	7.90	S	14.49	16.0	1.28
03	IR75608A/ BAU521R	103.8	12	87	83.2	116	8.10	S	17.39	18.94	3.84
CK-1	BR11	112	10	114	75.40	142	6.90	B	-	-	-
CK-2	BRRI dhan49	101	11	107	74.09	135	6.81	MS	-	-	-
CK-3	BRRI hybrid dhan4	109.5	10	91	81.50	120	7.80	S	13.04	14.54	

D/S: 12.7.14 D/T: 08.8.14 S= Slender, M= Medium, B = Bold, MS= Medium slender

Table 3. List of the hybrid combinations found heterotic from observational nursery during Boro season 2014-15

SL. No.	Cross combinations	PHT (cm)	No. of effective tillers /hill	Spikelet fertility (%)	Panicle length (cm)	TGW (g)	Grain yield (t/ha)	Grain type	DTM	Yield advantage over check varieties (%)		
										CK-1	CK-2	CK-3
1	BRRI13A/PR812R	110	9.2	86.52	25.2	32.56	9.0	M	140	16.88	8.43	-
2	BRRI28A/PR585R	97.4	9.6	83.60	18	34.42	9.31	M	138	20.90	12.16	-
3	BRRI28A/PR812R	103.4	8.6	93.18	22.2	33.96	8.94	M	141	16.10	7.71	-
4	BRRI28A/PR874R	103	9.8	91.88	24.2	28.78	9.0	M	141	16.88	8.43	-
5	BRRI28A/PR3028R	102.2	12	91.99	22.2	29.46	10	M	140	29.87	20.48	5.2
6	BRRI33A/BRRI22R	103.8	11.8	92.61	20.6	30.18	10.12	MS	150	31.42	21.92	6.52
7	BRRI33A/BRRI16R	102	11	88.12	22.8	31.04	9.02	MS	146	17.14	8.6	-
8	BRRI33A/BRRI28R	106.6	11	93.37	23.8	25.74	10	MS	147	29.87	20.48	5.26
9	BRRI33A/BRRI29R	105	8.2	91.39	21.8	24.24	9.24	M	145	20	11.32	-
10	BRRI33A/PR368R	103.4	8	83.65	21.4	29.14	9.5	M	146	23.37	14.45	0
CK-1	BRRI dhan28	110	12.6	72.49	18.6	20.96	7.7	S	141			
CK-2	BRRI dhan29	102.8	13	91.76	23	18.46	8.3	MS	156			
CK-3	BRRI hybrid dhan3	112.6	12	96.63	25.6	28.29	9.5	M	146			
Average		104.8	10.5	89.0	22.3	28.2	9.2	-	144.4			
Lsd $_{(0.05)}$		2.9	1.2	4.5	1.6	3.4	0.5	-	3.5			
CV (%)		3.9	16.3	7.1	10.2	16.9	7.4	-	3.4			

D/S: 5.12.14 D/T: 10.01.15 MS= Medium slender, M= Medium, S = Slender, TGW = Thousand grain weight, DTM = Days to maturity

Preliminary yield trials of promising hybrids

In T. Aman 2014, out of nine three hybrid combinations (IR79156A/PL-1, IR75608A/BRRI31R & BRRI21A/BasmatiR) were selected based on yield and growth duration and it was around 15 to 20 % and two to three weeks earlier than check varieties (Table 4). In Boro 2014-15, two hybrid combinations IR75608A/BRRI31R and IR75608A/BAU521R gave 1.01 t/ha and 1.49 t/ha yield advantage over BRRI dhan28 with similar growth duration. On the other hand, BRRI33A/BRRI31R, IR79156A/BRRI20R and BRRI33A/BAU521R gave 2.12 t/ha, 1.66 t/ha and 1.45 t/ha yield advantage over BRRI dhan28 and BRRI33A/BRRI31R and IR79156A/BRRI20R gave 1.54 t/ha and 1.12 t/ha yield advantage over BRRI dhan29 (Table 5).

Table 4. Results of preliminary yield trials during T Aman 2014

Entry	Designation	PHT (cm)	E/T	DFF	SF (%)	DTM	Yld (t/ha)	Grain type	Yld adv over cks		
									CK-1	CK-2	CK-3
01	IR79156A/PL-1	105.8	13	93	84.2	120	8.15	S	18.12	19.68	4.49
02	BRRI21A/ BasmatiR	111.6	11	88	81.0	117	7.90	S	14.49	16.0	1.28
03	IR75608A/ BRRI31R	103.8	12	87	83.2	116	8.10	S	17.39	18.94	3.84
CK-1	BR11	112	10	114	75.40	142	6.90	B	-	-	-

CK-2	BRRI dhan49	101	11	107	74.09	135	6.81	MS	-	-	-
CK-3	BRRI hybrid dhan4	109.5	10	91	81.50	120	7.80	S	13.04	14.54	

D/S:12.07.14, D/T: 08.08.14; Plot size= 30m^2

Table 5. Results of preliminary yield trials during Boro 2014-15

Ent#	Combination	DTM	PHT (cm)	ET/m^2	SF (%)	Yield (t/ha)	Yield advantage over checks (%)		
							CK-1	CK-2	CK-3
1	IR75608A/BRRI31R	144	100.7	276.1	86.52	8.38	1.01	-	-
2	BRRI33A/BRRI31R	149	102.6	290.4	89.99	9.45	2.12	1.54	0.76
3	IR79156A/BasmatiR	148	110.8	316.8	94.22	8.44	1.07	0.53	-
4	BRRI33A/BasmatiR	147	107.4	283.8	92.2	6.64			
5	BRRI21A/BasmatiR	141	106.9	297.0	92.14	7.98			
6	IR75608A/BasmatiR	142	096.1	277.2	74.49	7.58			
7	BRRI42A/BasmatiR	148	095.0	390.9	73.73	7.96			
8	BRRI43A/BasmatiR	142	101.4	297.0	95.59	7.10			
9	IR79156A/BRRI20R	149	096.6	310.2	83.77	9.03	1.66	1.12	0.34
10	IR75608A/BAU521R	142	097.6	369.6	84.36	8.86	1.49	0.95	0.17
11	BRRI21A/BAU521R	145	099.7	325.6	83.42	8.16	0.79	0.25	-
12	BRRI33A/BAU521R	152	104.0	282.3	97.23	8.82	1.45	0.91	0.12
13	BRRIdhan28(CK-1)	142	105.6	280.5	86.63	7.37			
14	BRRI dhan29(CK-2)	158	103.0	275.0	88.20	7.91			
15	BRRI hybrid dhan3 (CK-3)	148	104.2	376.2	90.69	8.69			
	Average	146.7	102.1	309.9	87.5	8.2			
	Lsd $_{(0.05)}$	3.1	3.0	26.0	4.6	0.5			
	CV (%)	3.1	4.5	12.6	7.9	9.4			

D/S: 05.12.14; D/T: 11.01.15; Plot size: 30 m^2 DTM= days to maturity; PHT = Plant height; ET/m^2 = No. of effective tillers per meter; SF (%) = Spikelet fertility

Seed Production of parental lines and hybrids

CMS line multiplication of released hybrids

During T. Aman 2014, seed yield 70 kg/plot (1.5 t/ha), 75 kg/plot (1.6 t/ha) and 18 kg/plot (1.1 t/ha) were obtained from BRRI10A, BRRI11A and IR58025A, respectively (Table 6). In Boro season 2014-15, seed yield of 110 kg (2.20 t/ha), 130 kg (2.35 t/ha) and 90 kg (1.72 t/ha) were obtained from BRRI10A/B, BRRI11A/B and IR58025A/B respectively (Table 7).

Table 6. CMS multiplication of BRRI10A, BRRI11A and IR58025A lines during T. Aman season 2014

Combinations	Plant height (cm)		50% flowering (days)		PER (%)	OCR (%)	Yield	
							(kg/ plot)	(t/ha)
	A line	B line	A line	B line	A line	A line		
BRRI10A/B	82	86	71	70	72	32	70	1.5
BRRI11A/B	80	83	73	71	75	34	75	1.6
IR58025A/B	86	90	77	77	69	29	18	1.1

D/S:B1=04.07.14 A/B2=07.07.14 B3=10.07.14; D/T: A/B=27.07.14.
D/S:B1=06.07.14, A/B2=09.07.14, B3=12.07.14; D/T: A/B=29.07.14.

D/S:B1=03.07.14, A/B2=06.07.14, B3=09.07.14; D/T: A/B=28.07.14.

Table 7. CMS multiplication of BRRI hybrid dhan2, BRRI hybrid dhan3 and BRRI hybrid dhan4 during Boro, 2014-15.

Combinations	Plant height (cm)		50% flowering (days)		PER (%)	OCR (%)	Yield (kg/ plot)	Yield (kg /ha)	Location
	A line	B line	A line	B line	A line	A line	F_1 seed		
BRRI10 A/B	82	83	121	122	86	45	110	2200	Gazipur
BRRI11A/B	84	85	124	125	85	47	130	2350	
IR58025A/B	86	88	121	120	81	40	90	1720	

D/S: B1= 29-11-14, A/B2 = 02-12-14, B3=05-12-14; D/T: A/B=31-12-14;
D/S: B1= 01-12-14, A/B2 = 04-12-14, B3=07-12-14; D/T: A/B=04-01-15;
D/S: B1= 03-12-14, A/B2 = 06-12-14, B3=09-12-14; D/T: A/B=05-01-15;
PER=Panicle Exertion Rate, OCR= Out Crossing Rate.

F_1 Hybrid seed production of BRRI hybrid dhan2, BRRI hybrid dhan3 and BRRI hybrid dhan4 during T. Aman 2014 and Boro, 2014-15.

During T. Aman 2014, seed yield were obtained 50 kg (1450 kg/ha) from BRRI10A/BRRI10R, 115 kg (1500 kg/ha) from BRRI11A/BRRI15R and 22 kg (1200 kg/ha) from IR58025A/BRRI10R (Table 8).

Table 8. F_1 seed production of BRRI hybrid dhan2, BRRI hybrid dhan3 and BRRI hybrid dhan4 during T. Aman, 2014

Combinations	PHT (cm)		Days to 50% flowering		PER (%)	OCR (%)	Yield /plot (kg)	Yield (kg/ ha)
	A line	R line	A line	R line	A line	A line		
BRRI hybrid dhan2 (BRRI10A/ BRRI10R)	75	102	88	86	75	44	50	1450
BRRI hybrid dhan3 (BRRI11A/ BRRI15R)	81	89	77	74	74	35	115	1500
BRRI hybrid dhan4 (IR58025A/ BRRI10R)	76	109	129	132	76	39	22	1200

D/S: R_1=06 Jul 2013 A=09 July 2013 R_2=12 Jul 2013 D/T R/A=30 Jul 2013
D/S: R_1=09 Jul 2013 A=13 Jul 2013 R_2=17 Jul 2013 D/T R/A= 03 Aug 2013
D/S: R_1=06 Jul 2013 A=09 July 2013 R_2=12 Jul 2013, D/T R/A=30 Jul 2013
PER=Panicle Exertion Rate, OCR= Out Crossing Rate.

In Boro 2014-15, seed yield obtained 100 kg (2.5 t/ha), 120 kg (2.65 t/ha) and 450 kg (1.7 t/ha) respectively from BRRI10A/BRRI10R, BRRI11A/BRRI15R and IR58025A/BRRI10R respectively (Table 9).

Table 9. F_1 seed production of BRRI hybrid dhan2, BRRI hybrid dhan3 and BRRI hybrid dhan4 during Boro, 2014-15.

Combinations	Plant height (cm)		50% flowering (days)		PER (%)	OCR (%)	Yield (kg / plot)	Yield (kg /ha)	Location
	A line	R line	A line	R line	A line	A line	F_1 Seed		

BRRI hybrid dhan2	81	88	119	121	85	48	100	2500	BRRI Gazipur
BRRI hybrid dhan3	83	90	121	122	87	49	120	2650	BRRI Gazipur
BRRI hybrid dhan4	85	89	120	121	87	41	450	1700	BRRI Gazipur

D/S: R1=27-11-14, A=30-11-14, R2=03-12-14; D/T: A/R=30-12-14;
D/S: R1=03-12-14, A=07-12-14, R2=11-12-14; D/T: A/R=06-01-15;
D/S: R1=01-12-14, A=04-12-14, R2=07-12-14; D/T: A/R=03-01-15;
PER=Panicle Exertion Rate, OCR= Out Crossing Rate.

Seed production of promising hybrids

Seed yield were obtained 130 kg (2.6 t/ha), 130 kg (2.6 t/ha), 30 kg (1.5 t/ha) respectively from IR79156A/BasmatiR, IR79156A/BRRI20R and IR79156A/PL-1R respectively during Boro 2014-15 (Table 10).

Table 10. Seed amount got from promising hybrid rice combinations during Boro, 2014-15.

Designation	PHT (cm)		D50%F		PER (%)	OCR (%)	Plot area (m^2)	Yield (kg/plot)	Seed yield (t/ha)
	A Line	R Line	A Line	R Line					
IR79156A/BasmatiR	95.5	101.3	128	128	73.3	45.2	500	130 kg	2.6
IR79156A/ BRRI20R	96.4	102.0	127	129	74.2	47.2	500	130 kg	2.6
IR79156A/PL-1R	98.4	106.5	126	129	68.0	46.0	200	30 kg	1.5

D/S: R_1=07-12-14, R_2=10-12-14, R_3= 13-12-14, A=10-12-14 ; D/T : R/A=17-01-15/20-01-15;
D/S: R_1=07-12-14, A=10-12-14, R_2=13-12-13; D/T: A/R=20-01-15
D/S: R_1=07-12-14, A=10-12-14, R_2=13-12-14; D/T: A/R=20-01-15

Dissemination of Hybrid rice technology

During this reporting year, hybrid rice division supplied a total of 1238.0 kg of parental lines and F_1 seeds to 7 seed companies along with BADC, farmers, BRRI staffs and different projects (Table 11). A total of 30150 kg F_1 seed was produced during Boro season 2014-15 with the technical assistance from BRRI under four seed companies and regional station of BRRI (Table 12).

Table 11. Amount of parental line and hybrid seeds supplied to different organization

Sl. No.	Recipient	Nos.	F_1 (kg)	A line (kg)	B line (kg)	R line (kg)
01	BADC	1	0.00	20.00	-	8.00
02	Seed Companies	7	70.0	300.00	-	100.00
03	Farmers	36	250.0	30.00	-	10.00
04	BRRI Scientists + staffs	10	100.00	-	-	-
05	IAPP + PGB+ CSISA	3	350.00	-	-	-
	Total	57	770.00	350.00	0.00	118.00
	Grand Total			**1238.00**		

Investigator: All staff of hybrid rice division.

Table 12. Seed production activities of BRRI developed hybrids during Boro seasons of 2014-15 both at private and public sectors

SL.	Company	Variety	Location	Area (Acre)	Seed produced (Kg)
01.	Nayan seed, Shibgonj, Bogra	BHD2	Shibgonj, Bogra	11.0	13000
02.	Nayan seed, Shibgonj, Bogra	BHD3	Shibgonj, Bogra	10.7	11000
03.	M/S A Hoque, Gaibandha	BHD2	Gaibandha	1.25	1400
04.	Hanif Seed Company Pirgong, Rangpur	BHD3	Pirgonj	0.33	300
05.	Hi- Tech Agro (HITCO), Thakurgaon	BHD3	Thankurgaon	0.66	500
06.	Matiur Rahman Sadek (farmer)	BHD3	Habigonj	0.66	800
07.	Mr. Sohel Ahmed	BHD3	Nilphamari	1.0	700
08.	Barisal (Farmer's field) IAPP	BHD3	Gajalia, Barisal.	0.66	650
09.	Rangpur R/S GOB	BHD3	Rangpur R/S	0.40	120
10.	Bhanga R/S GOB	BHD3	Near by Bhanga R/S	0.40	150
11.	Barisal (Farmer's field) GOB	BHD3	Gajalia, Barisal.	0.33	350
12.	BRRI HQ PGB project	BHD3	BRRI HQ	0.25	250
13.	BRRI HQ PGB project	BHD2	BRRI HQ	0.38	260
14.	BRRI HQ, GOB	BHD2	BRRI HQ	0.25	100
15.	BRRI HQ, GOB	BHD3	BRRI HQ	0.25	120
16.	BRRI HQ, GOB	BHD4	BRRI HQ	0.75	450
Total =				**29.27 Acre**	**30150**

Agronomy Division

Personnel

Md Abdul Jalil Mridha, *PhD*

Chief Scientific Officer and Head

Md Gous Ali, *PhD*

Principal Scientific Officer

Md Abu Bakar Siddique Sarker, *MS*

Principal Scientific Officer

Md Khairul Alam Bhuiyan, *MS*

Senior Scientific Officer

Shah Ashadul Islam, *MS*

Senior Scientific Officer

Rakiba Shultana, *MS*

Senior Scientific Officer

Amena Sultana, *PhD****

Senior Scientific Officer

Md Iftekhar Mahmud Akhand, *MS*

Senior Scientific Officer

Md Masud Rana, *MS*

Scientific Officer

Md Zakaria Ibne Baki, *MS*

Scientific Officer

Md Mostofa Mahbub, *MS*

Scientific Officer

Lutfun Nahar, *MS*

Scientific Officer

*** Joined BRRI

Agronomy Division

Summary

Planting practices

Fertilizer management

Weed management

Yield maximization

Project activity

SUMMARY

Yield performance was found significantly higher of BRRI dhan48 at Barguna sadar in Aus season and BRRI dhan52 and BRRI dhan62 at Uzirpur and BRRI dhan49 at Kolapara in T. Aman season with BRRI recommended practices.

Among eight promising lines, BR7697-16-2-2-1-1 gave comparable grain yield with BRRI dhan49, furthermore, it matured 2-6 days earlier in T. Aman season.

Among six promising lines in Boro season, BR7833-11-1-1-3-4 and BR7369-10-5-2-3 produced significantly higher grain yield irrespective of planting dates and matured 2-4 days earlier than BRRI dhan28 and BRRI dhan63 respectively.

The estimated optimum dose of nitrogen for BRRI dhan49, BRRI dhan56, BRRI dhan57 and BRRI dhan62 were 79, 66, 66 and 65 kg N ha^{-1} respectively. The optimum nitrogen dose for BRRI dhan58, BRRI dhan59, BRRI dhan60 and BRRI dhan61were 138, 142, 148 and 142 kg N ha^{-1} respectively.

BRRI dhan57 produced significantly higher yield (4.16 t/ha) than both NERICA-1 and NERICA-10 with urea 150 kg ha^{-1}.

NPK briquette produced 22-34% and 23% higher grain yield over farmer's practice during Aus and Boro season, respectively in three and four locations of Barisal region. However, USG application gave 18-32% higher grain yield in T. Aman season over farmer's practice in four locations of Barisal region.

Along with a hand weeding both post emergence herbicides Pretilachlor+ Pyrazosulfuran ethyl @ 750 g/ha controlled *Cyperus difformis* more than 80% and Bispyribac sodium @ 150 g/ha controlled *Cyperus difformis* and *Scripus maritimus,* 80.97% and 81.23% respectively in direct seeded Aus rice.

In Rangpur region, both BRRI dhan51 and BRRI dhan52 produced additional grain yield by transplanting of 45 day old seedling with 20 x 20 cm spacing and 4 seedlings per hill on 3rd week of July and applying 30 kg ha^{-1} additional N after 15 days of de submerge.

In Rangpur region, BRRI dhan56, BRRI dhan57 and BRRI dhan62 planted on 4th week of July by 25 days old seedling with 20 x 15 cm spacing, two seedlings per hill and weed management by either pre emergence herbicide or post emergence herbicide along with one hand weeding produced higher yield under drought prone area during T Aman season.

Nitrogen application (168 kg/ha) in 4 split gave the highest grain yield (7.61 t/ha) followed by USG application plot (7.16 t/ha) in mechanical transplanted condition in Boro season.

BRRI dhan60, BRRI dhan29 and BRRI dhan58 gave 21, 16 and 10 percent higher grain yield respectively with USG application than farmers practice in Gopalganj district.

Yield improvement of BRRI varieties were average 23% due to herbicide and BRRI weeder used and 59% and 50% weeding cost were reduced by herbicide and BRRI weeder used over hand weeding.

PLANTING PRACTICES

Comparative yield performance of rice by applying BRRI recommended practices during Aus and T. Aman seasons in Barisal region

Field trials were conducted at Barguna in Aus 2014 and at Uzirpur of Barisal and Kolapara, of Patuakhali in T. Aman 2014 to find out the suitable rice varieties for these locations. BRRI recommended fertilizer doses of TSP, MOP, Gypsum and $ZnSO_4$ were applied during final land preparation except urea which was top dressed as equal splits.

During Aus season at Barguna BRRI dhan48 produced the highest yield, which is statistically identical to BRRI dhan27, BINA dhan14 and BRRI dhan55. The lowest grain yield was found in local variety (Gotairri). The highest yield by BRRI dhan48 might be because of the highest number of grain panicle^{-1} and the lowest percentage of sterility (Table 1). During T. Aman season in Uzirpur, BRRI dhan52 produced the highest grain yield. Grain yield of BRRI dhan62 and local variety Kaoathoti was similar but growth duration of local variety was one month long than BRRI dhan62. In Kolapara, BRRI dhan49 gave the highest grain yield among the tested varieties (Table 2).

Effect of planting time on growth and yield of advanced lines in T. Aman season

Planting time is one of the key factors to release a variety and considering this, a trial was conducted at the BRRI,Gazipur in Aman 2014 to select the best promising lines. Eight promising lines viz. BR7697-15-4-4-2-1, BR7697-15-4-4-2-1, BR7697-15-4-4-2-2, BR7697-16-2-2-1-1, BR7369-52-3-2-1-1, BR7468-12-1-1-1-1, BR7472-16-2-1-2-1, BR7638-7-2-5-2 were evaluated with check varieties BRRI dhan32, BRRI dhan37 and BRRI dhan49. Entries were planted from 15th July to 14th September with 15 days intervals. Thirty- days - old seedling was transplanted with 20 x 20 cm spacing. The treatments were distributed in a split-plot design, placing planting date in the main plots and entries in the sub-plots. Grain yield and growth duration gradually decreased with the advancement of planting dates irrespective of entries. None of the promising line produced higher grain yield over check varieties irrespective of planting dates. However, only BR7697-16-2-2-1-1 showed comparable grain yield with BRRI dhan49, furthermore it matured 2-6 days earlier (Table 3).

Effect of time of planting on growth and yield of advanced lines in Boro season

Trials were conducted at the BRRI Farm, Gazipur during Boro 2014-15 to find out the optimum planting time of potential promising lines. Six lines BR7781-10-2-3-2, BR7369-10-5-2-3, NERICA Mutant, BR7833-11-1-1-3-4, BR7830-16-1-5-9-9, BR7369-52-3-2-1- 1 including check BRRI dhan28, BRRI dhan45, BRRI dhan50, BRRI dhan63 and BRRI dhan64 were planted from 1st November with 15 days interval. Forty - days - old seedlings were transplanted with application of N-P-K-S as urea, TSP, MOP and gypsum at 120-35-60-10 kg ha^{-1}.The grain yield and field duration were gradually decreased in delayed planting circumstances. BR7833-11-1-1-3-4 produced significantly higher grain yield irrespective of planting dates and matured 3-4 days earlier than BRRI dhan28. BR7369-10-5-2-3 also produce higher grain yield compared to BRRI dhan63 and matured 2-3 days earlier (Table 4).

FERTILIZER MANAGEMENT

Determination of Nitrogen requirement for newly released Boro and T. Aman varieties

Nitrogen fertilizer is one of the major concerns for having potential grain yield and economic benefit by reducing the use of urea, beside that it increases nitrogen use efficiency (NUE) and also improves soil environment. Therefore, two field experiments were conducted at BRRI Gazipur to determine nitrogen management options for newly developed varieties in T. Aman, 2014 and Boro, 2014-15. BRRI dhan49, BRRI dhan56, BRRI dhan57 and BRRI dhan62 were transplanted in T. Aman and another four varieties BRRI dhan58, BRRI dhan59, BRRI dhan60 and BRRI dhan61 were tested under Boro season.. In T. Aman N were applied at 25, 50, 75 kg ha^{-1} as prilled urea, LCC based (52 kg N ha^{-1}), USG (50 kg N ha^{-1}) and Control (without N). In Boro N were managed by 80,120, 160, 200 kg ha^{-1} as prilled urea with USG (75 kg N ha^{-1}) and control. The treatments were laid with split plot design, placing varieties in main and N management in the sub plot with three replications. Two years pooled data were considered to calculate the yield and optimum N rate. The optimum N doses of each variety were determined by regression of grain yield with N rates: $Y = a + bN + cN^2$. Where, Y is rice yield (kg/ha), N is nitrogen dose (kg/ha), a means intercept (estimated yield without N application), b and c are coefficients, respectively (Saleque *et al.,* 2004). Differentiating Y with respect to N of the Eqn. gives the nitrogen dose for the maximum yield. The estimated nitrogen dose for maximum yield N= -b/2c. The grain yield of T. Aman varieties showed at different levels of N and USG application was estimated through regression equation from two years pooled data (Fig. 1 A). The relationship of grain yield and applied nitrogen in different varieties was quadric. The quadratic regression equation of BRRI dhan49, BRRI dhan56, BRRI dhan57 and BRRI dhan57 were $y = -0.000x^2 + 0.054x + 2.610$; $R^2 = 0.880$** $y = -0.000x^2 + 0.047x + 2.719$; $R^2 = 0.963$**, $y = -0.000x^2 + 0.047x + 2.719$; $R^2 = 0.963$** and $y = -0.000x^2 + 0.035x + 2.631$; $R^2 = 0.975$**, respectively. Nitrogen treatment accounted about 88%, 96%, 96% and 97% variation in grain yield for BRRI dhan49, BRRI dhan56, BRRI dhan57 and BRRI dhan62, consequently. The estimated optimum dose of nitrogen for BRRI dhan49, BRRI dhan56, BRRI dhan57 and BRRI dhan62 were 79, 66, 66 and 65 kg N ha^{-1} respectively.

The variation of grain yield of Boro rice varieties at different levels of N with USG application was also estimated through regression equation using two years pooled data (Fig. 1 B). The relationship of grain yield and applied nitrogen in different varieties was quadric. The quadratic regression equation of BRRI dhan58, BRRI dhan59, BRRI dhan60 and BRRI dhan61 were, $y = -0.000x^2 + 0.047x + 3.347$, $R^2 = 0.979$**, $y = -0.000x^2 + 0.045x + 3.237$, $R^2 = 0.943$** , $y = -0.000x^2 + 0.046x + 3.342$, $R^2 = 0.976$** and $y = -0.000x^2 + 0.046x + 3.309$, $R^2 = 0.969$** respectively. Nitrogen treatment accounted for about 98%, 94%, 97% and 97% variation in grain yield for BRRI dhan58, BRRI dhan59, BRRI dhan60 and BRRI dhan61, respectively. The optimum nitrogen dose for BRRI dhan58, BRRI dhan59, BRRI dhan60 and BRRI dhan61were 138, 142, 148 and 142 kg N ha^{-1} respectively.

Response of Nerica rice to nitrogen fertilization in Aman season

An experiment was conducted during T. Aman 2014 at BRRI, Gazipur with three rice varieties viz. NERICA-1, NERICA-10 and BRRI dhan57 and five urea doses viz. 0, 50,100,150 and 200 kg ha^{-1}. TSP, MOP, gypsum and zinc was applied at 150-52.5-82.5-0 kg ha^{-1}. The experimental design was RCBD replicated thrice.BRRI dhan57 produced significantly higher yield (4.16 t ha^{-1}) than both of NERICA-1 and NERICA-10 with 150 kg ha^{-1} urea. Although, grains $panicle^{-1}$ and 1000-grains weight were not influenced by urea application in any tested entries, number of panicle production was significantly higher in BRRI dhan57 with higher level of urea application (Table 5).

Validation of nutrient management options for increasing yield at farmer's condition during Aus, Aman and Boro seasons in Barisal region

The experiment was conducted to determine the best option of fertilizer requirement for growing rice in Aus, Aman and Boro seasons at farmer's field. The treatments were; i) BRRI recommended fertilizer, ii) USG application, iii) NPK briquette application and iv) Farmer's practice. The experimental area was laid out in RCB design with three replications. BRRI recommended fertilizer dose of TSP, MOP, gypsum and $ZnSO_4$ were applied during final land preparation except urea. Although USG or briquettes were applied after 7 DAT, prilled urea were top dressed at three equal splits. In Aus and T. Aman, 2014 USG one piece (weight 1.8 g) and NPK briquette one piece (weight 3.4 g) and in Boro 2014-15 USG one piece (weight 2.7 g) and NPK briquette two pieces (weight 2.4 g each) were applied within four hills of rice plants as per treatment. NPK briquette treatment produced 22-34% higher grain yield during Aus season over farmer's practice in three locations (Table 6). On the other hand, USG treatment gave 18-32% higher grain yield in T. Aman season over farmer's practice in four locations (Table 7). During Boro season NPK briquette treatment produced 23% higher grain yield over farmer's practice in four locations of Barisal region (Table 8).

WEED MANAGEMENT

Weed control methods on productivity of direct dry seeded rice in Aus season

Weeds are a serious problem in direct seeded rainfed rice not only for Bangladesh, but also for the world. In this context, a study was undertaken at the BRRI farm, Gazipur to determine effective weed control methods in Aus season. BRRI dhan43 were sown in line on 22th April, 2014 with 20 cm spacing. The treatments were; i) Post-emergence herbicide + 1HW, ii) Post-emergence herbicide+ 2HW, iii) Hand weeding at 15 & 30 DAS and compared with iv) control (No weeding). The post-emergence herbicides Pretilachlor+ Pyrazosulfuran ethyl @ 750 g/ha, and Bispyribac sodium @ 150 g/ha applied at 6 DAS in direct seeding method. The treatments were distributed following RCB design with three replications. BRRI recommended fertilizer dose and other cultural management were applied. Six different weed species were observed in unweeded (control) plot where most dominating weeds were grass and sedges. Post-emergence herbicide Pretilachlor+

Pyrazosulfuran ethyl + 1HW controls *Cyperus difformis* more than 80% where as Post-emergence herbicide bispyribac sodium + 1HW control *Cyperus difformis* and *Scripus maritimus,* 80.97% and 81.23%, respectively (Table 9). So herbicide application along with one hand weeding effectively control weeds in direct dry seeded condition and consequently gave higher yield.

YIELD MAXIMIZATION

Validation of nutrient and crop management options for yield maximization of BRRI dhan51 and BRRI dhan52 at Rangpur region.

Two experiments were conducted at three different farmer's field separately at Pirgasa, Rangpur, Lalmonirhat sadar and Sayedpur, Nilphamari to identify and recommend appropriate nutrient management and other crop management option for yield maximization for BRRI dhan51 and BRRI dhan52 -submergence tolerant varieties. The tested treatments were: T_1 = Management 1 + AEZ Fertilizer based recommended nutrient management + 30 kg Nha^{-1} additional after 10 days de submerge, T_2 = Management 1 + AEZ Fertilizer based recommended nutrient management + 30 kg Nha^{-1} additional after 15-day desubmerge, T_3 = Management 2 + AEZ Fertilizer based recommended nutrient management + 30 kg Nha^{-1} additional after 10 days desubmerge, T_4 = Management 2 + AEZ Fertilizer based recommended nutrient management + 30 kg Nha^{-1} additional after 15-days desubmerge and T_5 = Farmer management. Where Management 1 was 30 days old seedling with 20 x 25 cm spacing, two seedlings per hill and 1st week of July transplanting and Management 2 was 45-day-old seedling with 20 x 20 cm spacing and 4 seedlings per hill and 3rd week of July. The experiment was laid down in RCB design with three replications. All fertilizers were applied as basal before transplanting except urea. Other intercultural operations were done as and when necessary.

Grain yield of BRRI dhan51 and BRRI dhan52 were significantly affected by different treatments during T. Aman 2014 season (Fig. 2 & Fig. 3) at different locations. The highest grain yield was observed at treatment T_4 followed by T_2 both the experiment by BRRI dhan51 and BRRI dhan52 but the lowest grain yield was obtained from treatment T_5 at each locations. Based on these two experiment's results from three different locations it may be concluded that for obtaining higher grain yield from BRRI dhan51 and BRRI dhan52 at Rangpur region at submergence ecosystem in T. Aman season transplanting should be done on 3rd week of July with 45-day-old seedling and four seedlings per hill, maintaining 20 x 20 cm spacing. Additional 30 kg ha^{-1} N with recommended rate after 15 days of de submerge at vegetative stage should be applied. (Note: BRRI dhan52 was totally damaged by 16 days submergence at Sayedpur, Nilphamari)

Validation of weed control option and crop management for yield maximization of BRRI dhan56, BRRI dhan57 and BRRI dhan62 at Rangpur region

These three experiments were conducted at three different farmer's field separately at Pirgasa, Rangpur, Kaliganj, Lalmonirhat and Sayedpur, Nilphamari to identify and recommend appropriate

weed and crop management option for yield maximization of BRRI dhan56, BRRI dhan57 and BRRI dhan62 under drought condition during T. Aman season. The tested treatments were: T_1 = Crop management-1 + Pre emergence herbicide + one hand weeding, T_2 = Crop management-1 + Post emergence herbicide + one hand weeding, T_3 = Crop management-1 + Pre emergence herbicide + Post emergence herbicide, T_4 = Crop management-2 + Pre emergence herbicide + one hand weeding, T_5 = Crop management-2 + Post emergence herbicide + one hand weeding, T_6 = Crop management-2 + Pre emergence herbicide + Post emergence herbicide and T_7 = Farmer's practice. Where Crop management-1: 25-day- old seedling with 20 x 15 cm spacing, two seedlings per hill and 4th week of July transplanting and Crop management-2: 35-day-old seedling with 20 x 20 cm spacing, two seedlings per hill and 1st week of August transplanting. The experiment was laid down in RCB design with three replications. All fertilizers were applied as basal before transplanting except N.

Grain yield of BRRI dhan56, BRRI dhan57 and BRRI dhan62 were significantly affected by different treatment at all locations (Fig. 4, Fig. 5 and Fig. 6) during T. Aman 2013 season. The highest grain yield was observed from treatment T_1, T_2 and T_3 by all the tested varieties which mean Management-1 performed higher grain yield than Management-2 at all the locations by both the tested two varieties. Similarly, the tested weed control options have no significant yield difference under both the two managements in all locations. Based on the three location's results it may be concluded that Crop management-1 i.e. 25-day-old seedling with 20 x 15 cm spacing, two seedlings per hill and 4th week of July transplanting with any one of the tested three weed management options i.e. Pre emergence herbicide + one hand weeding or Post emergence herbicide + one hand weeding or Pre emergence herbicide + Post emergence herbicide may be adopted for higher yield for BRRI dhan56, BRRI dhan57, and BRRI dhan62 under drought prone ecosystem of Rangpur region during T. Aman season.

PROJECT ACTIVITY

Livelihood improvement through resource conservation of farmer by PGB IADP

Field demonstration were carried out for balanced fertilizer application and weed management technologies to show the performance of balanced fertilization and cost effective weed management in the farmers field of Pirojpur, Gopalgonj and Bagerhat district during T.Aman 2014 and Boro 2015 under the project of IADP-PGB. During T.Aman 2014 season a number of 17 demonstrations were carried out regarding fertilizer management (Table 10). BRRI recommended rate of urea, TSP, MoP, gypsum and zinc fertilizer were used to compare with farmers practice fertilizer application. Different BRRI developed T.Aman varieties were used to popularize in different locations. In every location BRRI recommended fertilizer management practice over yielded compared to farmers' practice. Average 15% grain yield were increased over variety and locations by the practice of BRRI recommended fertilizer management.

Eighteen weed management demonstrations were conducted at different upazillas of Pirojpur, Gopalganj and Bagerhat districts during T.Aman 2014. In each upazilla three trails were set up. Weed management treatments were Herbicide + 1HW, BRRI weeder + 1HW which were compared with farmers practice. In every location farmers used to practiced hand weeding. Data showed that (Table 11) in all the locations herbicide+1HW and BRRI weeder+1HW produced more grain yield compared to farmer's practice. For herbicide treatment, average yield improvement over farmer's practice was 23% and for BRRI weeder+1HW treatment average yield improvement over farmer's practice wsa 21%. Table 12 showed that about 59% cost was reduced due to herbicide use whereas 50% cost was reduced when used BRRI weeder+1HW for weed management of rice.

During Boro 2014-15, a total of 45 field trail were conducted regarding fertilizer management of modern Boro rice in different upazillas of Pirojpur, Gopalganj and Bagerhat district. BRRI dhan28, BRRI dhan29, BRRI dhan50, BRRI dhan58, BRRI dhan60, BRRI dhan61, BRRI hybrid dhan2 and BRRI hybrid dhan3 were demonstrated with BRRI recommended balanced fertilizer compared with farmer practice. Results showed that in all locations, all the varieties gave 2-10% higher yield with BRRI recommended balanced fertilizer compared to farmer practice. Over locations BRRI dhan58 produced the highest grain yield compared with BRRI dhan28 and BRRI dhan29.BRRI dhan 58 may be replaced with BRRI dhan29 in that area (Fig. 7).

Fertilizer management options of Boro rice established by rice transplanter

The experiment was conducted under AFACI project to find out a suitable fertilizer management schedule for rice that transplanted by rice transplanter in Boro 2014-15 at BRRI farm, Gazipur. The Urea application treatments were T_1 = N 140 kg/ha at 3 split, T_2 = N 168 kg/ha at 3 split, T_3 = N 140 kg/ha at 4 split, T_4 = N 168 kg/ha at 4 split, T_5 USG (N75 kg/ha) and T_6 Control (No Nitrogen). BRRI recommended basal fertilizer of P, K, S and Zn were applied on the basis of Agro ecological zone in the plots and urea were applied according to treatment. In USG applied plot additional 40 kg/ha N was applied before panicle initiation stage when N deficiency symptoms were shown on leaf. The experiment was conducted in a randomized complete block design and replicated thrice. BRRI dhan29 were transplanted by machine with 24 days old seedlings in 12 January 2015 using a walking type 6 rows transplanter. Nitrogen application (168 kg/ha) in 4 split gave the highest grain yield (7.61 t/ha) followed by USG application plot (7.16 t/ha) in mechanical transplanted condition (Table 17).

Field validation of USG and BRRI recommended fertilizer management practice at Gopalganj region (PGB IADP)

The experiment was conducted at 22 and 20 farmers' field respectively in T.Aman and Boro season at Gopalganj areas under PGB IADP project to validate and disseminated a suitable fertilizer management for rice. BRRI recommended basal fertilizer of P, K, S and Zn were applied on the basis of Agro ecological Zone in the plots and urea were applied as USG and BRRI management. In USG applied plot of BRRI dhan58 and BRRI dhan29 an additional 40 kg/ha N was applied

before panicle initiation stage in some plots where N deficiency symptoms were founded. BRRI dhan29, BRRI dhan58 and BRRI dhan60 were planted in different upazila of Gopalganj. BRRI dhan60, BRRI dhan29 and BRRI dhan58 gave higher grain yield in USG applied plots and the increasing trends gave 21, 16 and 10 percentage of higher grain yields irrespective over the locations with almost same growth duration between the treatments (Table 14).

Table 1: Yield performance of modern rice varieties in Barguna Sadar, Baguna, Aus 2014

Treatment	Plant height at harvest (cm)	Panicle/m^2	Grains/panicle	Sterility (%)	Grain yield (t/ha)
BRRI dhan27	130.67	358	88	15.33	3.65
BRRI dhan48	99.00	375	109	14.33	4.06
BRRI dhan55	96.67	358	83	15.20	3.06
BINA dhan14	95.67	333	77	15.40	3.48
Local variety(Gotairri)	112.67	359	62	18.10	2.77
CV (%)	0.40	1.80	6.90	6.30	0.80
LSD $_{(0.05)}$	0.87	12.15	10.90	1.81	0.53

Table 2. Yield performance of modern rice varieties in T. Aman season at Barisal region

Uzirpur, Barisal			Kolapara, Patuakhali		
Treatments	Growth duration	Grain yield (t ha^{-1})	Treatments	Growth duration	Grain yield (t ha^{-1})
BRRI dhan41	149	4.40	BRRI dhan44	142	5.07
BRRI dhan52	147	5.09	BRRI dhan49	136	5.70
BRRI dhan62	103	3.28	BRRI dhan52	142	5.04
Local variety(Kaoathoti)	147	3.31	Local variety (Tepu)	132	4.10
CV%	0.60	5.00	CV (%)	0.70	3.50
LSD (0.05)	1.72	0.41	LSD $_{(0.05)}$	1.91	0.36

Table 3. Effect of planting time on yield and growth duration (in the parenthesis) of advanced lines/varieties in Aman, 2014-2015, BRRI, Gazipur.

Advanced lines/varieties	Date of transplanting				
	14 July	29 July	13 Aug.	28 Aug.	12 Sep.
BR7697-15-4-4-2-1	4.77 (135)	3.97 (131)	3.77 (127)	3.53 (123)	1.2 (118)
BR7697-15-4-4-2-2	4.30 (137)	3.80 (133)	3.30 (128)	3.20 (124)	*NF
BR7697-16-2-2-1-1	5.20 (134)	4.07 (130)	3.50 (126)	3.30 (122)	1.30 (118)
BR7369-52-3-2-1-1	3.90 (136)	3.83 (133)	3.57 (128)	3.23 (125)	*NF
BRRI dhan 37(ck)	3.73 (138)	3.07 (135)	2.93 (130)	2.73 (126)	*NF
BR7468-12-1-1-1-1	4.57 (132)	4.30 (128)	4.03 (124)	3.60 (120)	0.58 (116)
BR7472-16-2-1-2-1	4.43 (135)	3.93 (131)	3.87 (127)	3.67 (123)	*NF
BR7638-7-2-5-2	4.77 (133)	4.0 (129)	3.37 (125)	3.10 (120)	*NF
BRRI dhan 32(ck)	4.87 (129)	4.47 (125)	4.20 (121)	3.15 (118)	*NF

BRRI dhan 49(ck)	5.57 (136)	5.50 (132)	5.20 (129)	4.0 (125)	1.25 (121)

Table 4. Effect of planting time on yield and growth duration (in the parenthesis) of advanced lines/varieties in Boro, 2014-2015, BRRI, Gazipur.

Advanced lines/varieties	Date of transplanting				
	15 Jan.	30 Jan.	14 Feb.	1 Mar.	15 Mar.
BR7781-10-2-3-2	5.43 (145)	5.40 (142)	5.07 (138)	4.17 (134)	2.07 (130)
BR7369-10-5-2-3	6.90 (148)	6.67 (144)	6.23 (141)	4.13 (137)	*NF
NERICA Mutant	6.0 (145)	5.40 (141)	5.23 (137)	4.0 (135)	1.8 (132)
BR7833-11-1-1-3-4	7.23 (140)	6.65 (137)	5.96 (134)	4.23 (131)	3.73 (127)
BR7830-16-1-5-9-9	6.83 (152)	6.40 (148)	5.70 (144)	3.33 (141)	2.80 (137)
BR7369-52-3-2-1-1	6.5 (156)	5.90 (152)	5.37 (146)	*NF	*NF
BRRI dhan28 (ck)	7.06 (143)	6.50 (140)	5.83 (137)	4.13 (134)	3.67 (129)
BRRI dhan45 (ck)	5.97 (142)	5.67 (139)	5.13 (136)	3.70 (132)	2.63 (128)
BRRI dhan50 (ck)	6.07 (156)	5.73 (153)	5.40 (150)	4.20 (146)	2.67 (142)
BRRI dhan63 (ck)	7.02 (150)	6.77 (147)	5.93 (145)	4.07 (141)	3.37 (137)
BRRI dhan64 (ck)	6.63 (155)	6.27 (151)	6.0 (147)	3.57 (143)	2.67 (141)

Table 5: Effect of urea fertilizer on the performance of rice varieties in Aman 2014, BRRI, Gazipur

Urea doses (kg/ha)	Panicle/m^2	Grains/Panicle	1000-Grain weight (g)	Grain yield (t/ha)
	Nerica-1			
0	121	52	26.90	1.17
50	115	68	27.23	1.32
100	146	65	25.47	2.13
150	135	73	28.90	2.67
200	132	75	28.63	2.66
	Nerica-10			
0	131	68	24.13	1.37
50	127	79	25.13	1.67
100	143	77	22.83	2.35
150	150	76	24.90	2.65
200	147	74	25.26	2.64
	BRRI dhan57			
0	176	129	18.73	2.71
50	167	133	18.47	3.17
100	178	151	18.57	3.84
150	202	144	17.83	4.16
200	203	141	18.33	4.06
CV(%)	2.52	17.68	6.42	2.17
LSD (0.05)	6.50	Ns	Ns	0.093

Table 6: Effect of nutrient management options on the yield of BRRI dhan48 during Aus 2014 in Barisal region

Treatments	Grain yield (t ha^{-1})		
Location	*Bakerganj*	*Rajapur*	*Amtoli*
BRRI recommended dose	4.53	4.75	4.66
USG treated plot	4.76	4.88	5.02
NPK briquette plot	4.95	5.01	5.53
Farmer's practice	3.70	3.77	4.54
CV (%)	3.50	1.00	0.90
LSD $_{(0.05)}$	0.31	0.91	0.81

Table 7: Effect of nutrient management options on the yield of rice varieties during T. Aman 2014 in Barisal region

Treatments	Grain yield (t ha^{-1})			
Location	Babuganj	Jhalokathi Sadar	Barguna Sadar	Amtoli
Variety	*BRRI dhan52*	*Moulata*	*Sadamota*	*BRRI dhan52*
BRRI recom. dose	4.70	2.21	3.25	5.02
USG treated plot	4.94	2.50	3.42	5.42
Farmer's practice	3.73	1.86	2.91	4.56
CV (%)	3.30	3.20	2.80	1.80
LSD $_{(0.05)}$	0.33	0.16	0.23	0.21

Table 8: Effect of nutrient management options on the yield of rice varieties in Boro 2014-15 in Barisal region

Treatments	Grain yield (t ha^{-1})			
Location	Banaripara	Nolchiti	Barguna Sadar	Betagi
Variety	*BRRI dhan29*	*BRRI dhan55*	*BRRI dhan55*	*BRRI dhan28*
BRRI recom. dose	7.34	6.98	5.89	6.16
USG treated plot	7.05	7.08	6.14	6.21
NPK briquette	7.80	7.14	6.18	6.40
Farmer's practice	6.32	5.79	5.03	5.56
CV (%)	2.2	1.3	2.2	0.8
LSD $_{(0.05)}$	0.31	0.18	0.26	0.95

Table 9: Performance of the integrated weed control option for increasing yield of rice in Boro season at Barisal region

Treatment	Grain yield (t/ha)		
Location	Banaripara	Aguiljhara	Betagi
Variety	*BRRI dhan29*	*BRRI dhan28*	*BRRI dhan28*
Pretilachlor+ Pyrazosulfuran ethyl +1HW	7.19	6.18	6.21
Post Bispyribac sodium +1HW	7.28	-	-
Hand weeding	7.34	6.27	6.39
Farmer's practice	5.55	5.41	5.57
CV (%)	4.6	2.1	1.6
LSD $_{(0.05)}$	0.62	0.28	0.22

Table 10 Grain yield of modern T. Aman varieties in different Upozillas of Pirojpur, Gopalgonj and Bagerhat district compared to farmers practice during T.Aman 2014

Upozilla	Village	Variety	BRRI RP	FP	% Yield Improvement

Kashiani	Majraghat	BRRI dhan41	4.94	4.41	10.74
Gopalgonj	Kobra	BRRI hybrid dhan4	4.83	4.5	6.89
Sadar	Kobra	BRRI dhan34	3.84	3.8	0.99
	Gonapara	BRRI dhan33	4.90	4.3	12.32
	Manikda	BRRI hybrid dhan4	5.38	5.1	5.22
Tongipara	Kulsa	BRRI hybrid dhan4	5.29	4.45	15.85
	Nilpha	BRRI dhan39	5.37	4.22	21.41
Mollarhat	Voirabnagar	BRRI hybrid dhan4	5.81	4.33	25.43
	Garfa	BRRI dhan62	4.63	3.44	25.66
	Doibokandhi	BRRI dhan49	5.28	4.56	13.62
Fakirhat	Pagla	BRRI dhan54	5.29	4.23	20.10
	Betaga	BRRI dhan62	4.74	4.00	15.69
	Artaki	BRRI dhan52	5.72	4.73	17.28
Mukshudpur	Tangrakhala	BRRI dhan39	5.12	4.24	17.20
	Gopinathpur	BRRI dhan54	5.49	4.83	12.03
Sarupkathi	Krishnakathi	BRRI dhan41	5.02	4.32	13.91
	Krishnakathi	BRRI dhan41	4.88	4.2	13.94
Average yield improvement over FP irrespective of varieties					15

Table 11. Weed management technology validation in the farmer's field of Pirojpur, Gopalgonj and Bagerhat district compared to farmers practice during T.Aman 2014

Location	Variety	Weed management treatment	Yield (t/ha)	% Yield increase over FP
Mollarhat, Bagerhat	BRRI dhan49	Farmer's Practice (2HW)	4.32	-
		Pyrazosulfuron ethyl+ 1HW	5.12	19
		BRRI weeder+ 1HW	5.00	16
Nesarabad, Pirojpur,	BRRI dhan49	Farmer's Practice (2HW)	4.25	-
		Pyrazosulfuron ethyl+ 1HW	5.32	25
		BRRI weeder+ 1HW	5.12	20
Kashani, Gopalganj	BRRI dhan33	Farmer's Practice (2HW)	4.49	-
		Pretilachlor+ 1HW	5.44	21
		BRRI weeder+ 1HW	5.10	14
Goplagonj Sadar, Gopalgonj	BRRI dhan52	Farmer's Practice	4.20	-
		Pyrazosulfuron ethyl+ 1HW	5.30	26
		BRRI weeder+ 1HW	4.95	17
Tongipara, Gopalgonj	BRRI dhan52	Farmer's Practice	4.30	-
		Pyrazosulfuron ethyl+ 1HW	5.25	22
		BRRI weeder+ 1HW	5.11	19
Fakirhat, Bagerhat	BRRI dhan49	Farmer's Practice	4.40	-
		Pretilachlor+ 1HW	5.28	21
		BRRI weeder+ 1HW	4.90	16
Average yield increase in herbicide treated plot over FP				23
Average yield increase in BRRI weeder+1HW treated plot over FP				21

Table 12. Weed management cost reduction by using BRRI developed technology

Weed management	Yield (t/ha)	% Yield increase	Cost of weeding/ha	% cost reduction over FP
FP	4.49		13,500	-
Herbicide+ HW	5.44	21	5500	59
BRRI weeder + 1HW	5.10	14	6750	50

Table 13. Grain yield and yield components of Nitrogen management options in rice transplanter plot

Treatments	Panicle no /m^2	Grains /panicle	1000 grains weight (g)	Duration (Days)	Grain yield (t/ha)
N 140 Kg/ha @ 3 splits	302	104	22.56	154	6.50
N 168 Kg/ha @ 3 splits	304	111	22.59	153	6.63
N 140 Kg/ha @ 4 splits	307	109	22.65	153	6.87
N 168 Kg/ha @ 4 splits	317	114	22.94	155	7.61
USG	314	109	22.61	154	7.16
No Urea	274	100	22.34	151	5.71
CV%	5.2	9.2	1.5	0.4	6.3
$LSD_{0.05}$	27.83	17.43	0.60	1.14	0.75

Table. 14. Yield increased due to application of USG over farmers practice in different Upazila of Gopalganj district

Variety	Locations	Fertilizer management	Grain Yield (t/ha)	Duration (days)	Yield increase (%)
BRRI dhan60	Kashiani, Tongipara	USG	7.89	154.29	21%
	No of Farmer 08	Farmers practice	6.52	154.00	-
BRRI dhan58	Tongipara, Kotalipara	USG	8.69	161.00	10%
		BRRI	8.42	160.00	7%
	No. of Farmer 06	Farmers practice	7.98	158.00	-
BRRI dhan29	Gopalganj Sadar, Muksudpur	USG	8.97	163.00	16%
		BRRI	8.29	165.00	8%
	No of Farmer 06	Farmers practice	7.71	162.00	-

Fig.. 1. Grain yield of modern T.Aman and Boro varieties as affected by N levels from prilled urea and USG

Figure: 2 Effect of different nitrogen and crop management options for yield maximization of BRRI dhan51 at 3 different locations at Rangpur region in T. Aman season.

Figure: 3 Effect of different nitrogen and crop management options for yield maximization of BRRI dhan52 at 3 different locations at Rangpur region in T. Aman season.

Figure:4 Effect of different weed control options and crop management for yield maximization of BRRI dhan56 at 3 different locations at Rangpur region in T. Aman season.

Figure:5 Effect of different weed control options and crop management for yield maximization of BRRI dhan57 at 3 different locations at Rangpur region in T. Aman season.

Figure: 6 Effect of different weed control options and crop management for yield maximization of BRRI dhan62 at 3 different locations at Rangpur region in T. Aman season.

Figure 7. Grain yield of modern Boro varieties in different Upozillas of Pirojpur, Gopalgonj and Bagerhat district compared to farmers practice during Boro 2015

SOIL SCIENCE DIVISION

Scientific Personnel
Jatish Chandra Biswas, PhD
Chief Scientific Officer and Head
F M Moinuddin, MS[3]
Principal Scientific Officer
Pranesh Kumar Saha, PhD[1]
Principal Scientific Officer
A Islam, PhD[2]
Senior Scientific Officer
U A Naher, PhD[3]
Senior Scientific Officer
M Sajidur Rahman, MSc[4]
Senior Scientific Officer
F Rahman, PhD[4]
Senior Scientific Officer
A T M S Hossain, MS
Senior Scientific Officer
M M Haque, MS[4]
Senior Scientific Officer
S M Mofijul Islam, MS[4]
Scientific Officer
M M Iqbal, MS[4]
Scientific Officer
M N Ahmed, MS[2]
Scientific Officer
M N Islam, MS
Scientific Officer
M I U Sarker, BS[2]
Scientific Officer
F Alam, MS[2]
[1]PRL, [2]Training, [3]Transfer to BRRI regional station/other division
[4]On deputation for higher studies (MS/PhD)

SUMMARY

In T. Aman season, premium quality rice (PQR) genotypes needed maintenance dose of NPK while rainfed lowland rice (RLR) genotype, BR7468-12-1-1-1-1 required only 111 kg N ha^{-1} N and BR7638-7-2-5-2 required no K fertilizer. In Boro season, PQR genotypes required much lower P and K than applied nutrients. BR7369-52-3-2-1-1 required 190 kg N ha^{-1} but BR7781-10-2-3-2 needed 14 kg N ha^{-1}. Short duration Nerica Mutant needed higher 143, 40 and 32 kg ha^{-1} of N, P and K respectively. Micronutrient genotype BR7833-11-1-1-3-4 required more N (176 kg ha^{-1}) than BR7830-16-1-5-9-9 (155 kg ha^{-1}). But both the materials required higher P and lower K than applied rate.

A combination of 50 kg K and 50 kg N ha^{-1} for T. Aman rice (BRRI dhan49) and 150 kg K ha^{-1} and 100 kg N ha^{-1} for Boro rice (BRRI dhan29) cultivation seems to be suitable for desired grain yield of rice.

In AWD condition, Boro rice yield could be increased with the additional (50% more than recommended dose) N and K application.

In Grey Terrace soils (AEZ 28), BRRI dhan58 and BRRI dhan69 were able to produce 5.08-5.60 t ha^{-1} grain yield with 10% and 20% less of recommended fertilizer dose.

Long-term omission of N, P, K an S adversely affected rice yield though S and Zn omission had no negative effect on rice production in Grey Terrace soil of BRRI farm, Gazipur. Long-term application IPNS based chemical fertilizer showed increasing trend of rice yield, while inorganic fertilizer alone showed yield plateau.

Intensive rice cropping without fertilizer reduced grain yield of Boro rice to 0.50 t ha^{-1}. The trend in grain yield with NPKS fertilization over 33 years showed a positive increment compared to base year (1981). Soil productivity can be recuperated to its original state by addition of complete fertilizer dose. The STB fertilizer dose and INM could be good options for higher grain yield of rice in double or triple rice cropping pattern.

Vermicompost at 0.5 Mg ha^{-1} with full doses of chemical fertilizers could be used for sustaining rice productivity and paddy soil health.

Application of N as prilled urea (PU) and USG by applicators gave similar grain yield and N use-efficiency**.**

In both Rangpur and Barisal regions, BRRI recommended fertilizer dose and rice straw applied with IPNS based chemical fertilizer maximized rice yield. Application of rice straw with IPNS based chemical fertilizer can substitute full dose of K fertilizer in submergence and cold areas. Rice straw applied with IPNS based chemical fertilizer (except N) is a good practice to maximize rice yield in tidal flood ecosystem (Barisal, Jhalkathi, Barguna and Patuakhali).

The amount of floodwater NH_4^+-N was higher in broadcast PU, while it was negligible in deep placement of either urea or NPK briquettes. Deep placement of urea gave significantly higher

biomass yield as well as total N uptake in both AWD and CSW conditions. Nitrous oxide and NO fluxes were higher in UDP compared to PU treatment under AWD condition.

Significant variations existed in microbial population at different soil depths. A decreasing trend of population was found with increasing soil depth. Application of organic matter increased total nitrogen fixing and phosphate solubilizing populations. Missing of N and K significantly reduced microbial populations. Significantly high amount of phosphatase phytase and urease enzyme activities were found in organic matter amended treatments.

The effect of NPC fertilizer on Boro rice yield was promising. It helped in obtaining comparable grain yield with DAP and saved about 30% N.

SOIL FERTILITY AND PLANT NUTRITION

Site specific nutrient management for advanced lines

In site specific nutrient management (SSNM) technique N, P and K fertilizer recommendations are calculated based on i) nutrient requirement for selected grain yield goal, ii) indigenous nutrient supply capacity and iii) recovery of applied nutrients by the plants. However, nutrient requirements vary depending on genotypes, season and growing conditions. So, it is necessary to determine the requirement of these primary nutrients before releasing a new variety.

Field trials were conducted at BRRI farm, Gazipur during T. Aman 2014 and Boro 2014-15 seasons. In T. Aman, four PQR genotypes (BR7697-15-4-4-2-1, BR7697-15-4-4-2-2, BR7697-16-2-2-1-1 and BR7369-52-3-2-1-1) were evaluated with BRRI dhan37, three RLR genotypes (BR7468-12-1-1-1-1, BR7472-16-2-1-2-1 and BR7638-7-2-5-2) were evaluated against BRRI dhan32 and BRRI dhan49. In Boro season, three PQR genotypes (BR7781-10-2-3-2, BR7369-10-5-2-3 and BR7369-52-3-2-1-1) were compared with BRRI dhan50 and BRRI dhan63, two micronutrient genotypes (BR7833-11-1-1-3-4 and BR7830-16-1-5-9-9) were compared with BRRI dhan28 and BRRI dhan64; Nerica Mutant was compared with BRRI dhan28 and BRRI dhan45. Four fertilizer treatments viz T_1= NPK (AEZ-basis), T_2 = N omission (-N), T_3 = P omission (-P) and T_4 = K omission (-K) were imposed in the main plots and rice genotypes in the subplots with three replications. Sulphur was applied as blanket dose. NPKS @ 160-25-65-10 kg ha^{-1} in Boro and 120-15-60-8 kg ha^{-1} in T. Aman were used.

In T. Aman 2014, all PQR genotypes and check variety produced about 2 t ha^{-1} grain yields with added NPK fertilizers. However, PQR genotypes were 10 days earlier than BRRI dhan37. Omission of N, P and K from complete treatment had no effect on grain yield of tested genotypes indicating that a maintenance dose of fertilizer is enough for these entries.

All RLR genotypes out yielded BRRI dha32 with complete NPK fertilizer application. However, BR7638-7-2-5-2 genotype produced significantly higher grain yield (7.04 t/ha) than BRRI dhan49 (6.66 t/ha). Grain yield decreased significantly due to N omission. BR7468-12-1-1-1-

1 was not responsive to P and K omission. BR7472-16-2-1-2-1 and BR7638-7-2-5-2 were also responsive to P omission, while all the rice genotypes except BRRI dhan49 were not responsive to K omission. The magnitude of yield reduction due to nutrient omission was higher in N (0.2-2.25 t/ha) than P (0-1.79) and K (0-1.22 t/ha). The amount of fertilizers added for tested genotypes were 120, 15 and 60 kg ha^{-1} of N, P and K, respectively (Table 1).

Table 1. Requirement of N, P and K fertilizers for satisfactory grain yield of RLR genotypes, T. Aman 2014, BRRI-Gazipur.

Genotype	Nutrient requirement (kg ha^{-1})			Grain yield (t ha^{-1})
	N	P	K	
BR7468-12-1-1-1-1	111	-	-	5.68
BR7472-16-2-1-2-1	123	22	34	6.61
BR7638-7-2-5-2	135	27	-	7.04
BRRI dhan32	12	6	-	5.01
BRRI dhan49	77	22	49	6.66
Applied nutrient	120	15	60	

In Boro 2014-15, the PQR lines out yielded BRRI dhan50 with complete NPK fertilization. BR7369-10-5-2-3 produced the highest grain yield (5.79 t ha^{-1}) followed by BR7369-52-3-2-1-1 (5.59 t ha^{-1}). All the tested PQR genotypes were responsive to N omission. The magnitude of yield reduction due to nutrient omission was higher with N (2.41-3.16 t ha^{-1}) followed by P (0.30-0.61 t ha^{-1}) and K (0.31-0.71 t ha^{-1}). Nutrients applied for the tested genotypes were 160, 25 and 65 kg ha^{-1} of N, P and K respectively (Table 2).

Table 2. Requirement of N, P and K fertilizer for satisfactory grain yield of PQR genotypes, Boro, 2014-15, BRRI-Gazipur.

Genotype	Nutrient requirement (kg ha^{-1})			Grain yield (t ha^{-1})
	N	P	K	
BR7781-10-2-3-2	145	9	28	5.37
BR7369-10-5-2-3	160	7	14	5.79
BR7369-52-3-2-1-1	190	9	27	5.59
BRRI dhan50	148	5	12	5.00
BRRI dhan63	169	5	22	5.40
Applied nutrient	160	25	65	

Nerica Mutant gave similar yield with BRRI dhan28 but required four days more to mature than the check variety. Grain yield decreased significantly in all the tested genotypes with

omission of N and P nutrients. Nutrients applied were 160, 25 and 65 kg t ha^{-1} of N, P and K respectively (Table 3).

Table 3. Requirement of N, P and K fertilizer for satisfactory grain yield of short duration ALART materials, Boro, 2014-15 BRRI farm, Gazipur.

Genotype	Nutrient requirement (kg ha^{-1})			Grain yield (t ha^{-1})
	N	P	K	
Nerica mutant	143	40	32	4.56
BRRI dhan28	164	35	31	4.37
BRRI dhan45	140	46	28	4.42
Applied nutrient	160	25	65	

Micronutrient enriched genotypes gave similar yield with check varieties under complete fertilization. Grain yield decreased significantly with omission of N and P fertilizer nutrients. Potassium omission slightly decreased the grain yield of all genotypes except BRRI dhan28. Nutrients applied for satisfactory grain yield were 160, 25 and 65 kg $ha^{-1}$of N, P and K respectively (Table 4).

Table 4. Requirement of N, P and K fertilizer for observed yield of micronutrient genotypes, Boro 2014-15, BRRI-Gazipur.

Genotype	Nutrient requirement (kg ha^{-1})			Grain yield (t ha^{-1})
	N	P	K	
BR7833-11-1-1-3-4	176	54	24	5.06
BR7830-16-1-5-9-9	155	50	13	4.92
BRRI dhan28	187	52	51	5.08
BRRI dhan64	180	50	30	4.94
Applied nutrient	160	25	65	

Nitrogen and potassium rates for modern rice

The objectives of present study were to find out suitable ratio of N and K for MV rice cultivation and to study N and K dynamics in soil and plant systems.

The experiments were conducted at BRRI farm, Gazipur (AEZ 28) during 2014-15 seasons. Potassium was used at 0, 50, 100, 150 and 200 kg ha^{-1}) in the main plot and N at 0, 50, 75 and 100 kg ha^{-1} in T. Aman and 0, 100, 120 and 140 kg ha^{-1} in Boro season in the subplots and compared with BRRI dhan49 in T. Aman and BRRI dhan29 in Boro season. Phosphorus and S was applied as blanket dose.

Grain and straw yields. In T. Aman 2014, effect of K, N and their interaction on grain yield of BRRI dhan29 was significant (Table 5). At K_0, N rates significantly increased grain yield. At N_0, K rate was also responsible for increased grain yield. The highest grain yield of BRRI dhan49 (5.64 t ha^{-1}) was recorded when 150 kg K ha^{-1} and 75 kg N ha^{-1} were used but it was

statistically identical with 50 kg K and 50 kg N combination. So, this combination may be suitable for BRRI dhan49 rice cultivation to get optimum yield. Straw yield was significantly affected by K and N applications but the interaction effect was insignificant.

Table 5. Effect of N and K rates on grain and straw yields of BRRI dhan49, T. Aman 2014, BRRI-Gazipur.

K dose (kg ha^{-1})	N dose (kg ha^{-1})							
	0		50		75		100	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
0	3.39	4.91	3.65	5.60	3.70	5.78	4.39	5.66
50	4.72	5.32	5.25	5.74	4.94	5.56	4.94	6.39
100	4.62	4.92	5.34	6.01	4.94	6.79	4.96	6.74
150	4.85	5.04	5.24	6.62	5.64	6.19	5.58	7.49
200	4.82	5.52	5.33	6.47	5.22	6.25	4.94	7.05
N mean	4.48	4.91	4.96	5.60	4.89	5.78	4.96	5.66
$LSD_{0.05}$	for grain yield, K = 0.38 N= 0.20 K×N= 0.46							
	for straw yield, K = 0.58 N= 0.46 K×N= NS							

Uptake of N and K. In T. Aman season, total N uptake was not much influenced by K rates in a specific N rate, but its uptake was significantly influenced because of synergistic effect of K and N rates. The highest N uptake (83 kg ha^{-1}) was recorded with 150 kg K and 75 kg N combination. Significantly affected total uptake K, N rates and their interaction. The lowest K uptake was observed in $K_0 \times N_0$ (96 kg ha^{-1}) and $K_0 \times N_{100}$ (90 kg ha^{-1}) treatment combinations. The highest K uptake (176 kg ha^{-1}) was obtained in combination of 100 kg N ha^{-1} and 150 kg K t ha^{-1}. In Boro season, K, N and their interaction significantly affected gain and straw yields of BRRI dhan29 (Table 6). The highest grain yield (6.57 t ha^{-1}) was recorded in 150 kg K and 100 N combinations. In K deficient condition, increasing N levels significantly reduced grain. Straw yields increased with increasing N levels at K_0 condition and the highest straw yield was recorded in 100 kg K and 120 kg N combination.

Table 6. Effect of N and K on grain and straw yields of BRRI dhan29, Boro 2014-15, BRRI-Gazipur.

K dose (kg ha^{-1})	N dose (kg ha^{-1})							
	0		100		120		140	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
0	3.23	2.83	2.77	4.38	2.59	4.27	2.29	4.30
50	3.32	3.38	5.76	5.13	5.95	5.75	5.47	5.97
100	3.49	3.12	6.10	5.80	6.34	6.23	5.80	6.68
150	3.48	3.06	6.57	5.51	6.47	5.81	6.27	6.09
200	3.88	3.15	6.57	6.43	6.33	7.06	5.84	6.40
N mean	3.48	3.11	5.55	5.45	5.53	5.82	5.14	5.87
$LSD_{0.05}$	for grain yield, K = 0.27 N= 0.24 K×N= 0.55							

	for straw yield, K = 0.58 N= 0.46 K×N= NS

Nitrogen and K dose for rice under AWD situations

The objective of present study was to find out optimum N and K doses with standard P and S rates for AWD situations (10-20% water saving).

In Boro 2014-15, IR83140-B-36-B-B and IR83142-B-71-B-B lines along with BRRI dhan28 and BRRI dhan29 were tested under five fertilizer management options at BRRI farm, Gazipur. Treatment combinations were: T_1 = control (native nutrients), T_2 = standard dose of NPKS @ 138-18-64-11 kg ha^{-1}, T_3 = 25% more NK + standard dose of PS, T_4 = 50% more NK + standard dose of PS and T_5 = 75% more NK + standard dose PS. Experiment was laid out in a split-plot design with three replications. Fertilizer management was placed in the main plots and rice genotypes in the subplots. Forty-five-day-old seedlings were transplanted at 20- × 20-cm spacing. Irrigation was applied following AWD method. All plots were surrounded by 30 cm soil levee to avoid contamination between plots.

Grain yield at native nutrient conditions varied from 2.09 to 3.66 t ha^{-1}, being the highest in BRRI dhan29 (Table 7). Significant grain yield increase was observed in all rice genotypes due to application of recommended dose. IR83140-B-36-B-B produced the highest grain yield in T_5 (75% more NK) and it was identical with T_4 (50% more NK). IR83142-B-71-B-B gave the highest grain yield in T_4 treatment, which was significantly higher than other treatments. However, none of the tested lines out yielded check varieties. Similar trend was observed in straw yield.

Table 7. Grain yield (t ha^{-1}) of rice genotypes as influenced by fertilizer management options under AWD conditions, Boro 2014-15, BRRI-Gazipur.

Fertilizer dose (kg ha^{-1})	Genotype				
	IR83140-B-36-B-B	IR83142-B-71-B-B	BRRI dhan28	BRRI dhan29	Treat. Mean
T_1 = Control	2.12	2.09	2.13	3.66	2.50
T_2 = *Std. NPKS	5.25	5.19	5.29	6.24	5.50
T_3 = 25% more NK + Std. PS	5.39	5.13	5.20	6.22	5.49
T_4 = 50% more NK + Std. PS	5.53	5.73	5.49	6.29	5.76
T_5 = 75% more NK + Std. PS	5.64	5.48	5.63	6.06	5.70
Variety mean	4.79	4.72	4.75	5.70	
CV (%)	6.6				
$LSD_{0.05}$	Treat. = 0.28	Variety = 0.25	Treat.×Variety = NS		

*Std. = Standard dose for Boro season

Fertilizer package for low input rice variety (BRRI dhan69)

Most of the MVs express their yield potential only under high fertility management conditions; but farmers invariably apply lower levels of fertilizers to reduce cost of production. Further, application of higher levels of nutrients, especially N, usually invites pests and disease problems that will entail

additional cost. Under such circumstances, the varieties that provide fairly good grain yield with moderate levels of fertilizer application will be of much economic importance. Such varieties also would exploit and use both soil and fertilizer nutrients efficiently. A low input Boro rice variety (BRRI dhan69) has been released recently by BRRI for which fertilizer package development is needed.

A field experiment was conducted in Boro 2014-15 at BRRI farm, Gazipur with seven fertilizer treatments- T_1 = recommended dose (RD), T_2 = 10% less of RD, T_3 = 20% less of RD, T_4 = 30% less of RD, T_5 = 40% less of RD, T_6 = 50% less of RD and T_7 = control (without fertilizer). The recommended fertilizer dose was N-P-K-S-Zn @ 138-18-64-11-1.5 kg ha^{-1}, respectively. All fertilizers except urea were applied at basal; but urea was applied in equal three splits. BRRI dhan69 was tested with BRRI dhan58. Experimental design was split-plot with three replications, where fertilizer treatments were in the main plots and varieties were in the subplots.

Tiller and panicle productions varied significantly because of fertilizer levels and variety. At control conditions, tiller and panicle production of both the varieties were almost same and the lowest number of tiller m^{-2} (182 in BRRI dhan58 and 183 in BRRI dhan69) and panicles m^{-2} (168 in BRRI dhan58 and BRRI dhan69) were recorded. Reduction in panicle number was insignificant up to 30% less of RD. Fertilizer treatments significantly affected grain yield of BRRI dhan58 and BRRI dhan69 (Table 8), but varietal differences and interaction effect on grain yield was insignificant. The recommended fertilizer dose (T_1) produced the highest grain yield in BRRI dhan58; whereas BRRI dhan69 gave the highest with 10% less than RD. Yield potential of BRRI dhan58 and BRRI dhan69 could be achieved at 10% and 20% less fertilizer dose respectively compared to RD.

Table 8. Effect of reduced fertilizer doses on grain yield of low-input rice variety (BRRI dhan69), Boro 2014-15, BRRI-Gazipur.

Treatment	Grain yield (t ha^{-1})	
	BRRI dhan58	BRRI dhan69
T_1 = Recommended dose (RD)	5.60	5.08
T_2 = 10% less of RD	5.46	5.14
T_3 = 20% less of RD	5.12	5.09
T_4 = 30% less of RD	5.04	4.72
T_5 = 40% less of RD	4.20	4.44
T_6 = 50% less of RD	4.04	3.85
T_7 = control (without fertilizer)	1.72	1.70
CV (%)	7.8	
$LSD_{0.05}$ for treatment	0.40	
$LSD_{0.05}$ for variety	NS	
$LSD_{0.05}$ for treatment × variety	NS	

MANAGEMENT OF NUTRITIONAL DISORDERS IN RICE

Long-term effect of organic and inorganic nutrients on yield low land rice

Long-term missing element trial reflects a mirror image of rice response behavior under deficit conditions and it provides the opportunity of reverse response study. It can also be considered as an effective medium for crop growth response study for finding out nutrient use-efficient genotypes. So, a long term experiment was initiated on a permanent layout at BRRI farm Gazipur in 1985 Boro season having 12 treatments assigned in a RCB design with four replications (Table 9). Since Boro 2000, each plot was divided into two to include a reverse treatment and additional varieties, BRRI dhan29 and BRRI dhan31 to evaluate the reverse trends of missing elements. In Boro, NPKSZn was used @ 120-25-35-20-5 kg ha^{-1}, but in T. Aman it was 100-25-35-20-5 kg ha^{-1}. After 47th crop, treatments were modified with omission of Zn because of its sufficiency in the soil. The STB dose of NPKS was 138-10-80-5 kg ha^{-1} and 100-10-80-5 kg ha^{-1} for Boro and T. Aman respectively after 47th crop according to Fertilizer Guide-2005 (BARC, 2005). Higher level of available S in control plot compared to initial soil may be due to recent industrial urbanization effect and thus S dose was reduced. Urea N was applied in three equal splits at final land preparation, at active tillering and at 5-7 days before PI. The rest of the fertilizers were applied at final land preparation.

In Boro 2009-10, organic materials were used as third modification in T_5, T_8, T_9, T_{10} and T_{11} treatments. Oil cake (OC, 2 t ha^{-1}), saw dust (SD, 3 t/ha), cow dung (CD, 3 t ha^{-1}), mixed manure (CD: PM: SD: OC = 1:1:1:0.5) and poultry manure (PM, 2 t ha^{-1}) in T_{10}, T_9, T_5, T_{11} and T_8 treatments. Only N @ 138 kg ha^{-1} was applied as top dress with organic amended treatments. However, both missing and reverse management plots were merged for making 12 treatments. In T. Aman 2011-12, T_9 and T_{11} treatments were changed to accommodate 60 and 40 kg K ha^{-1} respectively. NPKSZn @ 100-7-80-3-5 kg ha^{-1} was used in T. Aman 2013 and it was 138-7-80-3-5 kg ha^{-1} in Boro 2013-2014. CD (3 t ha^{-1}), PM (2 t ha^{-1}) and mustard OC (2 t ha^{-1}) were used in T_5, T_8 and T_{10} treatments. Grain yield was recorded at 14% moisture content and straw yield as oven dry basis.

Table 9. Treatment details of long-term missing element experiment, BRRI-Gazipur, 1985-2015.

Original treat. 1985	Reverse treat. 2000	Treat. 2009-10	Treat. 2011-15
NPKSZn	All missing	NPKSZn	NPKSZn @138/100-7-80-3-5 kg ha^{-1}
NPSZn (-K)	NSZn (+K)	NPSZn (-K)	NPSZn (-K)
NKSZn (-P)	NKSZn (+P)	NKSZn (-P)	NKSZn (-P)
PKSZn (-N)	PKSZn (+N)	PKSZn (-N)	PKSZn (-N)
NSZn (-PK)	NSZn (+PK)	Cow dung @ 3.0 t ha^{-1}	Cow dung (3 t ha^{-1}) + IPNS fert.
NPKS (-Zn)	NPKS (+Zn)	NPKS (-Zn)	NPKS (-Zn)
NPKZn (-S)	NPKZn (+S)	NPKZn (-S)	NPKZn (-S)
NPK (-SZn)	NPK (+SZn)	PM @ 2 t ha^{-1}	PM (2 t ha^{-1}) + IPNS fert.
NP (-KSZn)	NP (+KSZn)	Saw dust @ 3 t ha^{-1}	NPKSZn @ 138/100-7-60-3-5 kg ha^{-1}

NK (- PSZn)	NK (+PSZn)	Oilcake @ 2.0 t ha^{-1}	Oil cake (2 t ha^{-1}) + IPNS fert.
N (-PKSZn)	N (+PKSZn)	Mixed Manure	NPKSZn @ 138/100-7-40-3-5 kg ha^{-1}
All missing	+ NPKSZn	Control	Control

In T. Aman 2014, Zn omission plot produced the highest grain yield (4.90 t ha^{-1}), which was statistically identical with complete fertilizer treatment (4.80 t ha^{-1}). Omission of N, P, K and S significantly decreased rice yield to 2.96, 3.65, 3.56 and 3.96 t ha^{-1} respectively (Table 10). Among organic materials treated plots, CD treated plot had the highest grain yield (4.02 t ha^{-1}) followed by OC (3.84 t ha^{-1}) and PM (3.75 t ha^{-1}). The K rates in complete fertilizers significantly influenced rice yield of BRRI dhan49. The highest rice yield (4.80 t ha^{-1}) was obtained with 80 kg K ha^{-1} and the lowest (3.79 t ha^{-1}) with 40 kg K ha^{-1} but there was no significant difference between 40 kg and 60 kg K ha^{-1}. In Boro 2014-15, grain yield decreased due to omission of nutrient s. Complete fertilizer treatment gave 6.68 t ha^{-1} grain yield, which significantly decreased to 2.1, 2.62, 3.90 and 3.95 t ha^{-1} due to omission of all nutrients, N, P and K, respectively (Table 10). Application of poultry manner @ 2 t ha^{-1} with IPNS based chemical fertilizer produced the highest grain yield (6.92 t ha^{-1}) and it was statistically similar with complete fertilizer treatment. Application of CD and OC with IPNS based chemical fertilizer produced statistically similar but slightly lower grain yield than complete fertilizer treatment. K at 60 kg ha^{-1} produced similar grain yield with complete fertilizer treatment but K at 40 kg ha^{-1} significantly reduced grain yield. Straw yield in complete fertilizer treatment was the highest (5.62 t ha^{-1}) followed by PM + IPNS based chemical fertilizer (5.22 t ha^{-1}). Omission of N, P, K, S and Zn decreased straw yield by 3.17, 0.98, 2.08, 0.68 and 0.86 t ha^{-1}, respectively.

Table 10. Effect of long-term missing element on grain and straw yields (t ha^{-1}), T. Aman 2014 and Boro 2014-15, BRRI-Gazipur.

Treatment	BRRI dhan49 T. Aman 2014		BRRI dhan29 Boro 2014- 2015	
	Grain	Straw	Grain	Straw
NPKSZn @138/100-7-80-3-5 kg ha^{-1}	4.80	6.89	6.68	5.62
NPSZn (-K)	3.56	6.05	3.95	3.54
NKSZn (-P)	3.65	6.47	3.90	4.64
PKSZn (-N)	2.96	4.90	2.62	2.45
CD (3 t/ha) + IPNS	4.02	7.13	6.57	4.17
NPKS (-Zn)	4.90	6.79	6.33	4.76
NPKZn (-S)	3.96	7.14	6.46	4.94
PM (2 t/ha) + IPNS	3.75	7.08	6.92	5.22
NPKSZn @ 138/100-7-60-3-5 kg ha^{-1}	3.93	6.71	6.29	4.62
OC (2 t/ha) + IPNS	3.84	7.66	6.09	4.91
NPKSZn @ 138/100-7-40-3-5 kg ha^{-1}	3.79	6.65	5.67	4.51
Control	2.67	4.53	2.1	1.81
$LSD_{(0.05)}$	0.45	0.65	0.63	0.62
CV (%)	8.2	7.0	8.29	10.16

*NPKSZn@ 100-7-80-3-5 kg ha^{-1} for T. Aman and 138-7-80-3-5 kg ha^{-1} for Boro

Yield trend. Rice yield trends over the years were increasing when nutrients were added from organic and inorganic sources, but it was stagnant under inorganic fertilizer alone (Fig. 1 and 2).

Grain yield (t/ha)

wopAD6F.tmpMicrosoft_Office_Excel_Worksheet1.xlsx

wopADCD.tmpMicrosoft_Office_Excel_Worksheet2.xlsx

Integrated nutrient management for double and triple rice cropping

The experiment was initiated in Boro 2008-09 at BRRI farm Gazipur in a clay loam soil. In Boro-Fallow-T. Aman pattern, BRRI dhan29 and BRRI dhan49 were used. In Boro-T. Aus-T. Aman pattern, BRRI dhan29, BRRI dhan43 and BR22 were included as test variety. Fertilizers used were: T_1 = control, T_2 = STB dose (NPKS @ 160-25-60-20 kg ha^{-1} for Boro, 70-12-48-10 kg ha^{-1} for T. Aus and 84-15-54-14 kg ha^{-1} for T. Aman), T_3 = STB (50%) + MM (CD @ 2 t ha^{-1} + ash @ 1 t ha^{-1} oven dried), T_4 = FP (NPKS @ 80-10-20-10 kg ha^{-1} for Boro, 70-10-15-0 kg ha^{-1} for T. Aus and 70-10-15-0 kg ha^{-1} for T. Aman). The experiment was laid out in RCB design with three replications.

Table 13 presents the grain yield of both double and triple rice cropping pattern. In Boro 2013-14 under triple cropping pattern, STB fertilizer dose produced significantly higher yield than 50% STB + MM treatment and FP. However, 50% STB + MM treatment gave significantly higher yield than FP under double and triple cropping pattern. The highest grain yield (3.00 t ha^{-1}) of BRRI dhan43 was found in 50% STB + MM treatment, which was statistically similar with STB dose (2.89 t ha^{-1}). In T. Aman 2014, under double cropping pattern, both STB dose and 50% STB + MM produced significantly higher grain and straw yields than FP. However, the highest value of grain yield (5.28 t ha^{-1}) was found with 50% STB + MM. Under triple cropping pattern, the highest grain yield (3.37 t ha^{-1}) was found with 50% STB + MM, which was statistically similar with STB dose. However, cumulative yield of triple cropping was always higher than double rice cropping pattern irrespective of treatments.

In Boro 2014-15, under double and triple cropping pattern, STB dose and 50% STB + MM produced significantly higher grain yield than FP. However, the highest grain yield (5.13 and 5.22 t ha^{-1}) was found with STB dose in both cropping patterns but it was statistically similar with 50% STB + MM. Grain yield of triple cropping was increased over double cropping except control treatment (Table 14). It may be concluded that STB (100%) dose of fertilizer and integrated nutrient management (INM) are good options for obtaining higher rice yields in double or triple rice cropping pattern.

Table 13. Annual grain production (t ha^{-1}) of double and triple cropping pattern under continuous wetland condition, BRRI farm, Gazipur, 2014.

Treatment	Double cropping			
	Boro 2013-14 (BRRI dhan29)	Fallow	T. Aman 2014 (BRRI dhan49)	Total
T_1 = Control	2.18	-	3.44	5.62
T_2 = STB	5.78	-	5.11	10.89
T_3 = 50% STB+MM	5.40	-	5.20	10.60
T_4 = FP	4.17	-	4.10	8.27
$LSD_{0.05}$	0.60	-	0.63	
CV (%)	6.8	-	7.0	
	Triple cropping			
	Boro 2013-14 (BRRI dhan29)	T. Aus 2014 (BRRI dhan43)	T. Aman 2014 (BR 22)	Total
T_1 = Control	1.89	1.84	2.45	6.18
T_2 = STB	5.59	2.89	3.29	11.77
T_3 = 50% STB+MM	5.29	3.00	3.37	11.66
T_4 = FP	4.27	2.60	2.84	9.71
$LSD_{0.05}$	0.22	0.16	0.48	
CV (%)	12	3.0	8.0	

Table 14. Yield scenario of Boro rice under different treatments of double and triple cropping pattern at BRRI farm, Gazipur, 2014-15.

Treatment	Yield (t ha^{-1})			
	Double cropping 2013-14 (11th crop)	Double cropping 2014-15 (13th crop)	Triple cropping 2013-14 (16th crop)	Triple cropping 2014-15 (19th crop)
T_1 control	2.18	1.69	1.89	1.53
T_2 STB	5.78	5.13	5.59	5.22
T_3 STB(50%) + MM	5.40	4.96	5.29	5.07
T_4 Farmer practice	4.17	3.98	4.27	4.04
$LSD_{0.05}$	0.60	0.86	0.56	0.71
CV (%)	6.8	10.96	6.6	8.93

SOIL AND ENVIRONMENTAL PROBLEMS

Greenhouse gas emission from rice field

Soil is considered to be one of the most important sources and sinks of greenhouse gases. So, experiments were conducted to study the effects of broadcast urea (BU), urea deep placement (UDP) and NPK briquette on flood water NH_4^+-N dynamics, biomass, grain yield and total NPK uptake by rice and N_2O and NO emission under ADW and continuous standing water (CSW) conditions.

Two field experiments were set up at BRRI farm, Gazipur. Experimental field soil was clay-loam in texture. Initial soil pH was 6.22, 1.75% organic C, 0.17% total N, 16 ppm available P and 0.25 cmol kg^{-1} exchangeable K. Table 16 shows the treatments. Rice varieties used were BRRI dhan46, BRRI dhan28 and BRRI dhan48 for T. Aman, Boro and T. Aus season respectively. Water

samples from all plots were collected for NH_4^+-N determination in acid washed plastic bottles in the morning after N fertilizer application for 7 days. First water sampling was done before and immediately after application of UDP, NPK briquettes and PU. Nitric oxide was measured with a Teledyne API T200 Chemiluminescence Analyzer and N_2O was measured with a Teledyne API T320U Gas Filter Correlation Analyzer and calibration was done by a Teledyne API T700 Dynamic Dilution Calibrator.

Table 16. Treatment description for T. Aus, T. Aman, 2014 and Boro 2015.

Treat no.	Description*	N rate (kg ha^{-1})		
		Aus	Aman	Boro
T_1	Check	0	0	0
T_2	Urea Briq	52	52	78
T_3	Urea Briq	78	78	104
T_4	Prilled Urea	104	78	156
T_5	Urea Briq	104	104	156
T_6	NPK Briq	51	51	81
T_7	Prilled Urea	78	52	104
T_8	NPK Briq	78	78	102

*Urea briquette considered as UDP

Ammonium-N in flood water. Deep placement of both UDP and NPK briq resulted in the lowest flood water NH_4^+-N compared to broadcasting of PU. Flood water NH_4^+-N concentration increased with increasing N rates from PU but it was not observed with increased N rates either from UDP and NPK briq. In PU, flood water NH_4^+-N was higher during initial 2 to 3 days after fertilization and then decreased steadily.

Grain yield and N uptake. Application of N irrespective of source and method of placement produced significantly higher grain and straw yields over N control in AWD condition (Table 17). In T. Aus 2014, there was no significant yield advantage among treatments. In T. Aman 2014, UDP at 78 kg N ha^{-1} gave significantly higher grain yield than PU treatment at similar rate under AWD conditions. Grain yield did not vary significantly because of N rates under CSW conditions; although UDP resulted in 33% save of N use. Total N uptake was significantly influenced by UDP-N_{78} under CSW conditions, but not under AWD conditions. In Boro 2015, UDP at 104 kg N ha^{-1} produced significantly higher grain yield than PU at similar N rate. In T. Aus 2014, total N uptake was not influenced by AWD, but significantly influenced by same N rates between PU and UDP under CSW conditions (Table 18). PU, UDP and NPK briq @ 52 kg N ha^{-1} produced similar result in T. Aman 2014. UDP at 78 kg N ha^{-1} significantly influenced N uptake than PU at similar rate under CSW (Table 18). In Boro 2015, total N uptake was also significantly influenced by deep placement of urea both at 104 and 156 kg N ha^{-1} compared to PU under both the conditions (Table 18).

Table 17. Grain yield of rice as influenced by N rates, sources and water management in different seasons, BRRI-Gazipur.

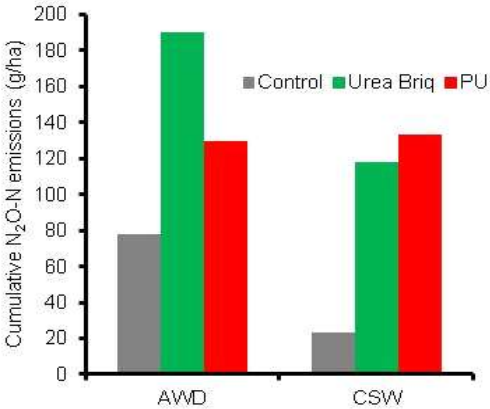
Treatment*	T. Aus, 2014	T. Aman, 2014	Boro, 2015

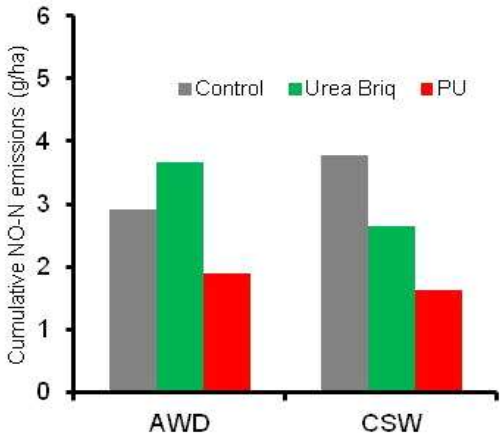
	(BRRI dhan48)		(BRRI dhan46)		(BRRI dhan28)	
	AWD	CSW	AWD	CSW	AWD	CSW
T_1	3.72b	3.82b	3.13c	3.54b	1.54c	1.84c
T_2	4.39a	4.49a	3.59ab	4.12a	4.64a	4.97ab
T_3	4.57a	4.64a	3.42bc	3.95a	5.12a	5.40a
T_4	4.40a	4.24a	3.78a	4.08a	4.60a	4.49b
T_5	4.32a	4.47a	3.66ab	3.95a	4.52a	5.06ab
T_6	4.57a	4.38a	3.54ab	4.04a	3.58b	4.82ab
T_7	4.36a	4.51a	3.50ab	4.12a	3.68b	4.32b
T_8	4.59a	4.31a	3.74ab	4.20a	4.57a	5.02ab
CV (%)	5.18	5.32	5.1	5.5	9.11	9.51

Table 18. Effect of N sources, rates and water management on total N uptake (kg ha^{-1}), BRRI-Gazipur.

Treatment*	T. Aus, 2014 (BRRI dhan48)		T. Aman, 2014 (BRRI dhan46)		Boro, 2015 (BRRI dhan28)	
	AWD	CSW	AWD	CSW	AWD	CSW
T_1	41c	45c	36b	39f	20.08d	22.89c
T_2	60b	65b	48bc	58cde	61.69b	65.49b
T_3	80a	86a	58a	65abc	74.30a	80.24a
T_4	68ab	67b	52ab	53e	61.73b	59.19b
T_5	78a	85a	60a	71a	82.26a	89.76a
T_6	62b	58b	48bc	61bcd	52.84b	63.87b
T_7	79a	67b	44c	53de	41.63c	56.45b
T_8	83a	56bc	50bc	68ab	59.99b	65.83b
CV (%)	12.82	10.11	8.71	8.18	9.44	8.78

Emissions of N_2O and NO. In Aus 2014, N_2O and NO emissions under AWD option were higher with UDP, but it was lower under CSW conditions (Fig. 4). Emissions of N_2O and NO from Urea Briq were higher (Fig. 4 and 5) might be because of higher substrate availability during drying period. However, measurements under AWD conditions were non-replicated except in Boro 2015. Therefore, more measurements are needed to confirm these results. Nitric oxide emission was the least under CSW conditions. In Aus and Boro seasons, N_2O emissions were higher when UDP was used under AWD conditions. However, both N_2O and NO emissions were higher during Boro season (Fig. 5). In monsoon, frequent rainfall disrupted AWD conditions, but in Boro season it was fully maintained. This might has acted favourably for higher N_2O and NO emission from UDP treated plots.





cv

Fig.4. Total nitrous and nitric oxide emissions during T. Aus 2014 as influenced by N sources and water management, BRRI-Gazipur.

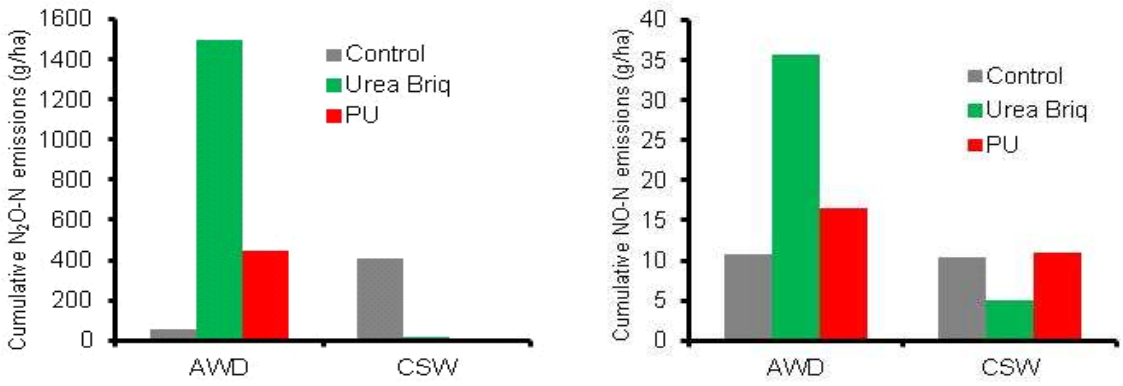


Fig 5. Total nitrous and nitric oxide emissions during Boro 2015 as influenced by N sources and water management, BRRI-Gazipur.

SOIL MICROBIOLOGY

Influence of fertilizer management on microbes and soil health

Biological indicators of soil health offer certain advantages over physicochemical methods. Among the various biological indicators that have been proposed to monitor soil health, soil enzyme activities have great potential to provide a unique integrative biological assessment of soils and the possibility of assessing the health of soil biota. The specific objectives of this study were to determine microbial population and enzyme activity in soil as an indicator of N and P nutrient availability which is related to soil health and crop productivity in long term nutrient management study.

The study was conducted at BRRI, Gazipur 2014-15 to find out the effect of long term nutrient management on soil microbial population and soil enzyme activity. Soil samples (0-60 cm) were collected after T. Aman 2014 harvest from complete fertilizer, –N, –P, –K, cow dung (CD) and PM treated plots and compared with control. Total microbial population, nitrogen fixing, phosphate solubilizing, phosphatase, phytase and urease enzyme activities were determined.

Microaerophilic bacteria. There were significant variations in total microaerophilic bacterial populations because of fertilizer management at variable soil depths. The highest population was found in CD (9.2 x 10^8 Cfu g^{-1} dry soil) and PM (6.7 x 10^8 Cfu g^{-1} dry soil) amended plots and the lowest in missing of N (9.3 x10^4 Cfu g^{-1} dry soil), K (3.5x10^5 Cfu g^{-1} dry soil) and control (2.7 x 10^5 Cfu g^{-1} dry soil) treatments. Occurrences of higher population in PM and CD treated plots might be a resultant effect of soil carbon and other available nutrients that favored their growth. Population was significantly low in –N, -K and control treatment where these nutrients were not added for last 45 years. This result reflected the need of major nutrients for their growth and survival. However, microbial population in –P treatment was higher than -N and –K treatments indicating that native soil P was enough for their survival.

Microbial population was high up to 20 cm depth in most of the treatments and then declined gradually. The lowest population was recorded at 45-60 cm soil depth. The levels of higher population up to 20 cm depth may be due to root activity. In the complete fertilizer treatment, total bacterial population was high up to 15 cm depth. However in K missing treatment, slightly lower population was found at the same soil depth. This may be due to competition of bacteria and plant root for limited soil K. In the missing N treatment, higher population was found only in the top soil (0-5 cm). Top soil contained higher amount of organic matter, which may have supported its growth. At 45 to 60 cm soil depth, no bacteria were found.

Free-living N_2 fixing bacteria. Among treatments, significantly higher free-living N_2 fixing bacterial population was recorded in PM and CD amended plots than others (Table 22). Organic matter provides carbon sources, which induces metabolic activity of these bacteria. In N missing treatment, population was high up to 30 cm soil depth and none at 45-60 cm. Substantial amount of population was also noticed in control treatment. On the other hand, N_2 fixing population was significantly low in complete fertilizer treatment and the lowest N_2 at 15 to 30 cm depth. From this finding it was clear that long term N fertilization significantly reduces N_2 fixing bacterial population in paddy soil. Long term absence of K fertilizer also reduced N_2 fixing population after 5-10 cm soil depth, which also indicates that limitation of soil K influence N_2 fixing population.

Table 22. Effect of long term nutrient management on free-living nitrogen fixing population (Cfu/g soil) at variable soil depth, BRRI-Gazipur.

Treat	Soil depth (cm)						
	0-5	5-10	10-15	15-20	20-30	30-45	45-60
Complete	1.4×10^5e	2.0×10^5d	1.2×10^5d	2.3×10^3f	1.8×10^3g	5.5×10^3e	3.7×10^3d
-K	2.6×10^5d	2.9×10^5c	1.1×10^5d	1.7×10^4e	4.9×10^3f	4.2×10^3e	1.7×10^2e
-P	3.4×10^5c	5.5×10^5b	2.5×10^5b	4.0×10^5b	1.0×10^5d	4.0×10^5b	1.0×10^5b
-N	2.8×10^5cd	2.6×10^5cd	2.1×10^5bc	2.0×10^5c	2.0×10^5c	3.4×10^4d	0.0
CD	5.8×10^6b	4.8×10^6a	2.2×10^6a	2.4×10^5c	3.1×10^5b	2.1×10^5c	9.2×10^4b
PM	8.1×10^6a	4.8×10^6a	2.1×10^6a	2.9×10^6a	2.4×10^6a	2.7×10^6a	1.9×10^6a
Control	1.7×10^5e	1.8×10^5d	1.8×10^5c	1.4×10^5d	7.2×10^4e	4.3×10^4d	8.6×10^3c

Phosphate solubilizing bacteria. Phosphate solubilizing bacterial (PSB) population was lower than N_2 fixing bacteria and significantly high population was found in PM and CD amended plots. The lowest population was found in N missing treatment and after 15 cm depth there was no PSB population (Table 23). Missing of P and K element also affected PSB population and after 20 cm soil depth their growth was absent. However, PSB population was found till 60 cm depth in control treatment. This finding proved that imbalanced fertilization hampered PSB population in paddy soil. In complete fertilizer treatment, PSB population gradually decreased from top soil to deeper layers and it was lower than CD and PM treatments. In general, a number of PSB

populations were maintained around root zone in all of the treatments, which may be the effect of rice root exudates.

Table 23. Effect of long term nutrient management on phosphate solubilizing bacteria population (Cfu/g soil) at variable soil depth, BRRI-Gazipur

Treat	Soil depth (cm)						
	0-5	5-10	10-15	15-20	20-30	30-45	45-60
Complete	3.8×10^{4}a	1.2×10^{4}e	7.0×10^{3}e	1.0×10^{3}e	4.0×10^{2}d	3.9×10^{2}d	0.0
-K	6.9×10^{3}c	1.1×10^{4}e	1.3×10^{3}c	2.8×10^{3}d	2.7×10^{2}c	0.0	0.0
-P	4.9×10^{4}a	6.2×10^{4}a	5.2×10^{4}a	4.0×10^{4}a	0.0	0.0	0.0
-N	1.7×10^{3}d	2.7×10^{2}f	1.1×10^{2}g	0.0	0.0	0.0	0.0
CD	5.1×10^{4}a	2.5×10^{4}c	2.3×10^{2}b	1.3×10^{4}c	8.8×10^{3}b	1.1×10^{3}c	1.1×10^{3}b
PM	4.9×10^{4}a	4.3×10^{4}b	8.5×10^{3}d	2.7×10^{4}b	3.3×10^{4}a	2.1×10^{4}a	1.9×10^{3}a
Control	1.5×10^{4}b	1.5×10^{4}d	5.1×10^{3}f	3.1×10^{3}d	3.0×10^{3}c	2.3×10^{3}b	1.2×10^{2}c

Urease and Phosphatase activity. In the present study the highest urease activity (102.2 µg NH_4-N g^{-1} soil 2 hr^{-1}) was found in PM amended plot at 0-5 cm soil depth, which was statistically similar (100.4 µg NH_4-N g^{-1} soil 2 hr^{-1}) to CD amended plot at 5-10 cm depth. However urease activity was higher up to 0-15 cm depth. Urease activity was comparatively lower in missing of N and K and control treatments (Table 24).

Table 24. Effect of long term nutrient management on urease activity (µg NH_4-N g^{-1} soil 2 hr^{-1}**) at variable soil depth, BRRI-Gazipur.**

Treat	Soil depth (cm)						
	0-5	5-10	10-15	15-20	20-30	30-45	45-60
Complete	59.6	68.6	52.7	32.0	25.8	21.2	20.3
-K	41.7	21.3	21.2	27.5	27.4	24.5	15.2
-P	61.5	84.3	44.3	31.1	44.6	20.8	15.5
-N	37.4	40.2	36.1	34.6	39.1	28.7	20.3
CD	85.1	100.4	62.8	36.9	36.2	32.7	27.1
PM	102.2	80.7	41.8	46.7	28.1	28.0	19.9
Control	42.6	52.3	35.2	26.4	24.4	15.3	11.9

Soil organic P mineralization depends on enzymatic activity of the phosphate solubilizing microbes. Among them, phosphatase and phytase are the major ones for solubilizing organic P. In this study, phosphatase activity was determined. There were significant variations in phosphatase enzyme among treatments and soil depth (Table 25). Irrespective of treatments, the highest amount of acid phosphatase was found in CD and PM amended soils. However, enzyme production decreased with increasing soil depth. In general, enzyme production was high in all of the treatments up to root zone. The lowest amount of phosphatase enzyme was produced in missing of N and K.

Table 25. Effect of long term nutrient management on phosphatase production (µg/g-soil/hr) at variable soil depth, BRRI-Gazipur.

Treat	Soil depth (cm)						
	0-5	5-10	10-15	15-20	20-30	30-45	45-60
Complete	104.59	97.81	31.07	6.74	5.97	0.00	0.00
-K	49.31	76.27	80.80	34.08	4.60	0.00	0.00
-P	96.68	99.03	72.71	68.91	0.00	0.00	0.00
-N	21.99	8.15	2.42	0.00	0.00	0.00	0.00
CD	112.23	103.52	97.32	82.25	43.62	25.56	20.96
PM	122.24	129.45	71.88	84.75	76.97	75.68	7.56
Control	81.27	72.58	57.11	38.99	30.74	25.56	2.72

Fig. 6. Microbial population at different soil depth (0-100 cm), BRRI, Gazipur

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IRRIGATION AND WATER MANAGEMENT

PERSONNEL

Md. Towfiqul Islam, *PhD*
Principal Scientific Officer and Head
Md. Maniruzzaman, *PhD*
Principal Scientific Officer
Md. Mahbubul Alam, *PhD*
Senior Scientific Officer
Ms. Shahana Parveen, *MS*
Senior Scientific Officer
ABM Zahid Hossain, *PhD*
Senior Scientific Officer
Debjit Roy, *MS**
Senior Scientific Officer
Mir Nurul Hasan Mahmud, *MS**
Senior Scientific Officer
Priya Lal Chandra Paul, *MS*
Senior Scientific Officer
Mst. Shetara Yesmin, *MS*
Scientific Officer

* Abroad for higher studies

IRRIGATION AND WATER MANAGEMENT DIVISION

Summary

Irrigation in AWD-15 cm below ground level was the best water application method for Boro rice production and water saving was around 8% for BRRI dhan28 and 15% for BRRI dhan29 along with the higher water productivity at Gazipur. There was no conflict in USG application in AWD method of irrigation. Based on indicators of evaluation for canopy cover and biomass and the required irrigation amounts by AquaCrop model, the AWD-15 irrigation regime appears to be the best water-saving option for rice production during the dry season in Bangladesh.

The survey data in four upazillas of Rajshahi district indicates that Boro coverage is decreasing day by day due to depletion of groundwater level below suction limit of STW. Number of deep-set (when pump is set below the ground surface) and very deep-set STWs is increasing with an increase of non-rice crop coverage.

The early establishment of T. Aman through supplemental irrigation effectively mitigated the terminal drought occurred at reproductive and ripening phases during T. Aman 2014. Both short and long duration T. Aman varieties suffered less drought and showed good yield performance as they were transplanted before 24 July. So transplanting before 24 July would be low risk period of drought and after that it would be high risk period.

There were no considerable yield differences when parch water table (PWT) went up to 25 cm below ground surface. The highest yield was found 5.65 t/ha for PWT at 15 cm and the lowest 5.63 t/ha for PWT at 25 cm.

Among the 10 study locations, the groundwater level of Gazipur, Comilla, Habiganj and Kushtia were found below the suction limit. So no STW is functioning there. Groundwater could be withdrawan by using force mood pump like DTW.

Less depth (3 cm) of water with alternate wetting and drying (AWD) irrigation method showed the best performance in terms of irrigation coverage

WATER USE EFFICIENCY IMPROVEMENT IN IRRIGATED AGRICULTURE

Validation of AquaCrop model and effect of USG in rice production under AWD water management

The field experiment was conducted at BRRI farm, Gazipur, during the dry season of 2014-15 to determine the crop yield under different fertilizer and water management and validating the yield and water requirement with AquaCrop model. BRRI dhan28 and BRRI dhan29 were used as test variety. The water and nitrogen treatments were:

Water

I_1 = continuous standing water
I_2 = Irrigation when water level reached 15 cm below soil surface and
I_3 = Irrigation when water level reached 20 cm below soil surface

Nitrogen

N_0 = No nitrogen
N_1 = Pilled urea applied @220 kg ha^{-1} and
N_2 = USG applied @2.70 gm between four hills

The experiment was laid out in a split-split-plot design with three replications. The water treatments were in main plot and variety in sub plot and fertilizer management in sub-sub-plot. Forty-two days-old seedlings were transplanted with 20 cm 20 cm spacing. Transplanting was done on 05 January in 2015 and harvested in late April for BRRI dhan28 and first week of May for BRRI dhan29. Measured quantities of irrigation water were supplied from a deep tubewell. Field

water depths for different water regimes were monitored by installing a partly perforated PVC pipe of 25 and 30 cm length and 10 cm diameter.

Input to the AquaCrop model consists of climatic parameters, crop, soil, field and irrigation management data. The weather data required are daily values of maximum and minimum air temperatures, reference crop evapo-transpiration (ETo), rainfall and mean annual carbon dioxide concentration (CO_2). For crop data, canopy cover and biomass were measured in every 15 days interval. Dry biomass of the above ground plant was also obtained by weighing the total biomass of the samples collected for LAI determination, after keeping them in the oven for 48 hours at 65°C. In this study, soil layers were considered upto 0.5 m, which consists of silty-clay textured soil. In CSW, water was ponding on the soil surface continuously, whereas, in AWD, ponding water was allowed to deplete to a certain level in the two treatments. The rainfall (RF), evaporation (EV) and water level patterns in the experimental fields during the two crop growing seasons are depicted in Fig. 1 and 2, respectively.

The model was validated against above ground biomass and grain yield from the field experiment during the 2014-2015 growth season of transplanted Boro rice for BRRI dhan28 only. Subsequently, the predicted output values were statistically compared with the observed biomass and yield data obtained from the experimental plot. The difference between model predicted and observed data was minimized using a trial and error approach in which one specific input variable was chosen as the reference variable at a time and adjusting only those parameters that influenced the reference variable the most. Statistical evaluation of the simulation results was made for calibration phases. The goodness of fit between simulated and observed values was corroborated by using various prediction error statistics. Model performance was evaluated in terms of prediction error (P_e), coefficient of determination (R^2), root mean square error (RMSE), the normalized root mean square error (NRSME), the Nash-Sutcliffe model efficiency coefficient (EF) and Willmott's index of agreement (*d*) (Raes *et al.*, 2012).

Field experimental results of applied irrigation water, rainfall, grain yield, above ground biomass, water productivity (WP) and harvest index under different water regimes during the growing season for model validation (2014-15) are shown in Table 1 and 2, based on three replicates. The lowest grain yield and biomass was observed to be 2.50 and 4.96 t ha^{-1} under the AWD-20 water regime in N0 fertilizer and the highest was 4.90 and 9.89 t ha^{-1} under AWD-15 water regime with USG fertilizer for BRRI dhan28, respectively (Table 1). Water productivity ranged between 3.22-3.50 kg ha^{-1} mm^{-1} (N0), 5.75-6.18 kg ha^{-1} mm^{-1} (Prilled urea) and 6.09-6.47 kg ha^{-1} mm^{-1} (USG), respectively (Table 1). Whereas, for BRRI dhan29, the lowest grain yield and biomass was observed to be 2.69 and 5.46 t ha^{-1} under the AWD-20 water regime in N0 fertilizer and the highest were 5.37 in AWD-15 and 10.89 t ha^{-1} under CSW water regime with USG fertilizer, respectively (Table 2). WP ranged between 2.48-3.13 kg ha^{-1} mm^{-1} (N0), 5.30-5.43 kg ha^{-1} mm^{-1} (Prilled urea) and 4.69-5.77 kg ha^{-1} mm^{-1} (USG), respectively (Table 2). It appears that from the three irrigation regimes and fertilizer management, the AWD-15 water regime provided the best option for water productivity, i.e. providing high yield relative to the water use. While this option resulted in the highest yields, it used significantly lesser water than the CSW option. The AWD-20 irrigation regime caused some apparent stress to the crop, reducing both biomass and yield production noticeably. The WP of the AWD-20 option seems to be in par with that of the AWD-15 option, but there is an increased risk of crop stress with the AWD-20 option, which should be carefully considered when irrigation water is not very scarce, and maximizing yield is of more interest than maximizing water efficiency – both in terms of water amount or its cost. On the other hand, during Boro season, without N fertilizer yield should be reduced drastically, so, N fertilizer is necessary for optimum yield production.

Table 1. Irrigation water depth, grain yield, above ground biomass, water productivity (WP) and harvest index for BRRI dhan28 under different water treatments at BRRI, Gazipur, Boro, 2014-15

Treat.	Irrigation water applied (mm)	Rainfall (mm)	Grain yield (t ha^{-1})	WP (kg ha^{-1} mm^{-1})	Biomass (t ha^{-1})	HI (%)
N0 Fertilizer						
CSW	520	264	2.526	3.22	5.082	0.49
AWD-15	486	264	2.622	3.50	5.220	0.50
AWD-20	462	264	2.496	3.44	4.962	0.50
Prilled urea (140 kg N/ha)						
CSW	520	264	4.609	5.75	8.954	0.50
AWD-15	486	264	4.635	6.18	9.171	0.51
AWD-20	462	264	4.242	5.84	8.580	0.49
USG						
CSW	520	264	4.778	6.09	9.733	0.49
AWD-15	486	264	4.895	6.53	9.890	0.49
AWD-20	462	264	4.695	6.47	9.590	0.49
LSD (5%)			0.16		0.22	

CSW = continuous standing water, AWD-15 = irrigation applied when water level at 15 cm below ground surface, AWD-20 = irrigation applied when water level at 15 cm below ground surface

Table 2. Irrigation water depth, grain yield, above ground biomass, water productivity (WP) and harvest index for BRRI dhan29 under different water treatments at BRRI, Gazipur, Boro, 2014-15

Treat.	Irrigation water applied (mm)	Rainfall (mm)	Grain yield (t ha^{-1})	WP (kg ha^{-1} mm^{-1})	Biomass (t ha^{-1})	HI (%)
N0 Fertilizer						
CSW	789	326	2.768	2.48	5.582	0.49
AWD-15	606	326	2.798	2.88	5.596	0.50
AWD-20	567	326	2.688	3.13	5.462	0.49
Prilled urea (140 kg N/ha)						
CSW	789	326	5.010	5.30	10.437	0.48
AWD-15	606	326	4.948	5.30	10.098	0.49
AWD-20	567	326	4.850	5.43	9.898	0.49
USG						
CSW	789	326	5.230	4.69	10.896	0.48
AWD-15	606	326	5.374	5.77	10.748	0.50
AWD-20	567	326	4.833	5.41	9.863	0.49
LDS (5%)			0.12		0.13	

CSW = continuous standing water, AWD-15 = irrigation applied when water level at 15 cm below ground surface, AWD-20 = irrigation applied when water level at 15 cm below ground surface

Table 3 presents comparisons of observed and modeled grain yield and biomass. Biomass and yield estimates were slightly over the observed values, yielding 2.74 to 11.46% overestimation for yield and 2.71 to 4.11% overestimation of biomass, depending on the irrigation regime and fertilizer doses. The differences in biomass vs. yield in the observations and the simulations indicate that the final HI value that the model used differed slightly from the observations, but the difference in HI remained at 1%.

(a)

Table 3. Validation results of biomass and grain yield under different water regimes for BRRI dhan28 at BRRI, Gazipur, Boro, 2014-2015

Treat.	Yield (t ha^{-1})		P_e	Biomass (t ha^{-1})		P_e
	Obs.	Sim.	(±%)	Obs.	Sim.	(±%)
CSWxN0	2.526	2.621	3.76	5.082	5.245	3.21
AWD-15xPU	4.635	4.762	2.74	9.171	9.548	4.11
AWD-20xUSG	4.695	5.233	11.46	9.590	10.450	2.71

CSW = continuous standing water, AWD-15 = irrigation applied when water level at 15 cm below ground surface, AWD-20 = irrigation applied when water level at 15 cm below ground surface

The AquaCrop model was calibrated to predict biomass and crop grain yield under three irrigation water regimes. Based on indicators of evaluation for biomass and the required irrigation amounts, the AWD-15 irrigation regime appears to be the best water-saving option for rice production during the dry season in Bangladesh. Regardless, the obtained season-end metrics in terms of simulated biomass and crop yield are suggesting high potential for the AquaCrop model to be reliably used in e.g. irrigation scheduling, yield prediction or potentially in climate related scenario studies in Bangladesh. After validation of the model the probabilistic yield will be estimated under AWD method for similar climatic condition.

Development of Soil moisture declination model for alternate wetting and drying (AWD) irrigation for Rice cultivation

Experiment was set up in BRRI farm, Gazipur, in Boro season 2014-15 to study the soil water dynamics for development of irrigation scheduling model. The experiment contains six treatments and each of them was replicated thrice. The treatments were-

T_1 = Continuous standing water (CSW)
T_2 = CSW with polythene protection around the field and levee
T_3 = Irrigation when water level 15 cm below ground level (GL)
T_4 = T_3 with polythene protection around the field and levee
T_5 = Irrigation when water level 30 cm below GL
T_6 = T_5 with polythene protection around the field and levee

RCB design was followed. BRRI dhan28 was the tested variety. Seeding was done on 20th November 2014. Forty-five days old seedlings were transplanted on 04th January 2015. Individual plot size was 5 m x 4 m and each plot was separated from others with 1 m buffer area. A spacing of 20 cm x 20 cm was maintained. Recommended fertilizer management and cultural practices were followed. To protect seepage losses polyethylene sheets were placed around the plots and levees of treatment T_2, T_4 and T_6. Irrigations were applied by measuring with a flow meter.

Soil samples were collected from different depths to determine the moisture content under different water level condition. In the continuous standing water plots, a closed bottom cylinder (steel drum) was placed to determine the daily evapotranspiration. A slopping gauge was installed in the drum to measure the daily water level in the drum. Partially perforated PVC pipe were installed in each plots to measure the daily water level. PVC pipe of 25 cm height and 15 cm perforation were installed below soil surface in treatment T_1, T_2, T_3 and T_4. PVC pipe having 40 cm height and 30 cm perforation were below soil surface installed in treatment T_5 and T_6. Water levels in the plots were measured daily. Daily temperature, relative humidity, sunshine hours, wind speed and rainfall data were collected from Plant Physiology Division, BRRI. Daily Reference crop evapotranspiration (ET_0) was calculated using ETo Calculator. Seepage and percolation rate was assessed from the daily water level fluctuation data of polythin protected and unprotected plots.

The experimental soil type is silty-clay loam. Soil samples were collected from different layers having 5 cm depth. In T_3 and T_4 samples were collected from 0-15 cm depths when water level in the PVC pipe reached different levels. In T_5 and T_6 samples were collected from 0-30 cm depths when the water level in the PVC pipe reaches different levels below the ground surface. Soil moisture content was determined by gravimetric method. Graphs were plotted for different layers with the soil moisture content and water level data. A relationship is also developed between parched water level below ground surface and soil moisture content in different layers.

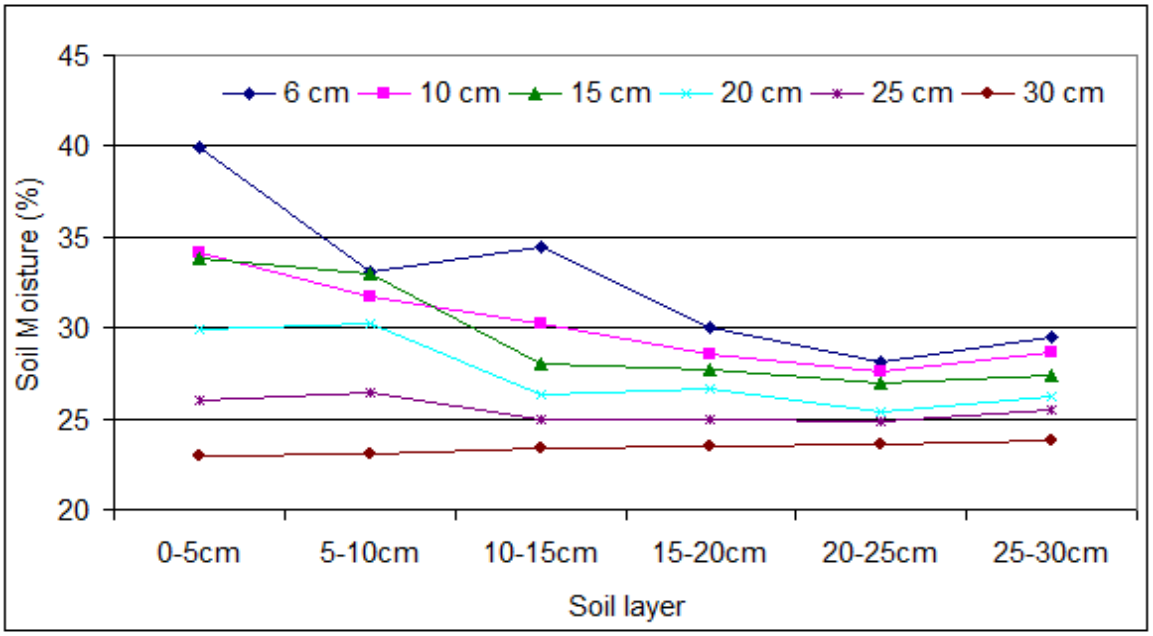
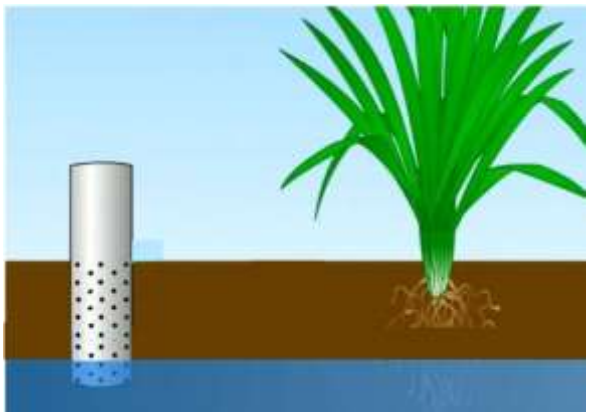


Fig. 1. Soil moisture content in different soil layers (0-30 cm) for different parched water level in the field

Fig. 1 shows the soil moisture content at different layers for different perched water level below the ground surface in treatment T_6. It shows that even near saturation, the soil moisture content decreases with soil depths. At the water level of 6.0 cm the soil moisture content in the 1st, 2nd, 3rd, 4th, 5th and 6th layers are 40.0, 33.5, 34.5, 30.0, 28.0 and 29.6 percent, respectively. It also shows that soil moisture content in the 1st, 2nd, 3rd, 4th, 5th and 6th layers reaches to 22.5, 23.1, 23.4, 23.5, 23.6 and 23.8 percent, respectively when the parched water level reached at 30 cm below the ground surface.

Fig. 2 shows different conditions that plant experienced during water depletion. When parched water level remains within 15 cm below ground surface the soil moisture content in the effective rootzone (0-30 cm) is greater than the field capacity and no stress is observed. When parched water level falls at 20 cm below ground surface the soil moisture content in the upper part (0-15 cm) of the effective rootzone is less than the field capacity and slight stress is observed. When parched water level falls at 30 cm below ground surface the soil moisture content in the effective rootzone is less than the field capacity and moderate stress is observed.



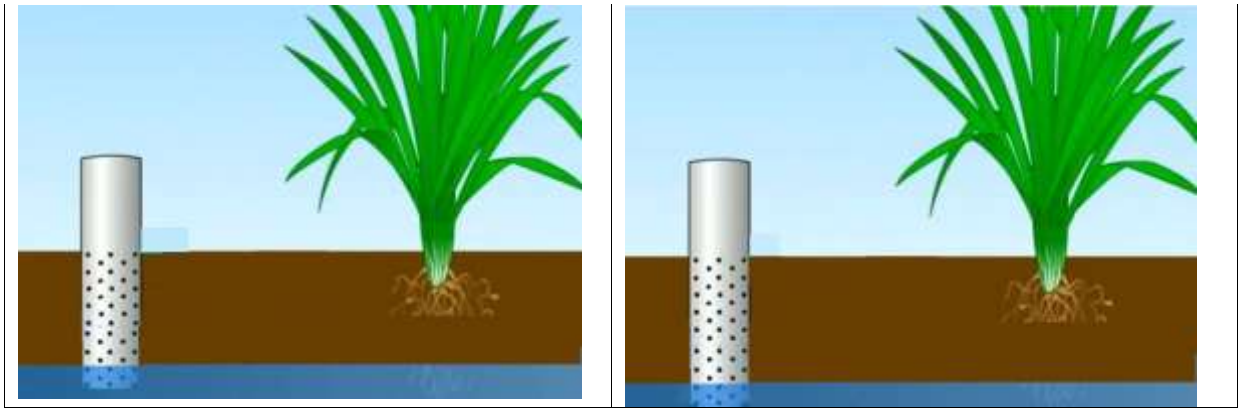


Fig. 2. Soil moisture condition in the effective rootzone of rice for different parched water level in the field

Different water regimes maintained in the treatments during the growth duration. The field growth duration was 100 days. In treatment T_1 and T_2 continuous standing water was maintained for 90 days and below saturated condition for 10 days (before harvest). Plots were remained in standing water condition for 61, 62, 46 and 49 days in T_3, T_4, T_5 and T_6, respectively.

Table 4 shows the number and amount of irrigation applied under different treatments. For land preparation (LP) 210 mm irrigation water was applied in the field. The number of irrigation was highest in T_1 (17) and lowest in T_6 (10). Total amount of irrigation applied in T_1, T_2, T_3, T_4, T_5 and T_6 during the growth season were 700, 584, 539, 482, 405 and 356 mm, respectively. A total of 90 mm rainfall was recorded during the field growth span. Table 4 also shows that irrespective of treatments polythin protected plots saves more water than the non-protected plots. This result also indicates polythin protection could be an effective measure for saving irrigation water in rice field.

Table 4. Number of irrigation, irrigation water applied and total water used for BRRI dhan28 under different treatments, Boro, 2014, BRRI farm, Gazipur

Treat-ment	Number of irrigation applied	Water applied for LP (mm)	Irrigation during growing (mm)	Rainfall (mm)	Total water used (mm)	Total water requirement (mm)	Irrigation water saved over T1 (%)
T1	17	210	700	90	1000	631.1	-
T2	14	210	584	90	874	631.1	16.6
T3	13	210	539	90	839	631.1	23.0
T4	12	210	482	90	782	631.1	31.1
T5	11	210	405	90	705	631.1	42.1
T6	10	210	356	90	656	631.1	49.1

Table 5 shows the yield of BRRI dhan28 under different irrigation treatments. Yield data showed that among the treatments, highest yield was obtained from continuous standing water plots (T1=5636 kg/ha, T2=5563 kg/ha) followed by 15 cm (T3=4951 kg/ha, T4=4894 kg/ha) and 30 cm (T5=4896 kg/ha, T6=4676 kg/ha) AWD plots. Yield were much lower in T_3 and T_4 plots compared to T_1 and T_2 plots for uncontrolled water stress occurred during the reproductive phase due to few days disorder of irrigation pump (DTW). Irrespective of treatments, higher yield was obtained from non-protected plots compared to the ploythin protected plots. This may be due to the obstruction of the border plants to extract nutrients from adjacent areas. Table 5 also shows the relative yield loss compared to the continuous standing water treatment (T_1). Water productivity was highest for treatment T_5 (7.25 kg/ha-mm) and lowest for T_1 (5.63 kg/ha-mm). Yield loss was highest in T_6

(17%) and lowest in T_2 (1.3%). Therefore, considering yield loss, water productivity and water saving T_2 and T_4 are found better than the others for irrigated rice cultivation.

Table 5. Yield, yield loss and water productivity of BRRI dhan28 under different treatments, Boro, 2015, BRRI farm, Gazipur

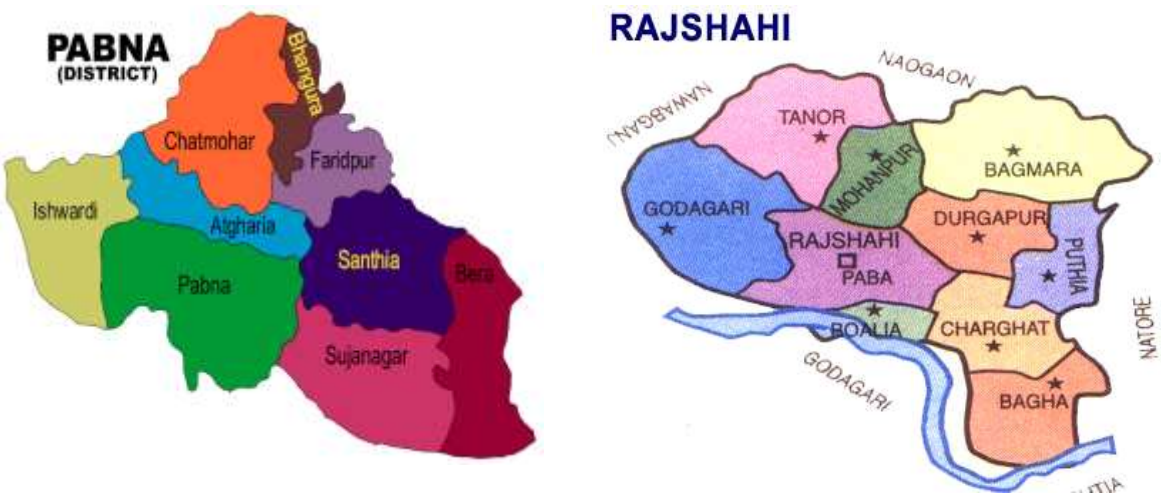
Treatment	Number of irrigation applied	Total water used (mm)	Grain yield (kg/ha)	Yield loss over T_1 (%)	Water productivity (kg/ha-mm)
T1	12	1000	5636	-	5.636
T2	10	874	5564	1.28	6.366
T3	9	839	4951	12.15	5.901
T4	8	726	4894	13.16	6.741
T5	7	675	4896	13.13	7.253
T6	6	646	4676	17.03	7.238

The study will be continued to determine soil moisture characteristics curve at different layers. Further analysis will be done to complete of the work. Soil moisture characteristics curve at different layers will be developed to evaluate the field capacity, permanent wilting point and available soil water content to develop a model for soil moisture dynamics. Prediction of irrigation schedule will be possible after development of the model.

Delineation of areas having water shortage during Boro rice cultivation in Northwest Bangladesh

The study was conducted in Pabna and Rajshahi districts of Bangladesh to locate STW areas facing water scarcity during Boro season and finding possible remedies in crop production.

Survey was conducted at 5 Upazilas (Atgharia, Chatmohor, Bhangura, Ishwardi and Faridpur) of Pabna district and 4 Upazials (Mohanpur, Bagmara, Durgapur and Puthia) of Rajshahi district (Fig. 3). A pre-structured questionnaire was used for the survey. Information was collected from ten STWs in each Upazila.



(a) Upozila of Pabna district, (b) Upozila of Rajshahi district

Fig. 3. Location of surveyed area

(a)

(b)

Fig. 4. STW placed at different depth below the soil surface at (a) Pabna and (b) Rajshahi

The groundwater level in Chatmohor, Bhangura and Faridpur Upazilas of Pabna district decline to 9.15-10.68 m below the ground surface during April-June. Whereas, the groundwater level in Mohanpur, Bagmara, Durgapur and Puthia Upazilas of Rajshshi district decline to 6.40-10.68 m below the ground surface during April-June. Due to the water level declination STW operation hampers significantly and Boro coverage decreased day by day. In some places STWs were converted to DSSTW (Deep-Set Shallow Tubewell) and VDSSTW (Very Deep-Set Shallow Tubewell). Which reduced the discharge significantly as a result irrigation cost was increased and its reliability was less. Therefore, farmers converted Boro rice area to Rabi crops (wheat, maize, grasspea, onion, garlic etc.) area to combat the water shortage. On an average 2139 ha and 608 ha Boro area has been decreased in the Upazilas of Pabna and Rajshahi district, respectively.

Average ground water level during dry period remains within 6.40-10.68 m in Pabna and Rajshahi district. Therefore, the pump of STW has to be set 1.5-4.5 m and 1.5-6.0 m below ground surface to withdraw the groundwater for crop irrigation in Pabna and Rajshahi district, respectively.

UTILIZATION OF WATER RESOURCES IN R AINFED ENVIRONMENT

Terminal drought mitigation adopting transplanting dates in T. Aman, 2014

The experiment was conducted **(where)** to determine the effect of drought for different transplanting dates in different growth stages of T. Aman rice. A long duration variety (BR11) and a short duration variety (BRRI dhan33) were tested during T. Aman season. There were six treatments with three replications in the experiment and the treatments were transplanting date 10 July (T_1), transplanting date 17 July (T_2), transplanting date 24 July (T_3) and transplanting date 31 July (T_4), transplanting at 7 August (T_5), transplanting at 14 August (T_6).

Thirty-day old rice seedlings were transplanted with 20 cm x 20 cm spacing. Individual plot size was 5m x 3m with 60 cm buffer zones. A USWB Class A evaporation pan and a rain gauge were installed near the experimental field to determine rainfall and evaporation amounts during the growing season of rice. Data were recorded at 09:00h daily to determine seepage & penetration, rainfall and evaporation from the experimental field. The historical rainfall data were collected from the Department of Agricultural Extension, Kushtia. Drought amount (deficit water in soil) was calculated using drought model (developed by Dr. Towfiqul Islam).

Drought amount at different growth stages of rice for different dates of transplanting is shown in Table 6. BRRI dhan33 suffered comparatively less drought than BR11 due to its shorter growth duration. From the drought pattern of the previous year in case of BRRI dhan33 drought in reproductive and ripening phases increased with delay transplanting (Fig. 4). In 2014, drought in reproductive and ripening phases increased (Fig.5) for transplanting after 24 July. When short duration variety transplanted before 24 July it can escape terminal drought.

For long duration variety, drought amount increased with late transplanting. Fig.6 represents terminal drought over transplanting dates for different growth phases in the previous years (2009-13) and Fig.7 drought in 2014. Drought in vegetative phase shows decreasing trends over transplanting dates (Fig. 6), reproductive and ripening phases have rising trends after transplanting on 24 July and ripening phase has almost similar trend. In 2014, vegetative phase shows decreasing trend on delay transplanting. But in reproductive and ripening phases severe drought occurred in case of transplanting after 24 July.

Table 6. Drought amount at different growth stages of rice, T. Aman, 2014

Treatment	Vegetative phase (mm)	Reproductive phase (mm)	Ripening phase (mm)	Total (mm)
BRRI dhan33				
10 July (T_1)	7.1	0	18.8	25.9
17 July (T_2)	7.1	0	26.8	33.9
24 July (T_3)	7.1	7.6	35.1	49.9
31 July (T_4)	7.1	7.6	44.1	58.8
07 August (T_5)	0	11.8	44.9	56.7
14 August (T_6)	0	40.8	40.9	81.7
BR11				
10 July (T_1)	7.1	40.8	39.9	87.8
17 July (T_2)	7.1	42.8	49.9	99.8
24 July (T_3)	10.3	39.6	54.9	104.8
31 July (T_4)	14.7	40.1	58.0	112.8
07 August (T_5)	7.6	59.1	57.0	123.7
14 August (T_6)	7.6	64.1	58.0	129.7

Fig. 4. Average drought pattern(2009-13) for BRRI dhan33

Fig. 5. drought pattern in 2014 for BRRI dhan33

Fig. 6. Average drought pattern(2009-13) for BR11	**Fig. 7. drought pattern in 2014 for BR11**

Yield and yield contributing character was shown in Table 7. BRRI dhan33 yielded highest (5.6 t/ha) when it was transplanted on July 17 and lowest yield was found 4.07 t/ha in case of transplanting on 14 August. For BR11, the highest yield was found for July 17 transplanting (5.96 t/ha) and lowest yield was observed in case of 14 August (4.64 t/ha). Yield decreased for both short and long duration variety after transplanting on 24 July.

Table 7. Yield and yield components for different transplanting dates, T. Aman 2014

Treatment	Growth duration	Plant height (cm)	Panicle/m^2	Filled grains/panicle	1000 grain weight (gm)	Yield (t/ha)
BRRI dhan33						
10 July (T_1)	124	114.67	261	139	25.36	5.27
17 July (T_2)	120	115.67	285	127.33	25.42	5.60
24 July (T_3)	120	111.67	248.3	130.33	23.39	5.40
31 July (T_4)	121	101.67	224	135.33	24.47	4.87
07 Aug (T_5)	119	102.63	262.3	121	23.02	4.51
14 Aug (T_6)	118	102.67	301.6	102.67	24.02	4.07
$LSD_{0.05}$	-	4.73	17.48	18.01	1.2	0.36
CV (%)	-	2.4	3.6	7.9	2.7	4.0
BR11						
10 July (T_1)	154	120.2	265.33	107.2	24.55	4.75
17 July (T_2)	147	116.0	333.3	106.3	24.47	5.96
24 July (T_3)	145	109.7	275.0	102.2	24.13	5.66
31 July (T_4)	143	107.3	304.3	143.5	24.79	5.41
07 Aug (T_5)	142	108.4	302.3	140.4	23.53	4.95
14 Aug (T_6)	139	104.3	296.7	127.4	23.85	4.64
$LSD_{0.05}$	-	5.97	34.7	17.7	0.91	0.32
CV (%)	-	3	6.4	8	2.1	3.4

Drought is an unpredictable phenomenon and it reappears after 5-10 years. Short duration variety faced fewer droughts due to its shorter growth duration. But both short and long duration variety faced fewer droughts when they transplanted before 24 July. So transplanting before 24 July would be low risk period of drought and after that it would be high risk period.

Determination of suitable time for application of supplemental irrigation in T. Aman, 2014

The experiment was conducted in Takimara, Kushtia Sadar, Kushtia to determine the relationship between perched water tables depletion during critical stages of rice and grain yield. BRRI dhan49 was used in this experiment during T. Aman 2014 season. There were three treatments with three replications in the experiment and the treatments were:
T_1 = Supplemental irrigation applied when water level reaches at 15 cm below ground surface
T_2= Supplemental irrigation applied when water level reaches at 20 cm below ground surface
T_3= Supplemental irrigation applied when water level reaches at 25 cm below ground surface

BRRI recommended cultural and fertilizer management practices were followed in growing the crop. Thirty-day-old rice seedlings were transplanted after proper land preparation with 20 cm x 20 cm spacing. Individual plot size was 8 m x 7 m, separated by 60 cm buffer zone. Supplemental irrigation was applied according to different treatment (T_1, T_2 and T_3). A USWB Class A evaporation pan and a rain gauge were installed near the experimental field for determining rainfall and evaporation amounts during the growing season of rice. Data were recorded at 08:30h daily to determine seepage & percolation, rainfall and evaporation from the experimental field.

Fig. 8 represents water level fluctuation and rainfall occurrence during the rice growth stages. Water stress and supplemental irrigation was applied according to different treatments. Yield is seriously hampered if crop suffered from water stresses during these periods. In 2014, the rainfall was mostly occurred in the vegetative part of the crop, but it was not uniformly distributed. So, supplemental irrigation was applied in all stages of crop. The number of supplemental irrigation application was eight, seven and six for the treatments T_1, T_2 and T_3. The depth of irrigation water was 5 cm above the ground surface in all irrigation applications. There were no considerable yield differences among the treatments (Table 8). The highest yield was found in T_1 (5.65 t/ha) and the lowest in T_2 (5.63 t/ha).

In terms of yield performances, T_1 performed slightly better than the other two treatments. But yield was insignificantly decreased following irrigation application when water level goes 25 (suitable water depth below ground surface). This is one year experiment and further trial is needed to draw a conclusion

Table 8. Yield and yield components for different supplemental irrigation depth, T. Aman 2012

Treatment	No. of irrigation applied	Days to irrigate after disappearing standing water	Plant height (cm)	No of Panicle/m^2	Filled grain per panicle	1000 grain wt (gm)	Yield (t/ha)
T_1	8	3	107.1	295	155.1	21.56	5.65
T_2	7	4	108	297	164.4	21.51	5.63
T_3	6	5	109.3	300	156.1	21.76	5.63
$LSD_{(0.05)}$			2.03	9.18	14.65	0.52	0.51
CV (5%)			0.8	1.4	4.1	1.1	3.5

T_1 = Supplemental irrigation applied when water level reaches at 15 cm below ground surface
T_2= Supplemental irrigation applied when water level reaches at 20 cm below ground surface
T_3= Supplemental irrigation applied when water level reaches at 25 cm below ground surface

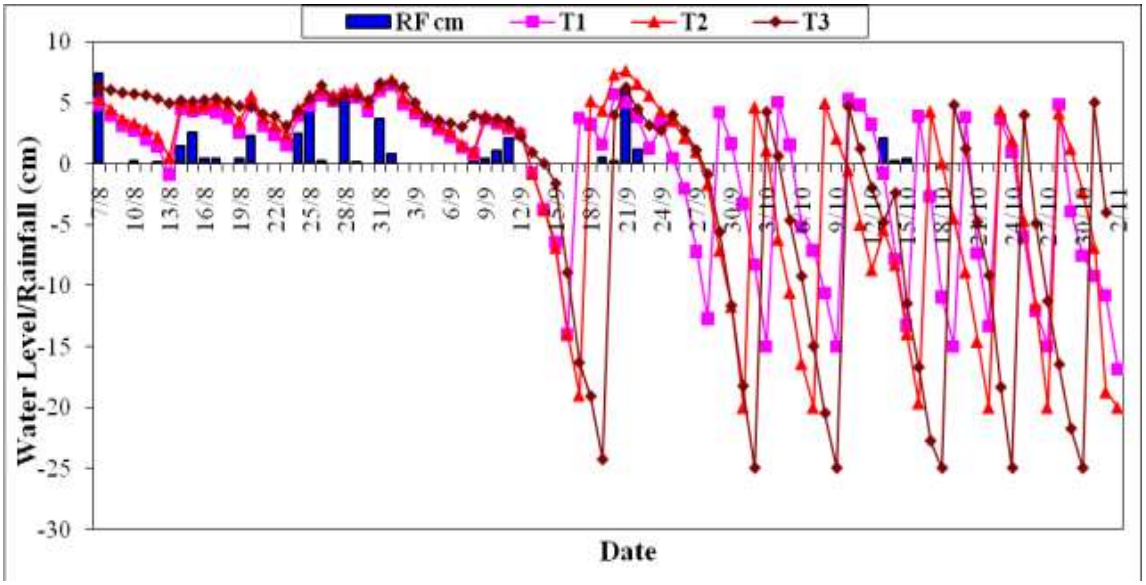


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Fig. 8. Rainfall and groundwater level fluctuation over the growing period

SUSTAINABLE MANAGEMENT OF GROUNDWATER

Monitoring of groundwater fluctuation and safe utilization in different geo-hydrological regions

The study was conducted to monitor the water level fluctuations and water quality to assess the availability and suitability for agriculture. Available water level recorder was used for measuring groundwater fluctuation.

The study was conducted at BRRI farm Gazipur, Comilla, Rajshahi, Habiganj, Kustia, Bhanga, Rangpur, Satkhira. Sonagazi and Barisal. Maximum and minimum groundwater level at different BRRI stations during 2014-15 are shown in Fig. 9. During the reporting period maximum lowering of groundwater table was observed in March/April and minimum in September/October. Among the BRRI R/S the highest depth (11.5 m) was observed in Comilla and lowest (0.82 m) in Satkhira area. The above information indicated that out of 9 BRRI R/S, 5 (Bhanga, Rangpur, Satkhira, Sonagazi and Barisal) are suitable for operating shallow tubewell (STW) and the rest 4 (Comilla, Rajshahi, Habiganj and Kustia) and BRRI H/Q are not suitable for using STW during the critical period (March/April) of Boro season. But during wet season all of the 9 sites are suitable for STW use as the water table depth is within the suction limit (8 m).

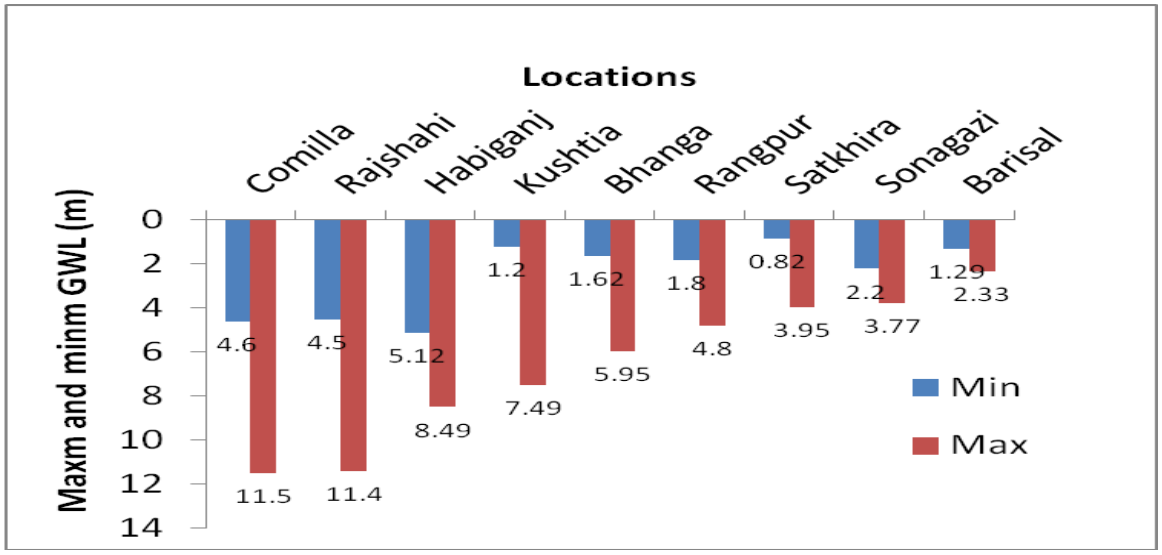


Fig. 9. Fluctuation of groundwater level at different BRRI Stations during 2014-15

The maximum and minimum groundwater level of BRRI H/Q, Gazipur from 1998 to 2014 has been presented in Fig. 10. The results showed that both maximum and minimum groundwater level at BRRI farm Gazipur is declining day by day and it is not fully recharged after the monsoon. In 1998 the maximum groundwater level was about 11.68 m (Fig. 10) from the ground surface which is 33.61 m in 2014. So, the lowering was about 22 m in 16 years. During the initial five years the lowering rate was not so high and it was only 3 m (14-11 m). But during the last five years (2009-2014) the lowering was about 10 m (2 m/year) which was 3 times more compared to the initial declination rate. Therefore, the present high rate of declination was very alarming. The lowering was due to increased pumping demand due to establishment of many factories and industries surrounding BRRI H/Q. The minimum groundwater level is also declining every year which indicated that the groundwater level is never fully recharged after the monsoon.

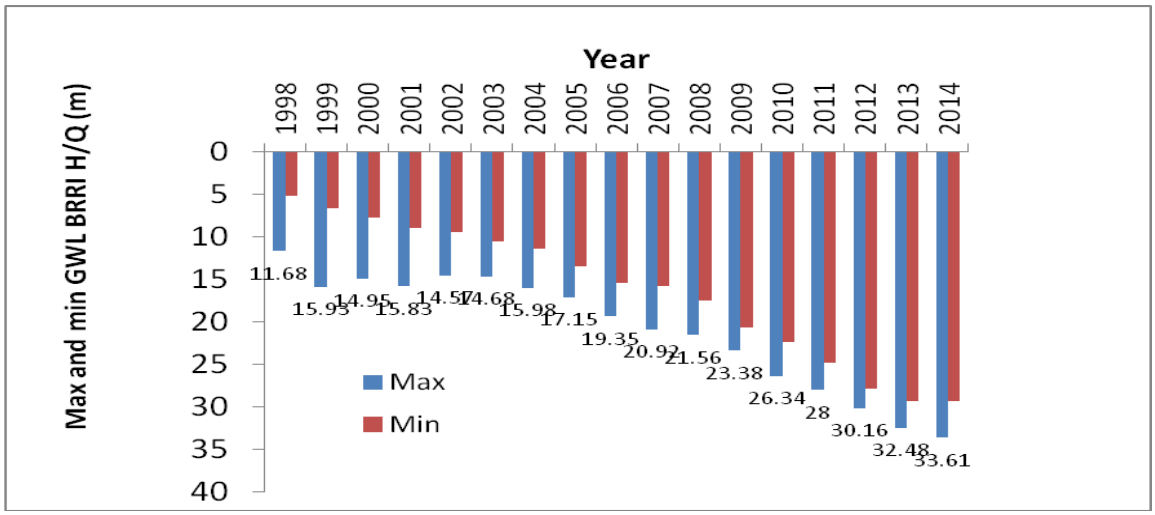


Fig. 10. Maximum and minimum GWL at BRRI H/Q during 1998-2014

RENEWABLE ENERGY

Effectiveness of solar pump for irrigated rice

The study was conducted to evaluate the suitability of solar pump for irrigation and multiple use. A solar irrigation system was installed at BRRI farm. The panel size was 1.5 m^2 x 8 = 12 m^2 and the capacity was 1600 watts. Submersible pump was used and the capacity was 1 kw. Pumping water has been started since September 2014. Surface water is being pumped from a pond at 3 m head.

The treatments were 3cm depth of irrigation at saturation level and 3cm depth of irrigation in AWD system. The rice variety was BRRI dhan63. The soil type was clay loam. BRRI dhan63 was transplanted on 29 January, 2015 and harvested on 1 May 2015. Fig. 11 showed that discharge rate rose with the increase of solar radiation and it went to peak in the noon (12.00 pm), and then discharge rate declined gradually as radiation fell. Maximum discharge was found at 10200 lit/hr (170 lit/min) at 12.00 pm when solar radiation recorded at 902 w/m^2 and the average discharge rate was 107 lit/min.

Fig. 11.Variation of discharge of solar pump with solar radiation at different time of day in Gazipur

During September 2014, daily discharge of pump has shown in figure 2.Due to cloudy sky sometimes the discharge rate was very low. The highest discharge was recorded at 64.3 m^3 and lowest at 25 m^3 (Fig. 12). The discharge rate of solar pump was measured every day in every month. Fig. 13 showed performance of solar pump from December 2014 to April 2015.

Fig. 12. Discharge of solar pump during September 2014

Fig. 13. Discharge of solar pump in different months

A comparative study has been done to determine irrigation coverage with respect to different depth of irrigation between actual and simulated data (Table 9). During Boro season, the average discharge of 1.5 hp solar pump was 55 m^3 per day. In this study, simulated irrigated areas for different depth of irrigation except 3 cm depth in AWD practice were calculated based on the average discharge. From table 9, it revealed that, when irrigation was applied at 7 cm depth in flooded condition, the irrigation coverage was 0.46 ha which was the least area and 5 cm depth of irrigation in AWD practice could be irrigated at 0.77 ha. Whereas, the actual irrigation coverage was 0.9 ha by applying 3 cm depth of irrigation in AWD practice. Hence, it concluded that, 3 cm depth of irrigation at AWD practice is the best irrigation schedule for Boro rice cultivation using solar pump.

Table 9. Comparison of simulated and actual data of irrigation coverage with respect to different depth of irrigation

Depth of irrigation	Area coverage (ha)
Flood irrigation (7 cm)	0.46 (3.5bigha)
1 cm irrigation daily	0.55 (4 bigha)
3 cm irrigation at saturation level	0.55 (4 bigha)
3 cm irrigation in AWD (actual data)	0.9 (7 bigha)
5 cm irrigation in AWD(actual data)	0.77 (5.8 bigha)

Summary

Plant Physiology division works on mainly abiotic stress (Salinity, submergence, drought, heat and cold), growth studies and weather parameter. A total of 340 rice genotypes of different sources like INGER, STBN, OT, advanced breeding lines and 200 germplasms were screened for seedling stage salinity tolerance of them about 60 materials and 25 germplasms were selected as a tolerant to moderately tolerant. A study was conducted to observe tolerance levels of salinity tolerant rice varieties at germination, post germination and seedling growth stage. For discriminating between tolerant and susceptible varieties for germination stage, post-emergence/early seedling and whole seedling growth period salinity level would be 25 dS/m, 10 dS/m and 8dS/m respectively. Six advanced breeding lines were tested for salt tolerance at reproductive stage among them breeding line IR78761-B-SATB1-28-3-24 is released as salt tolerant T. aman variety, BRRI dhan73. Three germplasm and one advanced breeding lines were characterized and Lambra, Bazail dhan and Kechrail were selected as tolerant genotype for whole growth period. Comparative study of four salt tolerant varieties were done for whole growth period and among them BRRI dhan47, BINA dhan10, BINA dhan8 showed more or less similar tolerance reaction. About 108 rice genotypes along with the tolerant check FR13A and susceptible check BR5 were characterized for submergence tolerance. Among the tested genotypes, 6 non-elongating type genotypes showed better survival after recovery. Performance of Nerica, ALART materials and anther cultured lines was studied under drought stress at reproductive stage and among the Nerica genotypes Nerica Mutant performed better than others. Nerica Mutant, two ALART and one anther cultured line performed better under drought stress. Two advanced breeding lines were tested for low water condition (aerobic condition) under transplanting method. Between the lines IR83142-B-71-B-B performed better at field capacity condition and rooting ability of this lines was also good. Two spikelet fertility QTL (*qSF4.1* and *qSF4.2*) were introgressed from heat tolerant rice genotype N22 to BRRI dhan28 and BRRI dhan29. Some 147 rice genotypes from BRRI gene bank accessions and INGER materials were screened for cold tolerance and 14 materials were selected. Advance rice genotypes IR77496-31-2-1-3-1 and IR62266-42-6-2 showed cold tolerant at seedling stage and other 2 advanced breeding lines BR7812-19-1-6-1-P4 and BR7813-1-3-1 had higher recovery after cold spell. The polythene covering seedbed techniques have visible benefits in raising seedling at low temperature condition. Development of field-based seedling raising technique for low temperature condition was conducted and it should be recommended to use rice husk amendment for growing better seedling only when temperature remains similar as prevailing condition and/or in combination with polythene cover if temperature falls below than the prevailing condition or when there is long cold spells.

SALINITY TOLERANCE

Identification of new sources of salinity tolerant donor from Bangladeshi rice germplasms at seedling stage.

To characterize Bangladeshi rice germplasms Plant Physiology Division is working for searching new sources of salinity tolerance as a routine and mandatory research. For the reporting year a total of 200 BRRI Gene Bank accessions (Acc. no 208 to Acc no.458) were characterized through IRRI standard method described by Gregorio *et al*., 1997 for seedling stage. Among the tested 200 germplasms, none of the genotype found tolerant, while only 25 germplasms showed average visual score (SES) 5.0 to 5.5 that is grouped in to moderately tolerant class. However, other genotypes showed visual score 6 to 9 that is susceptible to highly susceptible.

The accession number and name were provided below and moderately tolerant accessions marked as bold: 208 (Koha Binni), 209 (Lal binni), 210 (Lal Binni), 211 (Laksmi Bilash), 212 (Neel Kumari), 213 (Rotisail), 214 (Gabal Sail (Balam)), 215 (Dushor), 217 (Lao Bhug), 218 (Luha Gara), 220 (Raimihi), 221 (Sham Rash), 222 (Gopal Bhog), 223 (Gohul sail), 224 (Depa Dhan), 225 (Dud sar), 226 (Dhulaiti), 227 (Apchaya), 228 (Kolom), 229 (Sagar dhana), 230 (Khirloni), 231(Bashi Raj), 232 (Kataru Bhog), 233 (Nuria), 235 (Khorma), 236 (Kala Binni), 337 (Dudrat), 238 (Indra Sail), 239 (Lal Kumari), 240 (Kabra Balam), 241 (Birol (5)), 242 (Pura Binni (3)), 243 (Kashia Binni (2)), **244(Kashia Binni(2)),** 246 (Gurdoi (2)), 247(Kali Jira (3)), 248 (Telot), 249 (Bazail), 250 (Joli Aman), 252 (Baza), 253 (Boro), **254 (Ausha Boro),** 255 (Jagli Boro), 256 (Jagli Boro), 260 (Kali Boro), 263 (Shada Dumra), 264 (Sukhti), 265 (Faisha Mania), 266 (Inda), 267 (Thubri), 268 (Bolun), 269 (Phul Dumra), 270 (Kancha Ncni), 271 (Kola Dama), 272 (Bangal Bokri), 273 (Goria), **275 (Naria Buchi),** 276 (Khirsha Bhog), 277 (Sham Rush), 278 (Dudh Kalam), 280 (Bora Dudh Kalam), 281 (Lal Soru), **282 (Gojol Goria),** 284 (Ganjia), 285 (Bindi Pakri), 286 (Jhoshua), 287 (Akand Sail), 288 (Meny), 289 (Lal Dupa), 290 (Jiga Sail), 292 (Shul Kumor), 293 (Pahari Sail), 294 (Betu Dhan), 295 (Khar Mao), 296 (Til Kapur), 297 (Kanai Bansi), 298 (Ukni Madhu), 299 (Mal Shira), 300 (Puti Depa), 301 (Bawai Bhog), 302 (Pani Sail), 303 (Panati), **305 (Kala Jira), 306 (Joluya),** 307 (Shalya), 308 (Kochu Dula), 309 (Mal Sira), 311 (Akon Ali), 312 (Kandi Sail), 313 (Suhani), 314 (Bashi Aman), 315 (Binna Phul), 318 (Kalo Bhog), **319 (Bhog), 320 (Depa),** 321 (Muta Joshua), 322 (Shoru Joshuya), 324 (), 325(Depa), 326(Depa), 327(Luha Dang), 329 (Surja Mukhi), 330 (Kati Depa), 331 (Jab Siri), 332 (Jol Depa), 333 (Demshi Phul), 334 (Haldi Jan), 335 (Mukut Sail), 336 (Til Kabur), 337 (Aswina), 338 (Rosul Bhog), **339 (Lal Mughi),** 340 (Shaita), 341 (Naya Raj), 342 (Nil Komor), 343 (Haldi Amon), 344 (Sojoni), 345(Shil Kumor), 346 (Panati), 347 (Gojol Goria), 349 (Bura Horin), 350 (Sarod Mukhi), 352 (Kala Gochi), 353 (Naria Bochi), 354 (), 355 (Depa), 356 (Jhoshua), 357 (Jhoshua), 360 (Mal Sira), 361 (Mal Sira), 362 (Mal Sira), 363 (Lal Buchi), 364 (Betu), **367 (Jolo Koia), 368**

(Sapahar), 369 (Buchi), 370 (Teku), 371 (Bangal Dhari), 373 (Gochi Dhan), 374 (Hizal), 375 (Bhoria Bhaouee), 379 (Bir Madal), 380 (Shamraj), **382 (Mal Sira (2)),** 383 (Betu), 384 (Bihari Sail (2)), **385(Bhat Raj), 386(Mugi (s)),** 387 (Chini Sakkor), 388 (Chini Sakkor), 389 (Chini Sakkor), 391 (Lal Bihari), 392 (Bhoro Chalam), **393 (Sindur Kowta), 394 (Boron Dhan),** 395 (Modhu Mala), 398 (Chini Atop), **400 (Indar Sail (2)),** 402 (Boira Amon), 403 (Lal Parja), 404 (Panzra), 405 (Bashi), 406 (Buta), 407 (Panati), **408 (Muta Ganji), 409 (Loha Dang),** 411 (Moha Rani), 412 (Chemgul), 413 (Shaheb Guta), 414 (Ragu Sail (6)), 415 (Jinga Sail (1)), 416 (Jinga Sail (2)), 417 (Gouji (2)), 418 (Sona Mukhi), **419 (Sona Sail (4)),** 420 (Dhola Depa), 422 (Bokul Sail), 423 (Pajer), 425 (Khomon Dhan), 426 (Jota Ganj), 429 (Kali Ray), 430 (Nagra dhan), **432 (Bada dhan), 433 (Buchi), 434 (Rowal Doh), 435 (Mohini Sail),** 436 (Neel Konthi), **437 (Kati Sail),** 439 (Horma), 440 (Kaisa Phul), 441 (Kon Kochur), 443 (Jola), 444 (Tangul), 446 (Bansh Phul (2)), 447 (Tepa Khula), 448 (Kasia Phul (2)), 450 (Bas Kolom), 454 (Kolom Depa), 456 (Kolom) and 458 (Buta Sail).

Investigation of level of tolerances of modern salinity tolerant rice varieties at germination, post germination and seedling growth stage

Two experiments were conducted at the Laboratory and Net house of the Plant Physiology Division, BRRI, Gazipur during March to April 2015. All high yielding modern salinity tolerant varieties released in Bangladesh (BRRI and BINA) was tested with standard tolerant check Pokkali and sensitive check IRRI154 (NSICRc222). Investigation at germination and post-germination growth under salinity was carried out by the method described by Hakim, *et al.*, 2010; while the investigation at seedling stage was carried out according to Gregorio *et al.*, 1997 with some modification (here non-sprouted seeds were directly sown to the saline Yoshida solution).The present study was designed to generate data for the level of tolerances of all released high yielding salt tolerant varieties during germination, post germination and early seedling growth stage. Two different sets of salinity stress level was employed i.e. 0, 5, 10, 15, 20 and 25 dS/m for germination and post-germination study and 0, 4, 8, 12 dS/m for seedling growth stage. Both the experiment was laid out in Factorial RCB design with 3 replications. Seven traits such as final germination percent (FGP), speed of germination (SG), and germination energy percentage (GE %), plumule/seedling shoot and radicle/root lengths and dry weights were recorded and measured. Scoring through SES system, survivability and reductions of dry weights were also measured for post-germination and seedling growth. Data were processed before analyses especially count and percentage data were transformed through Arcsine transformation to stabilize error variances. All data were analyzed for ANOVA and means were separated by LSD with 5% level of probability.

Tolerances at germination stage: The effects of salinity stress on germination was judge in the present investigation by 3 parameters i.e. Final germination percent (FGP), Speed of germination (SG), and Germination energy percentage (GE %). ANOVA showed highly significant interactions and main effects for Variety × Salinity, Variety and Salinity. All germination related parameters

were negatively affected with increasing the level of stress. However, there are no such marked variations for all 3 parameters for all varieties till salinity level increased from 0-15 dS/m, except Pokkali. Interesting point is, Pokkali used in this experiment as tolerant local Indian accession, whereas it was identified as sensitive even sensitive then standard sensitive IRRI154. The reasons behind that this entry could be the sensitive Pokkali accession, because this was collected from IRRI and there are 16 accessions with same name Pokkali and most of the accessions are sensitive to moderately sensitive. Tested varieties could start to discriminate from 20 dS/m, where FGP drops <50% only for two variety Pokkali and BRRI dhan40 (Fig. 1). By defining salinity tolerance, 50% germination is the cut-off value for discriminating sensitive to tolerant varieties. At 25 dS/m salinity, final germination was completely inhibited for sensitive to moderately sensitive varieties such as BRRI dhan40, BRRI dhan41, BRRI dhan53, BRRI dhan54, Pokkali, and IRRI154 and it ranged from 0-11.67%. Two varieties, namely BRRI dhan67 and BINA dhan10 was maintained FGP 31.67% and 36.67% and these could be termed as moderately tolerant. However, three varieties namely, BRRI dhan47, BRRI dhan61 and BINA dhan8 was found tolerant at 25 dS/m salinity for germination having FGP >50% (Fig. 1). Therefore, 25 dS/m salinity could be considered as critical at germination for the tested rice varieties. Other two germination related parameters also showed similar trends (Fig. 2 and 3) and supports the results of final germination percentages. Salinity results in poor stand due to decrease in the rate of seed germination. Presumably, the osmotic effect and Na^+ toxicity effect due to salinity was the main inhibitory factor that reduced germination.

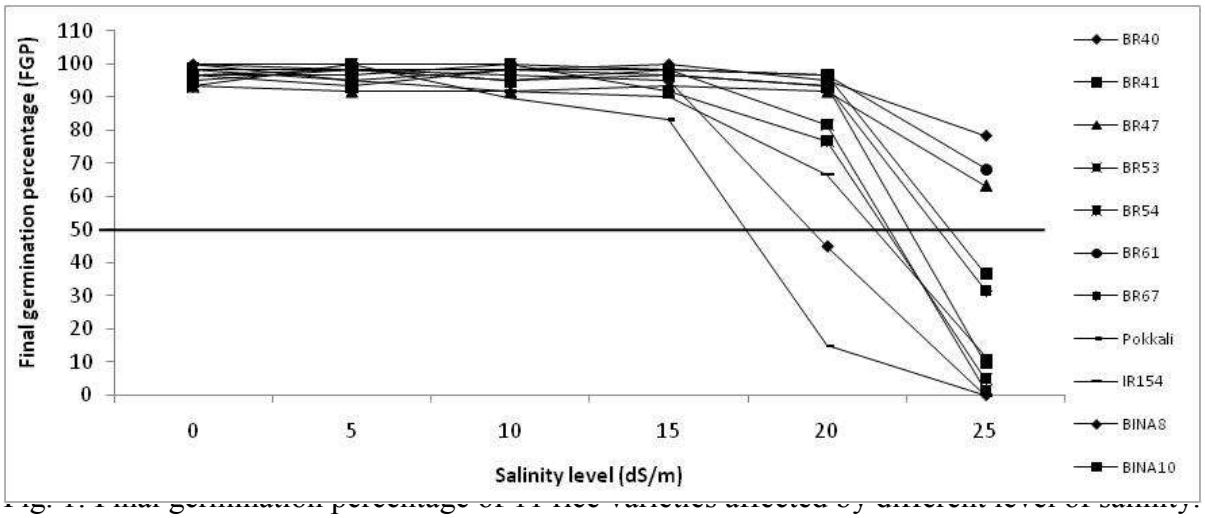
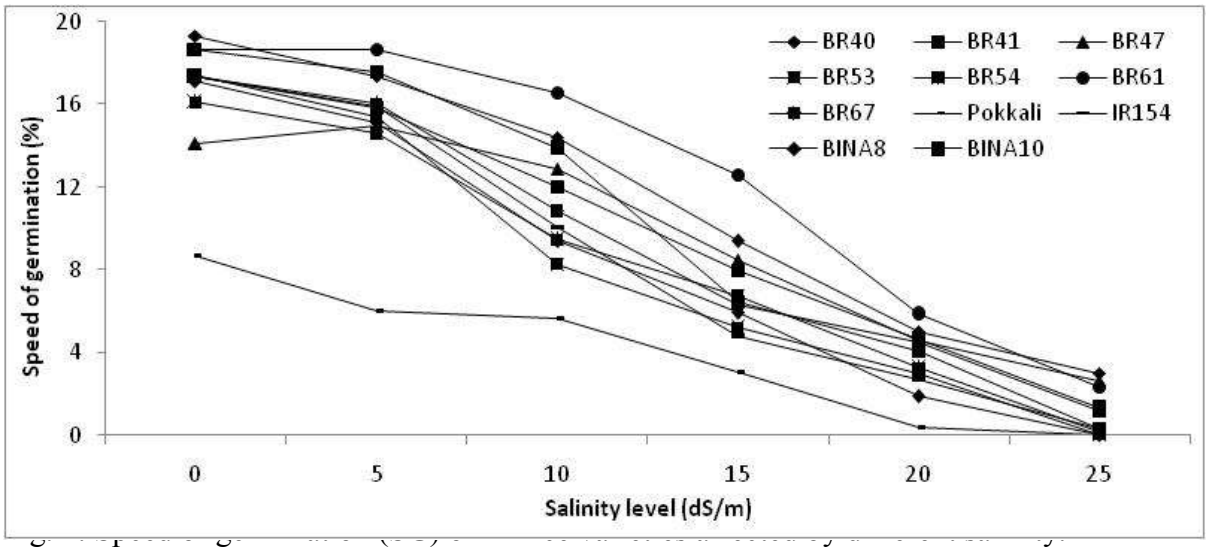
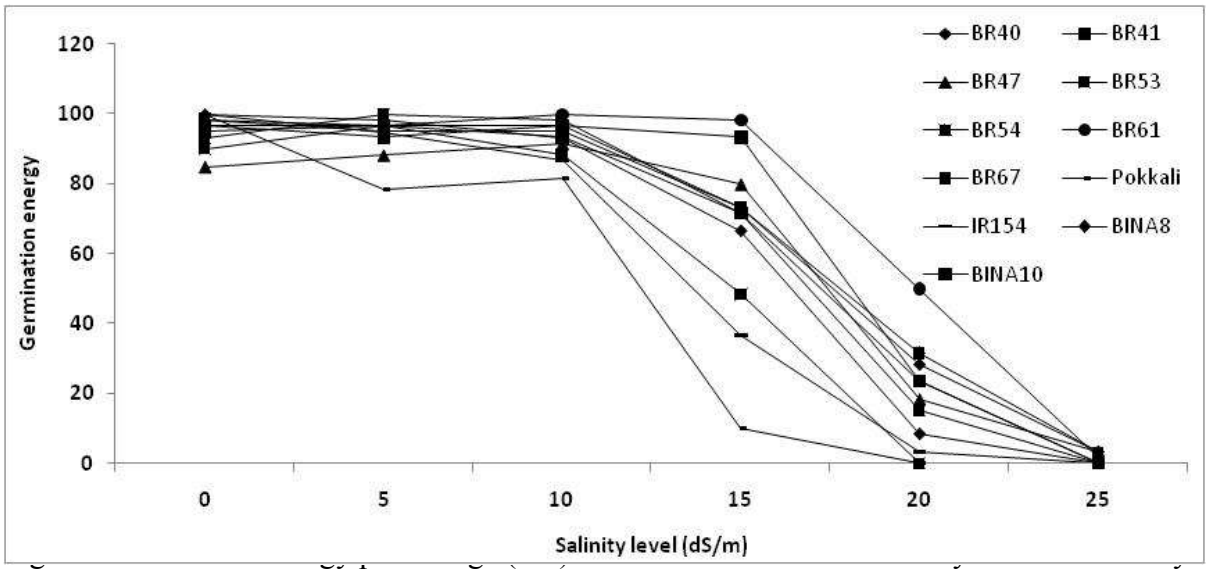


Fig. 1: Final germination percentage of 11 rice varieties affected by different level of salinity.





Tolerances at post-germination growth: Post-germination growth can be characterized through plumule and radicle length and dry weight reduction. Plumule and radicle length of all the tested rice varieties decreased at all the salinity level with increase in salinity. But the magnitude of reduction was more for radicle length compared to plumule length (Table 1 and 2). Interaction effects between factors were found significant for plumule length reduction while insignificant for radicle length reduction. However, plumule and radicle length reduction was found highest (-100.00%) at 25 dS/m salinity of the varieties BRRI dhan40 and Pokkali. This implies that the growth of these two varieties was completely ceased at 25 dS/m. At 20 dS/m salinity only 4 varieties i.e. BRRI dhan47, BRRI dhan61, BRRI dhan67 and BINA dhan10 could maintain good growth had reduction <50% and considered as tolerant (Table 1). However, regarding radicle length reduction there are no such trends observed at 20 and 25 dS/m salinity. BRRI dhan61 is the only variety could maintain good growth had reduction <50% at 15 dS/m (Table 2). The gradual decrease in root length with the increase in salinity as observed might be due to more inhibitory effect of NaCl salt to root growth compared to that of shoot growth. Similar to plumule and radicle length, dry weights also was inversely related to salt concentration. Plumule dry weight was relatively less sensitive to salt than radical dry weight especially at higher salt concentrations.

Interaction effects between two factors of plumule and radicle dry weight reduction were found insignificant, whereas main effects for both parameters were found significant. The tested varieties were classified based total dry weight (plumule and radicle) reduction during post-germination growth period according to the scale provided by Fageria, 1985. All varieties showed inconsistency on salt tolerance over increasing salt concentration. At an electrical conductivity of 5 dS/m, eight varieties were tolerant (T) and three were moderately tolerant (MT). But when salinity level increased to 10 dS/m, five varieties were tolerant (T); five were moderately tolerant (MT) and one was moderately susceptible (MS). While further increase of salinity to 15 dS/m, seven varieties were moderately tolerant (MT); three were moderately susceptible (MS) and one was susceptible (S). However, at 20 dS/m salinity, four varieties were moderately tolerant (MT); four were moderately susceptible (MS) and three were susceptible (S). At 25 dS/m salinity, there are only two groups moderately susceptible (MS) and susceptible (S). All varieties showed gradual deviation from their previous salt tolerant ranking from T to MT, MT to MS and MS to S, respectively. Therefore, in this study, BRRI dhan47, BRRI dhan61, BINA dhan8 and BINA dhan10 showed relatively better tolerance capacity compared to other varieties at high salinity level (Table 3).

Table 1: Reduction of plumule length over control of 11 rice varieties affected by different salinity

Salinity level (dS/m)	BR40	BR41	BR47	BR53	BR54	BR61	BR67	Pokkali	IR154	BINA8	BINA1
5	-14.62	-16.34	-16.34	-26.95	8.43	-26.59	-15.85	-35.89	1.14	-11.63	-9.53
10	-22.37	-29.94	-29.94	-20.09	-32.28	-0.98	-26.98	-58.75	-33.78	-41.14	-14.32
15	-60.54	-35.68	-35.68	-53.83	-33.07	-44.21	-45.86	-88.66	-46.78	-14.59	-52.85
20	-72.06	-76.19	-46.19	-81.70	-79.65	-41.54	-37.06	-93.33	-71.02	-60.06	-50.72
25	-100.00	-86.00	-86.00	-95.35	-92.86	-72.59	-81.31	-100.00	-78.02	-71.03	-83.63
Main effect for variety is significant at 1% level and LSD value is 6.64											
Main effect for salinity is significant at 1% level and LSD value is 4.48											
Interaction effect between Variety x Salinity is significant at 1% level and LSD value is 14.86											

Table 2: Reduction of radicle length over control of 11 rice varieties affected by different salinity

Salinity level (dS/m)	BR40	BR41	BR47	BR53	BR54	BR61	BR67	Pokkali	IR154	BINA8	BINA10
5	-8.95	-10.43	-16.16	-15.58	-6.44	-21.18	17.14	16.76	24.65	8.50	-32.66
10	-39.30	-39.02	-16.47	-33.51	-32.93	-8.70	-35.62	-72.26	-46.04	-63.13	-31.69
15	-69.42	-57.09	-67.85	-67.30	-73.04	-49.50	-87.53	-75.61	-83.57	-67.81	-76.40
20	-82.35	-70.64	-68.22	-80.98	-85.67	-83.44	-40.51	-93.53	-92.60	-55.34	-63.56
25	-	-	-	-	-	-	-	-100.00	-94.91	-60.87	-65.12

	100.00	90.63	83.76	97.44	86.38	84.00	79.57				
Main effect for variety is not significant at 5% level											
Main effect for salinity is significant at 1% level and LSD value is 10.26											
Interaction effect between Variety x Salinity is not significant at 5% level											

Table 3: Reduction of total dry weight (plumule and radicle) over control and classification of varieties for salinity tolerance (T= Tolerant; MT= Moderately tolerant; MS= Moderately sensitive; S= Sensitive)

Variety	Dry weight reduction at different salinity level (dS/m)					Classification for tolerance at different salinity level (dS/m)				
	5	10	15	20	25	5	10	15	20	25
BR40	-3.88	13.17	-67.82	-54.91	-100.00	T	T	S	MS	S
BR41	-15.65	-30.43	-41.65	-46.53	-75.59	T	MT	MS	MS	S
BR47	-0.21	-19.21	-28.65	-36.39	-58.75	T	T	MT	MT	MS
BR53	-20.62	-23.36	-33.51	-60.67	-87.94	MT	MT	MT	S	S
BR54	5.96	-32.22	-36.35	-67.01	-82.61	T	MT	MT	S	S
BR61	-7.79	-13.65	-32.91	-38.44	-58.76	T	T	MT	MT	MS
BR67	-4.18	-23.08	-33.00	-40.93	-54.83	T	MT	MT	MS	MS
Pokkali	-28.91	-56.39	-43.10	-63.70	-100.00	MT	MS	MS	S	S
IRRI154	-26.65	-29.07	-44.42	-56.02	-61.33	MT	MT	MS	MS	S
BINA8	2.02	-19.58	-32.36	-22.10	-51.17	T	T	MT	MT	MS
BINA10	-4.89	-17.96	-39.78	-36.05	-58.73	T	T	MT	MT	MS

Tolerances during seedling growth: This investigation was designed to know the behavior of tested varieties for prolonged period in to different levels of salinity stress. Seeds of all varieties were directly sown to different saline solution and scoring was carried out 30 days after sowing, which means throughout the seedling growth. Interactions effects between factors (variety x salinity), varietal main effect and salinity main effects were found highly significant (Table 4). All varieties scored 1 at 0 dS/m, because there is no growth retardation and no symptoms. While, at 4 dS/m, after a prolong period (1 month) varieties were score ranged from 3.03 to 5.69, i.e. tolerant to moderately tolerant. At 8 dS/m, only two variety BRRI dhan47 and BINA dhan10 showed SES 7.25 (moderately sensitive) but rests were highly sensitive. At 12 dS/m, the SES ranged 8.33 to 9.00 that means all were shown highly sensitive. The results revealed that, even at low concentration of salt for prolong period could be much more destructive than short period of time. Here, the known highly salt tolerant variety like BRRI dhan47, BINA dhan8 and BINA dhan10 were scored 3.94, 3.92 and 3.33 in at very low salinity 4 dS/m level over 1 month (Table 4). The threshold salinity at which growth of rice begins to be affected by the salt can be as low as 3 dS/m (~30 mM salt). In general, such low salt concentrations are unlikely to cause medium or long-term osmotic stress. Thus, seedling or early vegetative growth is very sensitive to salinity; there is a large genetic variation in response with many land races in particular found to be relatively tolerant.

Table 4: Standard evaluation system score (SES) of 11 rice varieties affected by different salinity

Salinit	BR4	BR4	BR4	BR5	POK	IR15	BR5	BR6	BR6	BINA	BINA1

y level (dS/m)	0	1	7	3		4	4	1	7	8	0
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	4.42	3.61	3.94	4.12	3.08	5.69	5.08	4.08	5.19	3.92	3.33
8	9.00	8.75	7.25	8.50	8.58	8.75	9.00	8.00	8.83	8.08	7.25
12	9.00	9.00	9.00	8.92	9.00	9.00	8.75	9.00	9.00	8.50	8.33
Main effect for variety is significant at 1% level and LSD value is 0.29											
Main effect for salinity is significant at 1% level and LSD value is 0.18											
Interaction effect between Variety x Salinity is significant at 1% level and LSD value is 0.59											

All seedlings were survived at 0 and 4 dS/m salinity, except IRRI154 and BRRI dhan67 (Table 5). Two seedlings of IRRI154 and BRRI dhan67 were died at 4 dS/m salinity in replication 1, this could be due to poor vigor of the seeds and seedlings. Though, there are no such effect on survivability were observed at 4 dS/m, but over a prolonged period, growth retardation and leaf injury and symptoms were visible for all varieties. Therefore, the SES values were higher for sensitive varieties compared to tolerant (Table 4). However, at 8 dS/m salinity, BRRI dhan47 and BINA dhan10 had survivability percentages >50% and considered as tolerant. BRRI dhan61 and BINA dhan8 had an intermediate survivability percentage 25% and 33.33% respectively. While, BRRI dhan40 and BRRI dhan54 had 0% survivability and rest of the varieties ranges from 4.17 to 16.67%. At 12 dS/m salinity, only two BINA varieties showed survivability ~20% but rest of the varieties showed very sensitive, survivability ranged from 0 to 8.33% (Table 5).

Table 5: Survivability (SUR) (%) of 11 rice varieties affected by different salinity level

Salinity level (dS/m)	BR40	BR41	BR47	BR53	POK	IR154	BR54	BR61	BR67	BINA8	BINA10
0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
4	100.00	100.00	100.00	100.00	100.00	91.67	100.00	100.00	91.67	100.00	100.00
8	0.00	12.50	58.33	16.67	12.50	4.17	0.00	25.00	4.17	33.33	50.00
12	0.00	0.00	0.00	4.17	0.00	0.00	8.33	0.00	0.00	20.83	20.83
Main effect for variety is significant at 1% level and LSD value is 6.28											
Main effect for salinity is significant at 1% level and LSD value is 3.79											
Interaction effect between Variety x Salinity is significant at 1% level and LSD value is 12.56											

Salinity level 25 dS/m, 10 dS/m and 8dS/m could be the critical level for discriminating tolerant to susceptible varieties for germination stage, post-emergence/early seedling and whole seedling growth period respectively.

Screening for salinity tolerance of advanced breeding materials with some varieties at the seedling stage

To identify salt tolerant genotypes at seedling stage fifteen genotypes namely IR78761-B-SATB1-28-3-24, **IR78761-B-SATB1-28-3-26,** IR73055-8-1-1-3-1, IR3484-3-B-7-1-1-1, IR78761-B-SATB1-68-6, **IR83440-4-B-11-2-1-1-AJY1-B,** BR7611-31-5-3-2, **Kechrail (Local), BRRI**

dhan47, BRRI dhan61 BINA dhan8, BINA dhan10, **IR77092-2R-B-10,** BR377-9-21-3B, **BRRI dhan41** including with tolerant and sensitive check IR58443-6B-10-3 and IR154 were screened under salinity (12 dS/m) stress. Screening was done as per Gregorio *et al*., 1997. Out of 15 genotypes, 7 (bold markings) genotypes showed visual score 5 that is moderately tolerant. However, other genotypes shows visual score 6 to 9 that is susceptible to highly susceptible. The survivality percentage of these genotypes varied from 70% to 82%.

Screening for Salinity Tolerance of INGER Materials at the Seedling Stage

Forty genotypes as IR13T134, IR12T125, IR13T135, IR12T253, **IR11T129, IR12T254, IR12T133, IR12T260,** IR11T163, IR12T201, IR11T171, IR11T180, IR11T183, IR11T184, IR11T193, IR11T196, IR11T197, IR11T210, IR11T219, IR11T230, IR11T258, IR13T143, IR13T144, IR13T145, IR13T148, **A-69-1, CSR28,** CSR 90 IR-2, IR28, IR45427-2B-2-2B-1-1, IR55179-3B-11-3, **IR58443-6B-10-3, IRRI 147, IR66946-3R-178-1-1,** IRRI 165, **NONA BOKRA,** IRRI 154, **POKKALI,** IRRI 123, SWARNA-SUBI including with tolerant and sensitive check BRRIdhan47 (Tolerant ck.), BRRIdhan61 (Tolerant ck.) and IR154 (Sensitive ck.), IR29 (Sensitive ck.) were screened for salinity tolerance under salinity (12 dS/m) stress. Screening was done as per Gregorio *et al*., 1997. Among 40 genotypes, 11 (bold markings) genotypes showed visual score 3 to 5 that is tolerant to moderately tolerant. However, other genotypes shows visual score 6 to 9 that is susceptible to highly susceptible. The survivality percentage of these genotypes varied from 66% to 100%.

Screening for Salinity Tolerance of OT Materials at the Seedling Stage

Forty three genotypes as **IR86385-98-2-1-B,** IR86385-114-1-1-B, **IR8638586385-117-3-1-B,** IR77674-3B-8-1-3-10-3-AJY2, IR77674-3B-8-2-2-6-3-AJY5, IR77674-3B-8-2-2-12-5AJY2, **IR83460-4-B-2-1-1,** IR83460-B-AJY5-5-SDO2, IR83425-B-AJY2-1-AJY2, IR64, BR8715-10-7-11, BR8733-9-6-1, BR8379-10-6-4-1, **BR8780-16-8-3-9, BR9090-2,** BR9090-4, BR9090-6, BR8715-1, BR8715-2, BR8715-4, BR8718-1, BR8718-3, BR8726-1, BR8726-2, BR8726-6, BR8726-8, BR8727-1, BR8727-2, BR8729-1, **BR8729-2,** BR8732-1, BR8732-2, BR8735-1, BR8735-7, BR8737-1, BR8737-2, **BR8738-2,** BR8740-1, **BR8742-2,** BR8742-7, BR8743-2, BR8747-4, BR8747-5 including with tolerant and sensitive check BRRI dhan53 (ck.), BRRI dhan54 (ck.) and IR29 (Sensitive ck.), BR49, IR154 (Sensitive ck.) were screened for salinity tolerance under salinity (12 dS/m) stress. Screening was done as per Gregorio *et al*., 1997. Among 43 genotypes, 8 OT materials (bold markings) showed visual score 5 that is moderately tolerant. However, other genotypes shows visual score 6 to 9 that is susceptible to highly susceptible. The survivality percentage of these genotypes varied from 65% to 88%.

Screening for salinity tolerance of STBN materials at the seedling stage

Twenty seven genotypes namely **IR87830-B-SDO1-2-3-B, IR87830-B-SDO1-2-2-B, IR87938-1-1-3-2-1-B, IR87830-B-SDO2-1-3-B, IR87916-4-1-2-1-1-B, IR87938-1-2-2-1-3-B, IR87831-3-1-1-2-2-BAY B, IR87938-1-1-1-2-1-3-B, IR87870-6-1-1-1-1-B, IR87872-7-1-1-2-1-B, IR87938-1-**

1-2-3-3-B, IR87938-1-2-2-2-1-B, IR87937-6-1-3-2-2-B, IR8786359-302-1-1-2-3-B, IR87952-1-1-1-2-3-B, IR8784645-305-6-1-1-1, IR87848-301-2-1-3-B, **IR87948-6-1-1-1-3-B,** IR87848-301-2-1-1-B, **IR87938-1-2-2-2-3-2-B,** NSIC Rc222 (IRRI 154), BRRI dhan65 including with tolerant and sensitive check IR58443-6B-10-3, BRRIdhan47 (Ck), BRRIdhan61 (Ck) and and IR29 were screened for salinity tolerance under salinity (12 dS/m) stress. Screening was done as per Gregorio *et al*., 1997. Among 27 genotypes, 16 STBN materials (bold markings) showed visual score 3 to 5 that is tolerant to moderately tolerant. However, other genotypes shows visual score 6 to 9 that is susceptible to highly susceptible. The survivality percentage of these genotypes varied from 66% to 100%.

Screening for salinity tolerance of advanced breeding materials at the seedling stage

Nine genotypes namely **BR7941-1-1-2-1**, **BR7941-41-2-2-2-4**, BR7941-30-1-1-1, BR7941-116-1-2-1, **BRRI dhan54 (CK.)**, **Sadamota (CK.), Dudkalom**, including with tolerant and sensitive check FL378 and BRRI dhan49 were screened for salinity tolerance under salinity (12 dS/m) stress. Screening was done as per Gregorio *et al*., 1997. Genotypes x salinity interaction showed significant variation for all the parameters except root characters. Salinity stress decreased the fresh and dry weight significantly for all the genotypes. But minimum decrease was observed in FL378 followed by BRRI dhan54, Dudkalom and genotype BR7941-116-1-2-1, BR7941-1-1-2-1 and Sadamota decreased more both for seedling dry and fresh weight. Salt stress increased Na^+ / K^+ ratio significantly for all the genotypes. Among the genotypes, BRRI dhan49 had the highest Na^+ / K^+ ratio. Genotype BR7941-41-2-2-2-4, BR7941-116-1-2-1, Dudkalom with check Sadamota and BRRI dhan54 showed less Na^+ / K^+ ratio. Na^+ / K^+ ratio in root was more or less similar for all the genotypes. By comparing different parameters among the genotypes 5 genotypes (bold markings) were moderately tolerant to salt stress than other genotypes, due to less uptake of Na^+ and maintainence of good balance of Na^+ / K^+ ratio in shoot.

Screening for Salinity Tolerance of some anther cultured lines at the Seedling Stage

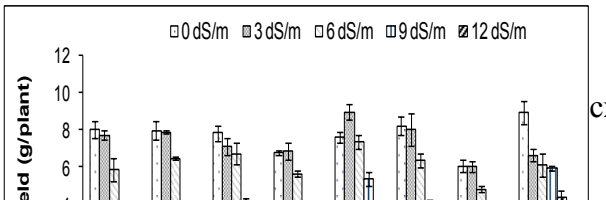
To identify salt tolerant genotypes at seedling stage 49 genotypes namely BR10384-AC10-2-1-3, BR9782-AC3-2-3-3, BR8018-AC2-2-2-1, **BR8019-AC4-1-1-3, BR8019- AC5-1-2-1, BR8019 – AC8-1-2-2,** BR8019 –AC9-3-3-1, BR8032-AC3-4-1-3, BR8032-AC4-1-2-2, BR8017-AC4-2-1-2, **BR8036-AC3-2-2-3, BR8036-AC2-1-2-1,** BR8036-AC6-2-2-1, **BR8009-AC3-1-1-2,** BR8009-AC7-1-1-3, **BR8009-AC8-1-2-2,** BR8033-AC1-1-2-1, **BR8033-AC3-3-2-3,** BR9787-BC2-41-3-2, BR9787-BC2-43-6-1, BR9787-BC2-44-7-1, BR9787-BC2-63-2-2, BR9787-BC2-63-2-4, BR787-BC2-173-1-3, BR9786-BC2-2-1-1, BR9786-BC2-98-1-1, BR9786-BC2-98-1-2, BR9786-BC2-117-2-2, BR9786-BC2-119-1-1, BR9786-BC2-124-1-2, BR9786-BC2-124-1-5, BR9786-BC2-132-103, BR9786-BC2-135-4-1, BR9786-BC2-139-2-3, BR9785-BC2-9-2-3, BR9785-BC2-6-2-2, BR9785-BC2-19-3-1, BR9785-BC2-20-1-3, BR9785-BC2-27-1-1, BR9785-BC2-19-3-5, BR9785-BC262-2-2, BR9785-BC2-10-1-3, BR9785-BC2 along with tolerant and sensitive check FL 378, BR40 and BR28, IR29 were screened for salinity tolerance under salinity (12 dS/m) stress. Another set

including six genotypes namely BR9783-AC3-1-3-2, BR9783-AC5-1-5-2, BR9783-AC6-2-2-2, BR9783-AC8-1-4-1 with tolerant and sensitive check IR58443-6B-10-3 (tolerant ck.) and IR154 (Susceptible ck.) were screened for salinity tolerance under salinity (12 dS/m) stress. Screening was done as per Gregorio *et al*., 1997. Out of 49 genotypes, 8 (bold markings) anther cultured lines showed visual score 5 that is moderately tolerant. However, other genotypes shows visual score 6 to 9 that is susceptible to highly susceptible. The survivality percentage of these genotypes varied from 60 to 70%.

Characterization and evaluation of advanced breeding materials for salinity tolerance at reproductive stage

Two PVT and four ALART namely IR78761-B-SATB1-28-3-24, IR78761-B-SATB1-28-3-26, IR73055-8-1-1-3-1, IR83484-3-B-7-1-1-1, IR78761-B-SATB1-68-6, IR83440-4-B-11-2-1-1-AJY1-B with standard tolerant check variety i.e. BRRI dhan47 and susceptible check i.e. IRRI154 were considered for this study at during T. Aman season to find out the yielding ability and to determine the tolerance reaction in varying salinity level at reproductive stage according to Glenn *et al*., 1997. The experiment was laid out in RCB design with three replications. Salt stress was applied 31 days after sowing; stress was made by adding NaCl in the bucket at 3, 6, 9 and 12dS/m. One control set (without salt) was also considered. At maturity plants were harvested and yield and yield components were measured. Water salinity and soil salinity was also recorded during the growth period.

Yield of tested genotypes was statistically similar upto 3 dS/m. Increasing salinity level to 9 and 12 dS/m, genotypes IR78761-B-SATB1-28-3-26, IR73055-8-1-1-3-1, IR78761-B-SATB1-28-3-6 performed better than other genotypes (Fig. 6). But BRRI dhan47 was the best yielder both at 9 and 12 dS/m. The best performance of BRRI dhan47 may be due to the vigorous growth as well as avoidance of cold stress because it suffered from both salt and cold stress during Boro season. All the tested genotypes and checks had shown increasing trends of yield reduction with increasing salinity level (Fig. 7). But upto 6dS/m the reduction was less than 25% and at 12 dS/m it was more than 60% for all the tested lines excluding tolerant check BRRI dhan47 (Fig. 7). However, the discrimination level between tolerant and susceptible genotypes would be considered at 9 dS/m. Days to heading were earlier for the genotype IR78761-B-SATB1-28-3-26 followed by IR78761-B-SATB1-68-6 and IR73055-8-1-1-3-1 than the tolerant check BRRI dhan47 only at 12 dS/m salinity level. The level of salinity developed in the soil ranged from 0 to 1 dS/m, 2 to 3.5 dS/m, 6 to 9 dS/m and 8.5 to 11 dS/m for 0, 3, 6, 9 and 12 dS/m salt application level, respectively. Considering the yield potentiality and tolerance ability at different salinity level, three lines IR73055-8-1-1-3-1, IR78761-B-SATB1-28-3-26 and IR78761-B-SATB1-68-6 could be proposed for further breeding program.



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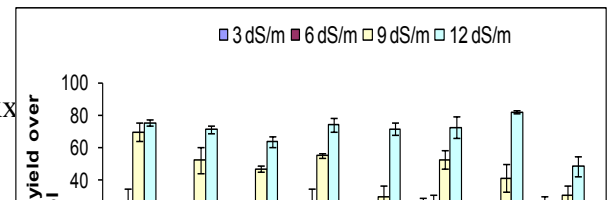


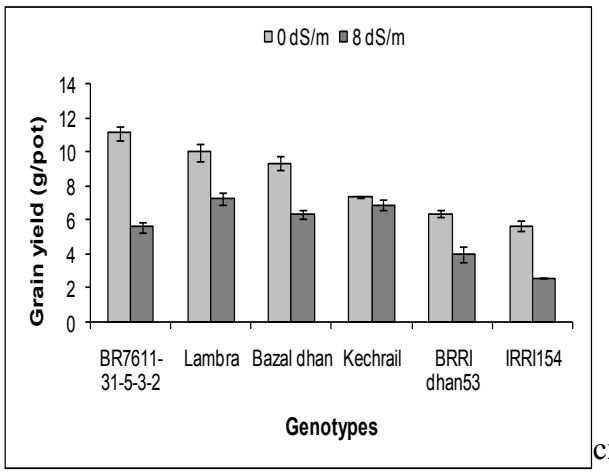
Fig. 6: Yield potential of tested lines and checks in varying salinity level. Error bar represents ±SE.

Fig. 7: Reduction of yield over control (%) among the tested lines and checks in varying salinity level. Error bar represents ±SE.

Characterization of germplasms for salinity tolerance at reproductive stage

Three germplasms and one advanced line as Lambra, Bazail dhan, Kechrail, BR7611-31-5-3-2 with tolerant and susceptible check BRRI dhan53 and IR154, respectively were considered for this study to find out the yielding ability and to determine the tolerance reaction under salinity stress at reproductive stage during T. Aman season according to Glenn *et al*., 1997. The experiment was laid out in RCB design with three replications. Salt stress was applied 35 days after sowing; stress was made by adding NaCl in the bucket at 8 dS/m. One control set was also considered. At maturity plants were harvested and yield and yield components were measured. Water salinity and soil salinity was also recorded during the growth period. In this study, genotypes x salinity interaction showed significant results for the parameters panicle number, filled grain number, sterility percentage and grain yield.

Yield of tested genotypes was maximum at control condition. But at 8 dS/m, the highest yielder was Lambra followed by Bazail dhan and Kechrail (Fig. 8). All the tested genotypes and checks showed increasing trends of yield reduction with increasing salinity level. Reduction percentage of yield remained below 50% for all the genotypes except the susceptible check, IR154. But the reduction was very minimum for all the germplasms and also reduced less than tolerant check, BRRI dhan53 (Fig. 9). Days to heading were insignificant for genotypes and salinity interaction. The level of salinity developed in the soil ranged from 0 to 0.5 dS/m and 4.5 to 5.5 dS/m for 0 and 8 dS/m salt application level, respectively during harvest. As yield potentiality is the most important indicator for selecting a genotype as future variety or tolerant source at stress condition. So, considering the yield potentiality and tolerance ability compare to checks, Lambra, Bazail dhan and Kechrail could be used for further breeding program.



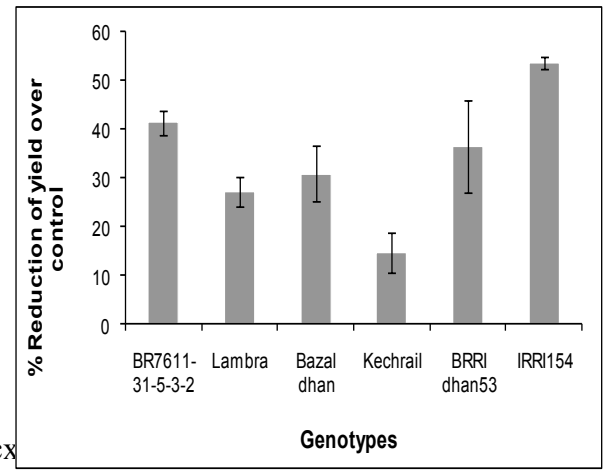


Fig. 8: Yield potential of tested lines and checks in varying salinity level. Error bar represents ±SE.

Fig. 9: Reduction of yield over control (%) among the tested lines and checks in varying salinity level. Error bar represents ±SE.

Comparative physiological study of salt tolerant varieties at reproductive stage

Four tolerant varieties, BRRI dhan47, BRRI dhan61, BINA dhan10 and BINA dhan8 with salt tolerant and susceptible check i.e. IR58443-6B-10-3 and IRRI154, respectively were considered for this study during T. Aman season to find out the yielding ability with other physiological parameters and to determine the tolerance reaction in varying salinity level at reproductive stage according to Glenn *et al*., 1997. The experiment was laid out in RCB design with three replications. Salt stress was applied 31 days after sowing; stress was made by adding NaCl in the bucket at 3, 6, 9 and 12dS/m. One control set was also considered. At maturity plants were harvested and yield and yield components were measured. During harvesting soils of each pot were sampled to measure salinity developed in the soil. In this study, genotypes x salinity interaction showed significant results for grain yield, filled grain number, panicle exertion rate, harvest index and days to heading and percent reduction of yield over control. Other parameters i.e. plant height, tiller number, panicle number, flag leaf damage, spikelet degeneration and sterility percentage all showed insignificant interaction at different salinity level.

Significant variation was found for grain yield per hill due to salinity x genotype interaction. At 0 dS/m salinity level, BRRI dhan61 and BINA dhan10 gave maximum grain yield. But increasing salinity level to 9 dS/m, grain yield became reducing and minimum reduction was found in BINA dhan10 followed by BRRI dhan47 and BINA dhan8. At 12 dS/m salinity level, the highest yield was observed in BRRI dhan47 and lowest in sensitive check IR154 (Fig. 10). Reduction percentage of yield due to salinity varied significantly for all the genotypes. Salinity level increased to 6 dS/m, yield reduction was more prominent in IR154 and BRRI dhan61. With the increase of salinity to 9 dS/m, yield reduction was observed for all the genotypes but very minimum for BRRI dhan47, BINA dhan10 and BINA dhan8. Yield is drastically reduced for all the genotypes at 12 dS/m salinity level (Fig. 11). At high salinity level (6, 9 and 12 dS/m) BRRI dhan47 and BINA dhan8 took more time for heading. Minimum days to heading was observed in genotype BINA dhan10 and IR58443-6B-10-3 for all salinity stress The level of salinity developed in the soil is 0.1, ~2.4,~ 4.5,~ 6 and ~ 8.5 dS/m for 0, 3, 6, 9 and 12 dS/m application level. So, considering the yield potentiality and other physiological parameters, BRRI dhan47, BINA dhan10 and BINA dhan8 showed the most tolerant ability at different salinity level.

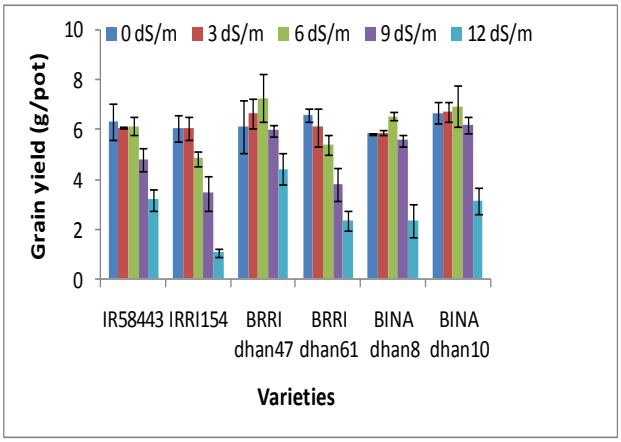


Fig. 10: Yield potential of tested varieties and checks in varying salinity level. Error bar represents ±SE.

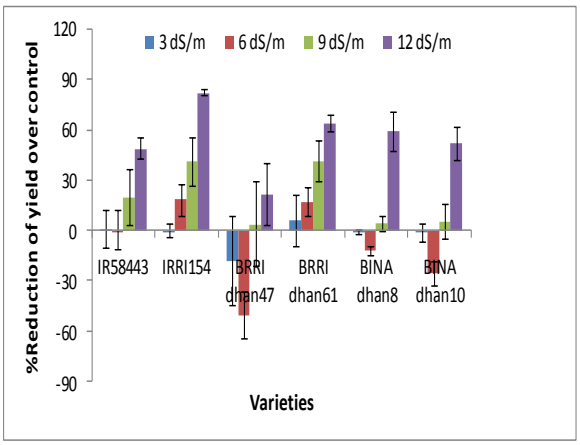


Fig. 11: Reduction of yield over control (%) among the tested varieties and checks in varying salinity level. Error bar represents ±SE.

SUBMERGENCE TOLERANCE

Characterization of some rice germplasm and advance breeding lines against complete submergence

The experiment was conducted at submergence tank of Plant Physiology Division, BRRI during T. aman'2014. A total of 99 germplasms (namely chakkol, botes war, rajmun, balam britta, lakhi, bora dhan, kanchon mori, kartik sail (2), balam, jhoda bazal, hiru yal, goda, nal bazal, tili bazal, dulai aman, chapa mali, deppol, pushon, kali gochr, iron, harali, bogra, ghori amaon, muirol, mura sail, dudh bazal, binni, jhaw lota, sada sakkol, botia, bhoban, balam, hirail, potka, til bazal (3), guda aman, mura bazal, mura bazal (2), mura bazal (3), pan kaich, pan kaich, keora, kaora, boteswar (2), kaksmi bini, ful badam, begum bichi, khama rang, galong, kalaba, hasna chikon, kerani dhan, thakor, tembro, lembur, lal binni, tuls mala, giring, nag pechi, khusbu chikon, tilock kochuri, jarga bet, bhua dhan, sandik sail, china irri, jhoria sail, halde medi, maitya cheng, bhoro dhan, kala bail, murki balam, suna muk, hibhatir chikon, kartik salil, gul chamlaish, parbr, kala kura, raj kumari, hati banda, aghani sail, raja sail, raja sail, pajam, chan moni, chan moni, kuisail, bigi dhan, chakkol (3), chakkol, chakkol (mota), bailam (kumra), joya, muijur, bazal (bhoro), kasoya, laita parsum, kaital, as maita, munshi sail, pathor nuti, sada dangor boro) and four advance breeding lines, BR5 (Sen. Ck.) and FR13A (Tol. Ck.) were tested to identify tolerant at the seedling stage under complete submergence condition. At 14 days after transplanting, the crop was allowed to complete submergence by maintaining 75 cm water depth for 14 days. During submergence period, the water of the tank was made turbid twice daily and the light intensity in upper level (normal), mid-level (30 cm below the water surface) and lower level (75 cm below the water surface) of the tank water were measured through light meter (LI-250). The water pH and temperature were also recorded. The average light intensity was 103-125, 19-28 and 2.3-6.2 W/m^2 upper, mid and lower level respectively. After turbidity average light intensity was 1-1.6 and 0-0.021 W/m^2 at mid and lower level respectively. The water p^H was 7-7.4 and temperature was 30-31^{0}C. At 14 days after

submergence, the water was drained out from the submergence tank. The recovery status and survival scoring was done by SES (IRRI, 1996). Among the tested genotypes, Kalaba, Kerani dhan, Thakor and IR77092-B-2R-B-10 genotypes were found 100% survivability with SES score 1, other 8 genotypes were found with good survivability (range 58.3-91.7% and very good recovery; the genotypes were obviously non-elongating type (range 9.2-59.6%). Where tolerant Ck. and sensitive Ck. FR13A and BR5 survivability was 100% 0% respectivly. Rest of the germplasms were found elongating type. From the results, selected germplasm may be used for further investigation and donor parent (Table 6).

Table 6: Elongation (%), survivality (%) and SES score of best performing genotype

Sl. No.	Acc. No.	Acc. Name	Elongation (%)	Survivability (%)	SES score	Remarks
1	712	MUIROL	9.2	83.3	5	Non-elongating
2	719	BHOBAN	47.9	83.3	5	Non-elongating
3	747	KALABA	32.4	100.0	1	Non-elongating
4	749	KERANI DHAN	58.5	100.0	1	Non-elongating
5	750	THAKOR	45.6	100.0	1	Non-elongating
6	767	MAITYA CHENG	17.0	83.3	5	Non-elongating
7	1838	PATHOR NUTI	48.6	66.7	7	Non-elongating
8	4096	SADADANGAOR BORO	19.6	75	5	Non-elongating
9		IR7867-4R	59.6	58.3	7	Non-elongating
10		IR72046-B-14-8-3-1	24.2	66.7	7	Non-elongating
11		IR77092-B-2R-B-10	38.1	100.0	1	Non-elongating
12		BR9377-9-14-7	29.0	91.7	5	Non-elongating
13		FR13A (Tol. Check)	13.5	100	1	Non-elongating
14		BR5 (Sen. Check)	45	0	9	

Effect of submergence under different water turbid condition

The experiment was conducted at submergence tank of Plant Physiology Division, BRRI during T. Aman'2014. Two germplasm namely Acc. 1838 and Acc 4069, 2 submergence tolerant BRRI varieties namely BRRI dhan51 and BRRI dhan52 and 3 breeding lines (IR72046-B-14-8-3-3-1, IR77092-B-2R-B-10 and BR9377-9-14-7) with tolerant check FR13A and sensitive check BR5 were used to determine the effect of submergence under different water turbid condition. Fourteen days old seedlings were grown in a line in three submergence tank (T1, T2 and T3). After 14 days of sowing the crop were allowed into complete submergence maintaining 75 cm water depth from the plant base for 14 days. During submergence period, the water of the tank were made turbid twice and three time daily for T2 tank and T3 tank respectively and one tank kept normal water condition (T1). Water temperature, light intensity and dissolve O_2 were also measured during submergence for the entire three tanks. Data was taken for survival percentage (30 days after

drained out of water), recovery score (at 7 days after drained out of water) and chemical analysis were done for leaf chlorophyl. SES score were taken according to Standard Evaluation System (IRRI, 1996).

Chlorophyll concentration in leaves decreased under submergence and with increasing submergence duration and all the genotypes showed similar trend to chlorophyll degradation for entire three tanks. The sensitive and tolerant genotypes had more or less similarly high leaf chlorophyll concentrations before submergence but, when submerged, the tolerant genotypes (except IR72046-B-14-8-3-3-1 for T1, IR77092-B-2R-B-10 for both T1 and T2 and BR9377-9-14-7 for T1 tank) maintained more chlorophyll than the sensitive genotypes

DROUGHT TOLERANCE

Performance of Nerica and ALART materials under drought stress at reproductive stage

This experiment was conducted in Plant Physiology net house at BRRI HQ, Gazipur during T. Aman season, 2014 to evaluate of six Nerica, and two ALART materials with check variety BRRI dhan56 shaded by polythene sheet. Twenty five day old seedlings were transplanted in drum (56 cm x 43 cm) containing 110 kg puddled soil in 2 sets where 1st set was grown in well-watered conditions and 2nd set under stress condition. At panicle initiation stage water was drain out from the 2nd set so that the plants experiences drought stress from the reduction division stage. The water table depth and soil moisture was recorded. At severe drought stress some life saving water was applied and calculated as follows: $= \Pi r^2 h$

Where, r = 56/2 = 28 cm (The radius of the circumference of pot at the base of the hill.)

h = 0.5 cm/day (the approximate evapotranspiration at the period of Nov-Dec.

During the reduction division stage and flowering period the average soil moisture was below field capacity (14-30%) which revealed plants suffered severe water stress both the reproductive and ripening stage. Due to water stress plant height and straw yield reduced remarkably reduced in all the varieties indicating growth was affected drastically. However, in IR82589-B-B-84-3 straw yield was reduced about 20%. Compared to control plants significant reduction was found in grain yield of all the varieties under stress condition (Table 7). Under control condition, the grain yield varied between 40.38 -58.88 g/plant while under stress condition this varied between 0.71-14.98 g/plant. Under control condition the highest grain yield was recorded in IR82589-B-B-84-3. But under stress condition none of the variety could produce more grain yield other than BRRI dhan56. Compared to the control plant, the percent yield reduction in BRRI dhan56 was about 71% but in other varieties it was 78 to more than 80%. Among the Nerica materials lowest reduction was found in Nerica Mutant which was 85%. Due water stress the sterility percentage was increased. Under stress condition, among the tested genotypes the lowest sterility percentage was found in IR82589-B-B-84-3 followed by IR83377-B-B-93-3 and Nerica Mutant. The yield reduction was possibly attributed to the percent increase in sterility. The root characters of IR82589-B-B-84-3, IR83377-B-B-93-3 and Nerica Mutant were also satisfactory (Table 9).

Among the Nerica genotypes Nerica Mutant performed better than others. Nerica Mutant and two ALART IR82589-B-B-84-3 and IR83377-B-B-93-3 were able to produce some grain under severe drought.

Table 7: Straw weight, grain weight and percent sterility of tested varieties as affected by water stress at reproductive stage

Designation	Straw weight (g/plant)			Grain weight (g/plant)			% Sterility	
	Control	Stress	% Reduction	Control	Stress	% Reduction	Control	Stress
WAS 122-IDSA 14-WAS B-FKRL. (NERICA-L8)	72.2	45.9	36.4	54.47	2.63	95.2	23.6	90.5
WAS 122-IDSA 1-WAS-2-B-1TGR 123(NERICA-L16)	71.6	55.3	22.8	40.38	3.18	92.1	33.4	84.9
WAS 161-B-6-B-1(NERICA-L-36)	72.2	49.1	31.9	45.60	1.20	97.4	21.0	95.5
WAS 161-B-4-1-TGR 51 (NERICA-L-32)	56.5	39.5	30.0	52.20	0.71	98.6	14.3	96.7
WAS 191-4-10(NERICA-L-54)	60.0	37.4	37.6	57.64	1.08	98.1	11.9	92.3
Nerica Mutant	57.3	35.9	37.2	46.42	6.92	85.1	14.1	72.9
IR83377-B-B-93-3	61.0	49.4	19.0	51.00	10.18	80.0	23.5	63.9
IR82589-B-B-84-3	56.2	44.9	20.1	58.88	12.81	78.2	14.0	59.7
BRRI dhan56	54.2	42.6	21.4	53.09	14.98	71.8	16.6	56.3
LSD (0.05)	5.1			6.10			7.8	

Performance of six advanced anther cultured breeding materials under drought stress at reproductive stage

Six advanced anther cultured breeding materials namely BR8009-AC2-1-1-2, BR8009-AC4-1-1-3, BR8009-AC7-1-2-2, BR009-AC8-1-2-4, BR8009-AC9-1-3-1 and BR8009-AC11-1-5-2 along with BRRI dhan56 were tested under control drought condition. The methodology was same as previous experiment. Under drought condition significant reduction was observed in straw yield in all the genotypes. Among the tested genotypes, due to drought stress lowest reduction of grain yield was found in BR8009-AC11-1-5-2 (85%) while the check variety BRRI dhan56 showed about 75% (Table 8). BR8009-AC11-1-5-2 also showed lowest percent sterility under drought condition. Root length, CRL and root shoot ratio was higher in BR8009-AC11-1-5-2 (Table 9). Based on the yield reduction, percent sterility and root characters it might be concluded that among the tested anther cultured genotypes BR8009-AC11-1-5-2 performed better under drought stress.

Table 8: Straw weight, grain weight and percent sterility of tested varieties as affected by water stress at reproductive stage

Designation	Straw weight (g/plant)			Grain weight (g/plant)			% Sterility	
	Control	Stress	% Reduction	Control	Stress	% Reduction	Control	Stress

BR8009-AC2-1-1-2	66.8	48.1	28.0	44.92	2.57	94.3	20.1	80.2
BR8009-AC4-1-1-3	62.9	51.1	18.9	60.17	2.64	95.6	16.2	83.4
BR8009-AC7-1-2-2	69.8	55.6	20.4	59.87	4.47	92.5	22.5	75.6
BR009-AC8-1-2-4	64.3	50.1	22.1	50.62	1.96	96.1	18.7	79.9
BR8009-AC9-1-3-1	75.9	58.5	23.1	52.34	3.90	92.5	15.7	86.4
BR8009-AC11-1-5-2	65.3	51.9	20.5	51.58	7.66	85.1	14.0	66.5
BRRI dhan56	58.4	47.0	19.5	56.45	14.03	75.1	19.6	57.8
LSD (0.05)	3.4			3.38			12.3	

Screening for deep rooting ability

To identify genotypes having deep rooting ability, 15 genotypes and a local upland variety Morichboti were tested following BRRI, 2006. Genotypic variation was present in root characters among the tested genotypes (Table 9). All the tested materials produced more than 40 cm long root. The longest root was produced by check variety Morichboti followed by BRRI dhan56. Among the Nerica materials, Nerica Mutant produced longest root (57.5 cm). The check variety Morichboti produced 72.3 cm long root. Considerable variation was present in cumulative root length (CRL). The highest CRL was also observed in check variety Morichboti. The highest amount of root produced by the anther cultured line BR8009-AC11-1-5-2 (237.5mg/g of shoot) followed by BR8009-AC2-1-1-2 (224.7 mg/g of shoot).

Table 9: Seedling height, root length, cumulative root length (CRL) and root shoot ratio of 15 genotypes

Sl. No.	Designation	Seedling height (cm)	Root length (cm)	Total CRL (cm)	CRL below 30cm (cm)	Root to shoot ratio (mg/gm)
1	WAS 122-IDSA 14-WAS B-FKRL. (NERICA-L8)	52.9	43.3	971.5	168.17	162.9
2	WAS 122-IDSA 1-WAS-2-B-1TGR 123(NERICA-L16)	56.7	49.7	1103.1	308.00	188.7
3	WAS 161-B-6-B-1(NERICA-L-36)	54.7	44.5	1180.5	201.17	177.7
4	WAS 161-B-4-1-TGR 51 (NERICA-L-32)	54.2	45.7	723.7	119.33	149.1
5	WAS 191-4-10(NERICA-L-54)	50.4	40.3	666.7	79.00	213.9
6	NERICA Mutant	54.4	57.5	1159.3	114.30	161.9
7	IR83377-B-B-93-3	58.3	55.7	961.3	152.00	199.7
8	IR82589-B-B-84-3	61.8	59.7	1286.9	110.30	194.6
9	BRRI dhan56	67.9	61.9	1314.3	166.30	192.7
10	BR8009-AC2-1-1-2	60.4	48.0	1147.0	152.67	224.7
11	BR8009-AC4-1-1-3	56.6	44.2	781.0	112.97	180.9
12	BR8009-AC7-1-2-2	57.1	51.8	763.0	156.67	199.1
13	BR009-AC8-1-2-4	51.2	41.0	910.9	99.00	182.5
14	BR8009-AC9-1-3-1	56.9	51.0	916.9	141.77	168.0
15	BR8009-AC11-1-5-2	58.4	55.7	1217.8	152.00	237.5
16	Morichboti	73.3	72.3	1586.2	207.17	216.0

AEROBIC RICE

Characterization and evaluation of aerobic rice genotypes under transplanting method

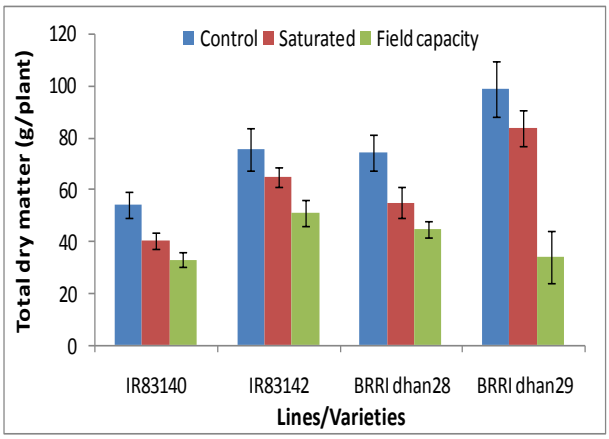
Two breeding lines along with standard Boro varieties BRRI dhan28 and BRRI dhan29 were considered for this experiment to study the physiological performance of aerobic rice lines in different watered condition and to determine the yield and yield components under transplanting method. Forty day old seedlings were transplanted in drum (56 cm x 43 cm) containing 110 kg puddled soil. The experiment was conducted in 3 sets where 1st set was grown in well-watered condition maintaining 4cm water level considering as control, 2nd set at saturated and 3rd set at field capacity condition, respectively. At tillering stage, water treatment was applied following RCB design with five replications. The water table depth and soil moisture was measured. To observe the root characteristics of these genotypes another experiment was conducted following the protocol of screening for deep rooting ability with the deep rooted check variety Morichboti (BRRI, 2006).

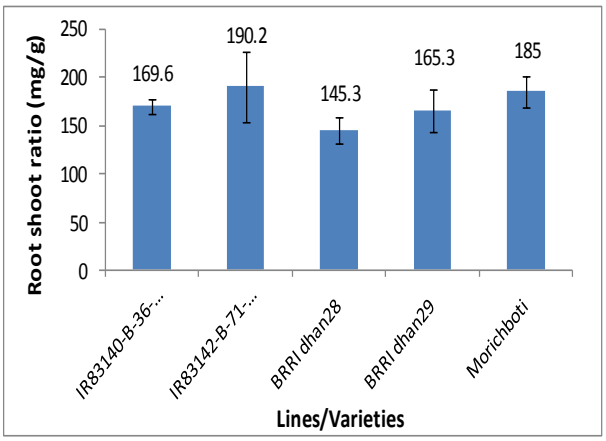
Water table ranged from 5 to 33 cm depth under saturated condition while at field capacity condition it was 1 to 15 cm depth below surface. During reproductive phase soil moisture ranged from 34 to 38% at saturated condition while for field capacity condition it ranged from 25 to 30%. At saturated and field capacity condition, the reduced amount of water was also recorded which was 60% and 75%, respectively. Grain yield varied significantly at different moisture levels for the tested genotypes. Under control condition, maximum and minimum grain yield was observed in BRRI dhan29 and IR83140-B-36-B-B, respectively. At saturated condition grain yield ranged from 17.30 to 43.09 g/plant. Grain yield of IR83142-B-71-B-B and BRRI dhan28 was statistically similar at field capacity condition. Maximum reduction was observed in BRRI dhan28 followed by IR83140-B-36-B-B at saturated condition. IR83142-B-71-B-B reduced the least grain yield both at saturated and field capacity condition compared to control condition which is less than 50%. The higher grain yield was due to higher number of filled grain number as well as thousand grain weight with high total dry matter production (Table 10). Maximum total dry matter was produced in BRRI dhan29 followed by IR83142-B-71-B-B at control and saturated condition. But under field capacity condition IR83142-B-71-B-B and BRRI dhan28 produced maximum amount of total dry matter (Fig. 12). Genotype IR83140-B-36-B-B produced minimum amount of total dry matter at all conditions. Root shoot ratio was also better in IR83142-B-71-B-B than check Morichboti and other genotypes (Fig. 13).

Table 10: Yield and yield components of tested genotypes at different moisture levels

Genotypes	Treatment	Filled grain no./plant	1000-grain wt. (gm)	Grain yield (g/plant)	% yield reduction
IR83140-B-36-B-B	Control	1178.2	20.97	24.52	-
	Saturation	861.2	20.36	17.30	29.44
	Field capacity	534.8	20.13	10.88	55.62
IR83142-B-71-B-B	Control	1373.4	23.59	32.52	-
	Saturation	1262.0	23.03	28.87	11.22
	Field capacity	893.0	22.04	19.90	38.80

BRRI dhan28	Control	1911.2	19.38	36.74	-
	Saturation	1400.8	18.11	25.47	30.67
	Field capacity	971.0	18.85	18.28	50.24
BRRI dhan29	Control	2500.0	18.58	46.70	-
	Saturation	2292.0	18.76	43.09	7.73
	Field capacity	621.0	16.51	10.85	76.76
LSD (0.05)	-	465.6	1.9	9.4	-





HEAT TOLERANCE

Development of heat tolerant BRRI dhan28 and BRRI dhan29 by introgressing spikelet fertility QTLs *(qSF4.1)* through Marker-Assisted Selection

BRRI dhan29 is the highest yielding and most popular inbred rice varieties in Bangladesh. In recent years, BRRI dhan29 has been experiencing regularly with sterility problems due to increase in temperature both in daytime (>35^{0}C) and also at nighttime (28-30^{0}C) during last week of March to April when it is in flowering stage. The main reasons of high temperature occurrence at flowering of BRRI dhan29 only due to its longer duration (~160 days) in Boro season; however the medium duration (~140 days) variety BRRI dhan28 has been experiencing high temperature when it is planted late during Boro season or when grown in Aus season. Therefore, this research was undertaken for improving heat tolerance of BRRI dhan28 and BRRI dhan29 during flowering by introgressing spikelet fertility QTL *(qSF4.1)* from N22 (IRGC19379).

Progress of 3rd round of backcrossing: 128 BC_2F_1 progenies produced from BRRI dhan28/N22//BRRI dhan28 and BRRI dhan29/N22//BRRI dhan29 were sown to the field during February 2015. A total of 18 and 22 progenies of BRRI dhan28 and BRRI dhan29 background were selected as heterozygotes in the *qSF4.1* QTL region through InDEl marker R4M30 (Fig. 14 & 15). After selection through marker, the selected progenies were further compared for similarity with BRRI dhan28 and BRRI dhan29 phenotypically i.e. by similarity of heading/flowering, plant height, tillering, panicle shape & size etc. After comparing 5 progenies from each cross combination were backcrossed with respective recurrent parent for getting third backcross

generation. At third backcrossing 40 and 109 BC_3F_1 seeds were produced for BRRI dhan28/N22///BRRI dhan28 and BRRI dhan29/N22///BRRI dhan29 respectively. All progenies at third backcross generation will be validated by tetra primers designed and recommended by IRRI (Ye, *et al.* 2015).

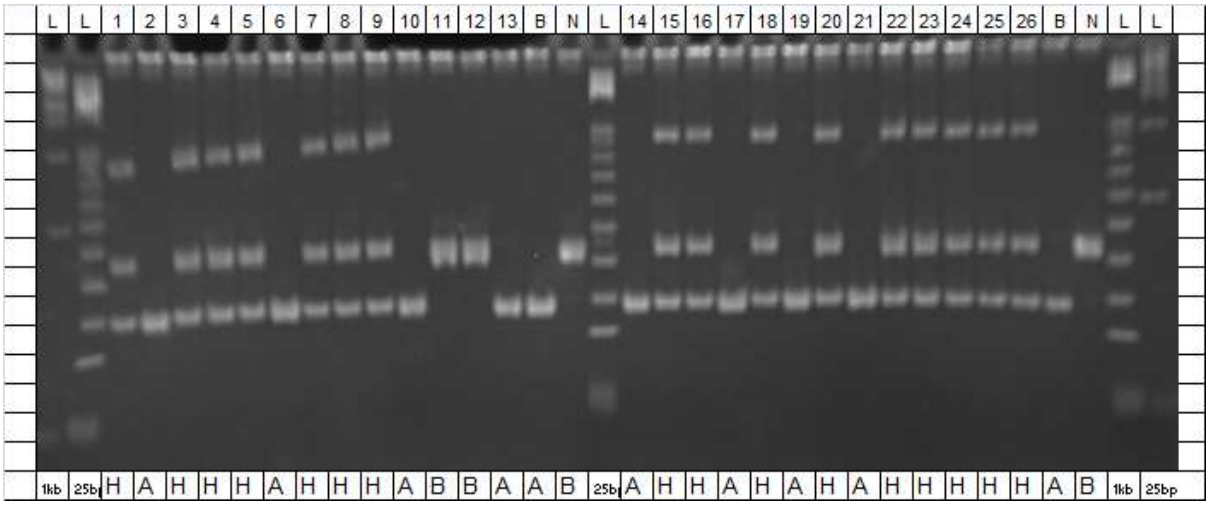


Fig. 14: PAGE1-Polyacrylamide Gel Electrophoresis (8%) of BC_2F_1 progenies of BRRI dhan28/N22//BRRI dhan28 genotyping through InDel marker R4M30 (where, B=BR28 and N=N22).

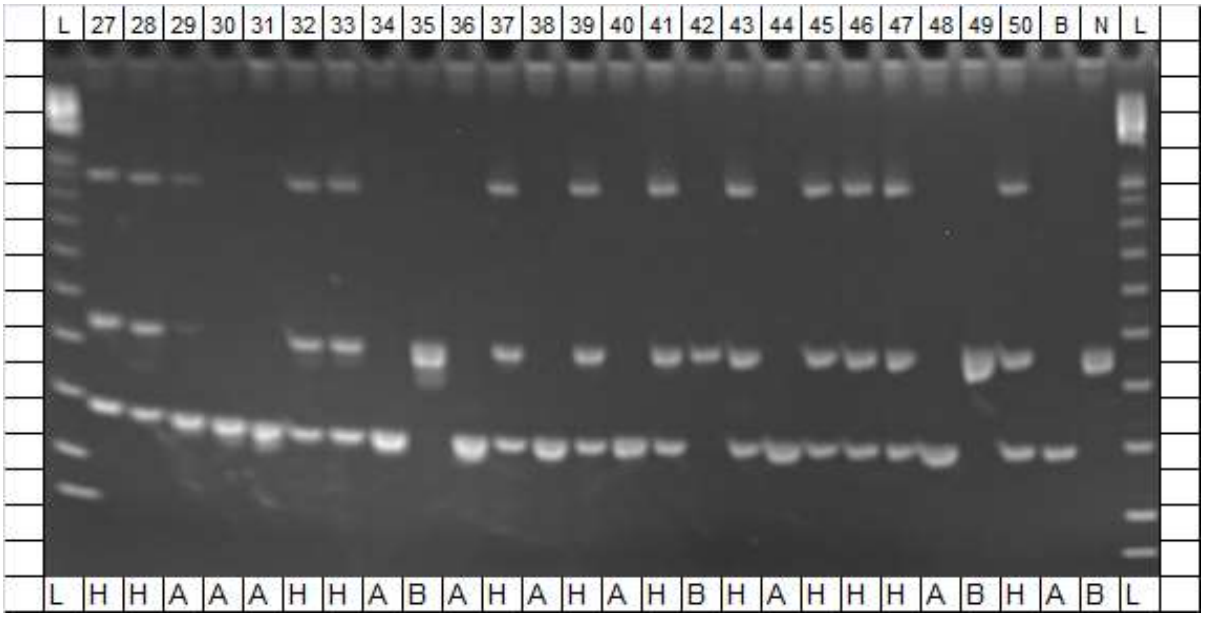


Fig. 15: PAGE1-Polyacrylamide Gel Electrophoresis (8%) of BC_2F_1 progenies of BRRI dhan29/N22//BRRI dhan29 genotyping through InDel marker R4M30 (where, B=BR29 and N=N22).

COLD TOLERANCE

Screening for cold tolerance at seedling stage under natural condition

Some 141 rice germplasms collected from gene bank and biotechnology division of BRRI along with 3 check varieties namely BR18, BRRI dhan28 and BRRI dhan36 were tested for seedling stage cold tolerance. During experimental periods (21 December 2014 to 31 January 2015) prevailing ambient temperature was above critical level which provided normal seedling growth of

all tested rice genotypes. None of the genotype could be selected as all entries including susceptible check BRRI dhan28 showed better vegetative growth with SES score ranging from 3 to 5.

Evaluation of advanced breeding lines for cold tolerance

Studies were carried out in BRRI farm Gazipur during boro 2014-15 season to observe the cold tolerance of advanced breeding materials. Four genotypes namely IR7749-31-2-1-3-1, IR2266-42-6-2, BR7812-19-1-6-1-P4 and BR7813-1-3-1 were evaluated along with BRRI dhan28, BRRI dhan36 and BR18 as checks. There were four seeding dates from 10 to 31 December 2014 at 7 days interval so that rice plants suffer from cold at seedling stage. Plant samples were collected at 40 days after sowing for each set and chlorophyl content, seedling height and shoot weight were measured. Seedling strength was calculated using shoot weight (mg) and seedling height (cm)

Temperature gradient shows that prevailing ambient temperature was lower at 1st sampling date (19 January 2014) and it increased with time. Chlorophyll content of two advanced lines IR7749-31-2-1-3-1 and IR2266-42-6-2 were comperatively higher in 1st to 3rd sets than other genotypes (Table 1) which indicate their seedling stage cold tolerance. However, two other genotypes BR7812-19-1-6-1-P4 and BR7813-1-3-1 had higher chlorophyl content in 4th set (Table 11) which indicate their faster recovery ability of cold injury. Seedling strength was also higher in IR7749-31-2-1-3-1 and IR2266-42-6-2 than BRRI dhan28 in 1st to 3rd sets but it was recorded higher values with BR7812-19-1-6-1-P4 and BR7813-1-3-1 at 4th set (Table 12). Rice genotype BR7812-19-1-6-1-P4 had the highest grain yield with a plant height of 101 cm and growth duration 148 days (Table 13). Considering seedling strength, plant height, growth duration and yield, BR7812-19-1-6-1-P4 and IR7749-31-2-1-3-1 are regarded as promising genotypes.

Table 11. Total chlorophyll content of rice genotypes at 40 days after sowing

Genotypes	Total Chlorophyll (mg/ g fresh wt)			
	Ist set	2nd set	3rd set	4th set
IR7749-31-2-1-3-1	4.894	4.955	5.114	5.190
BR7812-19-1-6-1-P4	4.348	4.400	4.823	5.288
BR7813-1-3-1	3.471	4.203	4.808	5.249
IR2266-42-6-2	4.850	4.900	4.881	5.005
BRRI dhan28	3.418	3.491	4.674	4.963
BRRI dhan36	3.713	4.430	4.574	4.633
BR18	3.970	4.315	4.501	4.942
LSD at 0.05	0.61			

Table 12. Seedling strength of some rice genotypes

Genotypes	Seedling strength (mg/ cm)			
	Ist set	2nd set	3rd set	4th set
IR77496-31-2-1-3-1	3.35	3.44	3.55	3.55
BR7812-19-1-6-1-P4	2.62	3.24	3.50	3.62
BR7813-1-3-1	2.63	3.34	3.40	3.76
IR2266-42-6-2	3.39	3.46	3.63	3.47

BRRI dhan28	2.39	3.15	2.83	3.50
BRRI dhan36	3.22	3.35	3.45	3.38
BR18	3.38	3.40	3.14	3.25
LSD at 0.05	0.21			

Characterization and evaluation of some cold tolerant rice genotypes for whole growth periods under natural condition

Some 23 rice genotypes were characterized and eveluated for cold tolerance along with BRRI dhan28 (standard boro variety) and BRRI dhan36 (cold tolerant only at vegetative stage) in BRRI farm Gazipur during boro 2014-15 season. There were two seeding dates i.e. 15 October and 15 November 2014. Vegetative vigour showed that rice genotypes MILYANG240 and HANARIUM were more tolerant genotypes than other genotypes including checks at vetative phase (Table 13). Fifteen October seeded rice plants suffered due to cold at reproductive phase which resulted in longer growth duration and lower yield as a result of higher sterility (Table 13). October seeding also reduced plant height and panicle, last internode, last leaf sheath and flag leaf length (Table 13). Reduction of last internode length might resulted in lower percentage of panicle exersion of those rice genotypes which are succeptible to cold at reproductive phase (Table 13). All the tested rice genotypes except GYABYEO had longer growth duration than checks. BRRI dhan28 which had significantly the lowest growth duration than other tested rice genotypes (Table 13). Rice genotypes IR87322-65-2 produced the highest yield than all other genotypes including checks. Panicles per hill and sterility were significantly higher in October seeded plants than November seeding. Significantly higher filled grains per panicles was recorded in IR87322-65-2 than than all other genotypes (Table 13). Considering panicle emergence, last internode length sterility, plant height growth duration and yield rice genotypes IR87322-65-2, JINMIBYEO, SAEGYEJINMI, IR02K101 and IR10K150 were selected as cold tolerant at reproductive phase which could be used as donor parents.

Table 13: Morpho-physiological parameters of some rice genotypes as affected by sowing time induced natural cold

Genotypes	Veg vigour	PACP at reprod (14 Oct)	Growth duration		Plant height		Panicle emergence (%)		Last internode length (cm)		Yield (t/ha)		Sterility (%)	
			14 Oct	14 Nov	14 Oct	14 Nov	14 Oct	14 Nov	14 Oct	14 Nov	14 Oct	14 Nov	14 Oct	14 Nov
DASAN	5	7	182	164	69.12	85.15	83.3	100	20.10	26.1	2.21	5.47	67.3	22
GAYABYEO	5	7	172	147	76.0	87.31	78.6	100	20.50	26.3	2.63	5.24	50.6	24
GZ8450-19-6-5-3	5	9	175	150	62.12	78.56	89.4	100	22.10	26.4	2.5	5.73	46.2	21
HANAREUM	4	7	172	150	69.0	83.2	75.9	100	18.00	22.8	2.91	6.14	63.5	23
HANGA	5	7	178	15	72.2	85.4	86.0	100	24.	27.	2.0	5.4	51.3	20

NGCHAL 1				8	5				10	5	5	5		
HR20654 -39-3-5	5	7	188	16 3	87.5	100. 3	89.6	100	25. 05	27. 9	2.8 4	5.4 3	27.5	19.2
IR05K10 1	5	7	188	16 2	89.7 5	90.7	98.8	100	29. 10	29. 4	3.0 9	5.8 1	27.1	21.4
IR05K10 6	5	6	186	16 1	95.1 2	97.2	96.2	100	25. 30	30. 1	2.6 7	5.9 2	41.1	23.3
IR10K14 8	5	6	192	16 4	92.3 7	93.6	97.3	100	25. 30	30. 3	3.1 7	5.3 5	43.6	20.2
IR10K15 0	5	5	190	15 4	86.3 7	92.7	99.2	100	25. 25	27. 1	3.7 8	6.1 6	35.2	16.0
IR10K15 2	5	4	184	15 4	89.1 2	93.4	98.7	100	25. 90	27. 9	3.1 9	6.1 4	32.2	18.8
IR87322- 65-2	5	4	177	15 6	88.5	92.5	89.6	100	24. 70	30. 0	4.4 5	7.4 6	32.0	19.9
IR02K10 1	5	5	178	15 5	77.6 2	89.6	94.2	100	28. 88	30. 1	4.2 2	6.4 5	39.1	23.7
IRRI142	5	7	189	16 0	91.2 5	92.3	98.1	100	26. 85	28. 0	3.5 7	6.2 3	32.6	21.2
IRRI152	5	6	187	15 6	94.3 7	97.7	97.6	100	28. 45	27. 4	2.3 3	5.0 2	34.0	18.4
JINMIBY EO	5	5	190	16 5	92.5	93.6	99.4	100	27. 40	27. 5	3.5 9	6.5 4	29.2	17.0
MILYAN G23	5	6	191	15 9	81.7 5	86.3	89.0	100	25. 10	30. 1	3.0 4	5.3 1	38.0	21.8
MILYAN G240	3	6	176	15 1	75.6 2	87.2	75.7	100	22. 80	26. 5	2.9 1	6.5 7	69.5	19.2
SAEGYE JINMI	5	5	186	16 5	81.4 3	84.1	95.8	100	23. 45	26. 3	4.1 8	6.2 4	39.6	20.4
SAMGA NG	5	7	176	15 0	72.1 2	86.5	90.9	100	22. 20	26. 3	2.6 9	5.6 1	53.5	18.0
IR50	5	7	174	15 0	59.6 2	73.4	75.4	100	18. 45	22. 6	1.8 6	5.3	43.8	22.4
IR72	5	7	176	15 6	62.1 2	75.8	87.8	100	21. 50	25. 2	2.0 1	5.4	75.8	20.0
IRRI102	5	7	186	16 2	65.5	76.3	80.5	100	21. 20	29. 0	2.8 2	5.0 2	59.9	21.9
BRRI dhan28	5	7	170	14 5	78.0	105.4	72.1	100	23. 48	28. 2	2.1 7	6.3 5	71.5	19.8
BRRI dhan36	5	6		14 8		96.5		100		28. 0		6.2 4		18.2
LSD at 5%	0.81	0.93	1.8 4	1. 45	7.85	3.7	8.5		2.8	2.9	0.4 5	0.5 6	9.73	2.54

International temperate rice observational nursery (IRTON, 2014)

Twenty two rice genotypes (IRTON materials) from IRRI and two local cheek namely, BRRI dhan28 and BRRI dhan36 (moderately cold tolerant variety at seedling stage) were tested in Rangpur district of Bangladesh. Seeding was done on 04 January 201. Vegetative vigor (Vg) and tillering ability were done at seedling stage and other parameters except heading (Hdg) were measured at maturity stage. Out of 22 genotypes 4 entries did not germinate. Among the tested genotypes three entries (IR68333-R-R-B-19, IR83222-F11-85 and HR20654-54-3-5) were selected as moderately tolerant to cold with other good agronomic characteristics specially yield. Rice genotypes IR68333-R-R-B-19 showed the best performance in relation to cold tolerance and yield.

Demonstration of nursery management by polythene covering for seedling raising in cold prone Northern part of Bangladesh during Boro season

For raising quality seedling in cold prone areas polythene covered seedbed technology has been developed few years earlier by Plant Physiology Division, BRRI but not taken sufficient initiative to disseminate it to the farmers. So, we conducted twelve on farm demonstrations in six locations of Rangpur, Kurigram and Nilphamari districts during Boro 2014-15 season through IAPP project. We used two rice varieties BRRI dhan28 and BRRI dhan58 and transparent polythene sheet which acts as greenhouse during day time in polythene covered seedbed for experimental purpose. Data on different seedling parameters (seedling height, weight, vigor, number of leaf and tiller), growth duration, plant height, yield and yield components were recorded and compared polythene covered seedbed treatment with uncovered control. Seedling height, fresh weight and vigor increased remarkably in seedlings of polythene covered seedbed than uncovered treatments (Table 14). There was no significant difference between the treatments for dry weight, number of leaf and tiller per seedlings (Table 14). Growth duration reduced about 4 days for both the varieties by covering seedbed with polythene. However, plant height, yield and yield component did not differ significantly between the treatments (Table 14).

We arranged a field day to show benefit of the technology among the surrounding farmers. Most of the farmers told this technology produced better seedlings due to less seedling mortality and higher seedling growth and they can transplant more areas. A trial farmer Md. Mofizar Rahman raised a very interesting thing and he told that seedlings from polythene covering had comparatively green seedlings with more numbers of roots than uncovered one.

From this demonstration program it is revealed that the polythene covering seedbed techniques have visible benefits in raising seedling at low temperature condition. Therefore, this polythene covering seedbed technology can be recommended for massive diffusion through extension service providers like DAE in cold prone Northern region of Bangladesh.

Table 14: Effect of seedbed covering by polythene sheet on rice

Variety	Seedbed covering	Seedling height	Fresh weight (mg/ seedling)	Dry weight (mg/ seedling)	Seedling vigor SES score	Leaf / seedling	Tiller / seedling	Growth duration (days)	Plant height (cm)	Yield (t/ha)
BRRI dhan28	Poly covered	19.36	174.50	43.71	4.50	4.56	1.01	145.50	99.6	6.99
	Uncovered	15.61	158.21	41.43	7.16	4.59	1.02	149.16	97.8	7.02
BRRI dhan58	Poly covered	16.14	170.68	42.49	4.33	4.66	1.00	152.0	94.0	8.22
	Uncovered	13.81	158.66	40.77	6.33	4.61	1.08	156.0	92.1	8.23
LSD at 5%		0.370	13.07	3.43	0.76	0.15	0.09	2.90	2.72	0.45

Development of field-based seedling raising technique for low temperature condition in the Boro season (CSISA-Year 2 result)

Rice grown in Boro season is suffering by low temperature at the starting of season, seedlings and early growth after transplanting suffers by low temperature at the end of December or early in the January when mean temperature goes below 10-12^{0}C. Last year's investigations with seedbed amendments by rice husk and seed priming showed positive effects for raising good and healthy

seedling separately in to two different experimentation. While, this year (2014-2015) the investigation was taken by combining both treatments with an additional treatment i.e. covering seedlings by polythene. Therefore, the present study combined three factors i.e. seedbed amendments by rice husk, seed priming and polythene cover to observe the interactions among the 3 factors and main effects of each factor to develop a field-based seedling raising technique for low temperature condition in the Boro season.

The prevailing air temperature during the growth of seedling remains quite high compared to previous year, especially during day time maximum temperatures. Therefore, the effects of polythene cover, rice husk and seed priming on seedling qualities were not much prominent, even in polythene cover treatment badly affects dry matter accumulation and root growth. However, rice husk treatment showed better and significant effect to the seedling qualities specially for improving seedling strength through increasing shoot & root weight as well as seedling height with some extent. But there are no such significant was observed for seed priming treatment in the prevailing temperature condition. From the present investigation, it should be recommended to use rice husk amendment for growing better seedling only when temperature remains similar as prevailing condition and/or in combination with polythene cover if temperature falls below than the prevailing condition or when there is long cold spells.

Plant Physiology

Rumena Yasmeen, *PhD*
Chief Scientific Officer
(Addl. Charge) and Head
Munnujan Khanm, *PhD*
Principal Scientific Officer
(Deputed to TOC)
Salma Pervin, *MS*
Senior Scientific Officer
Md Sazzadur Rahman, *MS*
Senior Scientific Officer
Md Mamunur Rashid, *PhD*
Senior Scientific Officer
Hirendra Nath Barman, *MS*
Senior Scientific Officer
Salma Akter, *MS*
Scientific Officer
Tuhin Halder, *MS*
Scientific Officer
Avijit Biswas, *MS*
Scientific Officer

ENTOMOLOGY DIVISION

SURVEY AND MONITORING OF RICE ARTHROPODS

STUDIES ON THE RICE INSECT PEST AND NATURAL ENEMY BIO-ECOLOGY

INTEGRATED PEST MANAGEMENT

CROP LOSS ASSESSMENT

EVALUATION OF CHEMICALS AND BOTANICALS

HOST PLANT RESISTANCE

Annual Report 2014-2015

Pest Management
Entomology Division

PERSONNEL

Nur Ahmed*[1], PhD, CSO (C.C.)
Sheikh Shamiul Haque, PhD, PSO
Md. Mosaddeque Hossain[2], MS, PSO
Md. Mofazzel Hossain, MS, PSO
Mahfuj Ara Begum[2], MS, SSO
Md. Nazmul Bari*[2], PhD, SSO
ABM Anwar Uddin, MS, SSO
Md. Panna Ali*, PhD, SSO
Jannatul Ferdous[*], MS, SSO
Mir Md. Moniruzzaman Kabir, MS, SO
Farzana Nowrin, BSc. Ag. (Hons), SO

[+] Divisional Head from 14-10-2014
[1] Joined during reporting period
[2] Transferred to Regional Station
[*] Deputed for PhD (in country/abroad)

SUMMARY

- The rice field and seedbeds of BRRI farm, Gazipur harboured GLH, WLH and GH in high number. In all five habitats spider, DF, LBB, CDB represented. In 20 hill counts SB, GH, LHC, RLF and WM appear in the rice field.
- Brown planthopper population were higher followed by green leafhopper, yellow stem borer and white-backed planthopper in all five locations. Among the natural enemies green mirid bug, spider, lady bird beetle, carabid beetle and ground beetle were most prevalent. Highest population of green mirid bug observed in Gazipur.
- Rice planthopper incidence started from 2nd week of September 2014. Peak incidence was found on October 29 to November 5 at Kasta, Sirajganj.
- The increasing trend, in the GLH, LBB and SPIDER abundance series between 1996 and 2005 has flattened out and is decreasing from 2006 to 2012. This indicates a periodic, slowly varying population abundance characteristic. Two different sampling methods showed different association with climatic variables particularly GLH population.
- Highest natural enemies, per cent parasitism by *Trichogramma zahiri* were observed in rice field nearby nectar-rich flowering plants. Moreover, there was no yield reduction observed in rice field surrounding by flowering plants compared with insecticide application.
- It was found that continuous use of insecticide had no effect on yield and yield contributing characters of rice when insect infestation below the ETL. So, farmers should avoid continuous/ indiscriminate use of insecticide which ultimately save production cost and save the environment from insecticidal pollution.
- One per cent (1%) damage of tillers by GM at mid-tillering stage caused 1.08 and 1.02 % yield loss of BRRI dhan52 and BRRI dhan49, respectively at field condition.
- A total of 108 commercial formulations of insecticides were evaluated against brown planthopper (BPH) and yellow stemborer (YSB). Among those 83 were found effective (81 against BPH and 2 against YSB). Effective commercial formulations were recommended to PTAC for registration and commercial use.
- Out of 79 entries 19 were found moderately resistant against BPH. Among the 49 entries 12 were selected as moderately resistant against WBPH. Among the 68 entries tested against GLH 2 entries were found moderately resistant. Out of 7 F_2 materials two were confirmed as moderately resistant to GM.
- Among 63 rice germplasm, Muktahar (Acc # 156) and Koha binni (Acc# 208) were recorded as moderately resistant (MR) (6-10% OS) to resistant (0-1% OS) against GM.
- Fumigation with Phostoxin tablet and Zinc Phosphide (<2%) bait mixed with wheat @ 5g bait caused 45% reduction of active rats.

SURVEY AND MONITORING OF RICE ARTHROPODS

Pest and natural enemy incidence at BRRI farm, Gazipur

Incidence of rice insect pests and their natural enemies along with their damage intensities was monitored weekly at BRRI farm Gazipur. Data collected from five (5) different habitats (seed bed, grass fallow, upland and irrigated rice, rice-ratoon) in Aus, T. Aman and Boro seasons 2014-15 and presented in Figs. 1-3. In Aus 2014, green leafhopper dominated in seed bed followed by grass fallow, upland and irrigated rice environment. Rice bug was most abundant in ratoon. In this season spider dominated in all five habitats. In T. Aman season, the highest population of grass hopper observed in seed bed followed by rice-ratoon and grass fallow habitats. Green leafhopper was dominated in irrigated rice. Among the natural enemies lady bird beetle (LBB), spider, carabid beetle and damselfly dominated in all the habitats. In Boro 2015 season, grass hopper was most abundant in seed bed, rice-ratoon, grass fallow and irrigated rice. Predator LBB and spider dominated in seed bed followed by rice-ratoon, grass fallow and irrigated rice.

Pest and natural enemy incidence in light trap

Rice insect pests and their natural enemies were monitored by using light traps during July 2014 to June 2015 at BRRI farms in Gazipur, Barisal, Rajshahi, Comilla and Sonagazi. All data of different population of insect pests and their natural enemies are demonstrated in Figs. 4-6. Brown planthopper population were higher (94,917) followed by green leafhopper (62,222), yellow stemborer (47816) and white-backed planthopper (45,182 no.) in all five locations. Brown planthopper dominated (80,940) in Gazipur, yellow stemborer (29,333) in Barisal and green leafhopper (14,513) in Rajshahi. Among the natural enemies green mirid bug, spider, lady bird beetle, carabid beetle and ground beetle were most prevalent. Highest population of green mirid bug (57,172) observed in Gazipur.

Light trap attracted considerable number of winged adult BPH than WBPH from the 3rd week of October to the end of November/ 2014 both at BRRI HQ, Gazipur and Barisal. The peak incidence of BPH was recorded in the 2nd week of November/2014 in both locations. Population of WBPH was comparatively lower than BPH during this period. However, peak numbers were recorded in November/2014 and May/2015. Among the natural enemies, green mired bug population was considerably higher in BRRI HQ, Gazipur than Barisal; indicating their density dependence with BPH population build-up.

Construction of epidemiology information inter-change system for migratory disease and insect pests in Asia region

Monitoring of Planthoppers with Yellow sticky trap (YST): Monitoring by YST during T. Aman 2014 indicates that the rice planthopper incidence started from 2nd week of September 2014. Peak incidence was found at Kanchaneswar on October 29 and that was from October 29 to November 5 at Kasta, and again highest on October 29 at Aurangail then decreased until harvest of the crop. Among the natural enemies, green mirid bug population was higher in Kasta on Novemver 5 than the other locations, and the population was comparatively lower in kanchaneswar than Aurangail. Spider population was almost similar during the observation period. In Boro 2015, BPH and WBPH population tended to increase at Dobila, Hamkuria and Washin from the 1st week of April and the peak population was in the end of April. Natural enemies were also observed all the year round.

Monitoring of Planthoppers with Aerial YST: RPH (BPH, WBPH and SBPH) and natural enemy (GMB and spider) were more active in the Boro seedbed, and higher number of insects was caught at 4.88 m height traps than the other one (2.44 m). Aerial movement of RPH in space do exist and it was higher in Dobila followed by Hamkuria and Washin.

STUDIES ON RICE INSECT PEST AND NATURAL ENEMY ECOLOGY

Global warming is expected to increase/decrease frequency of rainfall/precipitation, drought intensity and solar radiation which may affect rice ecosystems particularly arthropods e.g., pests and their natural enemies. The present study discuss influences of climatic variations from almost two decades, on yellow stem borer (YSB), brown planthopper (BPH), green leafhopper (GLH) and their natural enemies (spider, lady bird beetle-LBB, green mirid bug-GMB). Light trap and sweep net catches of arthropods from different rice habitats shows a strong bi-annual periodicity for BPH, YSB and GMB. The increasing trend, in the GLH, LBB and SPIDER abundance series between 1996 and 2005 has flattened out and is decreasing from 2006 to 2012. This indicates a periodic, slowly varying population abundance characteristic. Two different sampling methods showed different association with climatic variables particularly GLH population.

INTEGRATED PEST MANAGEMENT

Conservation of natural enemies through ecological engineering approaches

Highest natural enemies, per cent parasitism by *Trichogramma zahiri* were observed in rice field nearby nectar-rich flowering plants. However, least natural enemies and parasitism were found in rice field where four times (continuous/ prophylactic) insecticides were applied (Figs. 7-9). Moreover, there was no yield reduction observed in rice field surrounding by flowering plants compared with insecticide application. So, farmers should avoid the toxic and hazardous insecticides to control the insect pests by growing nectar-rice flowering plants on the bunds of surrounding rice crops.

Validation of BRRI Recommended Practices for Insect Pest Management

During the experimental period (Boro 2014-15) insect infestation remained below the economic threshold level (ETL). Green leafhopper (GLH), white leafhopper (WLH) grasshopper (GH), yellow stem borer (YSB), white stem borer (WSB), leaf roller (LR), rice hispa (RH), field cricket (FC), rice bug (RB), caseworm (CW), long horned cricket (LHC), dead heart (DH) and onion shoot (OS) were found in fortnightly sweeping and hill counting. No significant differences were observed for insect number and infestation among the treatments. More or less same insect pests were also observed in Barisal region. Highest number of RH found in Barisal region (0.38/20 hill) followed by LHC, YSB and GLH. Very small number of BPH and WBPH also observed at Barisal region.

Among the natural enemies spider (SPD), damsel fly (Dam. fly), and dragon fly (Drag. fly), ladybird beetle (LBB), carabid beetle (CBB) and long horned grasshopper (LHG) were found in sweeping. Damsel fly, CBB and LHG not found in T_1 during sweeping where fortnightly used insecticide. Except LBB, other natural enemies were found lowest in T_1 (insecticide treated plots) during 20 hill counting. During 20 hill counting no LBB and lowest number of CBB were observed in T_1 at Barisal region. Thus, it was indicated that continuous use of insecticide has the detrimental effect on the population of natural enemies. Initially, treatments T_2 and T_3 were refrained from insecticide used at the early crop stages (30 - 40 DAT) in all the locations. As a result natural enemy populations increased (though definite trend was found) both in T_2 and T_3 which might reduce pest population below the ETL. Therefore, no insecticide was used in T_2 and T_3. So, it should be avoid continuous/indiscriminate use of insecticide at early crop stage (30-40 DAT) to conserve natural enemy in the rice field.

No significant difference in yield was observed in other three treatments (T_1, T_2 and T_3) for both the locations. In T_1 insecticides (Carbofuran 5G@10.0kg/ha) were applied four times but no yield advantage was observed over the treatment T_2 and T_3 where perching and sweeping were done

without use any insecticide. Therefore, it was found that continuous use of insecticide had no effect on yield and yield contributing characters of rice when insect infestation below the ETL. So, farmers should avoid continuous/ indiscriminate use of insecticide which ultimately save production cost and save the environment from insecticidal pollution.

Validation of BRRI Recommended Practices for Insect Pest Management, T. Aman 2014: During the experimental period insect infestation in both Rangpur and Barisal region was below the economic threshold level (ETL). Yellow stemborer (YSB), dead heart (DH), rice leaf roller (RLR), caseworm (CW), long horned cricket (LHC), grasshopper (GH), green leafhopper (GLH), brown planthopper (BPH) and rice bug (RB) were found in Pirganj and Taraganj in fortnightly sweeping and hill counting. Caseworm (CW), LHC, GLH and BPH were not found in Taraganj and RB was not appeared in Pirganj during hill counting. Highest number of YSB found in both the locations of Pirganj and Taraganj followed by RLR during sweeping. Rice leaf roller population was found also highest in both the locations during sweeping. Similar insect infestation was observed at Barisal region during hill counting. One think is remarkable that rice hispa adult (RHA) and rice hispa grub (RHG) and their damages were also observed at Barisal region which normally not found at Rangpur region.

Among the natural enemies spider (SPD), ladybird beetle (LBB), staphylinid beetle (STB), carabid beetle (CBB) and damsel fly (Dam. fly) were noticed both in Pirganj and Taraganj. In 20 hill count study STB was not found in T_1 both the locations of Pirganj and Taraganj where continuously insecticide was used. Again, lowest CBB and Dam.fly was found at Pirganj and Taraganj respectively in the same treated plot. Similar detrimental effect of insecticide on natural enemies was also observed at Barisal region during hill counting. Thus, the findings indicated that use insecticide has the detrimental effects on natural enemies in the rice field.

No significant differences in yield were observed in other treatments (T_1, T_2 and T_3) in both the locations (Table 1 & 2). In T_1 insecticide (Carbofuran 5G@ 10.0kg/ha) was applied five times but no yield advantage was observed. In T_2 & T_3 only perching and sweeping were done fortnightly or when necessary without use any insecticide but no yield reduction was observed. More or less same finding was also observed at Barisal region. Therefore, it was concluded that continuous use of insecticide had no effect on yield and yield contributing characters of rice when insect infestation below the ETL. So, farmers should avoid continuous/ indiscriminate use of insecticide which ultimately save production cost and save the environment from insecticidal pollution.

CROP LOSS ASSESSMENT

Relationship between rice gall midge damage and yield loss

Yield loss occurred in gall midge infested hills compared to control hills. Highest yield loss occurred in BRRI dhan52 (18.08%) where 16.70% onion shoot observed (ranged 7.69 to 25%) followed by BRRI dhan49 (15.19%) where 14.94% onion shoots appeared (ranged 6.67 to 23.08%; Table 3). The results indicated that 1% damage of tillers at mid-tillering stage caused 1.08 and 1.02 % yield loss of BRRI dhan52 and BRRI dhan49, respectively at field condition.

EVALUATION OF CHEMICALS AND BOTANICALS

A total of 108 commercial formulations of insecticides were evaluated against brown planthopper (BPH) and yellow stemborer (YSB). Among those 83 were found effective (81 against BPH and 2 against YSB). Effective commercial formulations were recommended to PTAC for registration and commercial use.

HOST PLANT RESISTANCE

Screening of elite breeding lines, rice germplasm and rice varieties

A total of 79 entries were tested under controlled conditions in green house against brown planthopper (BPH), 49 against white backed planthopper (WBPH), 68 against green leafhopper (GLH) and 3 against gall midge (GM) during the reporting period. In addition 7 F_2 materials also tested against BPH.

Out of 79 entries 19 were found moderately resistant against BPH. Among the 49 entries 12 were selected as moderately resistant against WBPH. Among the 68 entries tested against GLH 2 entries were found moderately resistant. Among 3 AYT materials none were found resistant against GM. Out of 7 F_2 materials two were confirmed as moderately resistant (Table 4).

Screening of elite breeding lines, germplasm and rice varieties against gall midge (GM)

A total of 63 rice germplasm collected from GRS Division were screened against GM during the reporting period from July 2014 to June 2015. Among 63 rice germplasm, Muktahar (Acc # 156) and Koha binni (Acc# 208) were recorded as moderately resistant (MR) (6-10% OS) to resistant (0-1% OS) against GM at glasshouse condition.

VERTEBRATE PEST MANAGEMENT

Evaluation of different control measures against field rat**:** The experiments were conducted during transplanting of Boro/2015 rice. Four treatments were executed in 20 replicates individually with different management options. Live/dead rat(s) were observed for 10 consecutive nights. Fumigation with Phostoxin tablet caused the death of 9 rats out 20 active burrows indicating 45% reduction of active rats. However, similar results were recorded from Zinc Phosphide (<2%) bait mixed with wheat @ 5g bait in each burrow. Single capture live trap with lucrative bait (coconut oil + dried paddy wrapped by nylon net) caught highest number (15) of rat resulting 7.5% trap success in 10 consecutive nights.

Table 1. Plant characteristics, yield component and yield of different treatments in Pirganj and Taraganj T. Aman 2014

Treatments	Tiller/ hill (Mean ±SE)	Leaf/ hill (Mean ±SE)	Panicle/ hill (Mean ±SE)	Plant height (cm) (Mean ±SE)	Yield (t/ha) (Mean ±SE)
Pirganj					
T_1	12.91 ± 0.23 n=240	61.38 ± 1.23 n=240	11.87 ± 0.15 n=80	120.03 ± 0.59 n=80	5.84 ± 0.26a n=3
T_2	12.61 ± 0.21 n=240	60.56 ± 1.08 n=240	11.83 ± 0.15 n=80	118.19 ± 0.5 n=80	5.72 ± 0.28ab n=3
T_3	12.73 ± 0.24 n=240	61.00 ± 1.15 n=240	11.92 ± 0.15 n=80	119.75 ± 0.61 n=80	5.68 ± 0.27ab n=3
T4	12.47 ± 0.23 n=240	60.58 ± 1.12 n=240	11.73 ± 0.14 n=80	119.35 ±0.60 n=80	4.66 ± 0.20b n=3
F-value	*0.675 (NS)*	*0.116 (NS)*	*0.327 (NS)*	*1.834 (NS)*	*F=4.61 p<0.05*
Taraganj					
T_1	16.90 ±0.17a n=360	72.35 ± 1.09a n=360	11.89 ± 0.16a n=80	116.15 ± 0.58a n=80	5.66 ± 0.35a n=3
T_2	16.67 ± 0.16a n=360	71.75 ± 1.10a n=360	11.83 ± 0.26a n=80	115.24 ± 0.24a n=80	5.45 ± 0.37a n=3
T_3	16.49 ± 0.16a n=360	70.11 ± 1.11a n=360	11.84 ± 0.25a n=80	114.83± 0.69a n=80	5.35 ± 0.32a n=3
T4	15.81 ± 0.15b n=360	64.82± 1.30b n=360	10.88 ± 0.21b n=80	110.18 ± 1.08b n=80	4.34 ± 0.22b n=3
F-value	*9.817*	*10.93*	*4.78*	*11.59*	*F=3.38 p<0.05*

Data were analyzed using one-way ANOVA; NS: not significantly different at 5% level (Tukey's post hoc test). T_1 =Prophylactic use of insecticide, T_2 = Perching+ sweeping+need base insecticide application, T_3 = Perching, T_4 = Farmers practice.

Table 2. Plant characteristics, yield component and yield of different treatments in Barisal region T. Aman 2014

Treatments	Tiller/ hill (Mean ±SE)	Leaf/ hill (Mean ±SE)	Panicle/ hill (Mean ±SE)	Plant height (cm) (Mean ±SE)	Yield (t/ha) (Mean ±SE)
T_1	13.37 ± 0.30 n=60	41.37 ± 0.99 n=120	11.26 ± 0.31 n=60	127.37 ± 0.36 n=60	4.76 ± 0.12ab n=3
T_2	12.18 ± 0.27 n=60	41.79 ± 1.01 n=120	11.45 ± 0.31 n=60	127.45 ± 0.35 n=60	5.21 ± 0.10a n=3
T_3	11.95 ± 0.38 n=60	41.59 ± 0.96 n=120	11.21 ± 0.29 n=60	126.66 ± 0.38 n=60	4.60 ± 0.05ab n=3
T_4	12.08 ± 0.35 n=60	41.97 ± 0.97 n=120	11.13 ± 0.27 n=60	127.29 ± 0.42 n=60	4.23 ± 0.23b n=3
F-value	*0.487 (NS)*	*0.116 (NS)*	*0.808 (NS)*	*0.031(NS)*	*F=8.332* $p<0.05$

Data were analyzed using one-way ANOVA; NS: not significantly different at 5% level (Tukey's post hoc test). T_1 =Prophylactic use of insecticide, T_2 = Perching+ sweeping+need base insecticide application, T_3 = Perching, T_4 = Farmers practice

Table 3: Plant and yield contributing characteristics of gall midge damage hills and control hills, BRRI farm, Rajshahi, T. Aman 2014

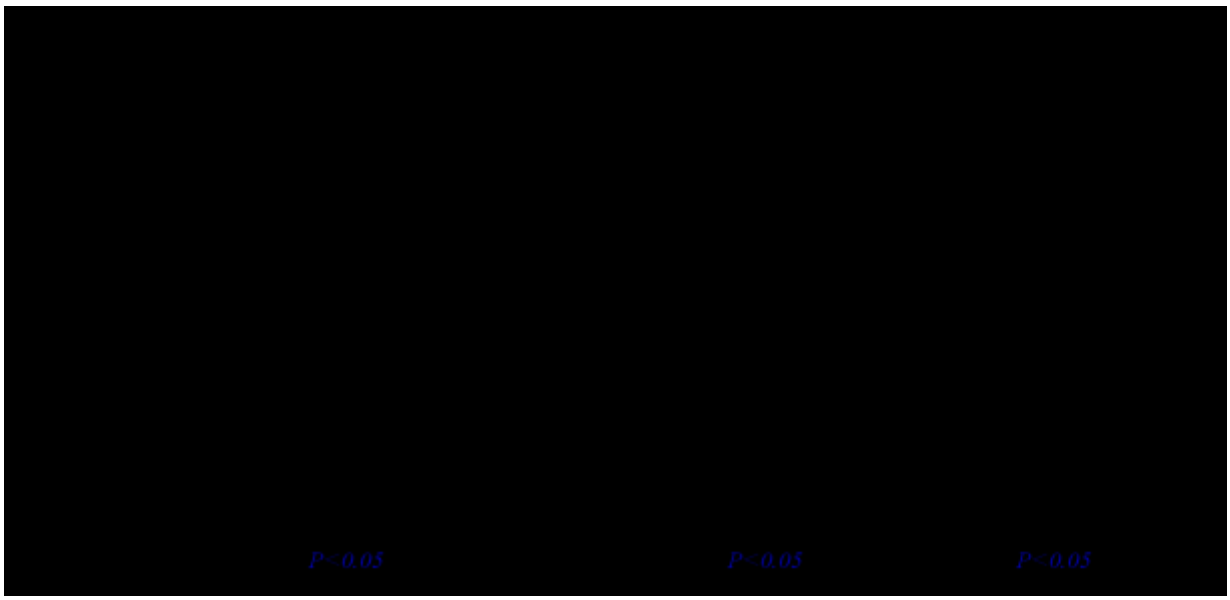


Table 4: Resistant reactions of rice entries against BPH, WBPH, GLH and GM, BRRI greenhouse, 2014-15.

Seed source	Entries tested (no.)	Target pest	Resistant entry	Reaction
Advance line	79	BPH	BR 7881-62-2-3-7-P_3 (RYT) IR 83142-B-71-B-B BR 7683-30-3-3-4 BR 7671-37-2-2-3-7 IR 77734-93-2-3-2 BR 8096-55-1-9-1 BR 7372-18-3-3-HR3 (COM) HHZ15-SAL13-Y1 HHZ23-DT16-DT1-DT1 HHZ15-DT4-DT1-Y1 HHZ11-DT7-SAL1-SAL1 CN-6 BR 7669-11-1-2-8-2-1 BR 8334-18-7-5 BR 8335-10-6-3-5 BR 8337-6-4-7-7 BR 8337-9-3-2-5 BR 8337-9-3-2-1 BR 8339-3-4-2-1	MR (5)
	49	WBPH	IR 83140-B-36-B-B IR 77734-93-2-3-2 BR 8079-52-2-2-2 BR 7369-10-5-2-3 BR 7369-52-3-2-1-1 HHZ23-DT16-DT1-DT1 BR 7800-63-1-7-3 BR 7840-54-3-2-1 BR 8257-37-1-2-2 BR 7669-11-1-2-8-2-1 BR 7718-55-1-3 BR 7718-55-1-3	MR (5)
Advance line	68	GLH	HHZ6-SAL3-Y1-SUB2 BR7718-55-1-3	MR (5)
AYT materials	3	GM	-	-
F_2 materials	7	BPH	BINA dhan10/ASD-7 BRRI dhan55/ASD-7	MR (3) MR (5)
Germplasm	63	GM	Muktahar (Acc # 156) Koha binni (Acc# 208)	MR (6-10% OS) R (0-1% OS)

Susceptible Check: BR3 (for all), Resistant ck: T27A, IR64 and Ptb18 for BPH, WBPH and GLH respectively. Scores were made according to SES. BPH= brown planthopper, WBPH= white-backed planthopper, GLH= green leafhopper, R= resistant (score 0-1), MR= moderately resistant (3-5), S=susceptible (7-9).

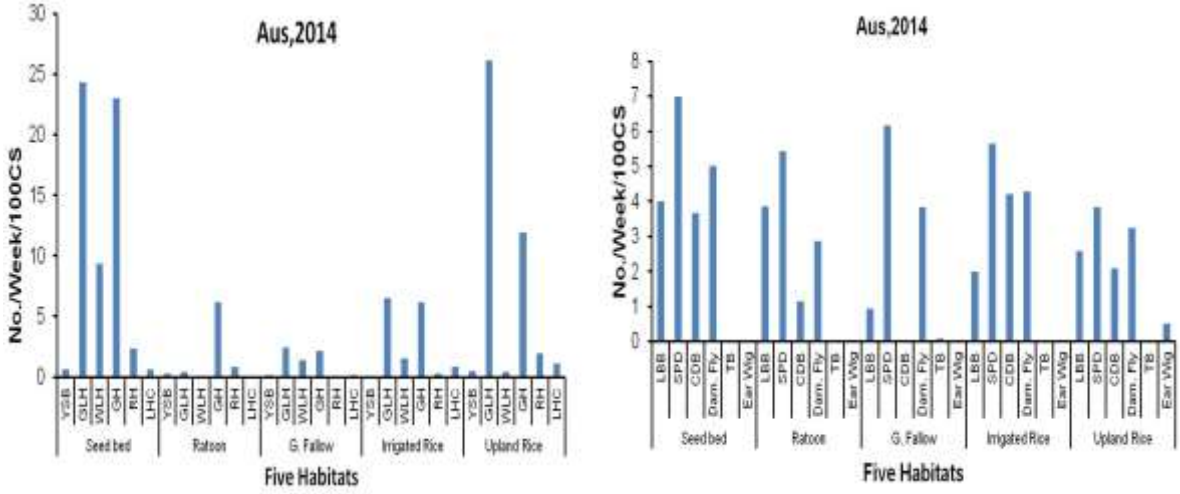


Fig.1: Incidence of insect pests and natural enemies in rice and non-rice habitats, Aus 2014, BRRI farm, Gazipur

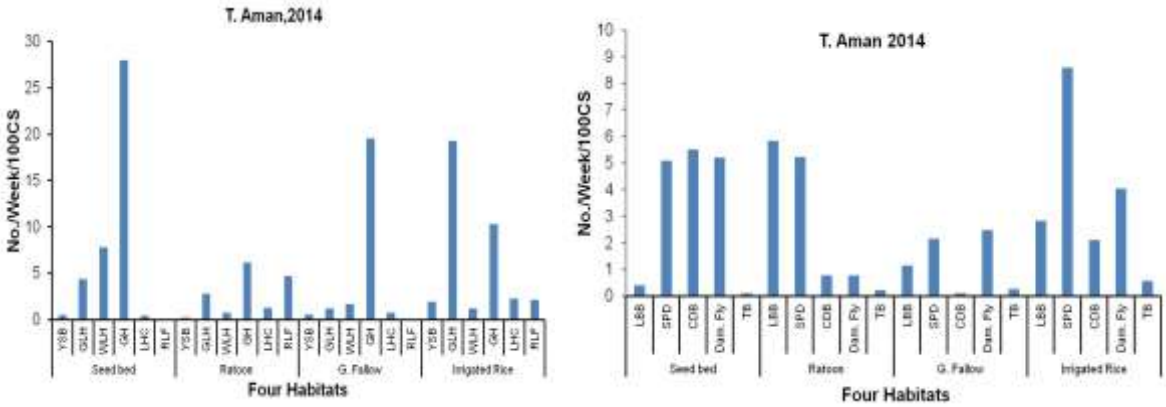


Fig. 2: Incidence of insect pests and natural enemies in rice and non-rice habitats, T. Aman 2014, BRRI farm, Gazipur

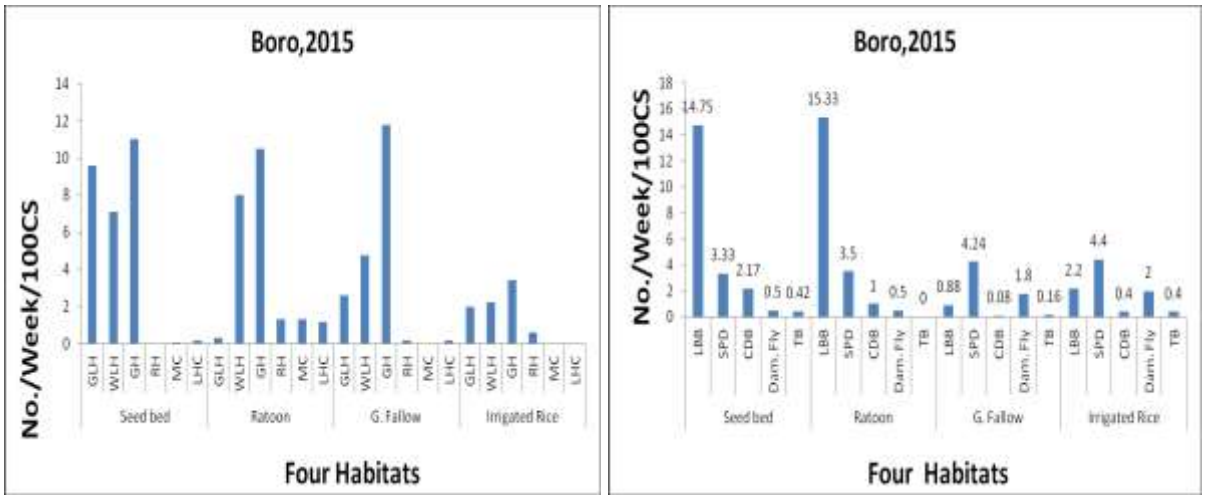


Fig. 3: Incidence of Insect pests and natural enemies in rice and non-rice habitats, T. Aman 2015, BRRI farm, Gazipur

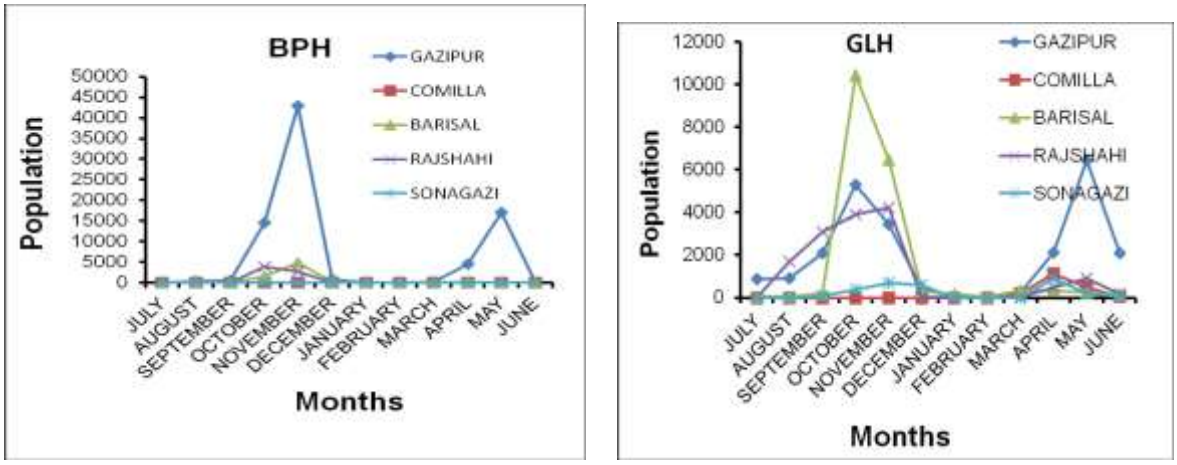


Fig.4: Incidence pattern of BPH and GLH in light trap, BRRI HQ and regional stations, July '14- June '15.

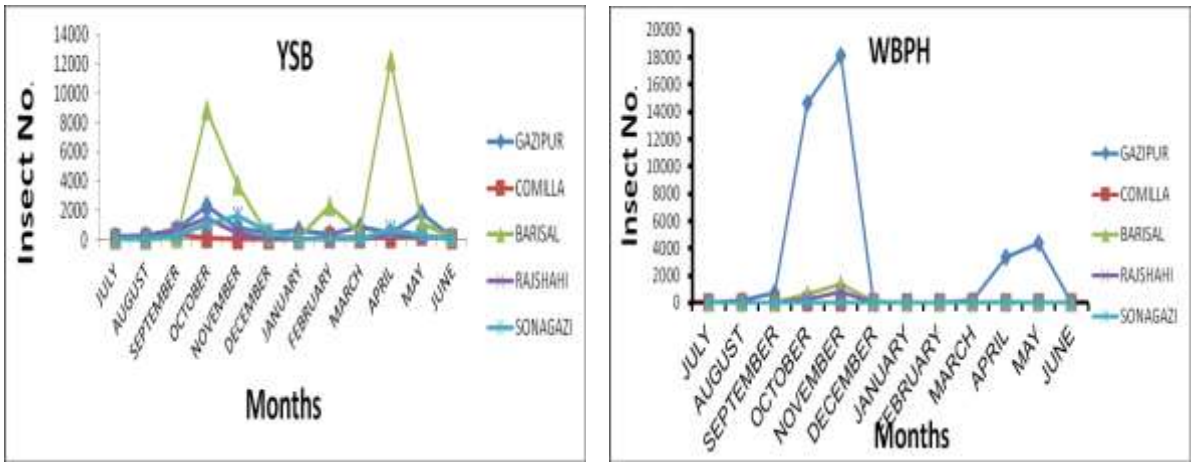


Fig. 5: Incidence pattern of YSB and WBPH in light trap, BRRI HQ and regional stations, July '14- June '15.

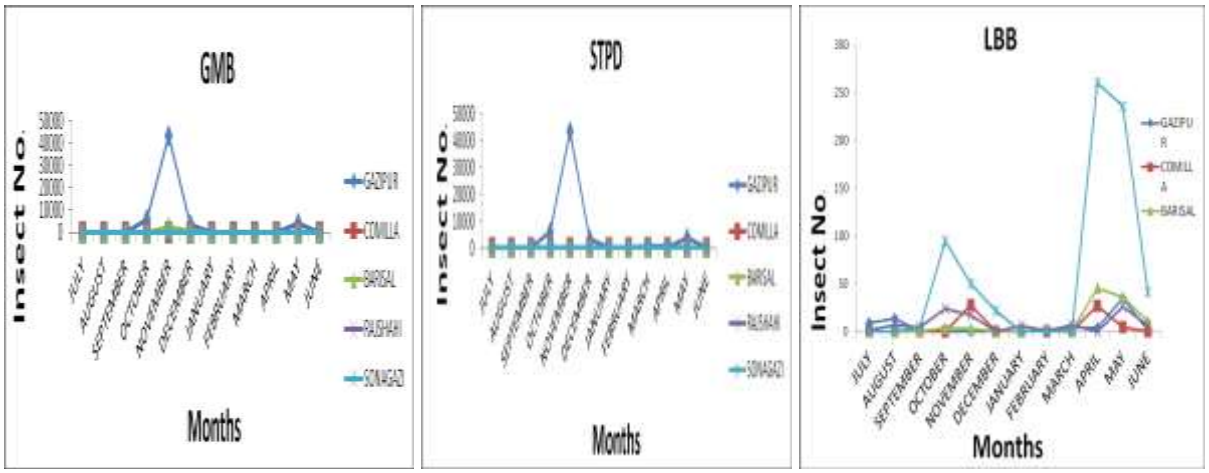


Fig. 6: Incidence pattern of GMB, STPD and LBB in light trap, BRRI HQ and regional stations, July '14- June '15.

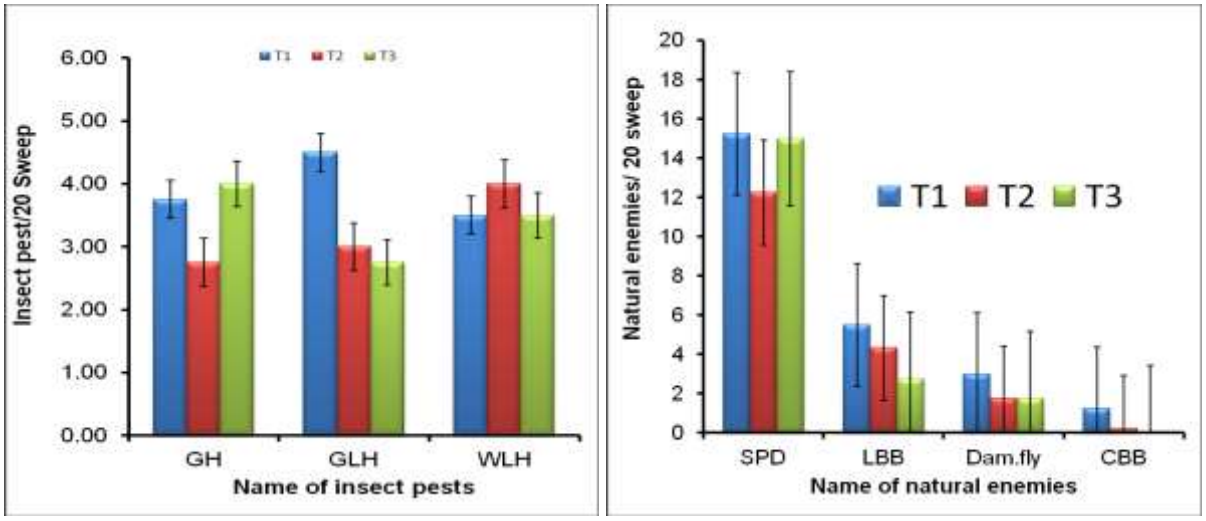


Fig 7: Incidence of insect pest and natural enemies in Gazipur, Boro 2014-15

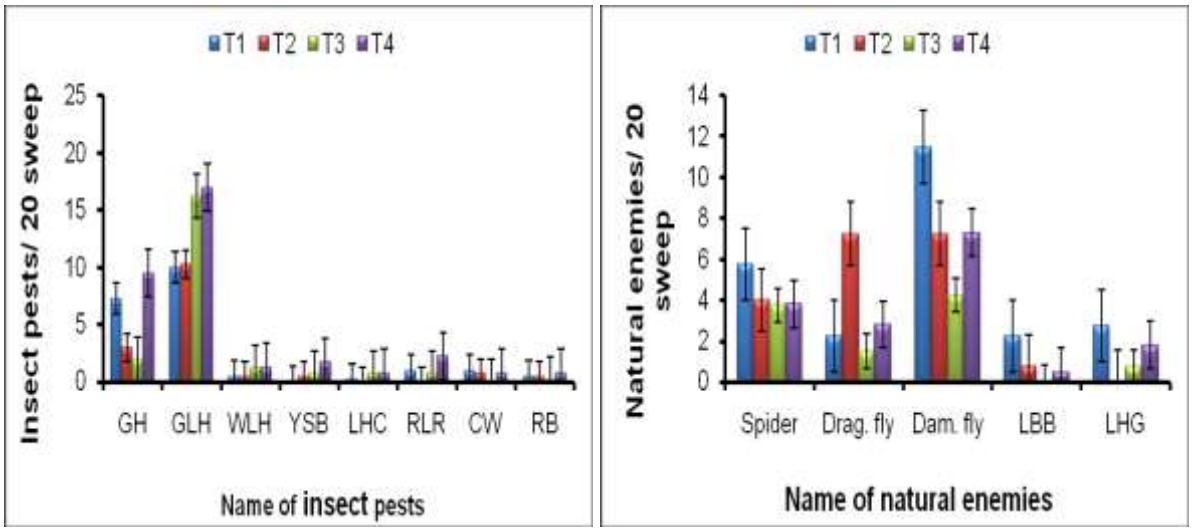
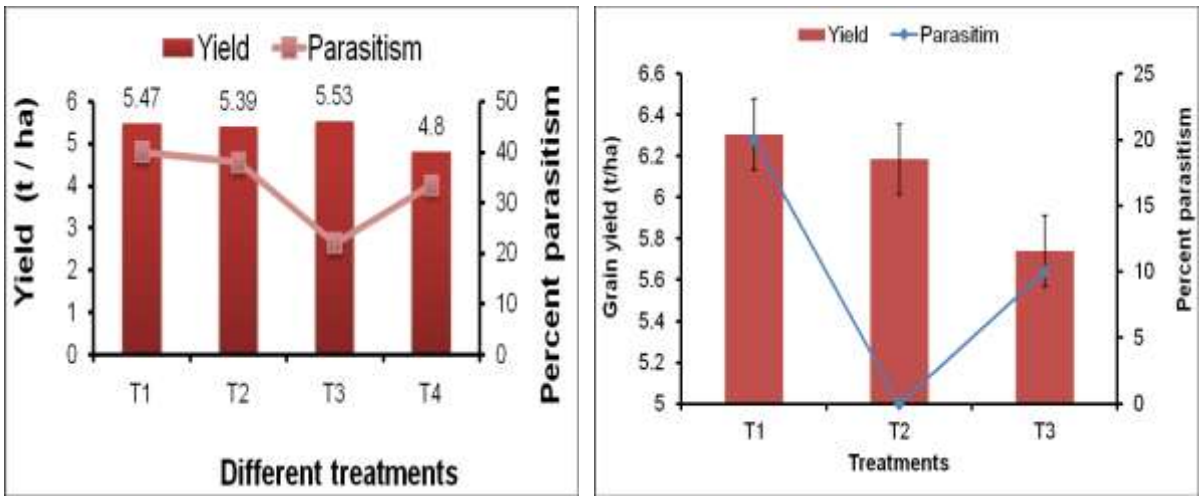


Fig 8: Incidence of insect pest and natural enemies in Rajshahi (T. Aman, 2014)



Rajshahi, T. Aman 2014 **Gazipur Boro, 2014-15**

Fig.9. Percent parasitism by *Trichogramma zahiri* and yield in different treatments at Rajshahi, T. Aman 2014 and Gazipur, Boro, 2014-15

Plant Pathology Division

PERSONNEL

Md Ansar Ali, PhD
Chief Scientific Officer and Head
Md Abdul Latif, *PhD*
Principal Scientific Officer and Head
Tahmid Hossain Ansari, *PhD*
Principal Scientific Officer
Q S A Jahan, PhD
Principal Scientific Officer
Md Shahjahan Kabir, *MS*
*Senior Scientific Officer***[a]
Mohammod Hossain, *PhD*
Principal Scientific Officer
Shamima Akter, *PhD*
Senior Scientific Officer
Mohammad Ashik Iqbal Khan, *PhD***b*
Senior Scientific Officer
Ahsanul Haque, *MS*
Senior Scientific Officer
Md Abul Monsur***c*
Senior Scientific Officer
Mst Tuhina Khatun***[a]
Senior Scientific Officer
Md Rejwan Bhuiwan, *MS*
Senior Scientific Officer
Md Mamunur Rashid, *MS*
*Senior Scientific Officer***[a]
Bodrun Nessa, *MS***[d]
Senior Scientific Officer
Anjuman Ara, *MS*
Scientific Officer

**[a] Deputation for higher studies in abroad
**[b] Lien in abroad
**[c] Deputation at Plant Pathology Division, BRRI
**[d] Deputation for higher studies (in country)

SUPPORT SERVICE PERSONNEL

Md. Sirajul Islam, *Dip-in-Ag.*, SA

Md. Nizamul Karim, *Dip-in-Ag.*, SA

Golam Mohammad, ST

Noor Mohammod Howlader, LA

Mohammad Ismail, LA

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Summary

Survey on rice diseases incidence in different rice ecosystems suggested that blast, brown spot, sheath blight and bacterial blight was more prevalent. The outbreak of blast disease occurred in BRRI dhan28. Incidence of brown spot was prominent in Rangpur region irrespective of the variety. A set of differential races of blast consisting of 15 isolates has confirmed from the previous 21 isolates. Parasexual study on rice blast and crabgrass blast isolates indicated no recombination occurred among the tested blast isolates. For the first time, *Fusarium* spp. is identified as the causal agents of seedling blight in Bangladesh. Under the resistance breeding, *Pi, Pi40, Pita2* and *Pish* were introgressed in the background of premium quality rice BR63 and Nyanmoni and also in IR64, BRRI dhan28 and BRRI dhan29. BC2F1 seeds of BRRI dhan29 introgressed with *Pi9, Pi40* and *Pita2* were also produced. Pathogenicity result showed that some progenies of BC3F1 or BC4F1 developed from the crosses between BRRI dhan28, BRRI dhan29 and a local improved variety with IRBB60 or IRRBB65 for Bacterial Blight (BB) resistance. Among the tested purelines, HRP (Mala) 7-10 was found the best considering agronomic and yield characteristics. Seeds of blast resistant multiline variety of IR64 were multiplied and large scale evaluation to be done in the next season. Among the tested Blast resistant multiline varieties of IR49830, IRBLsh-T produced the highest yield (5.0 t/ha). This line is also suitable for tidal non-saline sub-ecosystem. Four materials such as BR 7472-16-2-12-1, IR 73055-8-1-1-3-1, weed tolerant rice and IR 78761-B-SATB1-28-3-2b showed moderately resistant reaction against *Rhizoctonia solani.* Six materials IR 77542-551-1-1-1-1-2, BR7965-6-1-4, IRBB 65, IRBB 21, BR 8219-16-2 and BR 7941-41-2-2-2-4 showed moderately resistant reaction against *Xanthomonas oryzae* pv. *ovizae.* Seed treatment with Fungicide-8 (code) effectively controlled the seedling blight of rice. A protocol for healthy rice seedling raising initiative in trays (TSRI-protocol) was also developed (transferable technology). Five fungicides such as Palki 75WG, Indofil's Baan, Mactivo 75WG, Navita 75WG and Trigger 75WP were successfully controlled rice blast incidence (above 80%) and recommended for registration. In addition, a number of demonstrations were conducted in farmers' field under IAPP, Mujibnagar and PGB project activities where BRRI recommended practices for managing sheath blight and/or blast disease(s) were compared to farmers' practices for managing those diseases. In each demonstration, BRRI recommended practices were found to be more effective than farmers' practices.

Survey and monitoring of rice diseases at farmers' field

Survey and monitoring on rice diseases were carried out to know the present status of different rice diseases in different climatic environment. Different rice diseases were surveyed in both T. Aman and Boro season at different districts. In T. aman season, survey was carried out in different upazillas of Rangpur and Satkhira districts. In surveyed areas BB, brown spot, false smut and sheath blight diseases were prominent in both the districts. Incidence of other diseases was insignificant. In different upazillas of Barisal and Jhalokathi districts, incidence of brown spot, blast, narrow brown spot and bacterial leaf blight disease were recorded as 38-66%, 10-16%, 8-17% and 18-29%, respectively. Brown spot seems to be predominant in T. Aman season followed by blast and other diseases.

In Boro season, survey was carried out in Khulna, Bagerhat, Gopalgonj and Pirojpur district. In the surveyed areas bacterial blight (BB), neck blast, brown spot (BS), sheath blight and sheath rot diseases were observed. Among the diseases neck blast, BB and BS were found severe. Neck blast disease was found prominent in BRRI dhan28 in Bagerhat district (incidence 32% and severity 4), whereas, BB was observed in local and hybrid varieties in Gopalgonj Sadar (incidence 70%, Severity 5). Brown spot was severe in Gopalgonj district (incidence 82%, severity 6) next to Bagerhat district (incidence 40%, severity 3). In Rangpur region, survey was conducted in Lalmonirhat and Rangpur sadar upazilla. Blast incidence was epidemic in nature in BRRI dhan28. Most of the early planted variety which flowered at the time of drizzle raining was affected much with blast (5-90% panicle, severity 3-9). Other varieties like BRRI dhan29, few hybrid varieties were also affected with blast (% leaf infection 10%, panicle infected 5-10%, severity 3). Other diseases like BB (5% leaf, severity 3-5). In Barisal region, bacterial leaf blight (BB) disease showed highest incidence along with greater severity scale (7) followed by blast, brown spot, and leaf scald recorded as 22-48%, 8-19%, 23-37% and 7-13%, respectively. Survey was carried out in three upazillas Habigonj, Baniachang and Nabiganj of Habiganj district. Irrespective of locations, overall incidence of narrow brown leaf spot was observed highest (44% leaf, severity 2) which was followed by brown spot (43%, severity 3) and bacterial blight (10% leaf, severity 3). The incidence of sheath blight and neck blast was 1.3% (severity 3.6) and 2.0% (severity 3). Bacterial blight and narrow brown leaf spot were found less.

EPIDEMIOLOGY

Confirmation of the standard differential set of blast isolates

An investigation was carried out to confirm the reaction pattern of selected standard differential blast isolates with blast resistant genes; and to reduce the number of isolates for standard differential set to be selected for Bangladesh**.** With the collaboration of JIRCAS, Japan, Plant Pathology Division, BRRI has already selected 25 standard differential blast isolates for blast resistance studies. Inocula were prepared from stock inoculums following standard blast protocol developed by JIRCAS. Japan. Conidia were dislodged by gentle rubbing with a paint brush from incubated plates using sterilize distilled water with 0.01% Tween 20. Spore suspensions of 10^5 conidia were used for inoculating differential varieties of both *indica* and *japonica* background along with LTH (universal susceptible check). Inoculated seedlings were incubated in a dew chamber at 25ºC for 20 h; then transferred to a greenhouse maintaining 25±1ºC temperature and 70 to 80% relative humidity. Data on disease reaction were taken following JIRCAS scale. Depending on the preservation potentiality, rate of sporulation and consistency in reaction, fifteen isolates were confirmed as standard differential blast isolates for Bangladesh. But their potentiality in dividing the large scale germplasms according to their genetic background is going on, which is the most important characters of differential isolates.

Parasexual recombination between blast fungi *Pyricularia oryzae* and *P. grisea* on double inoculated lesion

The study was conducted at Saga University, Japan aiming to investigate the Parasexual ability of *Pyricularia* spp. under MS study. Two rice isolates TP106 and TP022 (*Pyricularia oryzae)*, and one crabgrass isolate SA13-1ME (*P. grisea)* were used in this experiment. SA13-1ME was used for the first inoculation and TP106 or TP022 was used for the second inoculation.

A total of 520 isolates collected from the double inoculated lesions were subjected to PCR-RFLP analysis of the ITS region to identify subcultures of the inoculated rice blast isolates (Table 1). As a result, four isolates from the double inoculated lesions with SA13-1ME and TP 106 were identified as subcultures of TP106.

The 319 isolates from the 48 double inoculated lesions with SA13-1ME and TP106, four isolates Ca32-1, Ca32-7, Ca42-4 and Ca44-4 had the PCR product that could be digested with *Dra*I (Fig. 1). SA13-1ME and TP106 differ in mycelial color, i.e., SA13-1ME produces colony with black and TP106 produces white one. The four isolates had colonies with the same color as that of colony of TP106. On the other hands, the other 315 isolates had colonies with black. These results indicate that the four isolates were derived from TP106. In other words, TP106 succeeded in colonization in the three lesions, Ca32, Ca42 and Ca44. On the contrary, in the 201 isolates from the 28 double inoculated lesions with SA13-1ME and TP022, isolates were not derived from TP022. All of the 201 isolates had PCR product that could not be digested with *Dra*I (Fig 1)

Table 1. Summary of *Pyricularia* isolates from double inoculated lesions on crabgrass

Combination	Number of isolates		Number of lesions tested[c]
	P. oryzae[a]	*P. grisea*[b]	
SA13-1ME/TP106	4	315	48 (3)
SA13-1ME/TP 022	0	201	28 (0)

[a] Number of isolates having *P. oryzae* ITS type
[b] Number of isolates having *P. griseae* ITS type
[c] Number of lesions where isolates having *P. oryzae* ITS type is in parenthesises

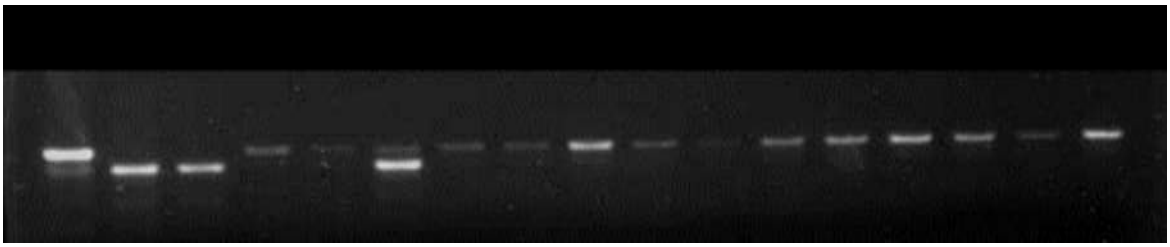


Fig.1. ITS-RFLP profiles of *Pyricularia* isolates from double inoculated leaves of crabgrass with *Pgrisea* and *P. oryzae*. ITS regions of isolates tested were amplified with PCR primers ITS5 and

ITS4. Amplicons were digested with *Dra*I and fractionated in 1.5% agarose gel. Lanes: 1, SA13-1ME; 2, TP106; 3,Ca42-4; 4, Ca44-2; 5, Ca44-3; 6, Ca44-4; 7, Ca44-5; 8, Ca45-1; 9, Ca45-2; 10, Ca45-3; 11, Ca45-4; 12, Ca45-5; 13, Ca45-6; 14, Ca46-1; 15, Ca46-2; 16, Ca46-3; 17, Ca46-4.

To access the recombination genotypes, a total of 17 isolates from three double inoculated lesions were subjected to MAGGY- DNA fingerprint analysis. However, unfortunately, recombinant DNA fingerprint patterns between TP106 and SA13-1ME were not detected among the 17 isolates.

Although TP022 was not recovered from the double inoculated lesions, the fact that TP106 was recovered from the double inoculated lesion indicates that rice blast fungus can invade and colonized in blast lesions on crab grass. Therefore, it can be expected that the recombinant event occurs in nature only when the rice blast pathogen opportunistically infects a blast lesions on crabgrass in which the crabgrass pathogen preexist. The opportunistic infection on the double inoculated lesions observed in this study potentially provides new insight into the life cycle of rice blast fungus.

PATHOGEN POPULATION BIOLOGY

Fusarium spp. identified for causing seedling blight

Efforts on raising rice seedling in trays have been failed due to severe infection of seedling blight disease. Further, recent observation shows the significant increase of this disease incidence in the field during cold environment. Therefore, isolation and identification of the causal pathogen of rice seedling blight occurred in the trays and field was investigated. The infected samples were collected from Gopalganj, Rajshahi and Gazipur. Pure culture of the fungi and its morphological and microscopic studies confirmed that all the tested samples were infected with *Fusarium* spp. This is the first report of *Fusarium* seedling blight of rice in Bangladesh.

DISEASE RESISTANCE AND MOLECULAR STUDIES

Pyramiding blast resistant genes

The experiment was conducted aiming the development of blast resistant lines. Monogenic blast resistant gene(s) *Pi, Pi40, Pita2* and *Pish* was introgressed in the background of premium quality rice BR63 and Noyanmoni and also in the back ground of IR64, BRRI dhan28 and BRRI dhan29. In another attempt, BC2F1 seeds of BRRI dhan29 introgressed with *Pi9, Pi40* and *Pita2* were also produced. The numbers of seeds produced from the crosses are shown in the Table 2. Confirmation of the F_1s will be done through MAS.

Table 2. No. of F1 seeds produced from the crosses between monogenic blast resistant line(s) and recurrent parent(s).

Recurrent Parent	Donor	Gene(s)	No. of F1 seed
Aman, 2014-15			
IR64	IRBL9W IR65482-4-136-2-2 IR93325	Pi9 Pi40 Pita2	62 86 27
Nyonmoni	IRBL9W IR93322 IR93324 IR93325	Pi9 Pish Pita Pita2	62 93 103 24
Boro, 2014-15			
BRRI dhan28	IRBL9W IR65482-4-136-2-2	Pi9 Pi40	87 37
BRRI dhan63	IR65482-4-136-2-2 IR93325	Pi40 Pita2	34 37
BRRI dhan29	IR93325 IR65482-4-136-2-2 IRBL9W	Pita2 Pi40 Pi9	66 (BC2F1) 20 (BC2F1) 8 (BC2F1)

Development of bacterial blight (BB) resistant variety

To develop BB resistant rice varieties, BRRI dhan28, BRRI dhan29 and a local improved varieties were used as recipient parents. IRBB60 and IRBB65 were used as donor parents. BRRI dhan28 and BRRI dhan29 were the two mega varieties for boro season and local improved variety is one of the popular varieties in south-west region of Bangladesh during T. Aman season. IRBB60 and IRBB65 are the BB resistant pyramid lines of IR24. Phenotyping and genotyping were applied for suitable plant selection. Result of the development of BB resistant variety is presented in Table 3. Pathogenicity result showed that some progenies of BC3F1 or BC4F1 developed from the crosses were resistant to most virulent isolate BXO9.

Table 3. Development of BB resistant materials from the crosses of BRRI dhan28, BRRI dhan29 and local improved variety and bacterial blight resistant pyramid lines of IR24

Recipient/Recurrent	Donor		Present status
	Designation	Target *R* gene	
BRRI dhan28	IRBB60	*Xa4, xa5, xa13, Xa21*	45 seeds of BC3F1
BRRI dhan29	IRBB60	*Xa4, xa5, xa13, Xa21*	30 seeds of BC3F1
Local Improved	IRBB60	*Xa4, xa5, xa13, Xa21*	35 seeds of BC4F1
Local Improved	IRBB65	*xa5, Xa7, xa13, Xa21*	30 seeds of BC4F1

Purification of locally improved Aus cultivar Mala through pure line selection

An investigation was carried out to develop and disseminate suitable Aus variety for tidal non-saline sub-ecosystem of Barisal region. Apparently good panicles of popular Aus variety Mala were collected from Bakerganj, Barisal during last Aus 2013 season. From the collected panicles, ten

panicles were selected for growing in Boro 2013-14 season at BRRI HQ, Gazipur following Head to Row system. Fertilizers and other cultural practices were done as per BRRI recommendation. BRRI dhan27, BRRI dhan48 and farmers Mala were used as check variety. Among the tested pure lines, HRP (Mala)-7-10 was found best considering agronomic and yield characteristics. Further purification as well as increasing of pure and healthy seeds of HRP (Mala)-7-10 are now going on.

Evaluation of blast resistant multiline variety of IR64

An investigation was carried out with a view to develop suitable blast resistant multiline rice variety for Bangladesh condition. NILs of IR64 harboring blast resistant genes developed by JIRCAS, Japan were tested in Blast hub of BRRI, Gazipur. According to literature, races of blast pathogen mostly variety specific and maintain the same race is an integral part of successful screening of blast resistant materials. To maintain the blast races on IR64, consecutively 3 years IR64 need to be grown in the same field. Last T. Aman/2014 season, IR64 was cultivated in 0.5 ha of land of BRRI HQ, Gazipur. Around 120 neck blast infected panicles were collected from the field of IR64. IR64 produced an average yield of 4.2 t/ha. The seeds of blast resistant multiline varieties have already collected from JIRCAS, Japan and seeds were multiplied in next season for upcoming large scale evaluation. There is a possibility to select any of the line as first blast resistant rice variety in Bangladesh.

Evaluation of blast resistant multiline variety of IR49830 suitable for tidal non-saline sub-ecosystem

An investigation was carried out to develop suitable blast resistant rice variety for tidal non-saline sub-ecosystem. NILs of IR49830 harboring blast resistant genes *Pish*, *Pi9* and *Pita-2* were selected as suitable materials from the last year T. Aman experiment at BRRI RS, Barisal. For further validation, in coming T. Aman/2015 season, these lines were grown in farmers' field of Barisal region. Sadamota or other popular varieties practiced by local farmers were used as check variety. Fertilizers and other cultural practices were done as per BRRI recommendation.

Considering the disease reaction and agronomic acceptance three lines such as IRBL9-W, IRBLta2Pi and IRBLsh-T (containing both blast and submergence resistant gene (s) along with taller seedling height**)** were found suitable for tidal non saline eco-system. Among them IRBLsh-T line produced highest yield of 5.01 and 4.88 t/ha in BRRI R/S, Barisal and farmers field at Bakergonj, Barisal, respectively (Fig. 2, Fig. 3). Further investigations especially G x E interaction is essential before selecting of these materials as prospective.

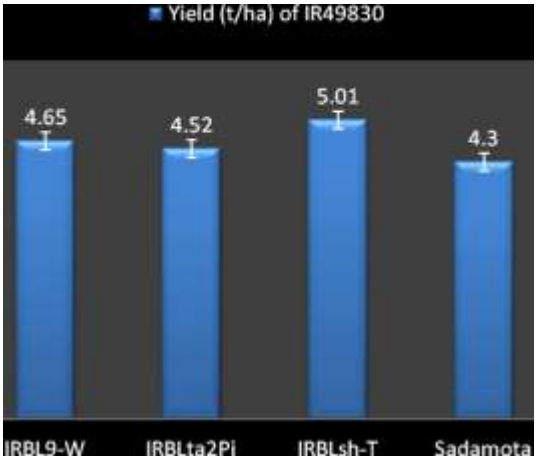


Fig. 2. Performance of IR49830 at BRRI R/S Barisal

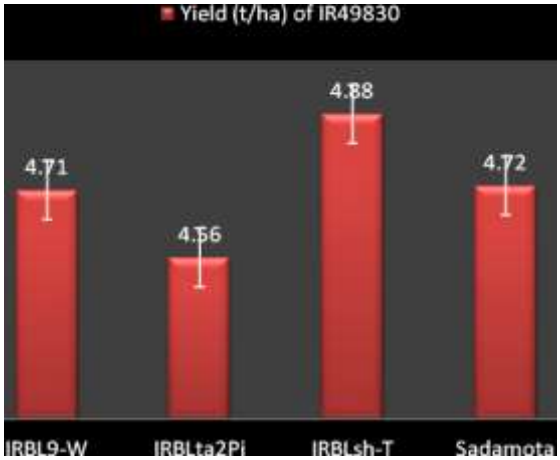


Fig. 3. Performance of IR49830 at Bakergonj, Barisal

Screening against bacterial blight disease

A total of 73 breeding materials were tested to identify bacterial blight (BB) resistant material. Among them BR7783-Ac6-3-2-2-1, HH26-SAL-Y1-SUB2, BR7840-50-3-2-1, showed moderately resistant against BB disease whereas BR7986-29-4, BR7833-19-2-3-5, BR8257-37-1-2-2,BR7358-5-3-9-1, BR7781-10-2-3-2,BR7800-63-1-7-3 and BRRI dhan29-SC3-28-16-10-8-HR1 were most susceptible to BB.

Screening advanced breeding lines and INGER materials against BB, ShB, Blast and False smut

An investigation was carried out to detect the disease reaction of advanced breeding lines against bacterial leaf blight, sheath blight, false smut and blast disease rice. Advanced materials were tested against virulent isolates of the respective pathogen. Blast resistant materials were screened only at seedling stage, BB at both seedling and maximum tillering stages, ShB only at maximum tillering stage and false smut under natural condition. Seedlings for blast screening were grown in seedling cell tray. For other diseases, seeds were sown in the seedbed and transplanted in the main field with BRRI recommended practices following appropriate design with three replications. In each case resistant and susceptible check were maintained. Out of 60 materials, four materials eg. BR 7472-16-2-12-1, IR 73055-8-1-1-3-1, weed tolerant rice and IR 78761-B-SATB1-28-3-2b showed moderately tolerant reaction against *Rhizoctonia solani.* Six materials IR 77542-551-1-1-1-1-2, BR7965-6-1-4, IRBB 65, IRBB 21, BR 8219-16-2 and BR 7941-41-2-2-2-4 showed tolerant reaction against *Xanthomonas oryzae* pv. *oryzae.*

Efficacy of phylloplane *Pseudomonas* strains against sheath blight of rice

The study was conducted at Universiti Putra Malaysia in Malaysia as a part of research collaboration through PhD study. The aim was to determine the efficiency of bacterial strains on sheath blight suppression. Virulent isolate of *R. solani* KLRs16 and two promising *Pseudomonas* bacterial strains UMB20 and BMB42 were used. Bacterial isolates were immobilized in peat materials as per methodologies. Plants were inoculated by *R. solani*. Data were recorded on AUDPC, percent tiller infection, disease progression rate, 100-grain weight.

Application of bacterial strains either individual or mixture significantly reduced the total AUDPC of sheath blight and tiller infection (%) compare to untreated plants upon challenge inoculation with *R. solani* (Table 4). The total AUDPC obtained from all the treatments ranged from 700.67 to 1042.57. Significantly the highest (1042.57) AUDPC was recorded in untreated plants and the lowest (700.67) was in plants treated with mixture strains. Sheath blight suppression over the control was 32.79%, 32.58% and 21.19% respectively in mixture strains of UMB20 and BMB42, UMB20 and BMB42. Combined application of bacterial strains significantly increased 100-grain weight compared to the control.

Table 4. Effect of bacterial consortium on sheath blight disease development in rice

Treatment	AUDPC (affected unit area)	Progression rate (unit /day)	(%) ShB suppression over control	% Tiller infection	% Reduction of TI over control	100-grain weight (g)
UMB20	702.88c	0.016b	32.57	83.19b	16.31	1.57ab
BMB42	821.57b	0.014bc	21.18	96.14a	3.28	1.52ab
UMB20+BMB42	700.67c	0.011c	32.54	87.12b	12.36	1.65a
Control	1042.57a	0.028a	-	99.41a		1.49b

AUDPC = Area under diseases progress curve, ShB = Sheath blight, TI = Tiller infection
Each data represents the mean of four replications. Mean values within a column followed by the same letters are not significantly different at $P \geq 0.05$ by Lsd.

Control of seedling blight and seedling raising initiative in tray (TSRI-protocol)

Raising rice seedling is facing severe infection of seedling blight disease in trays. Hence the disease hampered mechanical transplanting and its expansion at field. Therefore, screening fungicides against seedling blight disease of rice was done in the dry season in cold environment. The main objective was to control the disease generally severely damaged seedlings in the trays/field and for raising healthy seedling in trays/field (TSRI-protocol) Fifteen treatments consisting of 12 fungicides, MOP, Ash and control (no treatment) were tested with 3 replications. Fungicides were used as both seed treatment and seedling spray. The disease incidence was severe in the control treatment. Fungi-8 (code name) was found effective (zero incidence of disease) against the seedling

blight when treated the seeds at 0.2% solution before seed soaking. Further, spraying of fungicides was also effective (zero incidence) when sprayed at immediate after emergence of seedling (2-3 mm) from the soil. Application of MOP or ash was ineffective (severely infected). Management practices followed for disease free seedling production indicated a protocol (transferable technology) for healthy seedling raising initiative in trays (TSRI-protocol).

Effect of organic amendment to minimize blast in rice

This experiment was carried out to find out the effectiveness of rice husk to control blast disease of rice. Seven treatments including one disease and one healthy controls were evaluated (Table 4). The soil was amended with the organic amendments prior to seven days of transplanting. Spore suspension of fourteen days old pure culture of virulent *Pyricularis grisea* was sprayed at maximum tillering stage. Data were recorded on node (%) and neck (%) infection and yield (g/hill).

Significant difference was not found in neck blast incidence and yield among the treatments. The highest node blast incidence was observed in rice husk@2t/ha and lowest in rice husk ash@2t/ha+Nativo (Table 5). Na_2SiO_3 performed better to minimize node blast rather than neck blast. Both node and neck blast incidence was found lower in rice husk ash+Nativo, Nativo and in healthy control. Disease incidence was low because of heavy rainfall occurred after 6 hrs of inoculation. Although no significant difference in grain yield was observed but the highest yield was recorded in Nativo two sprayed and Nativo single spray with husk ash@2t/ha application. Disease incidence was also comparatively lower in these two treatments.

Table 5. Disease incidence and yield performance in different treatments used for blast disease management.

Treatments	Node blast (Incidence)	Neck blast (Incidence)	Yield (t/ha)
Rice husk @ 2.5 t/ha	6.36 a*	3.03 ns	7.448
Rice husk ash	4.66ab	1.74 ns	7.718
Nativo (2 spray)	2.97 ab	1.33 ns	8.60
Na_2SiO_3	2.54 ab	5.38 ns	6.748
Rice husk ash 2.0 t/ha + Nativo (1 spray)	1.70 b	1.24 ns	8.90
Disease control	5.09 ab	5.00 ns	6.974
Healthy control	2.13 ab	0.90 ns	7.206
Lsd (5%)	4.63	5.26 ns	2.54 ns

*same lettering in a column does not differ significantly

Effect of brine solution on rice seed borne fungi

Effect of brine solution was investigated against rice seed borne fungi. Infected or spotted seeds of BRRI dhan33 was treated with the brine solution for 24 hours at 0, 10, 20, 30 50 and 100%

solutions, previously prepared from the dilution of 2% brine solution. Treated seeds were placed on the blotter in the Petri dishes and investigated under sterio-bionocular microscope following ISTA seed testing rules. Incidence of fungi and percent germination of seed was recorded at 7 days after seedling. Root and shoot length (cm) of 15 days old seedlings was measured.

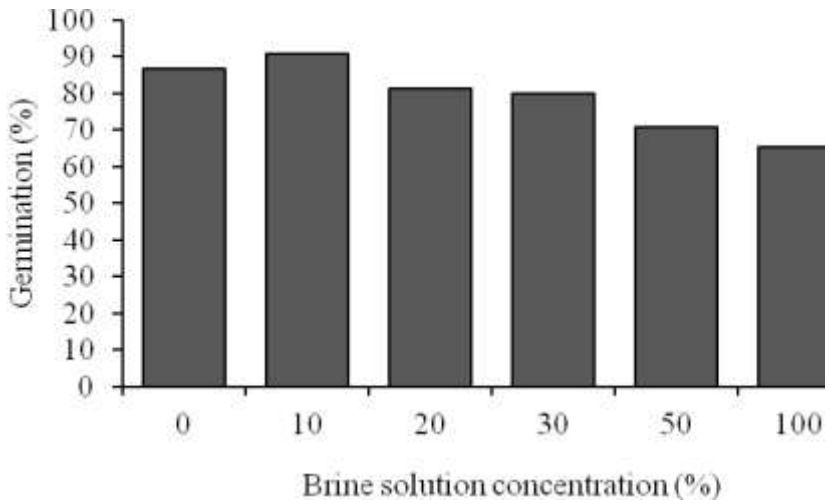


Fig. 4. Germination (%) of seeds at different concentrations of brine solution

The highest germination was observed in 10% brine solution (Fig. 4). However, brine solution has no significant effect on germination. Shoot length increased up to 30% brine solution but no consistent result was found in root length. The incidence of *Fusarium, Bipolaris* and *Curvularia* were detected as 2-7, 0-14 and 9-26% in treated seeds (Fig. 5). Other pathogens were detected very less amount (<3%) in both treated and untreated seeds. The percent infection of *Bipolaris* decreased significantly except for 30% brine solution. Incidence level of *Fusarium* also decreased but no consistency of the incidence was observed among different treatments. Further treatment has no effect on *Curvularia*. Further investigation will be needed to conclude the results.

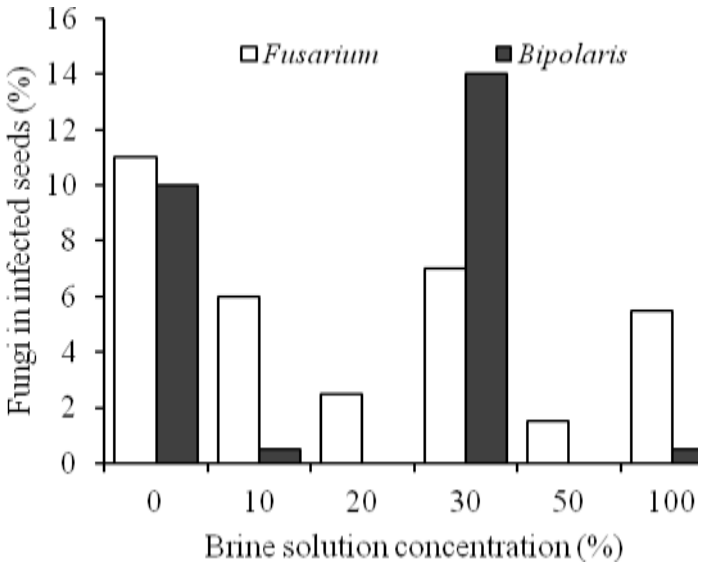


Fig. 5. Percent incidence of pathogens at different concentrations of brine solution

Evaluation of new chemicals against sheath blight and blast diseases of rice

An investigation was carried out to find out effective chemicals against sheath blight and blast diseases of rice at BRRI HQ, Gazipur. The plants were inoculated artificially. Effective chemicals after two years trial were recommended for final registration. Among the twenty four fungicides, six fungicides i.e. Avtar, Palki 75 WG, Mactivo 75 WG, Navera, Bravo and Seltima successfully controlled rice sheath blight disease (above 80%) in the year 2014 (Table 6). These six fungicides will undergo in next season for further confirmation. Whereas, out of twenty eight fungicides, only five fungicides i.e. Palki 75 WG, Indofil's Baan, Mactivo 75 WG, Navita 75 WG and Trigger 75 WP were successfully controlled rice blast disease (above 80%) in the year 2013 & 2014 and recommended for registration.

Table 6. Effect of different fungicides on rice sheath blight and blast disease

No.	Fungicides	% Disease reduction	No.	Fungicides	% Disease reduction
	Sheath blight			Blast	
1	Avtar	80.16	1	Palki 75WG	80.2
2	Palki 75 WG	80.12	2	Indofil`s Baan	80.6
3	Mactivo 75 WG	80.08	3	Mactivo 75WG	84.0
4	Navera	80.21	4	Navita 75WG	80.9
5	Bravo	80.17	5	Trigger 75WP	81.7
6	Seltima	80.21			

TECHNOLOGY DISSEMINATION

Demonstration on integrated rice disease management at farmers' field

An investigation was carried out to demonstrate rice disease management practices at farmers' field condition. BRRI recommended disease management practices were demonstrated at farmer's field of Barisal and Rangpur region. Mostly integrated disease management practices of Sheath blight and Blast were demonstrated. Area of each demonstration is around 33 decimal, 75% of demonstration plot was occupied by BRRI recommendation practice and 25% farmers` practice. The prescribed treatments were as follows:

In T. Aman-14 season, highest blast disease incidence 91% was obtained in BRRI dhan34 at farmer's practice while least disease incidence was recorded as 17% in the same variety at BRRI managed plot in Barisal region. Due to BRRI management intervention 81.32% blast disease decreased compared to farmer's management. Again, highest yield of 3.64 t/ha was obtained in BRRI dhan34 at BRRI managed plot while lowest yield was recorded as 2.23 t/ha in popular local variety Sakkorkhora under farmer's management. Here, 38.74% yield advantage was achieved due

to BRRI management intervention. Again, in Rangpur region, highest sheath blight disease incidence 85% was recorded in Swarna at farmer's practice while least disease incidence was obtained as 15% in BRRI dhan52 at BRRI managed plot. Due to BRRI management intervention 82.35% disease decreased than farmer's practice. Again, highest yield of 5.44 t/ha was obtained in BRRI dhan52 under BRRI management while lowest yield was recorded as 4.67 t/ha in BRRI dhan51 in farmer's practice. Here, a total of 14.15% yield advantage was achieved due to BRRI management intervention.

In Boro 2014-15 season, highest blast disease incidence 42.16% was obtained in BRRI dhan29 at farmer's practice while least disease incidence was recorded as 8.29% in the same variety at BRRI managed plot in Barisal region. Due to BRRI management intervention 80.34% disease decreased than farmer's management. Again, highest yield of 7.98 t/ha was obtained in BRRI dhan29 while lowest yield was recorded as 5.51 t/ha in BRRI dhan29 at farmer's managed plot. Here, 30.95% yield advantage was achieved due to BRRI management intervention. Again, in Rangpur region, highest blast disease incidence 44.27% was recorded in BRRI dhan29 at BRRI managed plot while least disease incidence was obtained as 6.47% in BRRI dhan29 at farmer's managed plot. Due to BRRI management intervention 85.39% disease decreased than farmer's practice. Again, highest yield of 7.12 t/ha was obtained in BRRI dhan52 under BRRI management while lowest yield (6.52 t/ha) was obtained in BRRI dhan52 at farmer's practice. Here, a total of 08.43% yield advantage was achieved due to BRRI management intervention. These demonstrations enhanced farmer's knowledge and skill to a great extent to manage rice sheath blight and blast disease.

Enhancing rice production through integrated blast disease management (PGB project).

BRRI recommended blast disease management was demonstrated in the rice production system to exhibit the increase of yield at farmers' plot in Gopalganj area. Two practices were followed: A) BRRI recommended practice: all cultural (water, weed and fertilizers) and chemical (Nativo spray) management practices were followed as BRRI guidelines and B) Farmers' practice (FP): farmers followed as their own practices to grow rice (no maintaining spacing distance, don't use clean cultivation, use low fertilizers dose rather than BRRI recommended dose and no idea about disease and how to manage disease). Fungicide (Nativo) was sprayed (1st) as soon as leaf blast was observed and second spray was done after 8-12 days after 1st spray in plots where BRRI recommended practices were followed. After 2 weeks of second spray disease severity and incidence were recorded and finally, neck blast, node blast and yield data were recorded.

In terms of disease incidence there was no significant variation observed in different locations. On the other hand, there was significant disease incidence was observed in BRRI recommended practices and Farmers' practices. Higher leaf blast incidence and severity was observed in BRRI dhan29 compared to hybrids. Highest panicle blast incidence was observed in farmers' practices compared to BRRI recommended practices in all trialed locations (Table 7). On contrary, there was no significant variation observed between BRRI practice and farmers practice for node blast incidence. In different locations there were no significant variation was observed for neck blast but for node blast. Higher panicle blast was observed in Kotalipara (80%) in farmers' practice.

Table 7. Disease incidence in BRRI recommended and farmers practices.

Location	Variety	Leaf blast Incidence (%)		Leaf blast Severity		Node blast (%)		Panical blast(%)	
		BRRI	FP	BRRI	FP	BRRI	FP	BRRI	FP
Gopalgnj sadar	Hira-6	0	0	0	0	84.67	100	19.3b*	58.3a
Tungipara	BRRI dhan29	4	5	1	3	93.19	95	34.9b	60.0a
Kotalipara	BRRI dhan29	0	0	0	0	58.19	38.69	4.69b	80a
Nazirpur	BRRI dhan29	5	10	3	3	97.52	86.46	28.3b	50.9a
Fakirhat	Hira-4	1	1	1	1	56.05	31.61	14.1b	76.8a
Mollahat	BRRI dhan29	5	5	3	3	87.40	65.99	44.3b	52.8a
Lsd 5% (BRRI*FP)						0.043		8.95	

*The same letters in a column do not differ significantly at 0.05.

In case of yield, significant variations were observed in different locations as well as in different practices. Highest yield was observed in Gopalgonj sadar (9.23t/ha) but highest yield increase was found in Tungipara (11.55%) (Table 8). Although higher node blast incidence was observed in Tungipara but didn't reflect on yield in BRRI recommended practices. Lowest yield increase was found in Kotalipara (0.71 t/ha) because of high stem borer infestation. Therefore, it is recommended to practice BRRI guidelines for disease management for getting better yield.

Table 8. Yield performance in BRRI recommended practice and Farmers' practice at different locations.

Location	Variety	Yield (t/ha)		Increase (%) in BRRI*
		BRRI*	FP**	
Gopalgonj sadar	Hira-6	9.23	8.87	4.16
Tungipara	BRRI dhan29	6.26	5.61	11.55
Kotalipara	BRRI dhan29	8.37	8.31	0.71
Nazirpur	BRRI dhan29	5.30	5.06	4.69
Fakirhat	Hira-4	8.9	8.28	6.23
Mollarhat	BRRI dhan29	8.45	8.25	2.40
Lsd 5%(BRRI*FP)		0.731		

*BRRI recommended practices, **FP: Farmers' practice

Enhancing rice yield through capacity building training for farmers

Training was conducted in six upazillas: Gopalgonj sadar, Tungipara, Kotalipara, Nazirpur, Mollarhat and Fakirhat. In each upazila 2 batches of training were performed on identification of major rice diseases and their management. Diseased plant samples and preserved samples were shown visually and helped them to identify the disease symptoms and mention the disease names. A total of 347 farmers gathered knowledge about rice diseases and the disease management. From this training farmers clearly understand about disease symptoms and insect attack. Farmers were also able to understand about major rice diseases and learned about the causal pathogens of the major diseases.

BRRI Annual Report for July 2014- June 2015

Rice Farming Systems personnel

F. M. Moinuddin, MS
Chief Scientific Officer[a]
Muhammad Nasim, *PhD*
Principal Scientific Officer[c]
S M Shahidullah, *PhD*
Senior Scientific Officer
Md Abdul Muttaleb, *PhD*
Senior Scientific Officer
Md Harunur Rashid, *PhD*
Senior Scientific Officer[d]
Amina Khatun, *PhD*[a]
Senior Scientific Officer
Md Khairul Quais, *MS*
Senior Scientific Officer
Shila Pramanik, *MS*
Senior Scientific Officer
Nargis Parveen, *MS*
Scientific Officer
ABM Jamiul Islam, *MS*
Scientific Officer[f]
Md Asad-Uz-Zaman, *MS*
Scientific Officer
Md. Tanbir Rubayet
MS, *Scientific Officer*[g]
Bir Jahangir Shirazy, BSc Ag,
Scientific Officer[g]
Hasina Sultana, MS,
Scientific Officer[g]

[a] Joined BRRI HQ on 8 February 2014
[b] On deputation for Post Doct. Fellowship in Foreign country
[c] On deputation for training in Foreign country
[d] Lien at IRRI
[e] Transferred at BRRI R/S, Comilla
[f] Transferred at BRRI R/S, Satkhira
[g] Joined as SO on 10 July 2013
[h] Transferred at BRRI R/S, Rajshahi

SUMMARY

From different cropping patterns for their water requirement in medium highland ecosystems the tested patterns gave significantly higher REY as well as higher gross margin and higher water productivity than check pattern. Tomato-Mugbean-T. Aman produced 277% higher rice equivalent yield (36.5 t/ha) than check pattern of two rice system (9.68 t/ha).

In long-term effect of three cropped cropping patterns on the agro-economic productivity and soil health, the Potato-Boro-T. Aman cropping pattern produced the highest REY of 17.8 t/ha and 16.7 t/ha in Rangpur and Gazipur, respectively followed by Boro-T. Aus-T. Aman (12.9 t/ha and 14.9 t/ha).

In maize intercropping technologies to develop suitable cropping pattern packages for maize based cropping pattern in Chuadanga, from the study, the find out was the total productivity of intercropping system was compared in terms of maize equivalent yield (MEY), which differed significantly among the treatments. Significantly highest MEY was obtained from CP_3 (31.0 t/ha) followed by CP_1 (25.6 t/ha). High value vegetables crop produced as intercrop with maize contributed significant difference among the tested patterns. Significantly lower MEY were obtained from sole maize plot.

In the high intensity Cropping Pattern for greater Kushtia, the highest REY was found from Maize+Potato/Pumpkin-T. Aus-T. Aman cropping pattern (25.69 t/ha) followed by Maize+Spinach-T. Aus-Aman cropping pattern (17.93 t/ha) and Maize –T. Aman (16.26) cropping pattern. And lowest REY was found from Mustard-Mungbean-Aus-Aman (15.15 t/ha) cropping pattern (Table 39).

From the improved cropping systems for greater Kushtia, the REY of improved cropping patterns Mustard-Boro-T. Aman (12.27- 13.93 t/ha), Maize-Mungbean-T. Aman (13.67- 13.86 t/ha), Maize-Til-T. Aman (15.60 t/ha) and Potato- Mukhikachu-T. Aman (40.06 t/ha) were significantly higher than the existing Boro-Fallow-T. Aman (10.22-11.65 t/ha), Maize-Fallow-T. Aman (11.00-14.42 t/ha) Maize-Jute-T. Aman (14.01 t/ha) and Boro-Mukhikachu-Fallow (30.23 t/ha) cropping pattern, respectively. Irrespective of locations, all of the improved cropping patterns gave higher gross margin than local check.

The highest grain yield was obtained with the T_4 treatment (4.90 t/ha.), followed by the T_5, T_6 and T_2 treatments, and minimum under T_1 (3.83 t/ha) treatments. In Boro season, the grain yield of rice was significantly affected by different treatments ($p \leq 0.05$). Highest grain yield was obtained from T_5 (8.55 t/ha) treatment, followed by the T_4 and T_2 treatments.

In Boro season, higher grain yield was obtained from the N_3 treatment (7.10 t/ha) followed by the N_2 (6.88 t/ha), N_4 (6.78 t/ha) and N_1 (6.70 t/ha) treatments and lower was in the N_6 (3.23 t/ha) treatment in BRRI dahn28 (Table 42). In BRRI dhan29, significantly higher grain yield was observed in N_4 (7.80 t/ha) treatment compared to all other treatments and lower was in the N_6 (3.15 t/ha) treatment. BRRI dhan29 achieved higher grain yield compared to BRRI dhan28, irrespective of different N treatments.

From the evaluation of BRRI prilled urea applicator in Boro and T. Aman rice in Boro-Fallow-T. Aman cropping system, the output of the study, the significantly higher grain yield was obtained from T_1 (5.66 t/ha) treatment followed by T_3 (5.60 t/ha) and T_2 (5.53 t/ha) treatments. The lowest yield was observed in T_5 (4.16 t/ha) treatment. In Boro season, the highest grain yield was obtained from T_3 (6.73 t/ha) followed by T_1 (6.22 t/ha) treatments in BRRI dhan28.

Irrespective of spacing, the hybrid variety of sunflower, Hysun33 produced higher seed yield in low, medium and high salinity level.Hysun33 produced higher seed yield at the spacing of 60 cm × 45 cm in low (2.85 t ha^{-1}), medium (2.73 t ha^{-1}) and high salinity (2.00 t ha^{-1}) level.

In the rice-based cropping pattern in partially irrigated ecosystem, the REY among the tested patterns ranged from 23 to 28.13 t ha^{-1} and apparently the higher REY was observed in CP_3 followed by CP_4 and CP_2. Higher gross return, gross margin and benefit cost ratio (BCR) were also obtained from CP_3 (Tomato-Mungbean-BRRI dhan62) followed by CP_4 (Tomato-Mungbean-BRRI dhan39) and CP_2 (Tomato-Mungbean-BRRI dhan56) and the lower was found in CP_1.

In the three crop systems for medium high tide wetland non saline ecosystem, the three crop system produced significantly higher REY of 42% to 162% than two crop system of Fallow-Jute-T.Aman cropping pattern (8.57 t/ha). Potato-Jute-T.Aman cropping pattern gave higher REY of 22.47 t/ha among the tested patterns. The gross margin of potato and lentil based three cropped system was 488% and 204% higher than Fallow-Jute-T.Aman system (23746 Tk/ha).

From the study of USG applicator, the findings was the highest REY of 27 t/ha observed in Potato (Diamont)-Maize (NK-40)-T. Aman (BRRI dhan57) cropping pattern followed by potato based cropping pattern. Inclusion of sunflower and mungbean gave about 211% and 96% higher REY, respectively than two rice system (7.17 t/ha). Fallow-T.Aus-T.Aman, Mungbean-Fallow-T.Aman, Fallow-Fallow-T.Aman/Grass pea was also trialed at Patuakhali, Jhalkathi and Barisal district, respectively. The REY of Fallow-T.Aus-T.Aman, Mungbean-Fallow-T.Aman and Fallow-Fallow-T.Aman/Grass was 151%, 55% and 91% higher than single T. Aman cropping pattern (3.19 t/ha).

Evaluation of different cropping patterns for their water requirement in medium highland ecosystem

Six cropping patterns were evaluated to find out the most water efficient profitable cropping pattern for sustainable food production. The experiment was conducted at East Byde, BRRI Experimental Farm, Gazipur during, Kharif II-2014, Rabi 2014-15 and Kharif I-2015 season. Cropping patterns viz., Tomato (BARI hybrid tomato-5)- Mungbean (BARI mug-6)- T. Aman (BRRI dhan49), Wheat (BARI gom-26)-Mungbean (BARI mug-6)- T. Aman (BRRI dhan49), Potato (BARI alu-7)-T. Aus (BRRI dhan48)- T. Aman (BRRI dhan49), Lentil (BARI masur-7)-T. Aus (BRRI dhan48)- T. Aman (BRRI dhan49) and Chickpea (BARI chola-9)- T. Aus (BRRI dhan48)-T. Aman (BRRI dhan49) were evaluated along with the check, Boro (BRRI dhan29)-Fallow-T. Aman (BRRI dhan49) in RCB design with three replications. Recommended management practices were followed for rice and non-rice crops. Irrigation water applied in each plot with bucket and data were recorded. Water productivity was measured with the following formula:

$$\text{Water productivity(kg/mm/ha)} = \frac{\text{Total yield of crop (Kg/ha)}}{\text{Water requirement of crop in mm (Rainfall+ Irrigation)}}$$

All of the tested patterns gave significantly higher REY as well as higher gross margin and higher water productivity than check pattern. Tomato-Mugbean-T. Aman produced 277% higher rice equivalent yield (36.5 t/ha) than check pattern of two rice system (9.68 t/ha). This cropping pattern also gave more than 1600% higher gross margin and higher water productivity (20.9 kg/mm/ha). All other tested patterns also showed the better performance in respect of REY, gross margin and water productivity than two rice cropping pattern (check).

Table. Yield of tomato, wheat, potato, lentil, chickpea, mungbean, rice and REY of different cropping patterns, BRRI, Gazipur, 2014-15

Cropping pattern	Yield t ha^{-1}			
	Rabi/ Boro	Mug/ T. Aus	T. Aman	REY
Tomato-Mugbean-T. Aman (CP_1)	67.23	1.02	4.61	36.50
Wheat- Mugbean-T. Aman (CP_2)	4.17	1.09	4.68	14.89
Potato-T. Aus-T. Aman (CP_3)	16.50	4.17	4.55	17.52
Lentil- T. Aus-T. Aman (CP_4)	1.80	4.15	4.83	16.45
Chickpea- T. Aus-T. Aman (CP_5)	2.04	4.16	4.58	14.59

Boro-Fallow-T. Aman (CP_6)	5.10	-	4.98	9.68
CV (%)	-	-	-	5.9
F for treat.	-	-	-	**
$LSD_{0.05}$ for Treat	-	-	-	1.96

Price (Tk/kg)- Tomato: 8, Wheat: 30, Potato: 10, Lentil: 80, Chickpea: 50, Mungbean: 52, Paddy: 18

Table. Economic performance of different cropping patterns, BRRI, Gazipur, 2014-15

Cropping pattern	TVC (000 Tk/ha)	GR (000 Tk/ha)	GM (000 Tk/ha)
Tomato-Mugbean-T. Aman (CP_1)	177	684	507
Wheat- Mugbean-T. Aman (CP_2)	158	279	122
Potato-T. Aus-T. Aman (CP_3)	218	328	110
Lentil- T. Aus-T. Aman (CP_4)	159	308	150
Chickpea- T. Aus-T. Aman (CP_5)	167	274	107
Boro-Fallow-T. Aman (CP_6)	152	182	29

Long-term effect of three cropped cropping patterns on the agro-economic productivity and soil health

A study was designed to determine the long-term implications of Potato-Boro-T. Aman, Maize-Mungbean-T. Aman and Boro-T. Aus-T. Aman cropping patterns on the system productivity, economics and soil fertility. The experiment was conducted during 2011-12 at the experimental farms, BRRI, Gazipur and BRRI Regional Station, Rangpur. The tested cropping patterns were, Potato-Boro-T. Aman, Maize- Mungbean-T. Aman, Boro-T. Aus-T. Aman and Boro-Fallow-T. Aman (check). The experiment was laid out in a RCB design with three replications. Recommended management practices were followed. Yield, REY and economic performance are presented in Table. Potato-Boro-T. Aman cropping pattern produced the highest REY of 17.8 t/ha and 16.7 t/ha in Rangpur and Gazipur, respectively followed by Boro-T. Aus-T. Aman (12.9 t/ha and 14.9 t/ha).

Evaluation of maize intercropping technologies to develop suitable cropping pattern packages for maize based cropping pattern in Chuadanga

This study was undertaken to assess the suitability of growing different short duration Rabi vegetables with hybrid maize in Maize-Sweet gourd-T. Aman cropping system. The study was conducted at farmer's field of Chuadanga Sadar, Kharif I-2014, Kharif II-2014 and Rabi 2014-15 seasons. Three cropping patterns viz., Maize+Spinach-Sweet gourd-T. Aman, Maize+Potato-Sweet

gourd-T. Aman and Maize+Carrot-Sweet gourd-T. Aman were evaluated along with the check, Maize-Sweet gourd-T. Aman in RCB design with three replications. Recommended management practices were followed for rice and non-rice crops.

The total productivity of intercropping system was compared in terms of maize equivalent yield (MEY), which differed significantly among the treatments. Significantly highest MEY was obtained from CP_3 (31.0 t/ha) followed by CP_1 (25.6 t/ha). High value vegetables crop produced as intercrop with maize contributed significant difference among the tested patterns. Significantly lower MEY were obtained from sole maize plot.

From the economic analysis, the highest gross margin was obtained from CP_3 (254000 Tk/ha) followed by CP_1. The CP_3, CP_1, CP_5 and CP_4 gave about 69%, 46%, 27% and 20% higher gross margin (GM) than the check pattern.

Table. Yield and maize equivalent yield (MEY) of different cropping patterns, Chuadanga, 2014-15

Treatment	Yield (t/ha)				MEY (t/ha)
	Maize	Vegetables	Sweet gourd	T. Aman	
Maize+Bushbean-Sweet gourd-T. Aman (CP_1)	12.56	5.27	17.16	4.07	25.55
Maize+Spinach-Sweet gourd-T. Aman (CP_2)	11.33	9.51	17.31	3.91	21.78
Maize+Potato-Sweet gourd-T. Aman (CP_3)	11.37	17.38	17.22	3.87	31.02
Maize+Red amaranth-Sweet gourd-T. Aman (CP_4)	11.93	5.33	18.17	3.82	23.38
Maize+Coriander- Sweet gourd-T. Aman (CP_5)	12.63	2.22	16.44	4.56	23.94
Sole Maize-Sweet gourd-T. Aman (CP_6)	12.93	-	17.36	3.94	21.19
CV (%)					6.0
F for treat.					**
$LSD_{0.05}$ for Treat					2.67

Price (Tk/kg)- Tomato: 8, Potato: 10, Bushbean: 15, Spinach: 4, Red amaranth: 10, Coriander: 20, Sweet gourd: 4, Paddy: 18

Table. Economic performance of different cropping patterns, Chuadanga, 2014-15

Cropping pattern	TVC (000 Tk/ha)	GR (000 Tk/ha)	GM (000 Tk/ha)	GM (%) over FP
Maize+bushbean-Sweet gourd-T. Aman (CP_1)	215	434	219	(+) 46
Maize+Spinach-Sweet gourd-T. Aman (CP_2)	217	370	153	(+) 2
Maize+Potato-Sweet gourd-T.	273	527	254	(+) 69

Aman (CP_3)				
Maize+Red amaranth-Sweet gourd-T. Aman (CP_4)	218	398	180	(+) 20
Maize+coriander-Sweet gourd-T. Aman (CP_5)	216	407	191	(+) 27
Sole Maize-Sweet gourd-T. Aman (CP_6)	210	360	150	-

Development of high intensity Cropping Pattern for greater Kushtia

The experiment was conducted at the farmer's field during the period from April 2014 to June 2015. Three cropping patterns viz., Mustard (BARI sarisha-14)-Mungbean (BARI mug-6)-T. Aus (BRRI dhan48)-T. Aman (BRRI dhan57), Maize (BARI hybrid bhutta-7/Indian hybrid varity)+Spinach (Local)-Sweet gourd (BARI misti kumra-2)-T. Aman (BRRI dhan57) and Maize (BARI hybrid bhutta-7/Indian hybrid varity)+Potato (Cardinal)-T. Aus (BRRI dhan48)-T. Aman (BRRI dhan57) were evaluated along with the check Maize (BARI hybrid bhutta-7/Indian hybrid varity)-Fallow-T. Aman (BRRI dhan57/BRRI dhan49) in RCB design with three replications. Recommended management practices were followed for rice and non-rice crops. A simple economic analysis was done to evaluate the total productivity of these cropping patterns.

The highest REY was found from Maize+Potato/Pumpkin-T. Aus-T. Aman cropping pattern (25.69 t/ha) followed by Maize+Spinach-T. Aus-Aman cropping pattern (17.93 t/ha) and Maize –T. Aman (16.26) cropping pattern. And lowest REY was found from Mustard-Mungbean-Aus-Aman (15.15 t/ha) cropping pattern (Table 39).

Table 39. Yield performance for different cropping pattern in Meherpur, 2014-15

Cropping pattern	Yield (t/ha)				REY (t/ha)
	T. Aus	T. Aman	Mustard/Maize	Mungbean/Potato/ Spinach/Pumpkin	
Mustard-Mungbean-T. Aus-T. Aman	4.35	4.1	1.3	0.7	15.15
Maize+Spinach-T. Aus-T. Aman	4.59	4.12	9.36	5.7	17.93
Maize+Potato/Pumpkin-T. Aus-T. Aman	4.21	4.58	9.16	14.5+7.47	25.69
Maize-T. Aman	-	5.27	12.78	-	16.26
LSD $_{(0.05)}$	-	-	-	-	2.21
CV (%)	-	-	-	-	5.90

Price (Tk/kg)- Mustard: 60, Mungbean: 80, Potato: 10, Spinach: 4, Maize: 17, Pumpkin: 5, Paddy: 20

Validation of improved cropping systems for greater Kushtia

Different ecosystems were selected by the joint effort of researcher and extension personnel in Chuadanga, Meherpur and Kushtia districts. Seven farmers in each block were selected for the improved cropping system demonstration to show the technological advantage of the improved systems over the existing system. In each trial, an improved cropping pattern was tested against the existing cropping pattern. REY of improved cropping patterns Mustard-Boro-T. Aman (12.27-13.93 t/ha), Maize-Mungbean-T. Aman (13.67- 13.86 t/ha), Maize-Til-T. Aman (15.60 t/ha) and Potato- Mukhikachu-T. Aman (40.06 t/ha) were significantly higher than the existing Boro-Fallow-T. Aman (10.22-11.65 t/ha), Maize-Fallow-T. Aman (11.00-14.42 t/ha) Maize-Jute-T. Aman (14.01 t/ha) and Boro-Mukhikachu-Fallow (30.23 t/ha) cropping pattern, respectively. Irrespective of locations, all of the improved cropping patterns gave higher gross margin than local check.

Effect of fertilizer management on yield of double transplanted Aman and Boro rice under T. Aman-Boro cropping systems

In this study in late situation double transplanting of Aman and Boro with fertilizer treatments were evaluated. The experiment was conducted during T. Aman 2014 and Boro 2014-15 seasons at BRRI Farm, Gazipur. In this experiment six planting methods along with three fertilizer application methods for double transplanting were applied. The design of the experiment was RCB with three replications. Nitrogen, P, K, S and Zn were applied as per recommendation. In T. Aman season, the grain yield ranged from 3.83 to 4.90 t/ha among the treatments. The treatment effect on grain yield was significant ($p \leq 0.05$). The highest grain yield was obtained with the T_4 treatment (4.90 t/ha.), followed by the T_5, T_6 and T_2 treatments, and minimum under T_1 (3.83 t/ha) treatments. In Boro season, the grain yield of rice was significantly affected by different treatments ($p \leq 0.05$). Highest grain yield was obtained from T_5 (8.55 t/ha) treatment, followed by the T_4 and T_2 treatments. The lower and statistically similar grain yields were observed from T_7 (6.07 t/ha) and T_1 (6.82 t/ha) treatments.

Table. Grain yield of DT Aman Rice in Boro-Fallow-T. Aman cropping pattern, BRRI Gazipur, 2014

Treatment	Grain yield (t/ha)
T_1= Normal transplanting with 60 DOS (TP: 25 Sep; Sowing: 25 Jul.)	3.83
T_2= Normal transplanting with 45 DOS (TP: 25 Sep.; Sowing: 10 Aug.)	4.05
T_3= Normal transplanting with 30 DOS (TP: 25 Sep.; Sowing: 25 Aug.)	-
T_4= Double transplanting with removed seedling (100%) and no fertilizer in 1st	4.90

transplanted plot	
T_5= Double transplanting with removed seedling (100%) and 1st split urea in 1st transplanted plot	4.63
T_6= Double transplanting with removed seedling (75%) and full fertilizer in 1st transplanted plot	4.50
T_7= Remaining 25% seedling in fully fertilized 1st transplanted plot	3.89
CV (%)	9.3
$LSD_{0.05 \text{ for treatment}}$	0.73

Table. Grain yield of DT Boro Rice in Boro-Fallow-T. Aman cropping pattern, BRRI Gazipur, 2014-15

Treatment	Grain yield (t/ha)
T_1= Normal transplanting with 80 DOS (TP: 25 Feb.; Sowing: 05 Dec.)	6.82
T_2= Normal transplanting with 60 DOS (TP: 25 Feb.; Sowing: 25 Dec.)	8.19
T_3= Normal transplanting with 40 DOS (TP: 25 Feb.; Sowing: 15 Jan.)	8.09
T_4= Double transplanting with removed seedling (100%) and no fertilizer in 1st transplanted plot	8.31
T_5= Double transplanting with removed seedling (100%) and 1st split urea in 1st transplanted plot	8.55
T_6= Double transplanting with removed seedling (75%) and full fertilizer in 1st transplanted plot	7.76
T_7= Remaining 25% seedling in fully fertilized 1st transplanted plot	6.07
CV (%)	9.8
$LSD_{0.05\% \text{ for treatment}}$	1.33

Evaluation of fertilizer management options in major crops in Kushtia region

Ten farmers of Hanurbaradi and Shuvorajpur block in Chuadanga and Meherpur district were selected for this trial during Kharif-II 2014 and Rabi 2014-15 seasons to compare the different fertilizer management options during T. Aman and Boro season. Each farmer's field was divided into three parts to imply the treatments viz., BRRI recommended fertilizer dose, soil test based fertilizer dose and farmer's usual fertilizer dose.

In Chuadanga, BRRI recommended fertilizer management and farmer's practice gave similar grain yield. Whereas soil test based fertilizer treatment resulted significantly lower grain yield compared to other treatments in T. Aman season. In Boro season, all the options gave similar grain yield.

In Meherpur, BRRI recommended fertilizer management and farmer's practice gave similar grain yield in T. Aman season. Soil test based fertilizer treatment gave significantly lower grain yield

compared to other treatments. In Boro season, BRRI recommended treatment gave significantly higher grain yield. Soil test based fertilizer treatment and farmer's practice gave the similar grain yield.

Nitrogen management options in Boro and T. Aman rice under Boro-Fallow-T. Aman cropping system

This study was undertaken to determine appropriate timing of split application of N for making accurate N fertilizer recommendations for rice. The treatments were: i) One third of N was applied at IT stage + one third at AT stage + one-third at PI stage (N_1); ii) One-half at IT stage + another-half at PI stage (N_2); iii) One third at IT stage + two-third at PI stage (N_3); (iv) One-fourth at IT stage + one-fourth at AT stage+ half at PI stage (N_4); v) Half at IT stage + another half at AT stage (N_5) and vi) N-control (N_6). BRRI dhan44 in T. Aman season and BRRI dhan28 and BRRI dhan29 in Boro season were grown. In T. Aman season, each treatment received 70 kg N/ha as urea and in Boro season, 119 kg N/ha and 136 kg N/ha as urea for BRRI dhan28 and BRRI dhan29, respectively. In T. Aman season, timing of N application treatments had significant effect ($p<0.01$) on grain yield. Significantly higher grain yield (5.50 t/ha) was observed in N_4 treatment followed by N_3 (5.47 t/ha), N_2 (5.33 t/ha) and N_1 (5.13 t/ha) treatments. In Boro season, higher grain yield was obtained from the N_3 treatment (7.10 t/ha) followed by the N_2 (6.88 t/ha), N_4 (6.78 t/ha) and N_1 (6.70 t/ha) treatments and lower was in the N_6 (3.23 t/ha) treatment in BRRI dahn28 (Table 42). In BRRI dhan29, significantly higher grain yield was observed in N_4 (7.80 t/ha) treatment compared to all other treatments and lower was in the N_6 (3.15 t/ha) treatment. BRRI dhan29 achieved higher grain yield compared to BRRI dhan28, irrespective of different N treatments.

Evaluation of BRRI prilled urea applicator in Boro and T. Aman rice in Boro-Fallow-T. Aman cropping system

The experiment was conducted in T. Aman and Boro seasons of 2014-15 to compare the yield under varying methods of N application. There were five treatments: (i) Hand broadcasting of prilled urea as per BRRI recommendation (T_1), (ii) USG application by applicator (2.7 g/4 hills) (T_2), (iii) Prilled urea application by applicator (70% of the recommended urea in broadcasting) (T_3), (iv) Hand broadcasting of prilled urea as per T_3 dose (T_4) and (v) N-control (T_5). BRRI dhan44 and BRRI dhan28 were grown in T. Aman and Boro season, respectively. The significantly higher grain yield was obtained from T_1 (5.66 t/ha) treatment followed by T_3 (5.60 t/ha) and T_2 (5.53 t/ha) treatments. The lowest yield was observed in T_5 (4.16 t/ha) treatment. In Boro season, the highest grain yield was obtained from T_3 (6.73 t/ha) followed by T_1 (6.22 t/ha) treatments in BRRI dhan28. The lowest yield was observed in T_5 treatment (3.65 t/ha).

Evaluation of different cropping patterns in saline area

The study was conducted to validate different cropping patterns in saline soils during 2014-15 with six different cropping patterns. The cropping patterns were: CP_1= T. Aman-Dibbled sunflower; CP_2=T. Aman-Zero tilled wheat (strip tilled); CP_3=T. Aman-Zero tilled wheat (line sown), CP_4=T. Aman-Spinach (broadcast, line sown); CP_5= T. Aman-dibbled Okra; CP_6= Fallow-Fallow-T. Aman (Check) following RCB design with six replications. On an average, transplanted Aman rice produced 4.15, 4.48 and 4.66 t ha^{-1} grain yield in low, moderate and high saline area, respectively. BRRI dhan53 yield range was 4.06 to 4.23 t ha^{-1}. The medium and high saline sites, farmers cultivated BRRI dhan54 which produced grain yield of 4.37-4.50 t ha^{-1} and 4.72-5.54 t ha^{-1}, respectively. Wheat yield was reduced more than 50% in high saline area compared to the yield of low and medium saline area. Indian spinach sown in line without tillage and by dibbling method produced a yield of about 30 and 26 t ha^{-1} which was slightly reduced in medium saline area and reduced by about 15% in high saline area. The study showed the feasibility of sunflower in different gradient of salinity, wheat and spinach in low and medium saline area.

Evaluation of sunflower varieties and spacing under different gradient of salinity

This study was undertaken to evaluate the suitable variety and optimum plant population for better productivity of dibbled sunflower in the saline soils. The treatments were: Variety V_1= BARI Surjomukhi-2, V_2= Hysun33, V_3= Advanced line and Spacing: S_1= 75 cm×45 cm: S_2= 60 cm×45 cm and S_3= 45 cm×30 cm following RCB design with six replications. Irrespective of spacing, the hybrid variety of sunflower, Hysun33 produced higher seed yield in low, medium and high salinity level.Hysun33 produced higher seed yield at the spacing of 60 cm × 45 cm in low (2.85 t ha^{-1}), medium (2.73 t ha^{-1}) and high salinity (2.00 t ha^{-1}) level.

Evaluation of fertilizer recommendation in rice-dibbled sunflower cropping sequence under different gradient of salinity

The experiment was conducted to enhance the productivity of rice-sunflower cropping system in the saline soils. Five different fertilizer management were F1= Full recommended fertilizer in rice in rice and sunflower (RR); F2= Full recommended P and K fertilizer in rice and sunflower (N omission); F3= Full recommended N and K fertilizer in rice and sunflower (P omission) F4= Full recommended P and N fertilizer in rice and sunflower (K omission); F5= Farmers' practice in rice and sunflower (FP) following RCB design with 3 replication.

The highest grain yield was recorded in the treatment of recommended dose of N, P, K fertilizer (4.62 t ha^{-1}) which was statistically similar to farmers practice (4.59 t ha^{-1}) and without K fertilizer (4.26 t ha^{-1}).

Evaluations of agronomic options for increasing the productivity of Boro rice in saline soils

The experiment was conducted to identify suitable agronomic options for boro rice in saline soils in Satkhira district. The treatments were: BINA dhan10, DS: Dec. 05, TP: Jan 10, 2-3 seedling/hill; BINA dhan10, DS: Nov. 25, TP: Jan 10, 5-6 seedling/hill; BRRI dhan61, DS: Dec. 05, TP: Jan 10, 2-3 seedling/hill; BRRI dhan61, DS: Nov. 25, TP: Jan 10, 5-6 seedling/hill; BRRI hybrid dhan3, DS: Dec. 05, TP: Jan 10, 1-2 seedling/hill; BRRI hybrid dhan3, DS: Nov. 25, TP: Dec 30, 1-2 seedling/hill; BRRI dhan28, DS: Dec. 05, TP: Jan 10, 2-3 seedling/hill; viii) BRRI dhan28, DS: Nov. 25, TP: Jan 10, 5-6 seedling/hill; BRRI dhan28, DS: Nov. 15, TP: Dec 20, 5-6 seedling/hill; BRRI dhan28, DS: Nov. 25, TP: Jan 10, 5-6 seedling/hill, 90 kg additional S/ha following RCB design with 3 replication. The highest grain yield (6.27 t ha^{-1}) was obtained from BRRI hybrid dhan3 transplanted 10 days earlier compared to farmers' average transplanting date (10 January) which was similar to BRRI hybrid dhan3 at normal planting date, BINA dhan10 both with 2-3 and 5-6 seedling $hill^{-1}$, BRRI dhan61 with more number of seedling (5-6 $hill^{-1}$).

Evaluation of rice-based cropping pattern in partially irrigated ecosystem

This investigation was undertaken to evaluate the pproductivity of recently released BRRI varieties in Vegetables-Mungbean-DS Aman cropping pattern at BRRI, Gazipur during 2014-15. Five different cropping patterns viz., Tomato (BARI Hybrid Tomato-5)-Mungbean (BARI Mug-6)-DS Aman (BRRI dhan57) (CP_1), Tomato (BARI Hybrid Tomato-5)-Mungbean (BARI Mug-6)-DS Aman (BRRI dhan56) (CP_2), Tomato (BARI Hybrid Tomato-5)-Mungbean (BARI Mug-6)-DS Aman (BRRI dhan62) (CP_3), Tomato (BARI Hybrid Tomato-5)-Mungbean (BARI Mug-6)-DS Aman (BRRI dhan39) (CP_4) and Tomato (BARI Hybrid Tomato-5)-Mungbean (BARI Mug-6)- DS Aman (BRRI dhan33) (CP_5) were evaluated in RCB design with three replications. The REY among the tested patterns ranged from 23 to 28.13 t ha^{-1} and apparently the higher REY was observed in CP_3 followed by CP_4 and CP_2. Higher gross return, gross margin and benefit cost ratio (BCR) were also obtained from CP_3 (Tomato-Mungbean-BRRI dhan62) followed by CP_4 (Tomato-Mungbean-BRRI dhan39) and CP_2 (Tomato-Mungbean-BRRI dhan56) and the lower was found in CP_1.

Table. Yield of rice, tomato and mungbean and REY of different cropping patterns, BRRI, Gazipur, 2014-15

Cropping pattern	Yield (t ha^{-1})			REY (t/ha)
	DS Aman	Tomato	Mungbean	
BARI hybrid tomato-5 - BARI Mug-6 - BRRI dhan57 (CP_1)	3.8	32.63	0.35	23.0
BARI hybrid tomato-5 - BARI Mug-6 - BRRI dhan56 (CP_2)	3.37	38.31	0.36	25.75

BARI hybrid tomato-5 - BARI Mug-6- BRRI dhan62 (CP_3)	3.74	42.02	0.34	28.13
BARI hybrid tomato-5 - BARI Mug-6 - BRRI dhan39 (CP_4)	4.14	37.83	0.29	26.06
BARI hybrid tomato-5 - BARI Mug-6 - BRRI dhan33 (CP_5)	3.81	32.83	0.39	23.23
CV(%)	19.8	9.5	25.9	9.6
F-values for CP	NS (1.41)	* (6.57)	NS (0.17)	NS (4.56)

* NS mean significant at the 0.05 probability level and not significant, respectively
Price (Tk/kg): Tomato:10, Paddy: 18, Mungbean: 55

Table. Economic performance of different cropping patterns, BRRI, Gazipur, 2014-15

Cropping pattern	Gross return ('000 Tk/ha)	TVC ('000 Tk/ha)	Gross margin ('000 Tk/ha)	BCR
BARI hybrid tomato-5 - BARI Mug-6 - BRRI dhan57 (CP_1)	414.00	156.09	257.91	2.65
BARI hybrid tomato-5 - BARI Mug-6 - BRRI dhan56 (CP_2)	463.50	156.09	307.41	2.97
BARI hybrid tomato-5 - BARI Mug-6 - BRRI dhan62 (CP_3)	506.34	156.09	350.25	3.24
BARI hybrid tomato-5 - BARI Mug-6 - BRRI dhan39 (CP_4)	469.08	156.09	312.99	3.01
BARI hybrid tomato-5 - BARI Mug-6 - BRRI dhan33 (CP_5)	418.14	156.09	262.05	2.68

Evaluation of musk melon intercropping with lentil in three crop system in tidal non saline ecosystem

Musk melon intercropping with lentil in Lentil-Jute-T. Aman cropping pattern was conducted to validate musk melon intercropping at five dispersed farmer's field during 2014-15 at Nazirpur upazila, in Pirojpur district. Intercropping system gave significantly higher rice equivalent yield (REY) of 24.46 t/ha than Lentil-Jute-T. Aman (13.17 t/ha) cropping pattern. The gross margin (GM) of intercropping system was 137% higher than without intercropping system (70747 Tk/ha). The BCR of intercropping and without intercropping system was 1.85 and 1.56, respectively. Musk melon as intercropped with lentil can increase the three crop system productivity at almost double of total REY and GM.

Table. Crop yield and rice equivalent yield (REY) of musk melon intercropping grown at Nazirpur, Pirojpur during 2014-15

Cropping Pattern	Yield (t/ha)				REY (t/ha)
	Lentil	Musk melon*	Jute	T.Aman	
CP1: Lentil+Musk melon-Jute-T. Aman	0.89±0.01	7200±128	2.05±0.06	3.79±0.10	24.46±0.32
CP2: Lentil-Jute-T. Aman (check)	1.05±0.05	-	2.02±0.04	3.89±0.09	13.17±0.30

±SE; *= Number of musk melon per hectare

Price (Tk/kg)- Lentil: 65, Jute = 35, Paddy = 15, Musk melon: 25 (Tk/piece)

Table. Profitability of musk melon intercropping grown at Nazirpur, Pirojpur during 2014-15

Cropping Pattern	REY (t/ha)	TVC* (Tk/ha)	GM (Tk/ha)	BCR
Lentil+Musk melon-Jute-T. Aman	24.46±0.32	198926±5931	167944±2454	1.85±0.03
Lentil-Jute-T. Aman (check)	13.17±0.30	126841±778	70747±3781	1.56±0.03

*Land rent, operation capital interest and family labor was not included

Development of three crop systems for medium high tide wetland non saline ecosystem

Inclusion of mustard, wheat, potato, lentil in Fallow-Jute-T.Aman cropping pattern under four different cropping systems was tested to intensify and diversify the double cropped cropping system at four to twelve dispersed farmer's field during 2014-15 in Pirojpur district. All of the three crop system produced significantly higher REY of 42% to 162% than two crop system of Fallow-Jute-T.Aman cropping pattern (8.57 t/ha). Potato-Jute-T.Aman cropping pattern gave higher REY of 22.47 t/ha among the tested patterns. The gross margin of potato and lentil based three cropped system was 488% and 204% higher than Fallow-Jute-T.Aman system (23746 Tk/ha). The BCR of theses two crop based three crop system was 1.71 and 1.57, respectively. For higher profitability, potato was the best followed by lentil, wheat and mustard as rabi crop in Fallow-Jute-T.Aman cropping pattern.

Table. Crop yield and rice equivalent yield (REY) of different cropping pattern grown at Nazirpur, Pirojpur during 2014-15

Cropping Pattern	Yield (t/ha)						REY (t/ha)
	Mustard	Wheat	Potato	Lentil	Jute	T.Aman	
CP1	1.15±0.09	-	-	-	1.98±0.08	3.72±0.04	12.17c

CP2	-	3.00±0.06	-	-	1.99±0.04	3.63±0.06	12.65bc
CP3	-	-	21.37±0.57	-	1.92±0.08	3.75±0.10	22.47a
CP4	-	-	-	1.10±0.04	2.03±0.04	3.78±0.08	13.27b
CP5	-	-	-	-	2.06±0.06	3.65±0.06	8.57d

±SE

Table. Profitability of tested five cropping patterns grown at Nazirpur, Pirojpur during 2014-15

Cropping Pattern	REY (t/ha)	TVC* (Tk/ha)	GM (Tk/ha)	BCR
CP1: Mustard-Jute-T. Aman	12.17	140810c	41740c	1.30c
CP2: Wheat-Jute-T.Aman	12.65	146263b	43487c	1.30c
CP3: Potato-Jute-T.Aman	22.47	197432a	139618a	1.71a
CP4: Lentil-Jute-T.Aman	13.27	126841d	72209b	1.57b
CP5: Fallow-Jute-T.Aman (check)	8.57	104804e	23746d	1.23c

*Land rent, operation capital interest and family labor was not included

Demonstration of USG application in Aman and Boro rice production

This investigation was undertaken to disseminate the USG use in farmer's fields to save urea and increase yield. Uses of urea super granule (USG) were demonstrated in more than twenty cooperative farmers' field during 2014-15. All other cultural activities and fertilizer dose will be followed as per BRRI recommendation. BRRI dhan55, BRRI dhan68 and BRRI hybrid dhan3 were used in USG trial. More than 1.0 t/ha higher yield advantage was found in BRRI hybrid dhan3 (8.05 t/ha) than other two varieties. Farmers' showed their interest to use the USG to save the amount of urea fertilizer especially in the water logged condition.

Testing of different cropping pattern in Rangpur region

Four different cropping patterns namely; Potato (Diamont)-Maize (NK-40)-T. Aman (BRRI dhan57), Potato (Asterix)-Boro (BRRI dhan55)-T. Aman (BRRI dhan49), Wheat-Mungbean-T. Aman, Potato – Boro (BRRI dhan28)-T. Aman (BRRI dhan49) with four check pattern was tested at six dispersed farmers' filed during 2014-15 in Rangpur, Kurigram, Lalmonirhat and Nilapkamari district. About 9 to 24% more gross margin was found in all of the proposed cropping pattern. The highest REY of 27 t/ha was observed in Potato (Diamont)-Maize (NK-40)-T. Aman (BRRI dhan57) cropping pattern followed by potato based cropping pattern.

Testing of different cropping pattern in Barisal region

This study was conducted to indentify the suitable cropping pattern for Barisal, Jhalokathi, Barguna and Patuakhali district during 2014-15. Three to six dispersed farmers' field was taken to carry out this study. Inclusion of sunflower and mungbean in Fallow-T.Aus-T.Aman cropping pattern was tested at Amtali, Barguna. Inclusion of sunflower and mungbean gave about 211% and 96% higher

REY, respectively than two rice system (7.17 t/ha). Fallow-T.Aus-T.Aman, Mungbean-Fallow-T.Aman, Fallow-Fallow-T.Aman/Grass pea was also trialed at Patuakhali, Jhalkathi and Barisal district, respectively. The REY of Fallow-T.Aus-T.Aman, Mungbean-Fallow-T.Aman and Fallow-Fallow-T.Aman/Grass was 151%, 55% and 91% higher than single T. Aman cropping pattern (3.19 t/ha).

Agricultural Economics Division

SUMMARY

Rice farmers still using more seeds and urea fertilizer than the recommended rate irrespective of cropping seasons but applied comparatively very lower amount of MP. Although, Boro growers obtained higher yield; hence, higher gross margin but T. Aman growers gained higher gross margin due lower cost of production and higher market price.

Due to lack of sufficient suitable domestic Aman varieties farmers of the border region, used to cultivate Indian varieties in this season. The area coverage of Indian varieties was 57% during 2012-13. Unless and until development of suitable domestic varieties for Aman season, cultivation of Indian varieties would continue. Breeders should consider the agro-climatic conditions and socio-economic demand of farmers' in the process of variety development. In this regard, short to medium growth duration, stress tolerant varieties associated with higher milling out-turn and market demand should be given due consideration.

Activity 1: Estimation of Costs- Return for MV Rice Cultivation at Farm Level

Economic decisions primarily concern with the most profitable level of input use in production process. It is therefore, important to verify cost and return of rice cultivation, which will help the farmers, researchers and planners to take decision. Hence, a macro level study was undertaken to explore the issue with the following specific objectives:

- Determine the level of inputs used in MV Aus, T.Aman and Boro rice cultivation;
- Estimate the cost of MV rice cultivation in different seasons; and
- Evaluate the profitability, factor and income shares of MV Aus, T.Aman and Boro rice cultivation at the farm level.

Methodology

Multistage random sampling technique was adopted to select the rice farmers from 10 agricultural regions of Bangladesh. In order to carry out the cost-return analysis, the study used a sample size of 120 Aus, 120 T.Aman and 120 Boro rice growing farmers.

RESULTS AND DISCUSSION

Level of inputs used

It revealed from the findings that the highest amount of human labor (98 man-days/ha) was used for MV T. Aman followed by MV Aus and MV Boro (88 man-days/ha and 80 man-days/ha) rice cultivation, respectively (Table 1).

Table 1. Per hectare Input used for MV rice cultivation in different season of Bangladesh, 2014-15.

Input items	Aus	Aman	Boro
Human Labour (man-day/ha):	88	98	80
Hired	42	43	43

Family	46	55	47
Seed (Kg/ha)	37	39	41
Fertilizer (Kg/ha):			
Urea	155	191	259
TSP	55	65	101
MP	60	54	78
DAP	-	15	10
Gypsum	10	22	51
$ZnSO_4$	-	1	4

As major activities were accomplished on contractual basis in Boro season labour requirement was lower. The seed rate used by the rice farmers for Aus, T.Aman and Boro rice cultivation were 37, 39 and 41 kg/ha respectively; showed a decreasing trend compared to previous years. It might be due that the farmers now days using quality seeds purchasing from different sources. Famers applied comparatively higher doses of Urea and TSP; although, they are far behind from the doses of MP fertilizer.

Costs of cultivation

Per hectare human labor costs were found Tk. 35090, Tk. 36261 and Tk. 43140 for Aus, T.Aman and Boro rice cultivation, respectively (Table 2). Costs of fertilizer for Boro was higher (Tk.10765/ha) compared to that of MV T. Aman (Tk.6873/ha) and Aus (Tk. 5222/ha) rice cultivation. Irrigation cost was much higher (13.57% of total costs) for MV Boro rice cultivation compared to other crops, since this crop is completely dependent on irrigation.

Table 2. Per hectare Cost of MV rice cultivation in different season of Bangladesh, 2014-15.

Input items	Season		
	Aus	Aman	Boro
Seedbed preparation (Tk/ha)	1852	2188	2487
Seed (Tk/ha)	1554	1463	1742
Human Labour	35090 (45.75)	36261 (53.18)	43140 (40.6)
Family Labour	14260	12628	10880
Hired Labour	13020	7925	12160
Contract	7810	6293	20100
Land Prep. Cost (Tk/ha)	**7782 (17.77)**	**7459 (10.12)**	**8095 (7.8)**
Fertilizer (Tk/ha)	5222(7.28)	6873(8.6)	10765(9.42)
Urea	2790	3606	4222
TSP	1313	1616	2222
MP	1019	876	1170
DAP	-	405	260
Gypsum	100	220	510
$ZnSO_4$	-	150	600
Cow-dung (Tk/ha)	-	-	1481
Irrigation (Tk/ha)	1850 (1.97)	748(1.06)	14089 (13.57)
Herbicide (Tk/ha)	165	380	308
Insecticide (Tk/ha)	1490	2268	2198
Variable Cost (Tk/ha)	**55005 (73.87)**	**57640 (72.73)**	**82824 (79.18)**
Interest on operating capital @10 for 5 months	815	900	1799

Land rent (Tk/ha)	16512 (24.59)	17515 (25.76)	19895 (19.17)
Total Cost (Tk/ha)	**72332**	**76055**	**104518**

Profitability

The yield received by the rice farmers in Aus, T. Aman and Boro seasons were 3879 kg/ha, 4320 kg/ha and 5587 kg/ha, respectively. Boro rice growers received higher gross return (Tk 94925/ha) compared to T. Aman (Tk 76032/ha) and Aus (Tk. 57409/ha) due to higher yield but T. Aman growers accumulated higher gross margin due to lower unit cost of production and higher market prices; while, the net return of all the seasons were negative on full costs basis (Table 3).

Table 3. Comparative costs and return of MV rice cultivation in different seasons of Bangladesh, 2014-15.

Items	Seasons		
	Aus	**Aman**	**Boro**
Yield (Kg/ha)	3879	4320	5587
Paddy price (Tk./kg)	14.00	15.00	14.98
Return from paddy (Tk./ha)	54306	64800	82195
Return from Straw (Tk./ha)	3103	11232	12730
Gross return (Tk./ha)	**57409**	**76032**	**94925**
Variable cost (Tk./ha)	55005	57640	82824
Total cost (Tk./ha)	**72332**	**76055**	**104518**
Gross margin (Tk./ha)	2404	18392	12101
Net return (Tk./ha)	-14923	-23	-9593
Unit cost of production (Tk./kg)	**18.65**	**17.61**	**19.05**
BCR (Undiscounted)	0.79	0.99	0.91

Conclusion

Rice farmers still using more seeds and urea fertilizer than the recommended rate irrespective of cropping seasons; although, applied comparatively very lower amount of MP. Boro growers obtained higher yield due to better cropping environment, good management practices and use of better genotypes. T. Aman growers obtained higher gross margin due lower cost of production and higher market price.

Activity 2: Domestic Vs Indian *Aman* Variety Cultivation in Border Region of Bangladesh: A Field Level Investigation

The study was conducted in the border region of Bangladesh (Panchagar, Thakurgaon, Dinajpur, Rangpur, Naogaon, Chapia Nawabganj, Rajshahi, Kustia, Chuadanga, Jessore and Satkhira) to find out the coverage and causes of Indian *Aman* varieties cultivated by the farmers. Intensive field surveys followed by several FGDs were conducted during-2014-15. Besides, information from DAE was also collected. The findings of the study revealed that due to lack of sufficient suitable domestic Aman varieties farmers cultivating Indian varieties in this season. The area coverage of Indian varieties was 57% during 2012-13. Unless and until development of suitable domestic varieties for Aman season, cultivation of Indian varieties would continue. So, the breeders should consider the agro-climatic conditions of border region and farmers' socio-economic demand in the

process of variety development. In this regards, short to medium growth duration, drought resistance, quality rice, higher milling out-turn and market demand should be given due consideration. In addition, demonstration, farmers' training and proper extension services may help to quick dissemination of domestic Aman varieties in the border region of Bangladesh.

Table 4. Scenario of Domestic and Indian Varieties Grown in Aman Season, 2014-15.

District	Domestic HYV	Indian HYV
Panchagar	BINA dhan7 (11%), BRRI dhan52 (4%), BRRI dhan51 (3%), BRRI dhan49 (2%) and Others (3%). Total 23%.	Swarna (69%), Ranjit (4%), Nepali Swarna (3%) and Mamun Swarna (1%). Total 77%.
Thakurgaon	BRRI dhan49 (4%), BR11 (3%), BINA-7 (7%), BRRI dhan52 (2%) BRRI dhan34 (2%) and Others (14%). Total 34%.	Swarna (63%), Nepali Swarna (1%), Ranjit (1%) and Suman Swarna (1%). Total 66%.
Dinajpur	BRRI dhan34 (16%), BRRI dhan49 (7%) BINA-7 (3%), BRRI dhan52 (2%), BR11 (2%), BRRI dhan51 (1%) and Others (2%). Total 33%.	Swarna (33%), Guti Swarna (18%), Nepali Swarna (5%), Swarna-5 (3%), Ranjit (3%), Mamun Swarna (2%), Suman Swarna (1%) and Others (2%). Total 67%.
Rangpur	BR11 (35%), BINA-7 (8%), BRRI dhan52 (6%), BRRI dhan33 (2%), BRRI dhan49 (2%) and Others (1%). Total 58%.	Swarna (39%), Ranjit (%) and Others (1%). Total 42%.
Naogaon	BRRI dhan49 (13%), BRRI dhan34 (6%), Pajam (6%), BINA-7 (4%), BR11 (3%), BRRI dhan32 (1%) and Others (1%). Total 34%.	Swarna (60%), Ranjit (4%), Zirasail (1%) and Others (1%). Total 66%.
Chapainababganj	BRRI dhan34 (11%), BINA-7 (5%), BRRI dhan51 (2%), BRRI dhan49 (1%) and Others (3%). Total 23%.	Swarna (70%), Zirasail (2%) and Others (1%). Total 77%.
Rajshahi	BINA-7 (11%), BRRI dhan33 (5%), BRRI dhan49 (4%), BRRI dhan39 (4%), BR11 ((2%), BRRI dhan51 (1%) and Others (6%). Total 33%.	Swarna (64%), Guti Swarna (2%) and Others (1%). Total 67%.
Kushtia	BRRI dhan39 (29%), BRRI dhan33 (11%), BRRI dhan49 (9%), BINA-7 (9%), BR11 (6%), BR10 (4%), BR23 (3%), BRRI dhan30 (3%) and Others (10%). Total 84%.	Swarna (15%) and Others (1%). Total 16%.
Chowadanga	BRRI dhan39 (13%), BRRI dhan49 (6%), BINA-7 (4%), BRRI dhan51 (3%), BRRI dhan33 (3%) and Others (5%). Total 34%.	Swarna (57%), Ranjit (8%) and Others (1%). Total 66%.
Jessore	BINA-7 (13%), BRRI dhan30 (10%), BRRI dhan39 (9%), BR10 (6%), BR11 (4%) and Others (11%). Total 53%.	Swarna (26%), Guti Swarna (10%), Minikit (10%) and Others (1%). Total 47%.
Satkhira	BR10 (16%), BR23 (16%), BRRI dhan30 (16%), BINA-7 (12%), BRRI dhan49 (11%), BR11 (9%), BRRI dhan39 (2%), BRRI dhan33 (1%) and Others (4%). Total 89%.	Swarna (6%), Jamaibabu (3%) Others (2%). Total 11%.
	Average of Domestic HYV 45%	Average of Indian HYV 55%

Table 4 and 5 shows the scenario of domestic and Indian varieties grown in the border region of Bangladesh during the Aman season, 2014-45. It is revealed that BR11, BRRI dhan33, BRRI dhan34, BRRI dhan39, BRRI dhan49, BRRI dhan52 and BINA7 were the major Bangladeshi varieties grown by the farmers which covered 45% of the area cultivated; whereas Indian varieties like Swarna (Lal Swarna, Guti Swarna, Mamun Swarna, etc) ZiraShail, Minikit, Ranjit and Jamaibabu covered 55% area during Aman season, 2014-15. The reasons for cultivating Indian varieties were good quality and taste, higher yield, higher market price and tolerant to stresses, etc.

Table 5. District-wise Domestic and Indian HYV Coverage (%) in Aman Season, 2014-15.

District	2012-13		2013-14		2014-15		Average	
	Domestic HYV	Indian HYV	Domestic HYV	Indian HYV	Domestic HYV	Indian HYV	Domestic HYV	Indian HYV
Panchagar	16	84	19	81	23	77	19	81

Thakurgaon	22	78	20	80	34	66	25	75
Dinajpur	36	64	33	67	33	67	34	66
Rangpur	57	43	68	32	58	42	61	39
Naogaon	27	63	34	66	35	65	32	68
Chapainababganj	15	85	18	82	23	77	19	81
Rajshahi	38	62	41	59	33	67	37	63
Kushtia	84	15	86	14	84	16	85	15
Chowadanga	41	59	28	72	34	66	34	66
Jessore	42	58	53	47	53	47	49	51
Satkhira	90	10	92	08	89	11	90	10
Average	**43**	**57**	**45**	**55**	**45**	**55**	**44**	**56**

Agricultural Statistics Division

ANNUAL REPORT OF AGRICULTURAL STATISTICS DIVISION, 2014-2015

SL. No.	Name	Designation	Working Days
Research Personnel & Supporting Staff			
1.	Md. Ismail Hossain, PhD	Principal Scientific Officer and Head	365
2.	Niaz Md. Farhat Rahman, MS	Senior Scientific Officer	365
3.	Md. Sahanur Alam Sumon, Ag. Diploma	Scientific Assistant	365
ICT Personnel & Supporting Staff			
1.	S.M. Mostafizur Rahman, B.Sc	System Analyst	365
2.	Md. Ful Miah, B.Sc	Cartographer	365
3.	Md. Mahfuz Bin Wahab, MSS	Programmer	365
4.	Kabita, M.Sc	Assistant Programmer	365
5.	Md. Abdullah Aziz, M.Sc	Data Analyst	365
6.	Mrs. Nuraiya Kulsom, BSS	Senior Data Entry/Control Operator	365
7.	Md. Aminuzzaman, B.Sc	Computer Assistant	365
8.	Mohammad Akhter Hossain, MA	Computer Assistant	365

Summary

Stability analysis of BRRI varieties
Development and validation of producer, consumer and producer cum consumer preference model for rice varieties
Stochastic frontier analysis and data envelopment analysis for efficiency of rice growing farmers
Effects of climate change on rice yield
Maintenance of rice and rice related variable Database
Groundwater depletion with expansion of irrigation in barind tract: A case study
Web portal management
Management of BRRI network and internet connectivity
Management information system (MIS) of BRRI
Personal data sheet (PDS) database of BRRI
Web mail and group mail of BRRI
Facebook group (BRRI Networks) of BRRI
Heritage of BRRI
Support Services

SUMMARY

In the reporting period BR11, BRRI dhan49, BRRI dhan51 and BRRI dhan52 were found as the most stable in T. Aman season while BR3, BR4 and BRRI dhan23 appeared to be below

average stable among the non-aromatic rice. In case of aromatic rice BR5, BRRI dhan34, BRRI dhan37 and BRRI dhan38 also appeared to be average stable varieties.

BRRI dhan28 and BRRI dhan29 was the only most stable variety and BR1, BR2, BR6, BR7, BR8, BR18, BR19, BR26, BRRI dhan27, BRRI dhan35, BRRI dhan55, BRRI dhan58 and BRRI dhan59 appeared to be below average stable in Boro season. In case of fine rice BRRI dhan50 also appeared to be average stable in Boro season.

Model analysis indicates that BR11, BR22, BRRI dhan32, BRRI hybrid dhan4 were more preferable and cultivable varieties in T. Aman season; BRRI dhan28, BRRI dhan29, BRRI dhan50, BRRI hybrid dhan3 in Boro season and BR9, BR16, BRRI dhan48 in Aus season due to higher yield among the producers and producer cum consumers. Pure consumers were found to prefer rice varieties on the basis of taste finess rice and availability of the varieties. Although, BRRI variety contributes about 90% of total production, it does not reflect in field label as the BRRI varieties are sold in different brand names. As for example, BRRI dhan28 sales as Nizersail and BRRI dhan29 as Jhingasail and Miniket etc.

Three mathematical models have been developed for consumers' and producers' and producer-cum-consumers 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 are used 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.

Farmer-specific technical efficiencies are estimated using rice growing farmers' survey data, which includes DEA models, applying the linear programming method. The technical inefficiency effects are modeled as a function of farmer-specific information about farmers, the farmer's experience in Boro rice cultivation, the linkages of agriculture extension personnel, the condition of soil in cultivated land, extra labour and knowledge of rice production. From the result, the cultivation experience of farmer and the linkage of the extension personnel in this cultivation affect the efficiency level of the farmers. This study finds the necessity of improving the quality of seed, the irrigation method and maintained the amount of fertilizer which has a significant effect on Boro rice production in selected area of Manikganj district, Bangladesh. Here we found that most of the farmers of Boro rice cultivation are efficient. Policies leading to improve the of irrigation method, the quality of seed and reduction of using pesticides could be beneficial in decreasing inefficiency of farmers in Bangladesh.

The climatic factors of maximum temperature and humidity showed statistically significant influences in Aus rice and the contributions have been found positive for both the parameters. The contribution of climatic factors has no significant effect on Aman rice. For Boro rice minimum temperature displayed statistically significant but negative correlation with the yield. Maximum

temperature and humidity has significantly affected the yield. The year to year variation due to climate change impact had on the Aus, Aman and Boro rice yield. Therefore, to the issue of climate change and ensuring food security, the concerned authorities should provide policy recommendations and action plans to adapt and to cope properly with the changing nature of climate factors.

Dry season Boro rice mainly depends on supplementary irrigation from groundwater, results in severe groundwater depletion. Main source of recharging of groundwater aquifer in this area is rainfall, but rainfall is also dropping here. Hydrographs are analyzed and groundwater level contour maps are prepared by Arc GIS version10 software from the monitoring wells data of Bangladesh Water Development (BWDB). For aquifer geometry a subsurface geological cross section made by RockWorks software from bore log data of Department of Public Health Engineering (DPHE) and Bangladesh Water Development (BWDB).Only two aquifers exist and in NW area shows effective aquifer thickness is shorter than SE portion. Average rates of maximum depth (dry season) and minimum depth (wet season) groundwater depilation are 0.23 meter/year and 0.38 meter/year respectively in Rajshahi district. In some upazilas these rates are much higher than that of average .Groundwater recharge condition is very poor in Tanore, Godagari, Mohanpur and Baghmara upazilas and vulnerable for Boro rice ie irrigated rice. A crucial relationship remains between Boro production and groundwater depletion. So crop diversification or less water consuming crops can be an option for the study area.

The scientists of this division were also engaged in helping scientists of other disciplines in planning experiments, statistical data analysis and interpretation of results. A total of 60 different types of analyses were performed during the reporting year. A number of maps were prepared using GIS and supplied to the scientists of other divisions whenever required. Besides, ICT cell of Agricultural Statistics Division provides ICT related support services to other divisions such as hardware, software and troubleshooting related problem etc.

STABILITY ANALYSIS OF BRRI VARIETIES

The newly developed stability model takes into account the performance of the genotypes across the geographical locations differing in land, soil and other biotic and abiotic factors and over the years characterizing fluctuation of weather variable, floods and drought etc.

Experiments are being conducted in the T. Aman and Boro seasons with BRRI released rice varieties since T. Aman 2014 and Boro 2014-15 in Gazipur and different regional stations. The collaborative regional stations in the T. Aman season are Rajshahi, Rangpur, Comilla, Sonagazi, Barisal, Satkhira and Kushtia and in the Boro season Rajshahi, Rangpur, Comilla, Habiganj, Barisal, Bhanga, Satkhira, Kushtia and Sonagazi.

The number of varieties is 27 and 25 in T. Aman and Boro season respectively. The design used is RCB with three replications and the effective plot size (harvest area) is 5 x 2 m^2 leaving the boarder. Recommended crop management practices are followed. The newly developed stability model was used to analyse the data.

The value of G_i (stability index of the ith genotypes) ranges from –1 to +3 ie, $-1 \le G_i \le 3$. The higher the value of G_i more is the stability of the genotype across the environments. Stability of a variety is characterized as follows:

Value of G_i	Nature of stability
≤ 0	Unstable
$0 < \mathbf{G_i} \le 1$	Below average stability
$1 < G_i \le 2$	Average stability
$2 < G_i \le 3$	Stable

Tables 1 and 2 present the results. Among the non-aromatic T. Aman varieties, BR11, BRRI dhan49, BRRI dhan51 and BRRI dhan52 were found stable and their stability ranks were 4, 2, 1 and 3 respectively, while BR3, BR4 and BRRI dhan23 appeared to be below average stable. BR10, BR22, BRRI dhan25, BRRI dhan30, BRRI dhan31, BRRI dhan32, BRRI dhan33, BRRI dhan39, BRRI dhan40, BRRI dhan41, BRRI dhan44, BRRI dhan46, BRRI dhan53, BRRI dhan54 and BRRI dhan56 were found to have average stability amoung-non aromatic T. Aman varieties. Among the aromatic T. Aman rice BR5, BRRI dhan34, BRRI dhan37 and BRRI dhan38 appeared to be average stable.

In Boro season, the only stable variety was BRRI dhan28 and BRRI dhan29 in each year. BR3, BR9, BR12, BR14, BR15, BR16, BR17, BRRI dhan36, BRRI dhan45, BRRI dhan47 and BRRI dhan50 appeared to have average stability. All other Boro varieties appeared to have average stability.

Table 1. Stability parameters of new model for grain yield for T. Aman.

Variety	Stability parameter			Stability index (G_i)	Stability rank (R_i)
	2002-14			2002-14	2002-14
	S_i	D_i	P_i	G_i	R_i
	Non-aromatic rice				
BR3	8.86	25.14	4	0.81	12
BR4	8.42	28.69	10	0.99	11

BR10	8.15	31.42	13	1.13	5
BR11	8.56	30.51	12	2.06	1
BR22	7.64	30.09	12	1.13	5
BR23	8.20	28.01	9	0.99	11
BR25	7.76	27.88	8	1.03	10
BRRI dhan30	8.40	29.78	11	1.04	9
BRRI dhan31	8.38	29.37	11	1.03	10
BRRI dhan32	8.11	31.52	13	1.14	4
BRRI dhan33	8.59	23.69	3	1.77	2
BRRI dhan39	7.80	25.23	5	1.91	2
BRRI dhan40	8.09	30.61	12	1.11	7
BRRI dhan41	8.03	29.94	11	1.08	8
BRRI dhan44	8.44	28.54	10	1.99	2
BRRI dhan46	8.73	27.32	9	1.91	2
BRRI dhan49	7.84	31.14	15	2.16	1
BRRI dhan51	6.61	30.36	13	2.28	1
BRRI dhan52	8.24	31.46	15	2.13	1
BRRI dhan53	7.85	23.42	6	1.83	2
BRRI dhan54	8.10	26.26	10	1.92	2
BRRI dhan56	8.21	14.89	3	1.50	3
BRRI dhan57	7.90	25.25	10	1.92	2
BRRI dhan62	8.10	15.92	3	1.50	3
BRRI hybrid dhan4	8.12	30.12	12	1.11	5
	Aromatic rice				
BR5	8.18	20.61	2	1.08	8(4)
BRRI dhan34	8.74	20.41	2	1.12	6(3)
BRRI dhan37	8.22	22.89	2	1.77	2(1)
BRRI dhan38	8.46	22.80	2	1.74	2(2)

Table 2. Stability parameters of new model for grain yield for Boro.

Variety	Stability parameter			Stability index (G_i)	Stability rank (R_i)
	2002-15			2002-15	2002-15
	S_i	D_i	P_i	G_i	R_i
	Non-aromatic rice				
BR1	8.40	0.22	21	0.33	13
BR2	7.48	-4.81	18	0.18	14
BR3	9.44	4.75	23	1.56	3
BR6	9.05	-6.55	18	0.05	15
BR7	4.06	0.80	21	0.70	10

BR8	2.66	-0.29	21	0.99	8
BR9	3.30	13.23	28	1.59	3
BR12	7.89	-2.43	20	1.25	5
BR14	4.48	11.41	27	1.27	5
BR15	2.97	10.05	26	1.49	4
BR16	7.50	10.10	26	1.96	2
BR17	2.83	8.66	25	1.46	4
BR18	22.20	0.57	21	0.15	14
BR19	6.31	3.18	23	0.61	11
BR26	5.65	4.65	23	0.75	10
BRRI dhan27	5.57	3.88	23	0.71	10
BRRI dhan28	2.83	9.68	26	2.51	1
BRRI dhan29	5.75	20.73	32	2.70	1
BRRI dhan35	7.59	3.51	23	0.56	12
BRRI dhan36	5.29	8.65	25	1.02	7
BRRI dhan45	9.11	-1.94	20	1.22	6
BRRI dhan47	18.48	-8.48	17	1.17	6
BRRI dhan55	19.34	-20.48	11	0.62	11
BRRI dhan58	28.39	-24.67	9	0.82	9
BRRI dhan59	27.83	-9.68	10	0.61	9
BRRI dhan60	5.65	20.23	31	1.49	2
BRRI dhan61	2.79	8.98	25	1.31	2
BRRI dhan64	5.35	19.93	30	151	2
BRRI hybrid dhan1	9.11	-5.25	17	0.03	13
BRRI hybrid dhan2	7.37	-4.62	19	0.15	11
BRRI hybrid dhan3	5.65	4.65	23	0.75	5
	Aromatic rice				
BRRI dhan50	13.58	-8.88	15	1.13	6 (1)

DEVELOPMENT AND VALIDATION OF PRODUCER, CONSUMER AND PRODUCER CUM CONSUMER PREFERENCE MODEL FOR RICE VARIETIES

This study is an attempt to evaluate the factors affecting producers′, consumers′ and producer-cum-consumers' preference for rice varieties, because no systematic study has been conducted in identifying the factors that could influence or affect the preference to rice variety.

For this study four locations/districts ie Panchagarh, Lalmonirhat, Kurigram and Thakurgaon were selected. Panchagarh and Lalmonirhat were selected as 'Rice deficit' area. Kurigram and Thakurgaon were selected as 'Rice surplus' area. Fifty farmers were selected from producer, consumer and producer-cum-consumer from each location and the selected farmers were categorized into three groups such as producers′, pure consumers′ (consume rice from market) and producer-cum-consumers.

The pure consumers were selected from the urban areas of Panchagarh, Lalmonirhat, Kurigram and Thakurgaon districts. Information was collected on the choice of varieties for production and consumption using a pre-designed questionnaire.

On the basis of newly developed three models for producers′ preference, consumers′ preference and producer-cum-consumer preference for rice varieties were used to achieve the objectives. From the validation of models, producer, consumer and producer cum consumers preferred rice varieties for their higher yield at Panchagarh, Lalmonirhat, Kurigram and Thakurgaon. On the other hand, the pure consumers preferred varieties based on their tastes.

BR11, BR22 and BRRI dhan32, BRRI hybrid dhan4 for T. Aman, BRRI dhan28, BRRI dhan29, BRRI dhan50 and BRRI hybrid dhan3 for Boro and BR9, BR16 and BRRI dhan48 for Aus were found to be more preferable and cultivable varieties due to higher yield among the producers and producer cum consumers. Pure consumers were found to prefer rice varieties on the basis of taste iness, 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 sales in different brand names, namely, BRRI dhan28 sales as Nizersail and BRRI dhan29 as Jhingasail and Miniket etc.

Three mathematical models have been developed for consumer and producer preference to rice varieties in four locations/districts 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.

Table 3. Reasons for liking varieties by the pure consumers in different location (%).

Reason	Panchagarh	Lalmonirhat	Kurigram	Thakurgaon
Tasty	28 (56%)	25 (50%)	27 (54%)	25 (50%)
Fine rice	7 (14%)	10 (20%)	9 (18%)	8 (16%)
Fine rice + tasty	8 (16%)	9 (18%)	6 (12%)	10 (20%)
Fine rice + non-sticky	7 (14%)	6 (12%)	8 (16%)	7 (14%)
Total	**50**	**50**	**50**	**50**

STOCHASTIC FRONTIER ANALYSIS AND DATA ENVELOPMENT ANALYSIS FOR EFFICIENCY OF RICE GROWING FARMERS IN BANGLADESH

Efficiency measurement has been the concern of researchers with an aim to look into the efficiency levels of rice growing farmers engaged in production activities. Identifying determinants of technical efficiency levels is a major concern in efficiency analysis. This study takes an attempt to provide estimates of technical efficiency and to compare technical efficiency among the rice growing farmers in Bangladesh using Data envelopment analysis. Through the use of DEA tools to estimate the technical efficiency of 420 rice growing farmers in selected areas of Bangladesh,

several conclusions are drawn. First, the DEA results showed the technical efficiency scores of all observed rice growing farmers.

To calculate the TE, we must define some notations first, and assume that there is a set of selected input variables (called m) and output (namely k) for each of the households (N).

Consider n paddy farmers with m inputs and k outputs each one producing different output (y) and using different inputs (x).

The efficiency of farmers (Constant Return to Scale):

$$Max_{\theta,\lambda}\theta$$

$$\text{Subject to } \theta y_r - \sum_{j=1}^{n} \lambda_j y_{rj} \geq 0,$$

$$-x_i + \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0,$$

$$\lambda_j \geq 0, \quad j = 1...n, \quad i = 1...m, \quad r = 1...k$$

The linear programming problem must be solved N times, once for each household in the sample and a value of θ is then obtained for each one (Coelli et al., 1998).

In case of variable returns to scale, the CRS model can be modified to account for the VRS by adding the convexity constraint: $\sum_{j=1}^{n} \lambda_j = 1$ to the CRS model.

The efficiency (Variable Return to Scale):

$$Max_{\theta,\lambda}\ \theta,$$

Subject to

$$\theta y_r - \sum_{j=1}^{n} \lambda_j y_{rj} \geq 0,$$

$$-x_i + \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0,$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0, \quad j = 1...n, \quad i = 1...m, \quad r = 1...k$$

Where, $\theta \leq 1$ is the efficiency score, x_{ij} the i-th input of the j-th farmers, y_{rj} the r-th output of the j-th farmers, λ_j the weight of the j-th farmers.

Thus, the technical efficient score under the VRS is always equal to or greater than the technical efficient score under the CRS. Therefore, both the CRS and the VRS methods are used in this paper to estimate the TE, because the CRS assumption is only appropriate when all households are operating at an optimal scale. However not all households may operate optimally due to imperfect competition, financial constraints, and other factors (Collie et al., 1998).

Table 4 shows the result of output-oriented technical efficiency indexes of the rice growing sample farmers. For Manikgonj sadar upazila the average overall technical efficiency (CRS-TE) is 69% with a minimum level of 3% and maximum level of 100%. Then, the pure technical efficiency (VRS-TE) results the mean index of 89*%* with a range of 3% up to 100%. It is evident from the results that the majority of the sample farmers' overall technical efficiency indexes and the pure technical efficiency indexes fall within the range of 0.03 and 0.90. For Manikganj ghior upazilla the average overall technical efficiency (CRS-TE) is 65% with a minimum level of 1% and maximum level of 100%. Then, the pure technical efficiency (VRS-TE) results the mean index of 85% with a range of 7% up to 100%. It is evident from the results that the majority of the sample farmers' overall technical efficiency indexes and the pure technical efficiency indexes fall within the range of 0.07 and 0.90. For Manikgonj singair upazila the average overall technical efficiency is 64% with a minimum level of 36% and maximum level of 100%. Then, the pure technical efficiency results the mean index of 100% up to 100%. It is evident from the results that the majority of the sample farmers' overall technical efficiency indexes and the pure technical efficiency indexes fall within the range of 0.01 and 0.70.

Therefore, to gain the TE score of rice growing farmers, the government should focus on encouraging rice growing farmers to produce more efficiently in terms of the utility of labour. In addition, the government policies should concentrate to invest in irrigation and increase the levels of rice farmer's education, knowledge about rice production and expenditure management through short training or extension services. There activities are also needed to be reformed and developed more efficiently. The study revealed that there was no possible relationship between the TE and agricultural policies. Another possible interpretation is that policies are not sufficiently strong or effective in helping farmers produce rice more efficiently. An in-depth study is needed to discover the reason of and solution to their ineffective policies.

Table 4. Distribution of Technical Efficiency ratings of rice growing farmers in Manikgonj district

Efficiency index	Sadar upazila		Ghior upazila		Singair upazila	
	Number of farms					
	CRS	VRS	CRS	VRS	CRS	VRS
<0.40	1 (0.71)	0 (0.00)	35 (25.00)	13 (9.28)	40 (28.00)	10 (7.14)
0.40 – 0.49	2 (1.43)	0 (0.00)	17 (12.14)	7 (5.00)	7 (5.00)	4 (2.86)
0.50 – 0.59	1 (0.71)	0(0.00)	15 (10.71)	7 (5.00)	3 (2.14)	2 (1.43)
0.60 – 0.69	0 (0.00)	0 (0.00)	8 (5.71)	8 (5.71)	11 (7.86)	2 (1.43)
0.70 – 0.79	7 (5.00)	0 (0.00)	7 (5.00)	5 (3.57)	5 (3.57)	3 (2.14)
0.80 – 0.89	21 (15.00)	0 (0.00)	4 (2.86)	1 (.071)	15 (10.71)	7 (5.00)
0.90 – 1.0	108	140	54	99	59	112

	(77.14)	(100)	(38.57)	(70.71)	(42.14)	(80.00)
Total	140	140	140	140	140	140
Mean Efficiency	0.64	1.0	0.65	0.85	0.69	0.89
Minimum Efficiency	0.36	1.0	.014	0.07	0.03	0.03
Maximum Efficiency	0.98	1.0	0.99	0.41	1.0	1.0

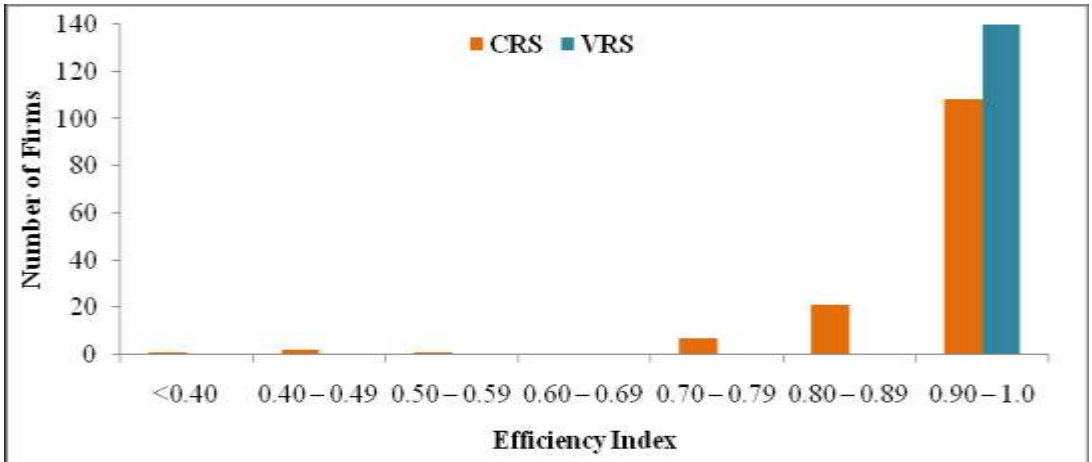


Fig. 1: Technical Efficiency (DEA) ratings of rice growing farmers in Manikgonj Sadar Upazilla of Bangladesh

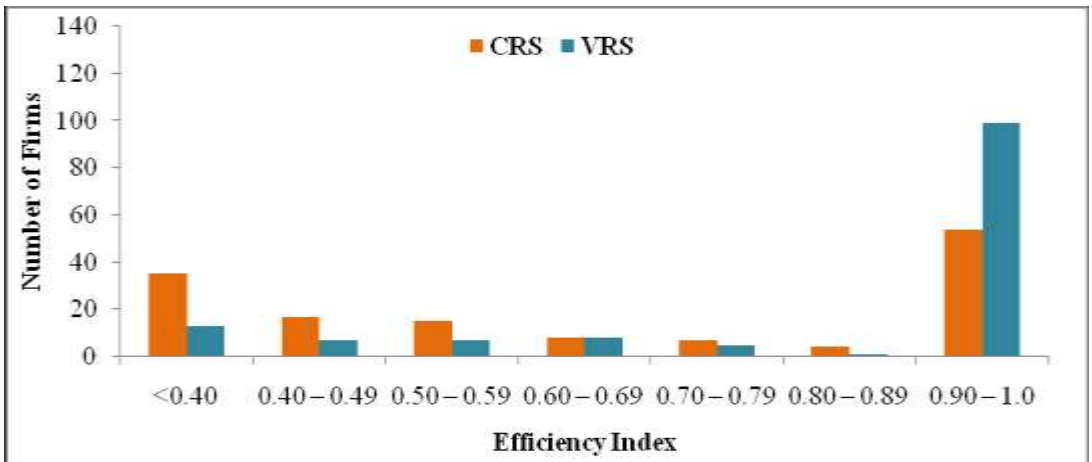


Fig. 2: Technical Efficiency (DEA) ratings of rice growing farmers in Manikgonj Ghior Upazilla of Bangladesh

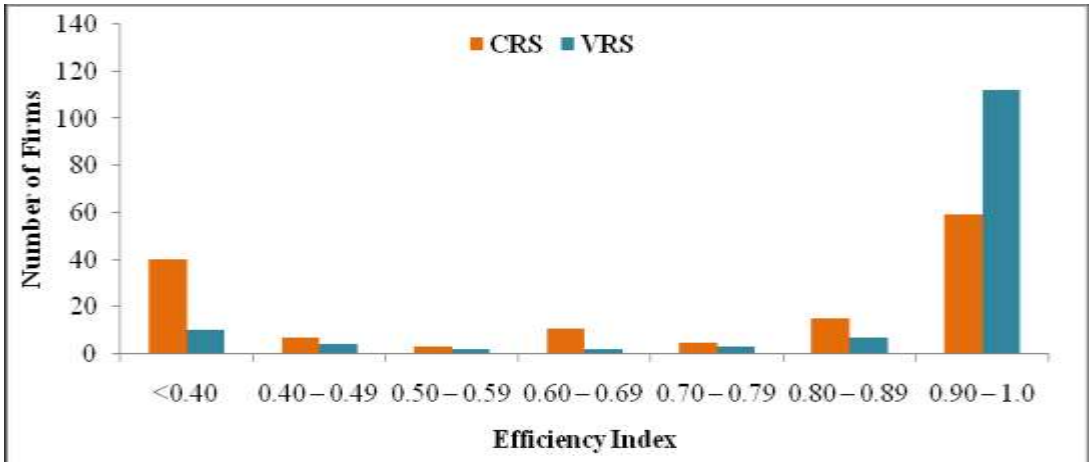


Fig. 3: Technical Efficiency (DEA) ratings of rice growing farmers in Manikgonj Singair Upazilla of Bangladesh

EFFECTS OF CLIMATE CHANGE ON RICE YIELD

This study has been undertaken to investigate the impacts of climate change (viz changing in maximum temperature, minimum temperature, rainfall, humidity and sunshine) on the yield of three rice seasons (viz Aus Aman and Boro rice) in Bangladesh. Using annual data of rice yield and climatic factors spanning from 1974 to 2014, a time-series multivariate regression model and spatial analysis were employed to assess the impact. Heteroskedasticity of national level time series data has been converted to normal data using transformation method. Spatial analysis showed the spatially changing the climatic variables and their changing pattern and directions.

Descriptive Statistics

Table 7 shows the descriptive statistics, which delineates the basic properties of all the variables under study. In case of yield, it is found that, among the three rice crops, the mean yield of Boro rice is the highest (2.80 t/ha). The observed mean yield of three rice crops under study according to the descending order is as follows: Boro >Aman >Aus. In case of climatic variables, the highest maximum temperature is noticed in the Aus (32.19 ^{0}C) growing season and the lowest minimum temperature were monitored in the Boro (18.28 ^{0}C) growing season. In case of rainfall, the highest total rainfall observed in the Aman (60,903 mm) rice growing season followed by Aus (57,785 mm) rice season. In view of humidity, the highest percentage of humidity (84.19%) is detected in the Aman season and the lowest value in the Boro (74.65%) season. Finally, highest sunshine (7.60 hour/day) is observed in the Boro season and lowest (5.44 hour/day) in the Aman season.

Trend Graph

In addition to explaining descriptive statistics and analyzing linear trend between time and climate variables, graphs are also constructed with time (t) as an explanatory variable to observe the spectacular impression about the variations and changes in trend (upward or downward) among the five climatic variables over the whole period (1974-2014) (Figures 4-8). Maximum temperature

fluctuated gradually, but the overall trend is observed to increase for all the seasons (Figure 4). Small variations are noticed in minimum temperature. However, the trend still appeared to be increasing for Boro season but slightly decreasing trend for Aus and Aman seasons (Figure 5). Rainfall in Aus and Boro rice growing seasons showed downward trends with distinct and greater fluctuations. The Aman season shows upward trend over time with greater fluctuations, which seriously affects the Aman rice crop (Figure 6). Humidity demonstrates a decreasing trend with minor deviations in Aus and Aman seasons but greater fluctuations in Boro season (Figure 7). Interestingly, sunshine exhibits a slow increasing (upward) trend for Aus and Boro seasons with greater fluctuations but in case of Aman season slow decreasing trend with low fluctuation (Figure 8). However, investigation is done to confirm whether these climatic trends and fluctuations affect crops yield in the later section.

Climatic condition of Bangladesh in 2014

In Aus season maps shows maximum temperature is decreasing west to east direction on the other hand minimum temperature decreasing south to north direction. From the total rainfall map most of the area covered by low rainfall (<1500mm) only eastern side shows high rainfall area but this area is very limited. Humidity maps implies that most area covered by intermediate humidity (75%-80%), high in southern area but some pocket areas are found with low humidity (<75%) in central and north-west region.

In Aman season maps shows maximum temperature is high in all over Bangladesh. Minimum temperature is increasing north-west to south-east direction but north-east is also low. From the total rainfall map most of the areas are covered by low rainfall (<1500mm) and is increasing west to east. A humidity map implies that humidity is increasing north to south direction but most of the area is low humidity area.

In Boro season the maximum temperature shows increasing trend from north to south direction where most of the area is covered by high temperature (>31) and minimum temperature is also increasing from north to south direction. The total rainfall map shows increasing trend from west to east direction. A humidity map implies that humidity is increasing north to south direction.

The Regression Results for Aus Rice

The regression trend line method is used to identify the climate change and time impacts on the yield. Table 8 presents the findings, which revealed that climate variables and time (year) affected the yield. The results further indicated that the effects of climate change on yield of Aus rice. Maximum temperature and humidity showed statistically significant influences on Aus rice yield and the contributions are found positive for both the parameters. Minimum temperature and rainfall displayed positive contribution but statistically insignificant effects on yield. In contrast, sunshine contribution is negative and insignificantly affected the yield. Year to year variation of temperature due to climate change had an impact on the Aus rice yield. The R^2 value implied that 96% of the yield variation of Aus rice is influenced by the climatic variability and change. The remaining

proportion of variation may be due to others relevant factors of Aus rice that are not included in this model. Durbin Watson test indicates that the chosen model is free of autocorrelation which is vital condition for any time series model. Overall (F-test) regression coefficients were statistically significant.

The Regression Results for Aman Rice

The results are presented in Table 8 which demonstrated that the effects of all the climatic parameters. The weather parameters are not significantly affected the Aman rice yield. The contributions of minimum temperature and sunshine are found negative. Rainfall and humidity have no effect and maximum temperature has little positive effect on yield. Yearly variation due to climate change impacted on the Aman rice yield at 1% level of significance. R^2 for Aman rice yield is 0.95 implies that about 95% variation of Aus rice yield is being explained by the selected multiple regression model. The remaining proportion of variation may be due to others relevant factors of Aus rice that are not included in this model. Durbin Watson test indicates that the chosen model is free of autocorrelation which is vital condition for any time series model. Overall (F-test) regression coefficients were statistically significant.

The Regression Results for Boro Rice

Boro rice is cultivated in Bangladesh using irrigation facilities during the dry season. The regression trend line method is performed to determine the climate-Boro rice relationship and the findings are presented in the Table 8 Results showed that, maximum & minimum temperature and humidity displayed statistically significant relation with the yield of Boro rice. The contributions of maximum temperature is found positive and & it is negative for minimum temperature. There is no effect of rainfall and humidity on Boro rice yield. Contrastingly, sunshine contribution is positive and insignificantly affected the yield. The year to year variation due to climate change impacted on the Boro rice yield. The R^2 value indicated that 96% variation in Boro rice yield is explained by the climatic parameters. Durbin Watson test indicates that the chosen model is free of autocorrelation which is vital condition for any time series model. Overall (F-test) regression coefficients were statistically significant.

Finally, the yield of Aus rice was influenced greatly by the maximum temperature and humidity. Any climatic variables for Aman rice yield have no significant effect. The influence of minimum temperature was observed to be detrimental for Boro rice. However, maximum temperature and humidity exposed positive inter-relation in respect of yield with statistically significant contribution.

Table 7. Descriptive statistics, 1981-2011

Variables	Rice Crops	Statistics					
		Mean	Std. dev.	Min.	Max.	Skewness	Kurtosis
Yield (t/ha)	Aus	1.29	0.39	0.90	2.50	1.35	1.33
	Aman	1.64	0.37	1.10	2.36	0.43	-1.01
	Boro	2.80	0.66	1.80	3.97	0.44	-0.94
Maximum temperature (^{0} C)	Aus	32.19	0.55	30.78	33.35	-0.13	-0.05
	Aman	31.34	0.42	30.47	32.17	0.16	-0.57
	Boro	29.66	0.53	28.53	30.90	-0.06	-0.15
Minimum temperature (^{0} C)	Aus	24.14	0.38	23.42	25.23	0.11	0.57
	Aman	24.24	0.30	23.69	25.18	0.72	1.48
	Boro	18.28	0.43	17.48	19.13	0.19	-0.61
Rainfall (mm/year)	Aus	57785	9870	31709	75015	-0.62	0.02
	Aman	60903	10903	38138	78835	-0.39	-0.74
	Boro	14954	4478	4582	25436	0.21	0.00
Humidity (%)	Aus	80.36	1.33	76.28	82.66	-0.75	0.74
	Aman	84.19	0.99	80.83	85.78	-1.13	2.25
	Boro	74.65	2.31	68.01	78.33	-0.80	0.34
Sunshine (hour/day)	Aus	5.97	0.42	5.22	7.21	1.08	1.49
	Aman	5.44	0.37	4.52	6.51	0.50	1.22
	Boro	7.60	0.71	6.42	9.40	1.00	0.68

Table 8. The regression results of Aus, Aman and Boro rice crops yield

Climatic factors	Aus			Aman			Boro		
	Coefficient	SE	t-value	Coefficient	SE	t-value	Coefficient	SE	t-value
Intercept	**-5.483**	**2.773**	**-1.977***	0.819	1.472	0.556	**0.474**	**0.242**	**1.960***
Maxt	**0.127**	**0.066**	**1.930***	0.024	0.062	0.384	**0.017**	**0.010**	**1.714***
Mint	0.031	0.070	0.438	-0.058	0.048	-1.216	**-0.018**	**0.009**	**-1.981***
Rainfall	0.000	0.000	-1.473	0.000	0.000	-1.463	0.000	0.000	-1.291
Humidity	**0.039**	**0.017**	**2.364****	0.000	0.000	0.322	**0.000**	**0.000**	**2.139****
Sunshine	0.474	0.393	-1.205	0.005	0.040	-0.124	0.450	1.842	0.244
Year	**-0.037**	**0.003**	**-14.002*****	**0.019**	**0.002**	**8.922*****	**-0.006**	**0.001**	**-11.753*****
Model R^2	0.96			0.95			0.96		
Adjusted R^2	0.95			0.94			0.95		
D-W test	1.88			1.53			1.27		
F-statistics	119.10***			98.64***			121.30***		

Note: *, ** and *** represents the 10%, 5% and 1% level of significance respectively.

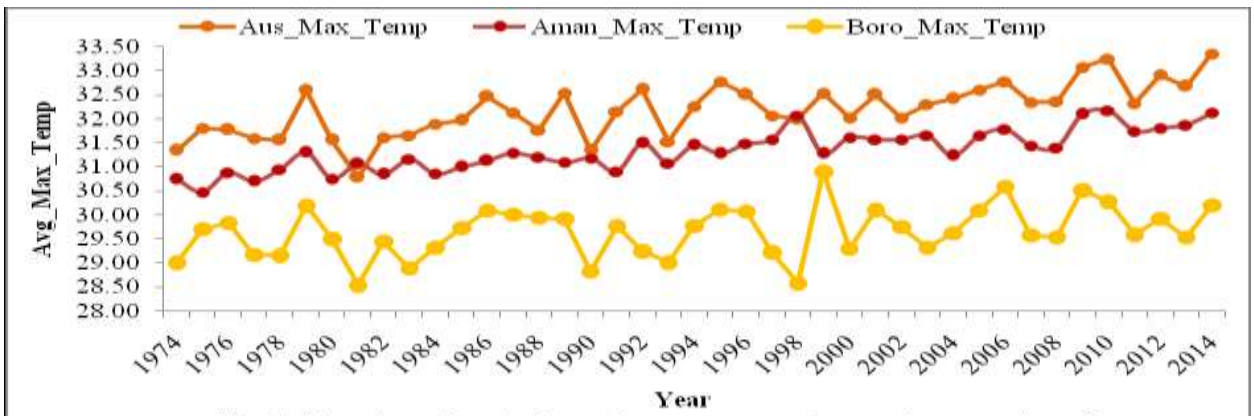


Fig 1: Trends and variations of average maximum temperature for aus, aman and boro from 1974-2014 in Bangladesh

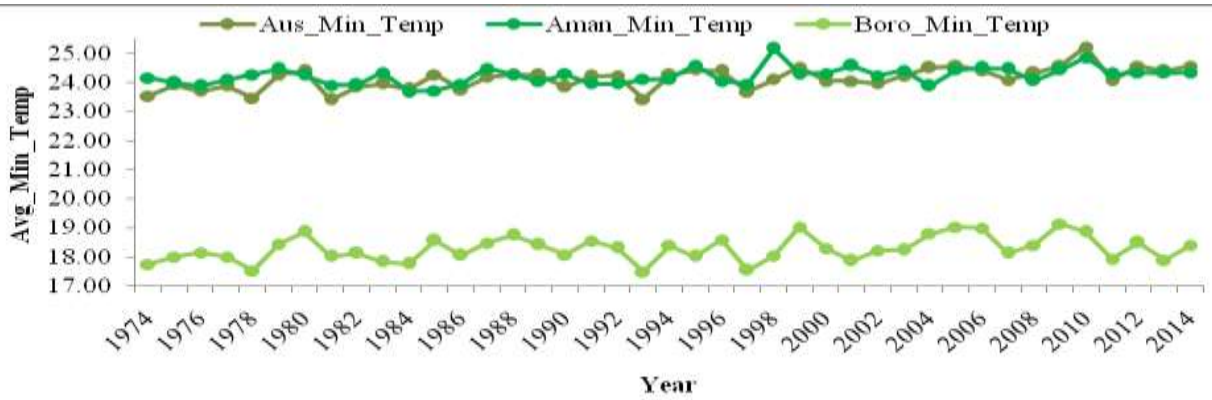


Fig 2: Trends and variations of average minimum temperature for aus, aman and boro from 1974-2014 in Bangladesh

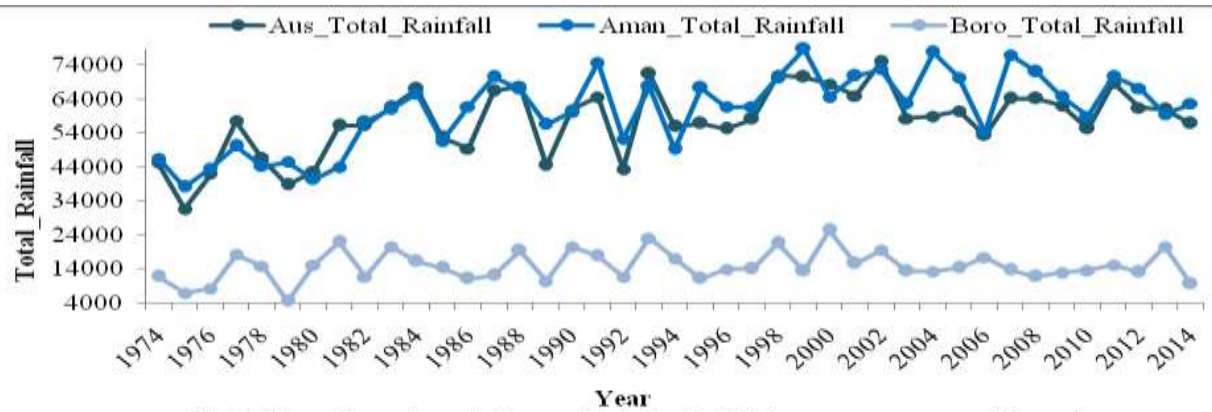


Fig 3: Trends and variations of total rainfall for aus, aman and boro from 1974-2014 in Bangladesh

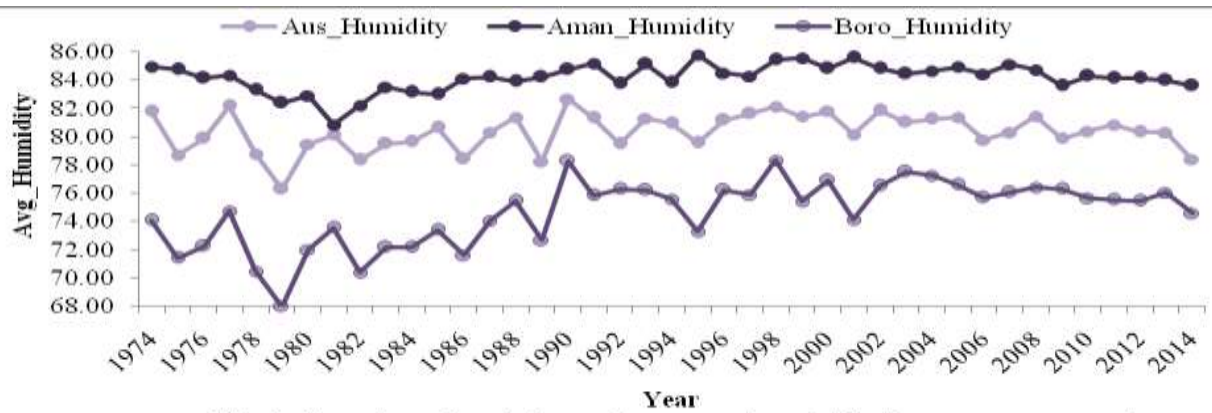


Fig 4: Trends and variations of average humidity for aus, aman and boro from 1974-2014 in Bangladesh

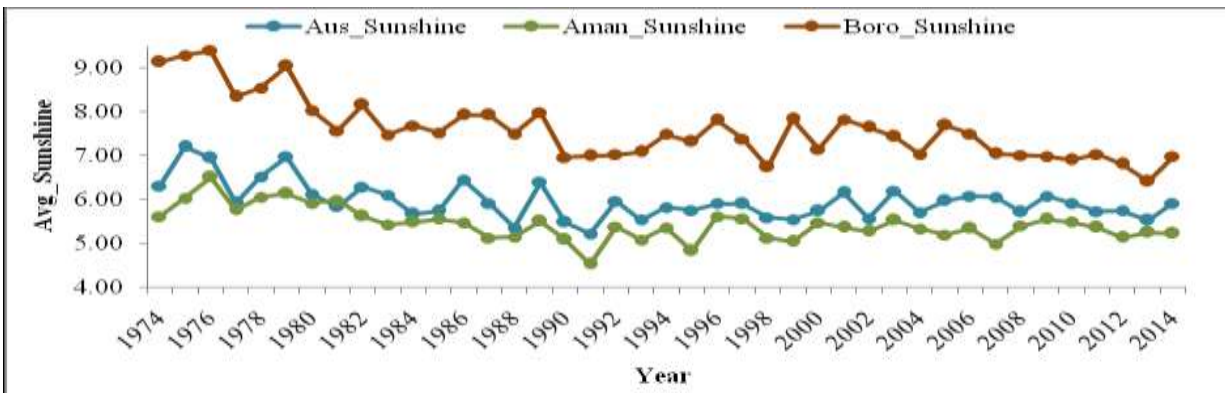


Fig 5: Trends and variations of average sunshine for aus, aman and boro from 1974-2014 in Bangladesh

Map 1: Avg. Max. Temp. (^{0}C) in Aus_2014

Map 2: Avg. Min. Temp. (^{0}C) in Aus_2014

Map 3: Total Rainfall (mm) in Aus_2014

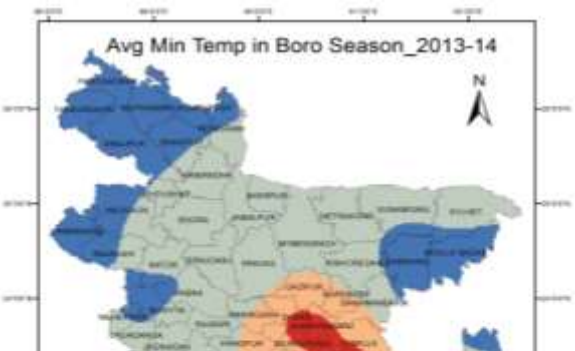
Map 4: Avg. Humidity (%) in Aus_2014

Map 5: Avg. Max. Temp. (^{0}C) in Aman_2014

Map 6: Avg. Min. Temp. (^{0}C) in Aman_2014

Map 7: Total Rainfall (mm) in Aman_2014

Map 8: Avg. Humidity (%) in Aman_2014



Map 9: Avg. Max. Temp. (^{0}C) in Boro_2014

Map 10: Avg. Min. Temp. (^{0}C) in Boro_2014

Map 11: Total Rainfall (mm) in Boro_2014

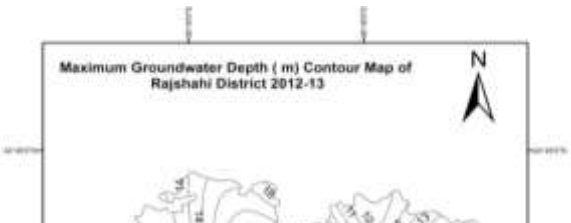
Map 12: Avg. Humidity (%) in Boro_2014

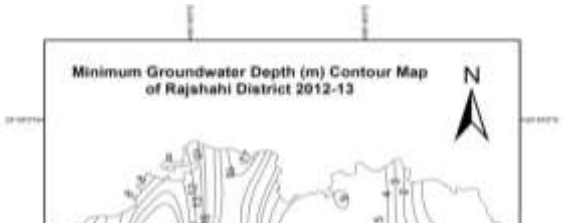
GROUNDWATER DEPLETION WITH EXPANSION OF IRRIGATION IN BARIND TRACT: A CASE STUDY

The study has described continuous declination of groundwater level with increase of groundwater irrigation in Barind Tract from mid 2000 to 2013 in the perspective of Rajshahi district which is located in severely drought prone area at northwestern part of Bangladesh. Dry season Boro rice

mainly depends on supplementary irrigation from groundwater, results in severe groundwater depletion. Main source of recharging of groundwater aquifer in this area is rainfall, but rainfall is also dropping here. Hydrographs are analyzed and groundwater level contour maps are prepared by Arc GIS version 10 software from the monitoring wells data of Bangladesh Water Development (BWDB). For aquifer geometry a subsurface geological cross section made by RockWorks software from bore log data of Department of Public Health Engineering (DPHE) and Bangladesh Water Development (BWDB). Only two aquifers exist and in NW area shows effective aquifer thickness is shorter than SE portion.

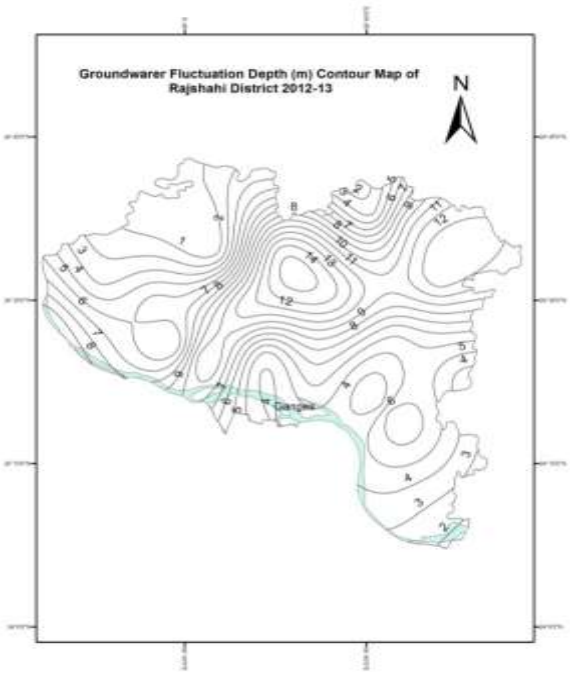
In this study it is found groundwater is depleting due to huge withdrawal all over Rajshahi and some areas are very critical especially the northern part. Main source of recharging of groundwater in this area is rainfall, which is also reducing. Average rates of maximum depth (dry season) and minimum depth (wet season) groundwater depilation are 0.23 meter/year and 0.38 meter/year respectively. Rate of declination of minimum depth is higher than that of maximum, which implies groundwater recharge coming down due to withdrawal of excessive groundwater. A significant change of minimum water depth observed after 2009. Among the upazilas, condition of Godagari and Tanore are very critical, in Godagari minimum depth depleted 17m and Tanore 8.1 m since the year 2000 to 2013. Moreover, recently these two upazilas maximum and minimum depths have got very closer So it can be said that there have some problem, in aquifer recharge thus the situation is very alarming and the area has lost suitability for Boro production. From the contour maps (maximum, minimum, fluctuation depth), groundwater level condition of Baghmara, Mohanpur and Tanore is very vulnerable and upazilas of Puthia, Charghat and Bagha so far are not in vulnerable position. Cross section of bore log data along the direction of NW to SE up to depth 250 m only two aquifers exist and in NW area shows effective aquifer thickness, which is shorter than SE portion that means areas of NW are very vulnerable to groundwater extraction. So it is clear that upazilas of Tanore, Godagari, Mohanpur and Baghmara are very vulnerable for irrigatin. There is a unblemished relation between Boro ie irrigated rice production and groundwater depletion. Thus future Boro production is threatened in the area even through it shows increasing treand. So, dependency of Boro of Barind area should be reduced. And groundwater depletion increased irrigation cost as water must be pumped farther to reach the surface, using more energy. In extreme cases, using such a well can be cost prohibitive. Moreover, some environmental negative effect may arise like reduction of surface water supplies, land subsidence, deterioration of water quality etc. Crop variation from water consuming crop (paddy) to less water consuming crops (vegetables, fruits etc), artificial recharging, increasing dependency on surface water, increasing irrigation efficiency including application of alternate wetting and drying (AWD) method, rainwater harvesting etc can be option for the study area.





Map 13. Maximum groundwater depth contour cap of Rajshahi district (2012-13).

Map 14. Minimum groundwater depth contour map of Rajshahi district (2012-13).



Map 15. Groundwater fluctuation depth contour map of Rajshahi district (2012-13).

MAINTENANCE OF RICE AND RICE RELATED VARIABLE DATABASE

The purpose of this activity is to maintain up-to-date information on rice and related crops and inputs and also to provide rice and related information to other research divisions and interested persons. Secondary data on rice and other important crops are collected periodically from Bangladesh Bureau of Statistics (BBS), Agricultural Marketing Directorate (AMD), Bangladesh Meteorological Department (BMD), Bangladesh Water Development Board (BWDB), Bangladesh Agriculture Development Corporation (BADC) and other sources periodically and computerized.

Existing databases have been updated. Also to make an agricultural database we want to initiate a database system where we can use updated software and database programme. Besides to

make this database, we will use SQL Server 2005 express edition/2008/2010/2012 version. We will also use Oracle 9i/10g/11i version.

BRRI Web Portal Management

ICT Cell, Agricultural Statistics Division make the Web Portal of BRRI using both English and Bengali language. BRRI web portal www.brri.gov.bd has been registered with BTCL. BRRI web portal is developed, managed and update by ICT Cell of Agricultural Statistics Division and uploaded information from concerned authority. It has been made by using Drupal, JQuery, CSS, HTML and MYSQL database.

BRRI website www.brri.gov.bd is being updated regularly with latest information as a routine work. We have already developed dynamic sitemap in BRRI website. We have also included Rice database, climate database, rice based maps and climate maps at BRRI dynamic website and updated regularly. To make more informative and updated, we developed individual web page including picture of Head quarter and all regional stations of BRRI.

Figure: BRRI Web Portal

Management of BRRI Network and Internet Connectivity

The main purpose of this activity is to manage and maintain ICT network and internet connectivity of BRRI, manage and maintain BRRI Local Area Network (LAN) and initiate e-Governance.

We have increased our Digital Data Network (DDN) bandwidth connectivity from 12 Mbps to 16 Mbps. Now our internet speed is faster than previous once. We have already setup WIFI connectivity to BRRI dormitory as per requirement of BRRI scientists and officers.

We have started to increase our bandwidth connectivity as per requirement of BRRI scientists and officers. Hopefully, within short time all the BRRI scientists and officers will get more speed for

internet access with smooth communication and they will be benefited to pass information internally as well as globally.

Management Information System (MIS) of BRRI

The objectives of this work is to manage and maintain BRRI MIS, get BACKUP of MIS (9 modules) every day. Data entry of the 8 (eight) modules has been already started in MIS Software. It is a continuous process. ICT cell of Agricultural Statistics division provide MIS Software related support services such as create user, permission and access MIS modules, installation etc.

Figure: MIS of BRRI

Personal Data Sheet (PDS) Database of BRRI

The objectives of this work are to develop "Personal Data Sheet (PDS)" database for all scientists, officers and staffs of BRRI, develop Personal Data Sheet (PDS) database using user name & password and get BACKUP of Personal Data Sheet (PDS) database regularly. We have created individual user name and password of PDS database for all scientists and class 1 officers as per requirement of the BRRI authority. Personal Data Sheet (PDS) database is updated regularly with latest information. It is a routine work.

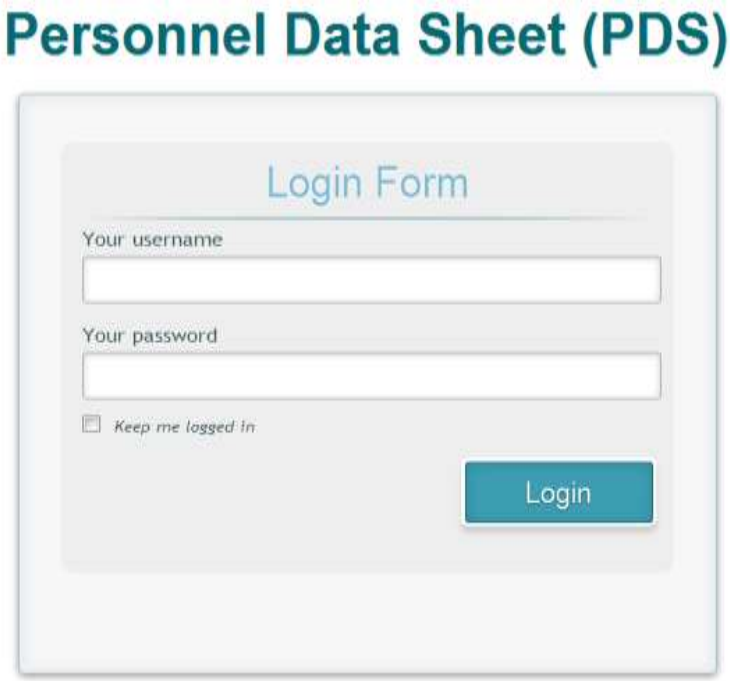


Figure: PDS database of BRRI

Digital Signature System of BRRI

The objectives of this program is to develop "Digital Signature System of BRRI" for all divisional heads, regional station heads and section head of BRRI, develop "Digital Signature System of BRRI" for research and administration works, develop unique system for the sender and develop proper integrity, accountability and confidentiality.

BRRI has already implemented Digital Signature Certificate processing by Controller of Certifying Authority (CCA) under Information & Communication technology (ICT) division of govt. of Bangladesh. Also, ICT Cell of Agricultural Statistics division distributed *116 (one hundred sixteen)* digital signature certificate of scientists and officers of BRRI. It has arranged a workshop by ICT Cell for distributing digital signature certificate for scientists and officers of BRRI, where officials of CCA have staged.

Web Mail and Group Mail of BRRI

The objectives of this work is to develop "Web mail" for all scientists and officers of BRRI for research and administration works and to develop "Group mail" for all scientists of BRRI for research and administration works.

We have created individual e-mail id into BRRI domain for all scientists and all class one officers as per requirement of the Ministry of Agriculture (MoA). We have created group mail for all scientists as per requirement of BRRI scientists. BRRI Web mail and Group mail Hosting into Bangladesh Computer Council (BCC) server.

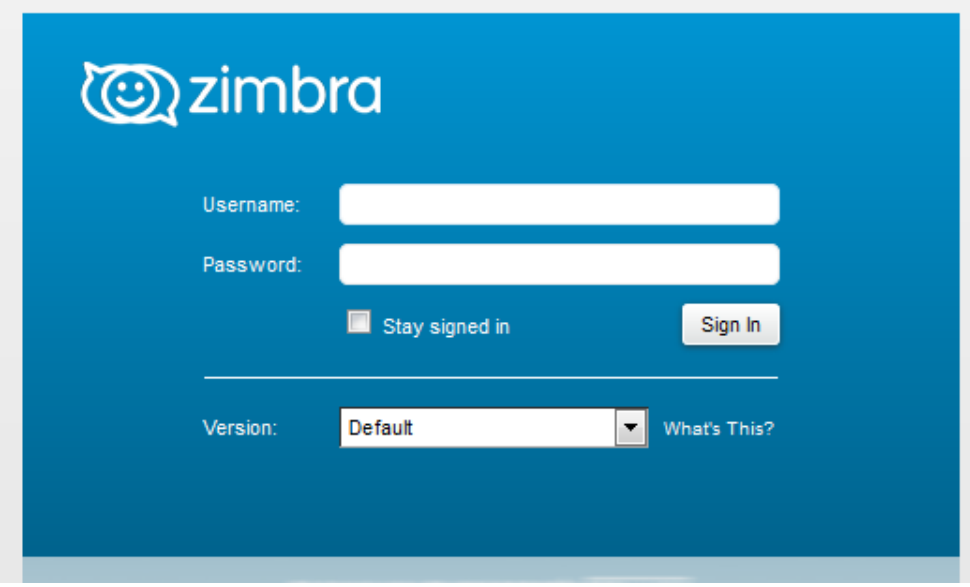


Figure: Web Mail of BRRI

Facebook Group (BRRI Networks) of BRRI

The main purpose of this work are to create a Facebook group for BRRI to promote all activities, where only official interactions, various problems and their solutions can be post and create a big forum for all kinds of scientists, officers and stuff's of BRRI. Where can post anything for noble work of rice and rice related activity of this forum.

BRRI introduced Facebook as per instruction from Ministry of MoA for using noble purpose. To build a linkage among all scientists, officers and stuff's, where *BRRI Networks* play an important role. Already *188 are* joined this *BRRI Networks* group. It will increase more gradually. *BRRI Networks* group is regular updated by skilled ICT Cell employee and to protect from all types of unwanted post, photo and other's spam, there have worked an ICT Cell employee as a moderator. So it is always safe and secured.

Heritage of BRRI

The objectives of this work are to develop "Heritage" for all retired scientists, officers, staffs, and labours of BRRI, develop Heritage for research and administration works, create and stimulate awareness amongst the present employees of BRRI about retired Scientists and officer's great activity so that they can follow their instruction and inform about their noble work and importance of preserving their all past document as a digital document in the central web portal of BRRI. So that, it will stay forever and all employee of BRRI will remember them all time.

We have created Heritage for all retired scientists, officers, staffs, and labours of BRRI as per requirement of the BRRI authority. We have created individual webpage including picture of all scientists, officers, staffs and all labours of BRRI. Heritage is updated regularly. It is a routine work.

Figure: Heritage of BRRI

SUPPORT SERVICES

The scientists of this division were also engaged in helping scientists of other disciplines in planning experiments, statistical data analysis and interpretation of results. A total of 110 different types of analyses were performed during the reporting year. A number of maps were prepared using GIS and supplied to the scientists of other divisions whenever required. ICT cell of Agricultural Statistics division has taken initiative in government perspectives but "BRRI Networks" group is first introduced amongst all National Agricultural Research System (NARS) and also first among all research institute. It is regular monitoring and updating with new information from any national and international newspaper or other sources. It is continuous process. ICT cell of Agricultural Statistics division will provides Antivirus related support services to other divisions such as setup antivirus software, clean virus, update antivirus database related problem etc.

BRRI ANNUAL REPORT

FOR

JULY 2014- JUNE 2015

FARM MANAGEMENT DIVISION

BANGLADESH RICE RESEARCH INSTITUTE

GAZIPUR-1701

CONTENTS

Sl.	Title	Page

1. PERSONNEL

Krishna Pada Halder	PhD	CSO and Head
Md. Sirajul islam	MS	PSO
Md. Mamunur Rahman[1]	PhD	SSO
Md. Rezaul Manir	MS	SO
Subrima Islam[2]	MS	SO
Md. Kamal Uddin	Dip in Agril	FM
Md. Nazrul Islam	Dip in Agril	AFM

1 Joined on 06.10.13 and transferred to BRRI R/S Satkhira on 07.08.14
2 Joined on 26.9.14 from higher studies

SUMMARY

The experiment was conducted at the West Byde of BRRI farm, Gazipur during T. aman'2014 to investigate the seed quality of rice that are affected by rainfed during reproductive and ripening phases. The treatments were two planting dates (D1= 16 August and D2= 12 September) and three rice varieties (V1= BRRI dhan40, V2= BRRI dhan41 and V3= BRRI dhan46). The treatments were arranged in a Randomized Complete Block design (RCBD) with three replications. The interaction between planting dates and variety was not significant in all the parameters of yield and yield components. The germination percentage (GM %), seedling vigor index (SVI), high density grain (HDG %), shoot dry weight (SDW) and root dry weight (RDW) were also not significantly affected by the interaction between planting dates and variety. Planting in 16 August produced higher number of tillers m^{-2}, panicles m^{-2}, grain $panicle^{-1}$, 1000-grain weight, grain and straw yield. Only the 1000 grain weight was significantly affected by variety. BRRI dhan46 produced the highest 1000 grain weight and grain yield followed by BRRI dhan41 and lowest in BRRI dhan40. The GM%, SVI, HDG%, SDW and RDW were significantly affected by planting dates. All of these parameters performed better in 16 August planting than 12 September planting. The highest GM% and HDG% was obtained from BRRI dhan46 followed by BRRI dhan41 and lowest in BRRI dhan40 but the SVI was the highest in BRRI dhan41 and lowest in BRRI dhan40. The SDW was the highest in BRRI dhan40 which was statistically identical to BRRI dhan46 but significantly decreased in BRRI dhan41.

The experiment was conducted at the West Byde of BRRI farm, Gazipur during T.aman'2014 to determine the tillering pattern, growth, yield and yield components rice as affected by seedling age. The treatments were six different ages of seedling, such as 15, 20, 25, 30, 35, and 40 days. The treatments were arranged in a Randomized Complete Block Design (RCBD) with three replications. The unit plot size was 4m X 4m. One seedling per hill at 20cmX20cm spacing was transplanted. Irrespective of seedling ages, the stem dry weight of all sampling dates increased slightly at PI stage then sharply increased at FS, after that decreased and reached minimum at maturity stage. The leaf dry weight also followed the same trend as stem dry weight. The panicle dry weight in all the treatments sharply increased from flowering to maturity stage. Irrespective of seedling ages, the tiller number gradually increased with the DAT and reached maximum at 45 DAT then gradually decreased and reached minimum at ripening and maturity stage. Fifteen days old seedling produced the highest number of tiller per hill from 15 to 120 DAT. The lowest number of tillers was recorded in 40 days old seedling in all the sampling dates. The panicle number m^{-2} also increased with decreasing seedling age. It was the highest in fifteen days old seedling and lowest in 40 days old seedling. Fifteen to 30 days old seedling produced identical and higher number of grain $panicle^{-1}$ and 40 days old seedling gave the lowest number of grain $panicle^{-1}$. The

highest grain yield obtained from 15 days old seedling transplanted plot followed by 20, 25, 30, 35 and lowest in 40 days old.

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, respectively.

This division produced about 12158 Kg rice of which 8275 Kg, 1180 kg and 2703 Kg was seed, noon seed and mixed rice, respectively. This rice was deposited to BRRI general store. This division also produced 11781 Kg breeder seed in collaboration with the GRS division.

BRRI has 734 labors of which 525 regular, 107 irregular. In the HQ, total labor is 447 of which 340 regular and74 irregular. The institute has 274 ha of land of which 163 ha was cultivable. Total labor utilization in different divisions was 171936 man days of which 58.46 %, 36.81% and 4.72% were utilized for research, support service and holidays, respectively. A total of Tk. 49188635.00 was paid as labour wages of which Tk. 28756881.7 and Tk. Tk. 18109299.94 and Tk. 2322453.35 were paid to the labours for research work, support service works and leaves, respectively. About 73.82 ha of land was utilized by different divisions in different season of which 6.53 ha in aus,32.62ha in aman and 34.66 ha in boro season. This division manages the BRRI flower garden to maintain the aesthetic view of the campus, this division created visible flower garden during summer and winter season.

RESEARCH

Seed quality of different T. aman rice as affected by rainfed (drought) in ripening (seed formation) phase

PI: **Md. Rezaul Manir** CI: **Dr. K P Halder**

Objective: **To investigate the seed quality of rice that are affected by rainfed produced in different planting dates**

Materials Methods:

The experiment was conducted at the West Byde of BRRI farm, Gazipur during T. aman'2014 to investigate the seed quality of rice that are affected by rainfed during reproductive and ripening phases. The treatments were two planting dates (D_1= 16 August and D_2= 12 September) and three

rice varieties (V_1= BRRI dhan40, V_2= BRRI dhan41 and V_3= BRRI dhan46). The treatments were arranged in a Randomized Complete Block design (RCBD) with three replications. The unit plot size was 4m X 3m. Yield and yield components data were taken. The germination percentage (GM%), seedling vigor index (SVI), high density grain (HDG%), shoot dry weight (SDW), and root dry weight (RDW) of seeds of harvested crop were also taken for observing the performance of seed quality. The collected data were analyzed using Crop Stat Software program.

Results and Discussion:

Yield and yield components:

The interaction between planting dates and variety was insignificant in all the parameters of yield and yield components. Therefore, only the main effect has been described and discussed below:

Effect of planting dates: The planting dates had significant effect on yield and yield components (Table 1). Sixteen August planting produced higher number tillers m^{-2}, panicles m^{-2}, grain $panicle^{-1}$ and 1000-grain weight. The maximum grain and straw yield was also recorded in 16 August planting and yield decreased significantly in 12 September planting might be due to decrease in rainfall, temperature and solar radiation during ripening phase (Fig: 1 and 2).

Effect of variety: Only the 1000 grain weight was significantly affected by variety (Table 1). BRRI dhan46 produced the highest 1000 grain weight followed by BRRI dhan41 and lowest in BRRI dhan40. The highest tiller number m^{-2} was recorded in BRRI dhan40 followed by BRRI dhan46 and lowest in BRRI dhan41. BRRI dhan41 gave the highest number of panicle m^{-2} but BRRI dhan40 produced the maximum number of grain $panicle^{-1}$. BRRI dhan46 produced the maximum grain yield followed by BRRI dhan41 and lowest in BRRI dhan40. The straw yield was not significantly affected by variety.

Seed quality:

The interaction between planting dates and variety was not significant on seed quality such as germination percentage (GM %), seedling vigor index (SVI), high density grain (HDG %), shoot dry weight (SDW) and root dry weight (RDW) (Table 2).

Effect of planting dates: The GM%, SVI, HDG%, SDW and RDW were significantly affected by planting dates. All of these parameters performed better in 16 august planting than 12 September planting.

Effect of variety: Variety had significant effect on all the parameters except RDW. The highest GM% (95.0) was recorded in BRRI dhan46 followed by BRRI dhan41 and lowest in BRRI dhan40 (88.83) but the SVI was the highest in BRRI dhan41 (5.63) and lowest in BRRI dhan40 (3.59). The HDG % significantly increased in BRRI dhan46 (87.13) and lowest in BRRI dhan40 (82.23) as the same trend also observed in GM%. The SDW was the highest in BRRI dhan40 (42.58 mg) which was statistically identical to BRRI dhan46 and significantly decreased in BRRI dhan41 (39.93 mg).

The variety had no significant effect on RDW but it was the highest in BRRI dhan41 (41.89 mg) and lowest in BRRI dhan40 (40.92 mg).

Conclusion: Sixteen August planting gave higher grain yield than 12 September planting. Among the varieties, BRRI dhan46 was the highest yielder than BRRI dhan40 and BRRI dhan41. Considering seed quality, 16 August performed better than 12 September planting. In case of varieties, BRRI dhan46 was the best in terms of GM%, SVI, HDG% and SDW.

Effect of seedling age on the growth, yield and yield components of rice

PI: **Dr. K P Halder** CI: **Md. Rezaul Manir**

Objective: To determine the tillering ability, dry matter production, yield and yield components of rice as affected by different seedling ages

Materials and Methods:

The experiment was conducted at the West Byde of BRRI farm, Gazipur during T. aman'2014 to determine the tillering pattern, growth, yield and yield components rice as affected by seedling age. The treatments were six different ages of seedling, such as 15, 20, 25, 30, 35, and 40 days. The treatments were arranged in a Randomized Complete Block Design (RCBD) with three replications. The unit plot size was 4m X 4m. One seedling per hill at 20cmX20cm spacing was transplanted. Tillers were counted from transplanting to maturity with 15 days intervals. Dry weight of leaf, stem and panicle were taken at different growth stages such as tillering, panicle initiation, flowering, dough and maturity stages. Yield and yield components data were also taken. The collected data were analyzed using Crop Stat Software program.

Results and Discussion:

Tiller Production: **The number of tillers produced at different days after transplanting (DAT) was significantly affected by seedling ages (Fig 3). Regardless of seedling ages, the tiller number gradually increased with the DAT and reached maximum at 45 DAT then gradually decreased and reached minimum at ripening and maturity stage i.e. 105 to 120 DAT. Fifteen days old seedling produced the highest number of tiller per hill from 15 to 120 DAT which was statistically identical with the tiller number produced from 20 and 25 days old seedling. The lowest number of tillers was recorded in 40 days old seedling in all the sampling dates which was statistically similar to the tiller number produced from 35 days old seedling.**

Dry Matter Production: **The dry matter data of leaves, stems and panicles were recorded at different growth stages (TS=Tillering stage, PI=Panicle initiation stage FS=Flowering stage, DS=Dough stage and MS= Maturity stage*)* and affected by seedling ages (Fig 4). Irrespective**

of seedling ages, the stem dry weight of all increased slightly at PI stage then sharply increased at FS, after that decreased and reached minimum at maturity stage. The leaf dry weight also followed the same trend as stem dry weight. The panicle dry weight in all the treatments sharply increased from flowering to maturity stage. In this experiment it has been observed that stem and leaf dry weight increased up to flowering stage after that decreased but panicle dry weight increased from flowering to maturity indicating that dry matter moved from stem and leaf to the panicles.

Yield and yield components:

The tiller number m^{-2}, panicle number m^{-2}, grain $panicle^{-1}$ and grain yield were significantly affected by seedling age but 1000 grain weight and straw yield were not significantly affected (Table 3).

Tiller number: The 15 days old seedling produced the highest number of tiller. The tiller number m^{-2} decreased gradually with increasing seedling age and the lowest number of tiller was recorded in 40 days old seedling. Twenty to 30 days old seedling gave statistically similar number of tiller m^{-2}.

Panicle number: The panicle number m^{-2} also increased with decreasing seedling age. It was the highest in 15 days old seedling which was statistically identical with the number of panicle produced from 20 to 25 days old seedling. Again 20 to 35 days old seedling produced statistically similar panicle number and lowest in 40 days old seedling.

Grain number: Twenty five and 30 days old seedling produced the highest number grain $panicle^{-1}$ which was statistically identical with grain $panicle^{-1}$ produced from 15 and 20 days old seedling. Forty days old seedling gave the lowest number of grain $panicle^{-1}$.

Grain yield: The highest grain yield obtained from 15 days old seedling transplanted plot followed by 20, 25, 30, 35 and lowest in 40 days old seedling but there was no significant difference between 15 to 25 days old seedling and between 20 to 30 days old seedling and also between 30 to 35 days old seedling.

Conclusion: Yield and yield components was higher in younger seedling used plot that produced more tillers and panicles. The plants those are produced from younger seedlings translocated more carbohydrate from source to sink might be the reason of higher yield in younger seedling used plot.

Monitoring labor wage rate at different locations of Bangladesh

PI: **Dr. K P Halder** CI: **Md. Rezaul Manir, Md. Sirajul Islam and Subrima Islam**

A survey was conducted to find out the laborers' wage rate at different locations around BRRI HQ such as Joydebpur, Chowrasta, , Salna, Board Bazar, Tongi, Konabari, etc (Table 4). It was observed that the average wage rate per day was Tk. 375-415. The highest wage rate of laboers was

in May (Tk. 385-440 per day) due to harvesting and post-harvest operations of boro rice and transplanting of aus rice. Another higher rate was during July-August (TK. 385-420 per day) due to harvesting and post-harvest operations of aus and transplanting of aman rice and the third higher wage rate was observed during December-January (Tk. 440-495 per day) due to the peak period for harvesting and post-harvest operation of aman rice and transplanting of boro rice.

In an another survey, it was observed that the wage rate varied from place to place and ranged between Tk. 250-300, 275-300, 275-300, 250-300, 250-300, 325-350, 325-350 and 300-350 at Habiganj, Rangpur, Rajshahi, Barisal, Sonagazi, Comilla Satkhira and Khulna, repectively (Table 5).

Rice Seed Production

PI: **Md. Rezaul Manir** CI: **Md. Sirajul Islam Dr. K P Halder and Subrima Islam**

In different seasons, this division produced 12158 Kg rice of which 8275 Kg seed, 1180 kg non seed and 2703 Kg mixed rice. These seeds were deposited to BRRI general store.

Breeder Seed: As a part of the project program of GRS division, this division produced about 11781 Kg breeder seed. These seeds were deposited to GRS division.

Support Services

PI: **Dr. K P Halder** CI: **Md. Sirajul Islam, Md. Rezaul Manir and Subrima Islam**

Land and Labor Management: Including Regional Stations, BRRI has about 734 labors of which 525 regular and 107 irregular. In BRRI HQ, total labor number is 447 of which 340 regular and 74 irregular labors. BRRI has 274 ha of land of which 163 ha is cultivable.

Labor Utilization: Total labor utilization in different division for research purpose, research related works, support service and leaves was171936 man days of which 58.46 %, 36.81 % and 4.72% were utilized for research, support service and holiday purpose, respectively.

Labor Wages: It was observed that total labour wages was Tk. 49188635.00 of which Tk. 28756881.7 and Tk. 18109299.94and Tk. 2322453.35 were paid to the labours for research work, support service works and leaves, respectively.

Land Utilization: A total of 73.82 ha of land were utilized by different division in different season of which 6.53 ha in aus, 32.62 ha in aman and 34.66 ha in boro season (Table 6).

Garden Management: This division always manages a visible flower garden to maintain an aesthetic view of the office area, some parts of the campus during summer and winter season.

Table 1. Yield and yield components of rice as affected by the date of planting and variety T. aman'2014

Treatments	Tiller m^{-2} (no.)	Panicle m^{-2} (no.)	Grain $panicle^{-1}$ (no.)	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Planting dates						
16 August	223	201	100	23.77	4.48	6.02
12 Sept	210	187	94	22.58	3.56	5.47
LSD at 5% level	*2.0*	*3.0*	*5.09*	*1.10*	*0.48*	*0.63*
Varieties						
BRRI dhan40	218	194	101	22.23b	3.96	5.67
BRRI dhan41	216	195	96	23.53ab	3.97	5.65
BRRI dhan46	217	194	95	23.76a	4.13	5.90
LSD at 5% level	*ns*	*ns*	*ns*	*1.35*	*ns*	*ns*

In a column, different small letters indicate the differences among treatments, ns=Not significant.

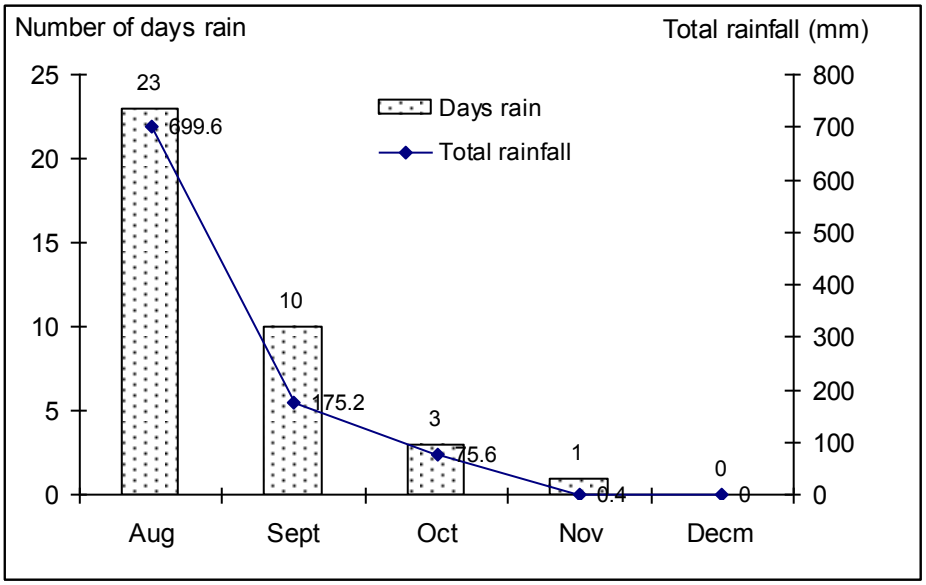


Fig: 1. Monthly number of rainy days and monthly total rainfall, T.aman'2014

(Vertical bar represents the number of rainy days)

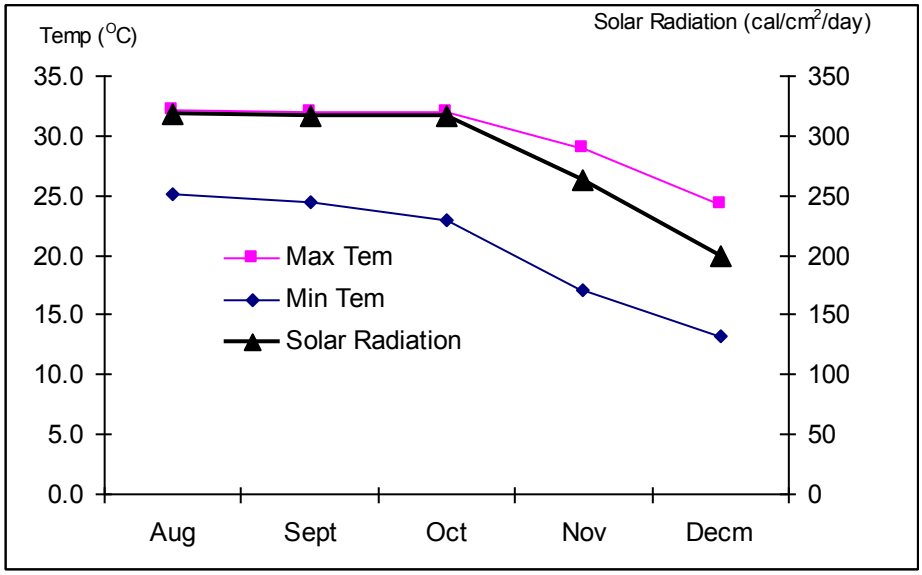


Fig: 2. Maximum and minimum temperature and solar radiation, T.aman'2014

Table 2. Seed quality of rice as affected by the date of planting and variety T. aman'2014

Treatments	GM %	SVI	HDG %	Shoot dwt of 10 Seedling (mg)	Root dwt of 10 Seedling (mg) at 10 days old
	Planting dates				
16 August	93.00	4.86	86.26	42.46	41.78
12 Sept	91.00	4.50	82.97	40.47	40.04
LSD at 5% level	*1.7*	*0.25*	*2.56*	*1.56*	*1.35*
	Varieties				
BRRI dhan40	88.83c	3.59c	82.23c	42.58a	40.92
BRRI dhan41	92.17b	5.63a	84.48b	39.93b	41.89
BRRI dhan46	95.00a	4.82b	87.13a	42.25a	41.42
LSD at 5% level	*2.11*	*0.31*	*3.15*	*1.91*	*ns*

In a column, different small letters indicate the differences among treatments, ns=Not significant. (GM%=Germination percentage, SVI=Seedling vigor index, HDG%=High density grain)

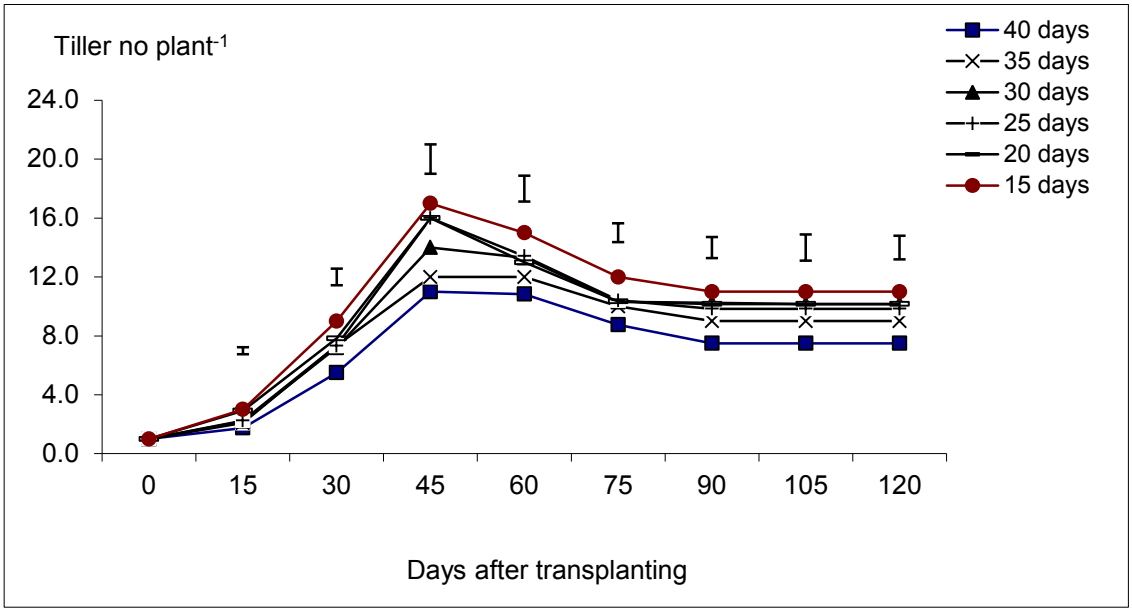


Fig:3. **Tiller number at different days after transplanting (DAT) as affected by seedling ages.**

(Vertical bar represent the Lsd (0.05) value indicates the differences between different seedling ages under same sampling date)

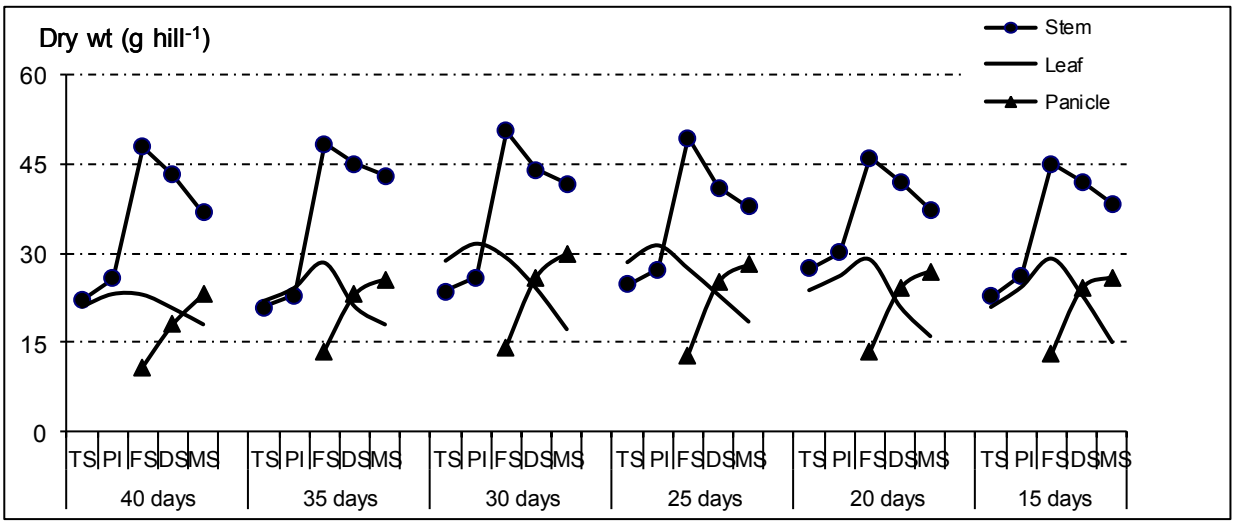


Fig 4. **Dry matter changes in leaves, stems and panicles at different growth stages of rice as affected by Different seedling ages.** ***(TS=Tillering stage,PI=Panicle initiation satge FS=Flowering stage, DS=Dough stage and MS= Maturity stage)***

Table 3. Yield and yield components of rice as affected by different seedling ages

Seedling ages	Tiller m^{-2} (no.)	Panicle m^{-2} (no.)	Grain $panicle^{-1}$ (no.)	1000- grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
40 days	196d	187c	92c	23.65	3.50d	5.14
35 days	253c	250b	94bc	24.19	4.31c	4.80
30 days	264b	250b	98a	23.54	4.70bc	5.45
25 days	267b	253ab	98a	24.22	4.80ab	5.58
20 days	268b	254ab	96a	23.54	4.89ab	5.80
15 days	280a	256a	97a	23.59	5.27a	5.63
LSD at 5% level	*4.8*	*5.3*	*3.0*	*ns*	*0.53*	*ns*

In a column, different small letters indicate the differences between treatments, ns=Not significant.

Table 4. Laborer's wage rate without stuff at different places around BRRI Gazipur during' 2014-2015.

Months	Remarks	
April	330-385	Normal period
May	385-440	Peak period. Harvesting and post-harvest operation of boro rice and transplanting of aus rice.
June	330-385	Normal period
July	385 -440	Peak period. Harvesting and post-harvest operation of aus rice and transplanting of aman rice.
August	395-420	
September	375-385	Normal period
October	360-385	
November	330-360	
December	440-495	Peak period. Harvesting and post-harvest operation of aman rice and transplanting of boro rice.
January	440-495	
February	330-385	
March	363-385	Normal period
Average	375-415	

* Wage rate of each month is the average rate of different places such as Joydebpur, Chowrasta, Salna, Board Bazar, Konabari etc.

Table 5. Laborer's wage rate without stuff at different locations of Bangladesh 2014-2015.

Locations	Wage rates (Tk.)
Habiganj	250-300
Rangpur	275-300
Rajshahi	275-300
Barisal	250-300
Sonagazi	250-300
Comilla	325-350
Satkhira	325-350
Khulna	300-350

Table 6. Land and labor strength of BRRI, 2014-2015.

Name of Station	Total land (ha)	Cultivable land		Labor (no.)		
		Area (ha)	% of total land	Muster Roll		Total
				Regular	Irregular	
1. HQ at Gazipur	76.83	44.45	57.9	340	107	447
2. Comilla	24.68	16.03	65.0	28	21	39
3. Hobiganj	35.03	25.90	73.9	30	10	40
4. Sonagazi	45.77	35.90	78.4	27	17	44
5.Barisal	41.10	10.74	26.1	21	12	33
6. Rajshahi	13.24	8.92	67.4	22	10	32
7. Bhanga	11.46	9.55	83.3	15	5	20
8. Rangpur	6.07	4.05	66.7	26	9	35
9. Kushtia	0	0	0	10	3	13
10. Satkhira	20.00	8.10	40.5	6	15	21
Total	274.18	163.64	59.7	525	209	734

Farm Machinery and Postharvest technology Division

Summary
Machinery development and testing
Milling and processing technology
Extension of agricultural machinery

Personnel

Muhammed Abdur Rahman, *Ph.D.*
Chief Scientific Officer

Md. Durrul Huda, *Ph.D.*
Principal Scientific Officer

AKM Saiful Islam, *Ph.D.*
Principal Scientific Officer

Md. Golam Kibria Bhuiyan[*+], *M.S*
Senior Scientific Officer
Md. Anwar Hossen[*], *M.S.*
Senior Scientific Officer
Bidhan Chandra Nath, *M. S*
Senior Scientific Officer
Md. Kamruzzaman, *M. Sc*
Senior Scientific officer
Subrata Paul, *M.S*
Scientific Officer
AKM Lutfar Rahman[*+], *M.S*
Scientific Officer
Md. Ashraful Alam[*], *M.S*
Scientific Officer
Md. Kamruzzaman[*], *M. S*
Scientific officer
Sharmin Islam[*++]
Agricultural Engineer
Haimonti Paul[*++]
Agricultural Engineer
Md. Nurul Momin Mondal, *Dip-in-Engg.*
Research Assistant

Md. Asgar Hossain, Tech. Trade Certificate
Foreman
Mihir Kumar Paul, Tech. Trade Certificate
Foreman

Md. Akram Hossain, *Tech. Trade Certificate*
Senior Mechanic

[*]On deputation for higher study
[*+] Join at FMPHT Division from deputation
[*++] Joint at BRRI on 10th July 2013

SUMMARY

A push-pull type single row conical weeder was fabricated in the FMPHT divisional research workshop. Laboratory basis test was conducted to find out faults. Float angle of the skid was considered as 25° which helps to make slippage of the rotor. 6 smooth and 6 serrated blades mounted on the periphery alternately on the rotor to uproot and buried weeds with traction and shear force.

A manual rice transplanter was fabricated at FMPHT research workshop. The performance test was conducted during Boro/2015 season at BRRI HQ research plot using 30 day's old (3-4 leaf) seedling of BRRI dhan28. The field capacity was found 0.033 ha/h at an operating speed 0.421 km/h. The transplanter successfully transplanted seedlings on an average hill-to-hill spacing 21 cm and 6 cm depth with 5-7 seedlings/hill. The missing and floating hills were observed 7.19% and 5.93% respectively. It was found that buried hill were 1.33/ m^2 during the operation.

A prototype of mini combine harvester was fabricated at the Janata Engineering workshop, Chuadanga under Public Private Partnership approach. BRRI provide design, drawing, technical and financial support to the workshop. The preliminary test was conducted during wheat and Boro 2015 season and some fault was identified. Rectification of these faults is under process.

A power chopper was developed to chop straw for cattle feed, mushroom bed and briquette materials in specific size. The performance test was conducted in FMPHT research workshop and five other places, BLRI Savar, Shajadpur of Sirajganj, Chuadanga, Jessore and Rangpur.

A de-husking machine was developed to improve the performance of existing engelberg huller. The capacity of developed de-husker was 500 kg/h and hulling efficiency was more than 90% in one pass. The head rice recovery was increased by 1-2% due to use of de-husker. In addition, bran and husk can be used for extracting bran oil and making briquette respectively.

A total 12 air blow type rice mills were fabricated at local manufacturing workshop Jamtoly, Ashulia, Savar, Dhaka. 7 of them were distributed and installed at farmers house under the supervision of BRRI and the rest of 5 were installed at NGO site under direct supervision KOICA Bangladesh office.

In the year of 2014-2015, a total 130 day-long demonstration cum informal training programs were conducted at different places of the project areas. About 5200 participants including farmers, machine operators and Sub Assistant Agricultural Officer (SAAO) were attended the demonstration cum informal training programmes. BRRI weeder, BRRI rice-wheat reaper, BRRI rice-wheat thresher (TH-7), BRRI open drum thresher, BRRI winnower, BRRI USG applicator and BRRI Prilled Urea applicator were also exhibited in demonstration. As a result awareness was created among the farmers on the benefit of using of BRRI farm machinery and they also wanted to purchase the machine subsidies prices.

In total 6 day-long and 48 two-day training programmes were conducted during Aman and Boro seasons 2014-15 in different location within the project areas. Altogether 132 and 960 participants mostly farm machinery operators were attended respectively in formal training programmes as trainee. A basic idea (how to operate new engine; when need to change air, oil & fuel filter etc.) on operation, repair and maintenance of diesel engine was shared with the participants. Trained operator was able to repair minor defects of the machine themselves. After training, the operators operated all machinery successfully.

One manufacturers training program was conducted during 2014-15. 15 participants from different farm machinery manufacturing workshops were attended 5 days long training. Training programme were consists of both the theoretical lecture and the hand on practical session.

AGRICULTURAL MACHINERY DEVELOPMENT AND TESTING

Design and Development of a Single Row Conical Weeder

A manually operated conical weeder was designed considering 14-16 cm width of operation for uprooting weeds and mulching of soil. An engineering design was done with the help of AutoCAD programming and prototypes were fabricated using locally available materials GI pipe, GI sheet, MS sheet, MS flat bar and MS shaft at the FMPHT divisional workshop. First version, second version and final version was fabricated in the divisional research workshop for single row operation in rice field. Some problem was found in the first version during field test. Those problems had been overcome in the second prototype and also found some mechanical error. For making easier and adjustable of the conical weeder, third version was fabricated in the research workshop. Skid and main frame is the basement of the conical weeder. The main frame holds the two conical rotors which help to rotate the rotors on the soil surface. All force (push and pull) exerted on the conical rotors by the main frame. Float angle of the skid was considered as 25° which helps to make slippage of the body. A float of 36 cm in length and 12 cm in width had been designed in front portion that prevents the penetration into soil. Float was designed 2mm thickness with 2 cm MS flat bar attached with thin metal sheet. Handle attached upon the main frame for exerted push and pull type of force to operate the conical weeder. The BRRI conical weeder has two cone shape rotors mounted in tandem with opposite orientation. Smooth and serrated blades are mounted alternately on the rotor to uproot and burry weeds when the rotors create a back and forth movement in the top 3 cm of soil. Thoroughly test and performance evaluation of the final version of single row conical weeder is going under process.

During design, the following criteria were considered:

- Easy weeding and simple of operation and maintenance
- Distance between row to row
- It should be minimum force requirement for operate in the field
- It should have simple and easy adjustment
- Locally available materials should be used to minimize the fabrication cost
- Light weight for easy handling
- It should be easy to repair and maintain
- It should be suitable for operation by a single person

Performance Evaluation of BRRI Manually Operated Rice Transplanter

BRRI manually operated (six-row) rice transplanter was fabricated at FMPHT divisional research workshop. The machine consists of two floats, a main frame assembly, picker bar assembly and handle. The row-to-row spacing is 20 cm whereas plant-to-plant spacing can be adjusted as per the requirement. The machine is backward pull-type and it needs mat-type seedlings for transplanting. Two floats facilitate the transplanter to slide over the puddled soil surface. Fixed opening type pickers are attached with the transplanting arm of the machine. Flat bar, B.I. sheet, angle bar, wall pipe, S.S. sheet, S.S. rod, chain & sprocket, spring, wood, nuts & bolts were used to manufacture this machine.

A preliminary performance test was conducted during Boro/2015 season at BRRI HQ research plot using 30 day's old (3-4 leaf) seedling of BRRI dhan28. The field capacity was found 0.033 ha/h at an operating speed 0.421 km/h. The transplanter successfully transplanted seedlings on an average hill-to-hill spacing 21 cm and 6 cm depth with 5-7 seedlings/hill. The missing and floating hills were observed 7.19% and 5.93% respectively. It was found that buried hill were 1.33/ m^2 during the operation. It has been observed that hill-to-hill spacing was wider at some places and narrower at

others resulting in deviation from the desired spacing. It may happen due the operator speed variation.

Design and Development of a Mini Combine Harvester

The combine harvester or "combine" is a machine that combining three separate operations comprising harvesting/reaping, threshing, and winnowing - into a single process. Combine harvesters have been a very significant part of the global industrial revolution and make a substantial contribution to food production worldwide – virtually no other invention has had the kind of impact on world food production that this workhorse has had. The most common in Bangladesh is still the traditional manual methods. This is accomplished by using hand sickle (called kachi). Combine harvester are gradually being introduced in Bangladesh.

Government and non-government organization imported combine harvest (head feed and whole feed) which are not affordable for the farmers due to high cost. Moreover the imported combine are big in size, those are tough to handle in small and fragmented land. The most of farm land have no road for easy accessibility of machines. Considering the above point, BRRI took initiatives to fabricate a mini combine harvester at the Janata Engineering workshop, Chuadanga under Public Private Partnership (PPP) approach. BRRI provide design, drawing, technical and financial support to the workshop. Locally available materials such as MS sheet, bar, rod, nut bolt, power transmission system, feeding, threshing and cleaning mechanism, wheel, base and frame, steering, hydraulics system (collected), were used to fabricate the combine. First prototype was developed and tested in wheat and Boro/2015 season to find out the performance, efficiency and operation fault. Following mechanical faults were identified and taking initiative to remove it.

Sl no.	Tested item/ find out Problem	Comments/Initiative will be taken
1	Cutter part weight was too much	The cutting efficiency was satisfactory and weight will be reduced.
2	Conveying length was too large	Conveyer length will be reduced.
3	Threshing drum length was small (61cm) and some un-threshed grain remained.	The threshing drum length will be increased up to (86cm) and the height of the thresher will be reduced.
4	The blower and cleaning sieve was large for cleaning the threshed grain.	The cleaning part will be deducted
5	The inclination angle of grain conveyer channel not justified and grain delivered screw length short	The grain conveyer channel inclination will be deducted (25^0) and grain delivered screw length will be enlarged (50 cm).
6	The combine working speed was not up to mark and tyre wheel was not suitable in wet field.	The tyre wheel will be replaced by crawler type and speed will be adjusted
7	The overall dimension of frame was un-used	The body dimension will be fixed up (152x152cm)

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Development of a Power Chopper Machine

Power chopper machine was developed to chop straw for cattle feed, mushroom bed and briquette materials, that's need specific sizes (length) of rice straw. Traditionally, chopping straw by sharpen cutting blade is time consuming and laborious. Existing manual chopper has not yet been popular in Bangladesh due to low cutting efficiency, excessive sliding tendency of the blade etc. Under this circumstance, FMPHT division of BRRI developed power chopper, which can chop dry, wet (fresh) rice straw in define sizes. Besides this, maize trunk, all kinds of fodder, small branches of tree etc. is also possible to chop.

The machine operated by 4 hp diesel engine or 2 hp electric motor by two labours. It can be chopped at least 1.5cm length of straw or others materials. The machine was manufactured with locally available materials i.e. MS sheet, Engle bars, casting iron, SS cutting blade. The main parts of the machine are frame, feeding tray, feeding cylinder, driver gear, cutting blade and output channel. On the consideration of ergonomics and safety is the main advantage of BRRI power chopper.

The performance test was conducted in FMPHT research workshop and five other places, BLRI Savar, Shajadpur of Sirajganj, Chuadanga, Jessore and Rangpur and result shown in Table 1. Manufacturing cost of this machine is Tk.25000-30000.

Table 1: The field performance of BRRI Power Chopper

Chopper	Straw (Dry) (kg/h)	Wet straw (kg/h)	Maize (kg/h)	Fodder (kg/h)	Small branches of tree (kg/h)
Motor operated	240	750	455	550	540
Engine operated	280	1000	485	675	600

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- **MILLING AND PROCESSING TECHNOLOGY**

Modification and Improvement of De-husking Machine

In Bangladesh there are 17,000 engelberg huller are operating throughout the country. Engelberg huller is still dominating in rice milling which contributing more than two third total productions. In the traditional engelberg milling system, husking and polishing occurring simultaneously. That's why husk and bran can't separate. To improve the existing engelberg system, a de-husking machine was developed. A 4kW 3 phase motor of 1440 rpm was used to operate rubber roll husker to separate husk from paddy and 38 cm diameter exhaust blower with 1.5kW motor of 2840 rpm used for removing husk. The de-husked paddy from de-husker used in existing engelberg huller mill for polishing. The capacity of developed de-husker was 500 kg/h and hulling efficiency was more than 90% in one pass. The head rice recovery was increased by 1-2% due to use of de-husker. In addition, bran and husk can be used for extracting bran oil and making briquette respectively.

Fabrication and distribution of Improved Air Blow Type Rice Mill

A total 12 air blow type rice mill was fabricated at local manufacturing workshop Jamtoly, Ashulia, Savar,Dhaka. Out of them 7 mills were distributed and installed at farmers under supervision of BRRI and 5 of them were installed at NGO site under direct supervision KOICA Bangladesh office.

INDUSTRIAL AND FARM LEVEL EXTENSION OF AGRICULTURAL MACHINERY

Demonstration cum Training of BRRI Developed Machinery at Farmer's Field

In the year of 2014-2015, a total 130 day-long demonstration cum informal training programs were conducted at different places of FMTD project areas. About 5200 participants including farmers, machine operators and Sub Assistant Agricultural Officer (SAAO) were attended the demonstration cum informal training programmes. As a result awareness was created among the farmers on the

benefit of using of BRRI farm machinery and they also wanted to purchase the machine subsidies prices. Drum seeder, BRRI weeder, BRRI rice-wheat reaper, BRRI rice-wheat thresher (TH-7), BRRI open drum thresher, BRRI winnower, BRRI USG applicator and BRRI chula were also displayed during the entire period of the fairs. Functions of these machines, advantages and disadvantages were displayed to the spectators by posters, display cards and leaflets. Awareness about the benefit of using machinery in farm operation was created among the farmers and other stakeholders.

Training on Operation, Repair and Maintenance of BRRI Farm Machinery

Total 48 numbers two day long training programmeswere conducted during Aman and Boro seasons, 2014-15 in different location within the project areas. Altogether 960 participants mostly farm machinery operators were attended in formal training programmes as trainee. A basic idea (how to operate new engine; when need to change air, oil & fuel filter etc.) on operation, repair and maintenance of diesel engine was shared with the participants. Trained operator was able to repair minor defects of the machine themselves. After training, the operators operated all machinery successfully.

Total 6 numbers day long training programmes were conducted during Aus, Aman and Boro seasons, 2014-15 in different upzila office within the project areas. Altogether 132 participants sub-assistant agriculture officer were attended in formal training programmes as trainee. Trained officer was able to repair minor defects of the machine themselves. After training, the operators operated all machinery successfully.

Training on Manufacturing Processes of BRRI Farm Machinery

One manufacturers training program was conducted during 2014-15. The training programme consists of 15 participants from different farm machinery manufacturing workshops for 5 days long training. Training programme were consists of both the theoretical lecture and the hand on practical session.

Workshop Machinery and Maintenance Division

Bangladesh Rice Research Institute

Gazipur 1701

Personnel

Engr Mahbubul Alam Zami, MS	Principal Scientific Officer and Head	12
Engr. Biraj Kumar Biswas, PhD	Senior Scientific Officer	12
Engr Mohammad Afzal Hossain, MS	Senior Scientific Officer	Deputation from 1 July 2015 (He is in Ph.D program)
Engr Hafizur Rahaman, BSc Agril Engineering	Scientific Officer	New, Joining date 26 July 2015

Workshop Machinery and Maintenance Division

SUMMARY

The power unit of a self-propelled reaper was developed and fabricated in research workshop of BRRI. The problem of this gearbox was identified through performance evaluation of power transmission systems in paddy and wheat field. The performance of the reaper was found satisfactory. The gear box of the power transmission systems was functionally well but it is little bit heavy. So, a new type of gearbox with compact size and reduced weight has been designed with the help of AutoCAD tools and developed at BRRI research workshop. In this machine for easy power transmission, a gearbox with mechanism of two forward and a backward speed have been introduced. Fabrication of power transmission system of the reaper is in progress and it will be tested in the next season.

WMM Division of BRRI has developed a self-propelled reaper for harvesting rice and wheat and the performance of this reaper is good in fragmented land as well as dry-land condition but it has a problem in wet-land condition. There is no suitable reaper in our country for wet-land condition. It does not move forward in wet-land during harvesting because its wheel goes down the soil and rotates in the same place. The self-propelled reaper wheel for wet-land condition has been designed

with the help of AutoCAD tools. Fabrication of the reaper wheel has been completed using the locally available materials at BRRI research workshop. It has been tested in BRRI farm.

Experiments were conducted at Harinakundu upazila, Jhenidah district in Boro and Aman 2014 seasons and BRRI farm, Gazipr in Boro 2015 season to determine paddy yield as influenced by different tillage depths. There were three tillage depths such as: 4-5 inches 5-6 inches and 6-7 inches in Jhenidah district and 4-5 inches and 6-7 inches in BRRI farm. The tillage depths were maintained by a power tiller. Tillage depths significantly affected the yield of BRRI dhan28 in Boro 2014, BRRI dhan56 in Aman 2014 and Boro 2015 season. The highest grain yield of BRRI dhan28 was found 7.50 t/ha in the tillage depth up to 6-7 inches and the lowest yield was found 6.88 t/ha in the tillage depth up to 4-5 inches in Boro season. On the other hand, in Aman 2014 season, the highest grain yield of BRRI dhan56 was found 5.40 t/ha in 6-7 inches tillage depth and the lowest yield was found 4.40 t/ha in 4-5 inches tillage depth. The highest grain yield of BRRI hybrid dhan2 was found 1.60 t/ha in 6-7 inches tillage depth and the lowest yield was found 1.35 t/ha in 4-5 inches tillage depth in Boro 2015 season. The highest yields of both the seasons were found under the higher tillage depths up to 6-7 inches and the lowest yields were obtained in the tillage depth up to 4-5 inches.

There are different kinds of transport/vehicles and farm machinery at BRRI. Repair and maintenance works of these were done by WMM Division. Repair works and of spare parts of these vehicles and farm machinery were also done under major and moderate/minor repair and maintenance work. The total cost of major and moderate/minor repair and maintenance was Tk 66,33,650.00 from July 2014 to June 2015. Among these major repair and maintenance cost was Tk 60,59,523 and moderate/minor cost was Tk 5,74,127.

DEVELOPMENT OF AGRICULTURAL MACHINERY

Design and development of power transmission system of a power unit

This Division of BRRI has developed a self-propelled reaper for harvesting rice and wheat. The gear box of self-propelled power unit was developed and fabricated in the BRRI research workshop (Fig. 1). Power transmission unit of the reaper was tested in paddy field at BRRI farm, Gazipur, BRRI RS farm Rajshahi, Rangpur and also in paddy and wheat field at Jhenidah District. The problem of this gearbox was identified through performance evaluation of power transmission systems. The performance of the self-propelled reaper was found satisfactory. The existing gear box has a provision of two forward speeds with a backward speed. When engine is started, all gears in the gear box move either engaging or disengaging clutch. Backward gear always moves but keeps idle when the reaper is in forward motion. Power is transmitted in reduced form from gear box to axle through chain and sprocket. This gear box is functionally well but it is little bit heavy. So, it is necessary to design a new type of gearbox with compact size and reduced weight.

Fig. 1. Actual view of BRRI developed self-propelled reaper.

Design consideration

The self-propelled reaper has been designed considering the following criteria:

- Simple, lightweight, and sturdy in design
- Functionally perfect for harvesting crops for which it has been designed
- Locally available materials have been used for construction of the different parts of the reaper due to avoid facing difficulties of unavailability of raw material
- The machine has been designed for a specific crop as well as multipurpose type without sacrificing its merits
- Small in size due to compact design
- The light duty low cost diesel engine has been used as a prime mover for the reaper
- The cost of machine per unit length is low, and thus the cost of harvesting operation is also low
- Harvesting losses have been controlled within acceptable limit
- Trouble free machine.

Power transmitting unit

Compact size with reduced weight power transmission unit of self-propelled reaper has been designed with the help of AutoCAD tools (Fig. 2) and developed at BRRI research workshop. Fabrication of reaper will be completed very soon and this will be used in the next season. Major components of self-propelled reaper have also been designed and these are as follows:

Power transmission System

Chassis of the power unit

Prime mover

Control accessories etc.

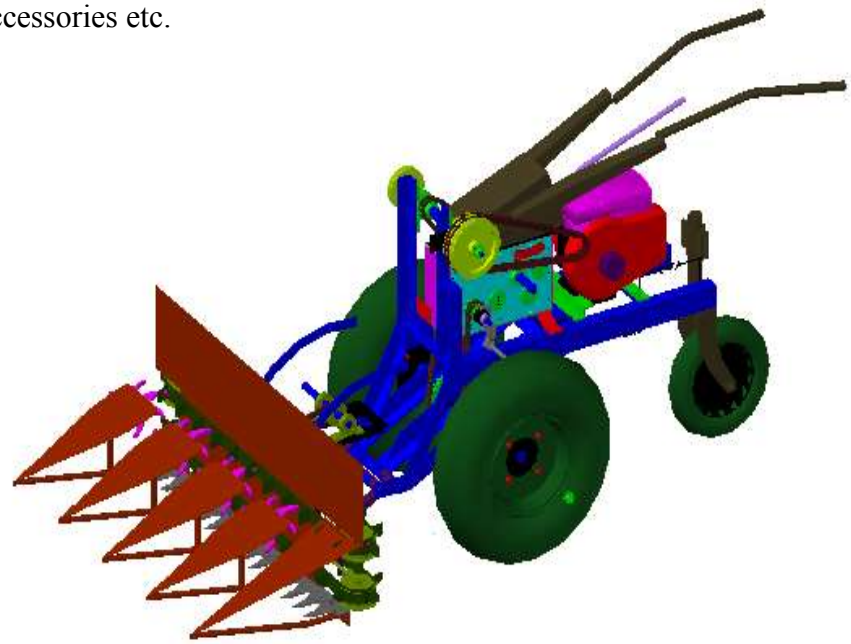


Fig. 2. AutoCAD drawing of power transmission unit of BRRI developed reaper

Chassis of self-propelled reaper unit

The chassis of the self-propelled reaper unit consists of the following items:

Mainframe

The main frame was made of 3.0 mm thickness 50.8×50.8 mm m/s angle bar. It was fitted horizontally to the ground. The driving handle was fitted to the upper end of the mainframe by electric arc welding. The tail wheel was also fitted to the back engine base frame by the arc welding. The main power transmission shaft was placed the upper end of the frame. Two ball bearings along with casing were used for connecting the shaft to the main frame. The gearbox along with the shaft was placed below the main power transmission shaft by the ball bearings with casings. Figure 3 shown the details.

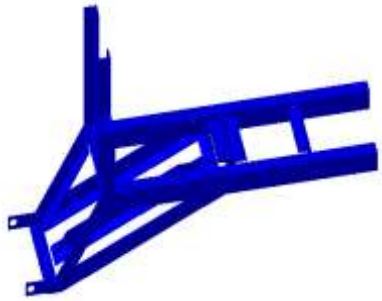


Fig. 3. AutoCAD drawing of mainframe of BRRI developed reaper.

Gearbox

The gearbox is a power-transmitting unit. It is simple in construction with forward and backward speed and a neutral gear position (Fig. 4). In this gearbox, for forward speed of the reaper, gears are moving along with shaft carrying with load. The gearbox consists of different parts as listed below:

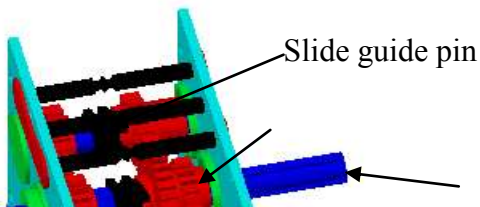
Gearbox casing
Gear shaft with key
Gear pinion and clutch

Ball bearing and journal bearing

Positive clutch slider

Slider guide pin

Gear liver mechanism etc.



Gear

Shaft

Side cover

Positive clutch slider

Fig. 4. AutoCAD drawing of gearbox of BRRI developed reaper.

Ball bearing and journal bearing

Five shafts were mounted to the sidewall of the gearbox by four pairs of ball bearing. A pair of ball bearing was also used at the partition in the gear box. Another two pairs of ball bearing were used at the wheel axle and one pair of ball bearing was used with power transmission shaft so that they move around the shaft independently.

Positive clutch slider

Two common forms of clutches are the square–jaw clutch and the spiral–jaw clutch. One of the members must always slide axially on feather keys or spines to engage and disengage the clutch. The square–jaw clutch is the simplest form and can theoretically transmit torque in either direction without introducing a component of force. The spiral–jaw clutch can be engaged at somewhat higher speeds without serious clashing, but it can transmit torque in only one direction without requiring an external axial force to maintain the engagement. Straight spines are also widely used to give positive engagement with no tendency to develop an axial force.

Driving wheels with axle

The diameter of wheel was 69.4 cm. One pair of 45 mm diameter m/s shaft was used for driving wheel axle. Two pair's ball bearings with pillow type casing were used to fit the wheel axle to the inclined trusses. A pair of 21.9 cm diameter sprocket was used in this axle to transmit power from the gearbox by a roller chain.

Driving handles with tail wheel

The driving handles were made of 20 mm diameter m/s pipe. It is fitted to the upper end of the main frame by electric arc welding. Two m/s rods were used to connect the other ends of the engine base frame to driving handles by electric arc welding.

Gear shifting lever along with accessories

Clutches are used to connect or disconnect shafts as required by the gear shifting lever. Two common forms of clutches are the square–jaw clutch and the spiral–jaw clutch. In this study, the positive spiral jaw clutches was used.

Main power transmission shaft along with pulley and sprocket

Continuous mechanical power is usually transmitted along and between rotating shafts. The transfer between shafts was accomplished by gears, belts, chains or other similar means for matching the torque/speed characteristics of the interconnected shafts (Fig. 5). Shafts were supported in two bearings (sliding or rolling), which allowed the shafts to turn freely. There was no appreciable torque exerted by the bearings. A sliding bearing was needed for a lubricant film in the clearance space between shaft and bearing bush and in the fully hydrodynamic bearing illustrated the oil dragged into the wedge-shaped gap causing a pressure build-up (similar to that in hydroplaning), which supported the shaft without metal-to-metal contact and little friction.

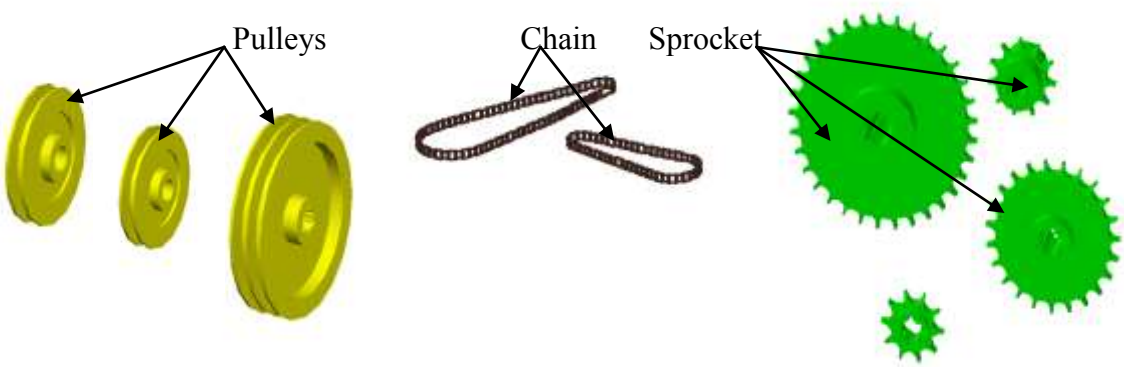


Fig. 5. AutoCAD drawing of pulleys, chain and sprocket.

Modification of reaper travelling wheel for wet-land condition

Harvesting of cereal grains by machines is an important part of mechanized agriculture. It is the first and major post-harvest

operation for separation, processing and storage of grains. Delayed harvesting due to shortage of labour and bad weather conditions often causes yield loss, which can be minimized by use of reaper/harvester. Paddy is grown all round the year whereas wheat is grown only in the winter season (Rabi) in Bangladesh. These crops are harvested traditionally by using sickle, which is very tedious and time consuming. Due to fragmented land, self-propelled reaper is more suitable for harvesting rice and wheat in our land condition. A low cost self-propelled reaper has been developed by WMM Division of BRRI using locally available material for harvesting rice and wheat. The performance of this reaper is good in fragmented land as well as dry-land condition. However, it has a problem in wet-land condition. At present, there is no suitable reaper in our country for wet-land condition. During harvesting in wet-land, it does not move forward because its wheel goes down the soil and rotates in the same place. So, there is a scope to modify a reaper-wheel for wet-land condition for harvesting rice and wheat. For this reason, this experiment has been undertaken at research workshop BRRI, Gazipur during 2013-14 to modify a self-propelled reaper wheel using locally available materials.

The complete design of self-propelled reaper wheel has been done with the help of AutoCAD tools (Fig. 6). Fabrication of the reaper wheel has been completed according to the design using the locally available materials at BRRI research workshop (Fig. 7). It will be tested in the next season.

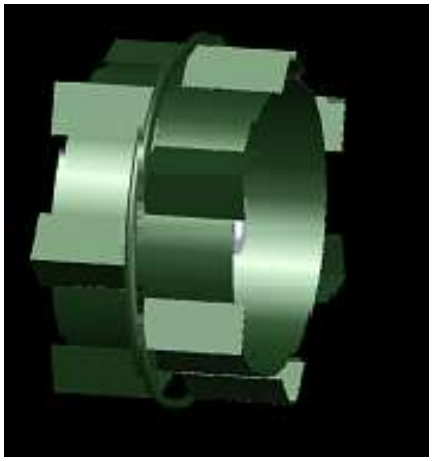


Fig. 6. AutoCAD drawing of reaper travelling wheel.

Fig. 7. Actual view of reaper travelling wheel for wet-land condition.

Determination of tilling efficiency of power

This experiment was conducted at BRRI farm Gazipur in Boro 2015 season. The tillage depths were 4-5 inch and 6-7 inch where BRRI hybrid dhan2 was cultivated in Boro 2015 season. Other experiments were conducted at Harinakundu upazila under Jhenidah district in Boro 2014 and Aman 2014 seasons. There were three tillage depths such as: 4-5 inches, 5-6 inches and 6-7 inches in Jhenidah district. BRRI dhan28 was cultivated in Boro 2014 season and BRRI dhan56 was cultivated in Aman 2014 season. The tillage depths were maintained by a power tiller. The paddy was irrigated and weeding as well as other intercultural operations were done as and when necessary. Paddy was harvested at full maturity. The weights of paddy were recorded plot-wise.

The effects of tillage depths on grain yield of BRRI hybrid dhan2 in Boro 2015, BRRI dhan28 in Boro 2014 and BRRI dhan56 in Aman 2014 seasons were varied from different tillage depths. The highest grain yield of BRRI hybrid dhan2 (breeder seed) in Boro 2015 season was found 1.60 t/ha in the tillage depth up to 6-7 inch and the lowest yield was found 1.35 t/ha in the tillage depth up to 4-5 inch (Table 1). Table 1 shows the highest grain yield of BRRI dhan28 was found 7.50 t/ha in the tillage depth up to 6-7 inches and the lowest yield was obtained 6.88 t/ha in the tillage depth up to 4-5 inches in Boro 2014 season. Table 1 also shows the highest grain yield of BRRI dhan56 in Aman 2014 season which was 5.40 t/ha in the tillage depth up to 6-7 inches and the lowest yield was found 4.40 t/ha in the tillage depth up to 4-5 inches. The highest yields of all the seasons were found under the higher tillage depths up to 6-7 inches and the lowest yields were obtained in the tillage depth up to 4-5 inches (Table 1). The deep tillage (6-7 inches) might have favoured the roots to proliferate down into the deeper layers of the soil profile to extract more nutrients and moisture that has led to higher growth and yield of both the seasons. Higher tillage depth favourably influenced the soil-water-plant ecosystem, thereby improved crop yields.

Table 1: Yield of paddy with different tillage depths.

Year	Season	Paddy	Tilling Depth (inch)	Paddy Yield (t/ha)
2014	Boro	BRRI dhan28	4-5	6.88
			5-6	6.96
			6-7	7.50
	Aman	BRRI dhan56	4-5	4.40
			5-6	4.84
			6-7	5.40
2015	Boro	BRRI hybrid dhan2 (breeder seed)	4-5	1.35
			6-7	1.60

ANNUAL REPORT FOR 2014-2015
(JULY 2014 – JUNE 2015)

XVI. TECHNOLOGY TRANSFER
ADAPTIVE RESEARCH DIVISION

BANGLADESH RICE RESEARCH INSTITUTE
GAZIPUR – 1701

Name and Designation of Scientists (July 2014-June 2015)

Md Shafiqul Islam Mamin, PhD
Chief Scientific Officer and Head
Md Atiqul Islam, PhD
Principal Scientific Officer
Md Rafiqul Islam, MS
Principal Scientific Officer
Biswajit Karmaker, MS
Senior Scientific Officer
Shahnaz Parveen, MS
Senior Scientific Officer
Shamsunnaher, MS
Scientific Officer
Afruz Zahan, MS
Scientific Officer
Rajesh Barua, MS
Scientific Officer
Md Romel Biswash, MS
Scientific Officer

SUMMARY

During the reporting period (2014-2015), 32 advanced breeding lines for different seasons were evaluated by conducting 10 advanced line adaptive research trials (ALART) in different agro ecological regions of Bangladesh according to the objectives of varietal improvement programme. Considering specialty on some important characteristics like grain yield, shorter growth duration, grain size, good grain quality, stress tolerance, micronutrient enriched, non-shattering habit, phenotypic acceptability and farmers' opinion, nine advanced lines for different seasons were recommended for proposed variety trial (PVT). Among these, one was selected for B. Aus, six for T. Aman and two for Boro season. During B. Aman (DWR) 2014, none of the advanced lines was found to be more suitable than the local check varieties. During B. Aus 2014, BR6848-3B-12 was found suitable for PVT. During T. Aman 2014, BR7941-116-1-2-1 and BR7941-41-2-2-2-4 for tidal submergence, IR77092-B-2R-B-10 and BR9377-9-21-3B for salt tolerance, BR7638-7-2-5-2 for Rainfed lowland rice ecosystem and BR7697-15-4-4-2-2 for premium quality rice were found suitable for PVT. During Boro 2015, BR7781-10-2-3-2 as premium quality rice and NERICA Mutant as short duration variety were selected for PVT.

During Aus 2014, Aman 2014 and Boro 2015, Seed Production and Dissemination Programme (SPDP)s were conducted by using different BRRI varieties and other technologies at different locations of Bangladesh under GOB and different projects like Integrated Agricultural Productivity Project (IAPP), Mujibnagar Integrated Agricultural Development Project (MIADP), Enhancing Quality Seed Supply Project (EQSS) etc. A total of 166 demonstrations were conducted in 90

upazilas of 42 districts, from which about 351 tons of paddy grains were produced and 54 tons were retained as seeds by the farmers for next year cultivation. About 44 thousand farmers gained knowledge and awareness about BRRI varieties through demonstrations following field days, field visit and other interactions. Among them about 14 thousand farmers were motivated to adopt BRRI varieties.

During Aus 2014, Aman 2014 and Boro 2015, adaptive trials were conducted in different locations of Barisal and Rangpur regions under IAPP to indentify the most sutable varieties for those specific areas. For Barisal region BRRI dhan48 for T. Aus and BRRI dhan41and BRRI dhan44 for T. Aman were found most suitable. In Boro season, BRRI dhan47 and BRRI dhan58 were found most suitable for Barisal region. For Rangpur region, it was Swarna, BRRI dhan49 and BRRI dhan57 for T. Aman. and BRRI dhan58 for Boro season. During the reporting period, ARD conducted 28 farmers' training at different locations in which 930 trainees (farmers and SAAOs of DAE) participated. The division also conducted 75 field days at different locations of the country. About 12,350 persons participated in those occasions. A total of 5.5 tons quality seeds of popular and recently released rice varieties were produced at BRRI farm, Gazipur under ARD for conducting adaptive trials in different locations of the country in Aus, Aman and Boro seasons.

TECHNOLOGY VALIDATION

Advanced Line Adaptive Research Trial (ALART)

B. Aus 2014. Four advanced lines: BR6855-3B-12, BR6855-3B-13, BR6848-3B-12 and BR6976-2B-11-1 along with BRRI dhan43 as check were tested in West byde (BRRI Gazipur), Gazipur (Kapasia), Noakhali (Sadar), Feni (Sonagazi), Sylhet (Golapgonj), Faridpur (Modhukhali), Magura (Sadar) and Kushtia (Doulatpur) during B. Aus 2014. In terms of yield performance, all the tested advanced lines except BR6976-2B-11-1 performed better than the check variety BRRI dhan43 (Table 1). Among the lines, BR6848-3B-12 was found to be lesser infected by disease. In addition this line had about 1.0 t/ha yield advantage over the check variety BRRI dhan43. Although BR6848-3B-12 was to some extent Sheath blight suceptible, still considering the yield advantage, grain size, growth duration and phenotypic acceptance BR6848-3B-12 may be recommended for PVT, if the disease reaction is accepted by pathologist.

Table 1. Grain yield (t/ha), growth duration, 1000-grain weight (TGW) and plant height of some advanced lines under ALART grown in different locations of Bangladesh during B. Aus 2014.

Genotype	Location									Growth duration (day)	TGW (g)	Plant height (cm)
	Grain yield (t/ha)											
	L1	L2	L3	L4	L5	L6	L7	L8	Mean	Mean	Mean	Mean
BR6855-3B-12	2.84	2.90	3.32	4.29	3.31	2.74	4.08	2.18	3.21	109	28.2	109
BR6855-3B-13	3.05	3.32	3.46	4.31	3.47	2.90	4.56	2.10	3.40	108	28.5	108
BR6848-3B-12	3.37	3.60	3.34	4.88	3.94	2.96	4.81	2.26	3.64	104	24.3	112
BR6976-2B-11-1	2.23	2.65	2.68	3.83	2.25	2.45	3.34	1.58	2.62	106	23.2	91
BRRI dhan43 (ck)	2.68	2.57	2.78	3.22	3.11	2.34	3.10	1.64	2.68	105	23.0	108
LSD (5%)	**0.53**								**0.19**	**0.7**	**0.2**	**0.9**

L1-Gazipur (BRRI), L2-Gazipur (Kapasia), L3-Noakhali, L4-Feni, L5-Sylhet, L6-Faridpur, L7-Magura, L8-Kushtia

T. Aman 2014 (Tidal Submergence). Four advanced lines: BR7941-1-1-2-1, BR7941-41-2-2-2-4, BR7941-30-1-1-1 and BR7941-116-1-2-1 along with BRRI dhan44, Sadamota and Dudkalam as checks were tested at farmers' field in eight locations such as Barisal (Sadar), Barisal (Bakergonj), Patuakhali (Sadar), Patuakhali (Dumki), Jhalokathi (Sadar), Jhalokathi (Nolchiti), Borguna (Betagi) and Pirojpur (Sadar) during T. Aman 2014. Average seedling height, which is an very important factor for the survival of rice plant in tidal non-saline ecosystem, of all the tested advanced lines ranged from 64-74 cm which was longer than the check variety BRRI dhan44 (54 cm) (Table 2). Considering seedling height, grain yield, grain size and growth duration, BR7941-116-1-2-1 and BR7941-41-2-2-2-4 were recommended for PVT.

Table 2. Grain yield (t/ha), growth duration, TGW and Seedling height of some advanced lines under ALART (Tidal submergence) grown in different locations of Bangladesh during T. Aman 2014.

Genotype	Location	Growth	TGW	Seedling

	Grain yield (t/ha)									duration (day)	(g)	height (cm)
	L1	L2	L3	L4	L5	L6	L7	L8	Mean	Mean	Mean	Mean
BR7941-1-1-2-1	3.36	3.65	3.40	3.33	3.30	3.92	1.79	3.63	**3.30**	148	25.41	**64**
BR7941-41-2-2-2-4	3.91	4.20	4.00	4.07	4.10	4.07	1.57	4.13	**3.76**	151	23.56	**72**
BR7941-30-1-1-1	3.40	3.90	3.83	3.53	3.90	4.47	1.90	3.75	**3.59**	147	26.10	**74**
BR7941-116-1-2-1	4.30	5.24	4.73	4.77	4.00	4.85	2.33	4.50	**4.34**	145	26.42	**70**
BRRI dhan44 ck	3.98	4.40	4.63	3.70	3.60	3.83	1.66	3.80	**3.70**	147	26.52	**54**
Sadamota ck	3.42	4.41	3.57	3.96	3.50	3.63	1.43	2.71	**3.33**	164	28.05	**70**
Dudkalam	3.19	3.51	3.93	3.57	3.70	3.87	2.01	3.25	**3.38**	139	26.93	**73**
LSD (5%)	**0.63**								**0.22**	**0.69**	**0.24**	

L1-Borguna (Betagi), L2-Jhalokathi (Sadar), L3-Jhalokathi (Nolchiti), L4-Patuakhali (Sadar), L5-Patuakhali (Dumki), L6-Barisal (Sadar), L7-Barisal (Bakergonj), L8-Pirojpur (Sadar)

T. Aman 2014 (Salinity). Six salt tolerant advanced lines: IR73055-8-1-1-3-1, IR83484-3-B-7-1-1-1, IR78761-B-SATBI-68-6, IR83440-4-B-11-2-1-1-AJYI-B, IR77092-B-2R-B-10 and BR9377-9-21-3B along with BRRI dhan41 and BRRI dhan54 as checks were tested at farmers' field in seven saline prone areas such as Khulna (Batiagahta), Khulna (Dumuria), Bagerhat (Rampal), Patuakhali (Kalapara), Satkhira (Debhata), Satkhira (Shymnagar) and Satkhira (Kaligonj) during T. Aman 2014. Based on grain yield, grain size, growth duration, salt tolerance and farmers' opinion, IR77092-B-2R-B-10 and BR9377-9-21-3B were recommended for PVT (Table 3). Although most farmers did not prefer short duration variety at saline prone area of the trials, still IR73055-8-1-1-3-1 or IR78761-B-SATBI-68-6 might be considered for saline areas which produced similar mean yield to that of check variety BRRI dhan54 but the growth duration of those entries was found to be 12-14 days earlier than BRRI dhan54 and 22-24 days earlier than BRRI dhan41. In some locations of saline areas, short duration T. Aman varieties are necessary to escape soil salinity at reproductive stage, which may be increased in the month of October and November when the rain water availability is decreased. So short duration T. Aman varieties are needed in those areas to grow other salt tolerant non rice crops in rabi season.

Table 3. Grain yield (t/ha), growth duration, TGW and plant height of some advanced lines under ALART (Salinity) grown in different locations of Bangladesh during T. Aman 2014.

Genotype	Location								Growth duration (day)	TGW (g)	Plant height (cm)
	Grain yield (t/ha)										
	L1	L2	L3	L4	L5	L6	L7	Mean	Mean	Mean	Mean
IR73055-8-1-1-3-1	4.03	3.60	3.75	2.95	3.53	4.23	4.49	3.80	125	23.5	106
IR83484-3-B-7-1-1-1	4.15	2.76	3.10	2.91	3.80	4.25	4.41	3.63	124	23.3	105
IR78761-B-SATBI-68-6	4.38	3.56	3.00	3.60	3.67	4.46	4.64	3.90	123	23.8	108
IR83440-4-B-11-2-1-1-AJYI-B	3.90	2.79	2.92	3.36	3.28	3.75	4.45	3.49	124	23.6	103
IR77092-B-2R-B-10	4.67	3.86	4.20	3.62	4.51	4.55	5.03	4.35	140	23.4	112
BR9377-9-21-3B	3.80	1.71	4.07	4.48	5.02	4.57	5.11	4.11	149	24.3	125
BRRI dhan41 (Ck)	3.85	2.34	4.10	4.34	4.67	4.54	5.06	4.13	147	23.7	122
BRRI dhan54 (Ck)	4.25	1.35	4.30	3.56	4.36	4.41	4.78	3.86	137	23.8	119
LSD (5%)	**0.46**							**0.17**	**0.4**	**0.2**	**1.1**

L1-Satkhira (Debhata), L2- Satkhira (Shymnagar), L3- Satkhira (Kaligonj), L4-Khulna (Batiaghata), L5-Khulna (Dumuria), L6-Bagerhat (Morelganj), L7-Patuakhali (Kalapara),

T. Aman 2014 (RLR). Three advanced lines: BR7468-12-1-1-1-1, BR7472-16-2-1-2-1 and BR7638-7-2-5-2 along with BRRI dhan32 and BRRI dhan49 as checks were tested at farmers' field in west byde (BRRI Gazipur), Rajshahi (Godagari), Barisal (Sadar), Chittagong (Hathazari), Comilla (Muradnagar), Kishoregonj (Pakundia), Sylhet (Sadar), Jessore (Jhikorgacha), Satkhira (Sadar) and Kushtia (Sadar) during T. Aman 2014. Although BR7638-7-2-5-2 was to some extent susceptible to BLB, brown spot and sheath blight along with irregular flowering and maturity, still considering the yield, growth duration similar with BRRI dhan49 and less infection of false smut disease and farmers' opinion, BR7638-7-2-5-2 may be recommended for PVT, if the disease reactions is accepted by pathologist (Table 4).

Table 4. Grain yield (t/ha), growth duration, TGW and plant height of some advanced lines under ALART (RLR) grown in different locations of Bangladesh during T. Aman 2014.

Genotype	Location											Growth duration (day)	TGW (g)	Plant height (cm)
	Grain yield (t/ha)													
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	Mean	Mean	Mean	Mean
BR7468-12-1-1-1-1	5.70	5.48	4.60	3.40	5.38	3.94	4.30	3.74	4.11	5.12	4.58	130	20.80	109
BR7472-16-2-1-2-1	5.61	5.59	4.73	4.00	5.38	3.66	4.07	4.11	4.05	5.25	4.64	130	20.66	110
BR7638-7-2-5-2	5.71	5.67	5.35	3.67	5.23	3.59	5.57	4.16	5.42	5.39	4.98	136	21.72	110
BRRI dhan32 ck	5.00	4.45	5.00	4.60	5.78	4.24	5.34	4.23	4.80	5.31	4.88	132	21.03	121
BRRI dhan49 ck	5.53	5.06	5.96	5.00	5.47	4.00	5.54	4.41	4.90	5.34	5.11	136	19.80	102
LSD (5%)	**0.44**										**0.13**	**0.41**	**0.22**	**0.68**

L1-Jessore, L2-Barisal, L3-Chittagong, L4-Comilla, L5-Kishoreganj, L6-Satkhira, L7-Sylhet, L8-Rajshahi, L9-Gazipur, L10-Kushtia

T. Aman 2014 (PQR). Four premium quality advanced lines: BR7697-15-4-4-2-1, BR7697-15-4-4-2-2, BR7697-16-2-2-1-1 and BR7369-52-3-2-1-1 along with BRRI dhan37 as check were tested at farmers' field in west byde (BRRI Gazipur), Rajshahi (Godagari), Barisal (Sadar),

Chittagong (Hathazari), Comilla (Muradnagar), Kishoregonj (Pakundia), Sylhet (Sadar), Jessore (Jhikorgacha), Satkhira (Sadar) and Kushtia (Sadar) during T. Aman 2014. On an average, all the tested entries gave higher yield, ranged from 4.24 to 4.63 t/ha, than the check variety BRRI dhan37 (3.59 t/ha) (Table 5). Based on grain yield, grain size, grain quality, growth duration, phenotypic acceptance and farmers‘ opinion, BR7697-15-4-4-2-2 may be recommended for PVT.

Table 5. Grain yield (t/ha), growth duration, TGW and plant height of some advanced lines under ALART (PQR) grown in different locations of Bangladesh during T. Aman 2014.

Genotype	Location											Growth duration (day)	TGW (g)	Plant height (cm)
	Grain yield (t/ha)													
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	Mean	Mean	Mean	Mean
BR7697-15-4-4-2-1	4.54	5.00	5.10	4.80	3.80	5.20	3.74	5.00	3.50	3.70	4.44	131	22.2	122
BR7697-15-4-4-2-2	4.33	5.40	5.27	4.60	4.50	5.10	4.67	4.90	3.60	3.90	4.63	131	21.5	121
BR7697-16-2-2-1-1	3.77	4.90	5.23	4.96	4.11	5.31	4.00	4.70	3.30	4.00	4.43	134	22.7	120
BR7369-52-3-2-1-1	4.03	5.00	5.00	4.50	4.00	4.82	4.00	4.30	3.10	3.69	4.24	131	23.8	122
BRRI dhan37 ck	4.00	4.60	3.74	2.90	3.31	3.68	4.48	3.50	3.00	2.66	3.59	148	16.7	130
LSD (5%)	**0.47**										**0.15**	**0.43**	**0.23**	**4.55**

L1-Chittagong, L2-Kushtia, L3-Jessore, L4-Satkhira, L5-Rajshahi, L6-Kishoreganj, L7-Sylhet, L8-Barisal, L9-Gazipur, L10-Comilla

B. Aman 2014 (DWR). Two advanced lines: BR224-2B-2-5 and BR5915-B-7 along with Gabura (Ck.) and existing local check of the respective area were tested in Manikgonj (Shibaloy), Tangail (Basail), Pabna (Bera), Hobigonj (Baniachong), Shirajgonj (Tarash) and Comilla (Homna) during B. Aman 2014. But the trials at Hobigonj (Baniachong) was abandoned due to some unavoidable situation. Yield performance of all the DW genotypes was very poor. In all locations except Tangail and Comilla, local check variety gave higher yield than the tested lines and check variety Gabura (Table 6). At Tangail and Comilla, all the entries including checks gave statistically similar yield. Farmers did not prefer the advanced lines due to its lower yield and longer duration. On the other hand, they preferred their respective local varieties. So, none of the advanced lines was recommended for PVT.

Table 6. Grain yield (t/ha), growth duration and TGW of some advanced lines under ALART (DWR) grown in different locations of Bangladesh during B. Aman 2014.

Genotype	Location						Growth duration (day)	TGW (g)
	Grain yield (t/ha)							
	L1	L2	L3	L4	L5	Mean	Mean	Mean
BR224-2B-2-5	1.91	2.02	1.98	1.98	1.99	1.98	179	24.43
BR5915-B-7	2.03	1.92	1.80	1.89	1.91	1.90	176	24.73
Gabura (ck)	1.10	1.99	1.70	1.83	1.99	1.92	174	25.08
Local (ck)	2.28	2.14	2.15	2.03	1.98	2.11	170	24.82
	Sarsaria	**Dhaldigi**	**Horinchamra**	**Hijoldiga**	**Khama**			
LSD (5%)	**0.20**					**0.09**	0.22	0.25

L1-Sirajganj, L2- Pabna, L3- Manikganj, L4-Comilla, L5-Tangail

Boro 2015 (PQR). Three premium quality advanced lines: BR7781-10-2-3-2, BR7369-10-5-2-3 and BR7369-52-3-2-1-1 along with BRRI dhan50 and BRRI dhan63 as checks were tested in 12 locations such as BRRI research farm (Gazipur), Rangpur (Sadar), Barisal (Sadar), Chittagong (Hathazari), Comilla (Muradnagar), Kishoreganj (Pakundia), Habiganj (Sadar), Khulna (Dumuria), Sathkhira (Sadar), Kushtia (Sadar), Pabna (Sadar) and Nilphamari (Syedpur) during Boro 2015. On an average in 12 locations, BR7781-10-2-3-2 gave the highest yield (5.84 t/ha), ranged from 5.32 to 6.66 t/ha, among all the advanced lines (Table 7). Considering grain yield (5.84 t/ha), growth duration (155 days), grain size, phenotypic acceptance and farmers‘opinion, BR7781-10-2-3-2 was recommended for PVT.

Table 7. Grain yield (t/ha), growth duration, TGW and plant height of some advanced lines under ALART (PQR) grown in different locations of Bangladesh during Boro 2015.

Genotypes	Locations													Growth duration (day) Mean	TGW (g) Mean	Plant height (cm) Mean
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	Mean			
	Grain yield (t/ha)															
BR7781-10-2-3-2	5.56	6.30	5.51	6.13	5.62	5.53	5.32	6.66	5.36	6.47	5.77	5.47	5.84	155	17.0	104
BR7369-10-5-2-3	5.21	6.20	4.63	5.62	5.16	5.02	4.74	6.26	5.41	6.05	5.72	5.42	5.45	160	23.6	106
BR7369-52-3-2-1-1	5.23	6.51	5.37	5.90	5.25	5.16	5.00	6.64	4.87	5.76	6.07	5.53	5.61	157	24.7	101
BRRI dhan50 (Ck)	5.68	6.40	6.12	5.71	5.90	5.65	5.38	6.51	5.10	5.96	5.62	5.53	5.80	156	19.5	85
BRRI dhan63 (Ck)	5.24	6.46	5.65	5.64	5.77	4.80	5.22	6.60	5.11	6.13	5.46	5.39	5.62	153	21.2	87
LSD0.05	0.46												0.13	0.3	0.22	1.1

L1-Barisal, L2-Chittagong, L3-Comilla, L4-Gazipur, L5-Habiganj, L6-Khulna, L7-Kishoreganj, L8-Kushtia, L9-Pabna, L10-Rangpur, L11-Satkhira, L12-Nilphamari

Boro 2015 (MER). Two micronutrient enriched advanced lines: BR7833-11-1-1-3-4 and BR7830-16-1-5-9-9 along with BRRI dhan28 and BRRI dhan64 as checks were tested in 12 locations such as BRRI research farm (Gazipur), Rangpur (Sadar), Barisal (Sadar), Chittagong (Hathazari), Comilla (Muradnagar), Kishoregonj (Pakundia), Habiganj (Sadar), Khulna (Dumuria), Sathkhira (Sadar), Kushtia (Sadar), Pabna (Sadar) and Nilphamari (Syedpur) during Boro 2015. Considering all required characteristics, none of the advanced lines was found suitable for PVT (Table 8).

Table 8. Grain yield (t/ha), growth duration, TGW and plant height of some advanced lines under ALART (MER) grown in different locations of Bangladesh during Boro 2015.

Genotypes	Locations													Growth duration (day)	TGW (g)	Plant height (cm)
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	Mean	Mean	Mean	Mean
	Grain yield (t/ha)															
BR7833-11-1-1-3-4	6.24	6.59	5.94	5.39	5.84	5.75	5.25	6.25	5.29	5.72	6.10	6.31	**5.89**	**152**	**30.1**	**85**
BR7830-16-1-5-9-9	5.80	6.44	6.35	6.06	5.58	5.74	5.95	6.80	5.94	6.53	5.65	6.68	**6.12**	**153**	**27.1**	**99**
BRRIdhan28(Ck)	6.30	6.41	5.84	5.22	5.60	6.09	5.94	6.20	5.80	6.71	5.89	5.97	**6.00**	**143**	**22.9**	**96**
BRRIdhan64(Ck)	5.65	5.52	5.29	5.45	6.20	5.42	5.55	6.32	5.89	6.20	5.52	6.12	**5.76**	**152**	**25.5**	**102**
LSD0.05	**0.69**												**0.20**	**0.79**	**0.31**	**0.95**

L1-Barisal, L2-Chittagong, L3-Comilla, L4-Gazipur, L5-Khulna, L6-Kishoreganj, L7-Kushtia, L8-Pabna, L9-Rangpur, L10-Satkhira, L11-Nilphamari, L12-Habiganj

Boro 2015 (Short duration). NERICA Mutant along with BRRI dhan28 and BRRI dhan45 as checks were evaluated in 12 locations such as BRRI research farm (Gazipur), Rangpur (Sadar), Barisal (Sadar), Chittagong (Hathazari), Comilla (Muradnagar), Kishoregonj (Pakundia), Habiganj (Sadar), Khulna (Dumuria), Sathkhira (Sadar), Kushtia (Sadar), Pabna (Sadar) and Nilphamari (Syedpur) during Boro 2015. Grain yield ranging from 5.06 to 7.10 t/ha in different locations, NERICA Mutant gave higher average yield (6.08 t/ha) than the check varieties BRRI dhan28 (5.87 t/ha) and BRRI dhan45 (5.61 t/ha). Average growth duration of NERICA Mutant was 148 days which was four and six days longer than BRRI dhan28 (144 days) and BRRI dhan45 (142 days), respectively (Table 9). Considering several aspects, NERICA Mutant was recommended for PVT.

Table 9. Grain yield (t/ha), growth duration, TGW and plant height of some advanced lines under ALART (Short duration) grown in different locations of Bangladesh during Boro 2015.

Genotypes	Locations													Growth duration (day)	TGW (g)	Plant height (cm)
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	Mean	Mean	Mean	Mean
	Grain yield (t/ha)															
NERICA Mutant	6.95	6.26	6.23	5.50	6.20	5.76	6.45	5.22	7.10	5.81	6.37	5.06	6.08	148	24.7	100
BRRI dhan28 (Ck)	5.91	5.76	5.84	6.11	5.96	5.82	5.80	5.15	6.56	6.04	6.16	5.28	5.87	144	23.0	95
BRRI dhan45 (Ck)	5.76	5.93	5.58	5.92	5.66	5.55	5.62	5.01	6.10	5.55	5.93	4.69	5.61	142	28.2	94
LSD0.05	**0.57**												**0.17**	**0.5**	**0.18**	**1**

L1-Barisal, L2-Chittagong, L3-Comilla, L4-Gazipur, L5-Habiganj, L6-Khulna, L7-Kishoreganj, L8-Kushtia, L9-Pabna, L10-Rangpur, L11-Satkhira, L12-Nilphamari

Boro 2015 (Cold Tolerant). Three cold tolerant rice genotypes: IR77496-31-2-1-3-1, BR7812-19-1-6-1-P4 and BR7813-1-1-3-1 along with BRRI dhan28 and BRRI dhan36 as checks were evaluated in 10 cold prone areas such as BRRI research farm (Gazipur), Rangpur (Sadar), Naogaon (Sadar), Pabna (Sadar), Panchagar (Sadar), Moulovibazar (Srimangol), Dinajpur (Sadar), Chuadanga (Alamdanga) and Nilphamari (Syedpur) during Boro 2015. Farmers did not show so much interest about the advanced lines compared to BRRI dhan28, although some yield advantage was found in advanced lines (Table 10). Considering grain yield, growth duration, grain type, disease reaction, phenotypic acceptance and farmers‘opinion, none found suitable for PVT.

Table 10. Grain yield (t/ha), growth duration, TGW and plant height of some advanced lines under ALART (Cold Tolerant) grown in different locations of Bangladesh during Boro 2015.

Genotype	**Location**										Growth duration (day)	TGW (g)	Plant height (cm)
	Grain yield (t/ha)												
	L1	L2	L3	L4	L5	L6	L7	L8	L9	Mean	Mean	Mean	Mean
IR77496-31-2-1-3-1	6.90	6.71	5.65	5.76	6.79	5.44	6.63	5.75	5.93	6.17	158	25.13	84
BR7812-19-1-6-1-P4	6.52	6.80	6.37	6.15	7.05	5.80	5.93	6.72	6.59	6.44	160	27.60	95
BR7813-1-1-3-1	6.85	6.52	5.75	6.35	7.51	5.90	6.75	5.75	6.96	6.48	156	25.13	96
BRRIdhan28(Ck)	6.45	5.35	5.80	6.02	6.70	5.81	6.15	5.85	6.20	6.04	144	21.59	93
BRRIdhan36(Ck)	5.25	5.12	4.82	4.75	5.25	6.20	5.75	5.55	5.66	5.37	145	23.21	88
LSD (5%)	**0.41**									**0.14**	**1.13**	**0.30**	**1.86**

L1-Dinajpur, L2-Gazipur, L3-Kushtia, L4-Naogaon, L5-Pabna, L6-Ponchogor, L7-Rangpur, L8-Nilphamari, L9-Habiganj

On-farm evaluation of different urea applicator machines on growth and yield of boro rice.

The experiment was conducted at 5 farmers' fields. There were three treatments of urea application like using USG applicator, prilled urea applicator and hand broadcasting. Urea application using prilled urea applicator and hand broadcasting of urea gave significantly about 0.8 t/ha higher yield

than USG applicator (Table 11). Plant growth was found uneven using USG applicator where as almost uniform plant growth was found using prilled urea applicator. The overall performance of prilled urea applicator was found the best in respect to plant growth and grain yield urea saving (about 30% compared to hand broadcasting),. However, it needs cost-benefit economic analysis.

Table 11. Effect of different methods of urea application on grain yield and yield components of BRRI dhan58 during Boro season.

Treatment	Grain yield (t ha^{-1})	Panicles m^{-2} (No.)	Grains $panicle^{-1}$ (No.)	Growth duration (day)	Plant height (cm)
USG applicator	6.00	308	105	153	86
Prilled urea applicator	6.78	365	111	155	98
Hand broadcasting	6.88	366	112	155	100
$LSD_{0.05}$	0.30	11	9	4	4

Technology Dissemination

Seed production and dissemination programme (SPDP)

For rapid dissemination of newly released BRRI varieties among the farmers, Adaptive Research Division (ARD) conducts seed production and dissemination programme (SPDP) in every season of the year. This is an effective programme for the adoption of BRRI varieties through quality seed production. During the reported period, the SPDPs were conducted in different locations of the country in Aus, Aman and Boro seasons under different funding sources. In this programme, mainly BRRI varieties are demonstrated in farmers' fields.

GOB funded

SPDP, T. Aus 2014. SPDPs with USG were conducted in 24 upazilas of 12 districts (Rajbari, Khulna, Bagerhat, Jessore, Chapainawbgonj, Dinajpur, Gazipur, Comilla, Sylhet, Rangamati, Chittagong and Cox's Bazar) under GOB core program. BRRI dhan48 and BRRI dhan55 were used as varieties in that program. Averaged in different locations, yield of BRRI dhan48 and BRRI dhan55 were found to be 4.52 t/ha and 4.18 t/ha, respectively. Total production through demonstrations of BRRI dhan48 and BRRI dhan55 were 46, 652 kg and farmers retained 4,246 kg seeds from those varieties for next year cultivation. About 4,725 farmers gained awareness about the varieties through field visits, discussion and knowledge sharing. About 865 farmers were motivated to cultivate these varieties in next year.

SPDP with USG, T. Aman 2014. SPDPs with USG were conducted in 24 upazilas of 12 districts (Rajbari, Khulna, Bagerhat, Jessore, Chapainawbgonj, Dinajpur, Gazipur, Comilla, Sylhet,

Rangamati, Chittagong and Cox's Bazar). BRRI dhan38, BRRI dhan41, BRRI dhan46, BRRI dhan49, BRRI dhan53, BRRI dhan54, BRRI dhan57, BRRI dhan62 and BRRI hybrid dhan4 were used as varieties in demonstrations. Total production by those varieties was 37,593 kg, from which 7,715 kg quality seeds were retained by the farmers for next year use. About 5583 farmers gained knowledge about those varieties and the beneficial effect of USG and more than 910 farmers were motivated to cultivate those varieties and USG.

SPDP with USG, Boro 2015. SPDPs with USG were conducted in 14 upazilas of 10 districts (Gopalganj, Rajbari, Khulna, Sherpur, Netrokona, Kishoreganj, Brahman Baria, Rangamati and Cox's Bazar). A total of 7 modern rice varieties (BRRI dhan47, BRRI dhan50, BRRI dhan58, BRRI dhan59, BRRI dhan63, BRRI hybrid dhan2 and BRRI hybrid dhan3) were used. Total production was 37,320 kg and farmers retained 8,210 kg seeds of those varieties for next year use. A total of 4,742 farmers gained knowledge through field visits, discussion and knowledge sharing and a total of 1,056 farmers were motivated to adopt those varieties and USG.

Integrated Agricultural Productivity Project (IAPP)

For rapid dissemination of newly released BRRI varieties among the farmers, the Seed Production and Dissemination programme (SPDP) was under taken in Barisal and Rangpur region of the country under IAPP during 2014-15 in Aus, Aman and Boro seasons.

SPDP, T. Aus 2014. SPDPs were conducted in 14 upazilas of 4 southern and 3 northern districts. The southern districts were Barisal, Jhalokathi, Patuakhali and Borguna as the saline or non saline coastal tidal submergence rice ecosystem. On the other hand, the northern districts were Kurigram, Nilphamari, and Lalmonirhat as the drought prone ecosystem. BRRI dhan48 and BRRI dhan55 were selected for the Barisal and Rangpur region. Mean grain yield of BRRI dhan48 and BRRI dhan55 were 4.06 and 3.64 t/ha, respectively across the locations. Total production of BRRI dhan48 and BRRI dhan55 was 7059 and 12661 kg, respectively from which 2140 and 1272 kg were retained as seeds by the farmers for next season cultivation. About 2390 farmers gained knowledge about the modern rice varieties and 627 farmers were newly motivated to cultivate the varieties.

SPDP with USG, T. Aman 2014. SPDPs were conducted in 14 upazilas of 4 districts of Barisal region (Barisal, Patuakhali, Jhalokathi and Barguna) and 3 districts of Rangpur region (Nilphamari, Lalmolnirhat and Kurigram). BRRI dhan41, BRRI dhan44, BRRI dhan49 and BRRI dhan52 were selected for Barisal region while BRRI dhan49, BRRI dhan56, BRRI dhan57 and BRRI dhan62 were selected for Rangpur region. Total production of BRRI dhan41, BRRI dhan44, BRRI dhan49 and BRRI dhan52 was 19697 kg in 8 upazilas of Barisal region, from which 2870 kg was retained as seeds by the farmers for next season cultivation. About 2510 farmers gained

knowledge about the modern rice varieties cultivated and 556 farmers motivated to cultivate the varieties. Most farmers preferred BRRI dhan41 for its higher yield, less pest infestation and medium bold grain and 206 farmers were motivated to cultivate this variety. BRRI dhan49 performed the best in Rangpur region although it was infected by False Smut disease in some locations. A total of 14039 kg grains were produced in 6 upazilas of Rangpur region from which 2025 kg were retained as seeds by the farmers for next season. Farmers were impressed for earliness with a good yield of BRRI dhan57 and BRRI dhan62. They opined that after harvesting BRRI dhan57 and BRRI dhan62, it created ample opportunity to establish *rabi* crop in time at Rangpur region. About 1631 farmers gained knowledge about the varieties through demonstration and 550 farmers were motivated to cultivate the varieties in next season.

SPDP with USG, Boro 2015. SPDPs with USG were conducted in 6 upazilas of 3 districts of Barisal region (Patuakhali, Jhalokathi and Barguna) and 3 districts of Rangpur region (Nilphamari, Lalmolnirhat and Kurigram). BRRI dhan47, BRRI dhan55 and BRRI dhan61 were selected for Barisal region whereas BRRI dhan50, BRRI dhan58 and BRRI dhan59 were selected for Rangpur region. The trial at Kurigram was damaged due to severe cold. A total of 6,620 kg grains were produced in Barisal region and farmers retained 815 kg seed for next season cultivation. About 595 farmers gained knowledge about varieties and 136 farmers were motivated to cultivate these varieties in Barisal region. In Rangpur region total grain production was 5,157 kg and farmers retained 495 kg seeds for next season cultivation. About 510 farmers gained knowledge about varieties and 126 farmers were motivated to cultivate those varieties and to use USG in Rangpur region. Farmers preferred BRRI dhan58 for its higher yield. Despite some milling problem of BRRI dhan50, farmers preferred BRRI dhan50 for its basmati type grain and good yield.

Adaptive trials under IAPP

Adaptive trial is one of the most important trials for the farmers in which they may be able to choose the appropriate variety for their area as per local demand. In adaptive trial a combination of some varieties were cultivated together in the farmers' field with one or two local standard checks. Through this trial farmers are able to compare the cultivated varieties in their local condition and it will help the farmers to choose one or two or more varieties on the basis of local demand and ago-ecological condition of that location.

T. Aus 2014. Four adaptive trials were conducted in 4 upazilas of 4 districts of Barisal region (Barisal, Jhalokathi, Patuakhali and Borguna) as the saline or non saline tidal submergence ecosystem. Trials were not conducted in Rangpur region due to some problems raised at that tome. BR24, BRRI dhan27, BRRI dhan48, BRRI dhan55 and local check (Mala, Surayamoni and Gota IRRI) were used in Barisal region. Across the varieties and locations, BRRI dhan48 produced higher grain yield compared to the other modern and check varieties. In general, insect infestation

and disease infection were comparatively higher in all the modern varieties while the local check varieties were almost pest free. For these reason, farmers still cultivate the local varieties although local varieties produce lower yield. Moreover, the local varieties required lower inputs and minimum take care. But mean growth duration of the local varieties was higher compared to the modern varieties. Considering overall performance and local situation, BRRI dhan48 was found to be the most suitable variety in T. Aus in Barisal region.

T. Aman 2014. Seven adaptive trials were conducted in 7 upazilas of 4 and 3 districts of Barisal region (Barisal, Jhalokathi, Patuakhali and Borguna) and Rangpur region (Nilphamari, Lalmonirhat and Kurigram). BRRI dhan41, BRRI dhan44, BRRI dhan49, BRRI dhan52 and local check (Jafor IRRI, Sadamota, Dudkalam) were used in Barisal region while BRRI dhan49, BRRI dhan56, BRRI dhan57, BRRI dhan62 and local check (Swarna, Binadhan-7) were used in Rangpur region.

Barisal region. Among the varieties under adaptive trials, BRRI dhan41 gave the highest grain yield (4.50 t ha^{-1}) which was statistically similar to that of BRRI dhan44, BRRI dhan49 and BRRI dhan52. However, it was significantly higher than the local check Jafor IRRI, Sadamota and Dudkalam. Growth duration of the tested modern rice varieties varied significantly across the locations. Among the varieties, mean growth duration was the highest (163 days) in the local check variety Sadamota followed by BRRI dhan41 (147 days). The lowest mean growth duration (133 days) was found in BRRI dhan49. Based on grain yield growth duration and overall performance, modern varieties were found suitable to cultivate in Barisal region.

Rangpur region: Across the varieties and locations, local check Swarna gave the highest grain yield (5.03 t ha^{-1}) followed by BRRI dhan49 (4.92 t ha^{-1}) and BRRI dhan56 (4.68 t ha^{-1}). The lowest yield (3.51 t ha^{-1}) was in BINA dhan-7 used as check variety. Though the yield and grain quality of BRRI dhan49 was looked appreciable, however false smut infection in some places disappointed the farmers. BRRI dhan57 and BRRI dhan62 also performed considerably well with its shorter growth duration that could create wider options to establish Rabi crops in time. Swarna required the highest growth duration (146 days) followed by BRRI dhan49 (134 days) whereas the lowest growth duration (103 days) was in BRRI dhan62. Based on grain yield, growth duration and farmers opinion, Swarna was considered as the most popular variety and thereafter BRRI dhan49 and BRRI dhan62. Farmers especially in the Rangpur region preferred Swarna for its higher grain yield; low inputs requirements, mild drought tolerance and minimum take care. If we take proper measure against false smut of BRRI dhan49 then it would be one of the most popular varieties in Rangpur region. Some farmers preferred BRRI dhan57 and BRRI dhan62 due its shorter growth duration and fine grain.

Boro 2015. Sixteen Adaptive trials were conducted in 8 districts of Barisal and Rangpur regions under IAPP. BRRI dhan47, BRRI dhan55, BRRI dhan58, BRRI dhan59, BRRI dhan61 and Bhajan

(local check) were used in Barisal region while BRRI dhan29, BRRI dhan50, BRRI dhan55, BRRI dhan58, BRRI dhan59 and farmers seed of BRRI dhan28 as local check were used in Rangpur region.

Barisal region. Across the locations and varieties, BRRI dhan58 performed the best and gave the highest grain yield (7.00 t ha^{-1}). and BRRI dhan61 gave the lowest yield (5.28 t ha^{-1}). BRRI dhan47 gave reasonably better yield (5.78 t ha^{-1}). Irrespective of location and variety, the highest growth duration (165 days) was recorded for the local check variety Bhajan followed by BRRI dhan29 (161 days). The mean growth duration of the highest yielder, BRRI dhan58 was 155 days followed by BRRI dhan59 (151 days) and the lowest was in BRRI dhan55 (147 days). Among the varieties, considering grain yield and growth duration BRRI dhan58 and BRRI dhan47 were found suitable for Barisal region.

Rangpur region. BRRI dhan29 and 58 gave similar grain yield (respectively 6.53 t $ha^{-1}$and 6.57 t ha^{-1}), but significantly higher than the other tested varieties. The lowest yield was found in BRRI dhan59 (5.12 t ha^{-1}) and farmers seed of BRRI dhan28 (5.10 t ha^{-1}). The highest mean growth duration (164 days) was recorded in BRRI dhan29 that was followed by BRRI dhan58 (155 days) while the lowest growth duration (147 days) required for BRRI dhan28 used as local check. Based on grain yield, growth duration and farmers' comments, it was concluded that BRRI dhan58 and BRRI dhan50 would be suitable for Rangpur region.

Mujibnagar Integrated Agricultural Development Project (MIADP)

In the middle western regions of Bangladesh and in the western part of the Ganges river floodplain there are predominantly four districts viz., Kushtia, Meherpur, Chuadanga and Jhenaidah and called the high Ganges river floodplain. The land type is predominantly high and medium high and climate is dry with low rainfall. High lands are well drained. In that situation Boro rice cultivation is not cost effective for high cost of irrigation because of low water holding capacity of the lands. Then only very short duration Boro rice can be grown which needs lesser irrigation. Predominantly short duration Upland or T. Aus and T. Aman varieties need to be disseminated to increase overall production of that region.

SPDP, T. Aus 2014. SPDPs were conducted in 19 upazilas of 4 districts (Kushtia, Meherpur, Chuadanga, Jhinaidah) by using BRRI dhan48 and BRRI dhan55. Total grain production of BRRI dhan48 and BRRI dhan55 was 35,329 kg from which farmers retained 4,900 kg seeds for next season cultivation. A total of 2,569 farmers gained knowledge about BRRI dhan48 and BRRI dhan55 through demonstrations by discussion, field visit and knowledge sharing. About 1,259 farmers were motivated to cultivate the varieties in the next year.

SPDP, T. Aman 2014. SPDPs were conducted in 19 Upazilas of the above 4 districts under MIADP. BRRI dhan49, BRRI dhan56 and BRRI dhan62 were used as cultivars in the selected upazilas. Total grain production by those varieties was 42,329 kg and farmers retained 7,265 kg

seeds for next year cultivation. A total of 4,832 farmers gained knowledge about the varieties and 2,052 farmers were motivated to cultivate in the next year (out of which more number of farmers, 861 were motivated to grow BRRI dhan62). BRRI dhan62 is zinc enriched short duration T. Aman variety. The average growth duration of the variety was only 103 days with a good average yield of 3.8 t/ha. That's why farmers preferred it drought prone areas of MIADP.

SPDP, Boro 2015. SPDPs were conducted in 12 upazilas of above mentioned 4 districts under MIADP. BRRI dhan50, BRRI dhan58 and BRRI dhan59 were used for each upazila. Mean growth duration of BRRI dhan50, BRRI dhan58 and BRRI dhan59 were 153, 155 and 155 days, respectively. The average grain yield of BRRI dhan50, BRRI dhan58 and BRRI dhan59 were 5.66, 6.91 and 6.41t ha^{-1}, respectively. Total production obtained from BRRI dhan50, BRRI dhan58 and BRRI dhan59 were 9093, 11095 and 10296 kg. Farmers retained 1749, 1735 and 1568 kg seeds of BRRI dhan50, BRRI dhan58 and BRRI dhan59 respectively for next season cultivation. As a whole total production was 30484 kg and retained seeds was 5052 kg. A total of 4491 farmers gained knowledge respectively about varieties. About 2,915 farmers were motivated to cultivate the varieties in the next year.

Enhancing Quality Seed Supply Project (EQSS)

Quality Seed Production and Dissemination Program (QSPDP)

T. Aman 2014. QSPDPs were conducted in 10 upazilas of 6 districts (Narshingdi, Sherpur, Tangail, Netrakona, Mymensingh and Kishoreganj) under EQSS project. BRRI dhan49, BRRI dhan56, BRRI dhan57 and BRRI dhan62 were used in each upazila. The average grain yield of BRRI dhan49, BRRI dhan56, BRRI dhan57 and BRRI dhan62 were 5.02, 4.51, 4.48 and 4.51 t/ha respectively. Total production of BRRI dhan49, BRRI dhan56, BRRI dhan57 and BRRI dhan62 were 6722, 6084, 6010, 5481 kg and retained seeds by the farmers were 1275, 795, 670 and 650 kg respectively for further use in the next season and for distribution to other interested farmers. As a whole total production was 24,297 kg and retained seeds was 3,390 kg. A total of 2936 farmers gained knowledge about those varieties and a total of 1529 farmers were motivated to cultivate those varieties.

Boro, 2015. QSPDPs were conducted in 10 upazilas of 5 districts (Norsingdi, Kishoregonj, Gazipur, Tangail and Comilla) under EQSS project. BR16, BRRI dhan50, BRRI dhan55 and BRRI dhan58 were used in each upazila. Total production of BR16, BRRI dhan50, BRRI dhan55 and BRRI dhan58 were 8206, 7979, 8434 and 9317 kg and retained seeds by the farmers were 940, 750, 1165 and 935 kg, respectively for further use and for distribution to other interested farmers. As a whole total production was 33936 kg and retained seeds was 3790 kg. A total of 6088 farmers

gained knowledge about those varieties and a total of 1522 farmers were motivated to cultivate those varieties.

Farmers Training and Promotional activities

Farmers' Training. During the reporting period, ARD conducted a total of 28 Farmers' Training at different locations of the country in which a total of 930 trainees (844 farmers and 86 SAAOs of DAE) participated.

Field day/Farmers' rally: ARD conducted 75 Field days at different locations of the country under different projects (IAPP, MIADP, EQSS) and GOB during Aus 2014; Aman 2014 and Boro 2015. A total of about 12,350 (approx.) persons participated in those occasions. These programs also generated much enthusiasm about modern rice production technologies and BRRI varieties which help rapid dissemination of technologies.

Seed Production at BRRI Farm

Seeds of recent and promising rice varieties were produced in T. Aus, T. Aman and Boro seasons during the reporting period under the close supervision of Adaptive Research Division. A total of 5.5 tons quality seeds of different BRRI varieties were produced which were used for follow up adaptive research trials.

BRRI Annual Report 2014-15

Training Division

Summary
Training need assessment
Capacity building and technology transfer
Effectiveness of imparted rice production training
updating (BRKB)

Personnel list

Md Islam Uddin Mollah, PhD

Md Shahadat Hossain, PhD

Md Fazlul Islam*, PhD

Shahanaz Parveen**, MS

* Transferred to ARD on 23 October 2014
** Joined at Training Division 30 November 2014

SUMMARY

The Training Division has conducted 74 training programmes in the reporting period with course duration from 3-day to one week. A total of 1,381 participants from different government and non-government organizations were trained through these courses. Need based course curriculum was developed for these courses. The highest number of participants were from the Department of Agricultural Extension (DAE). The overall improvement of knowledge for extension personnel in 1-week rice production training (RPT) varied widely and ranged from 235 to 304%. The improvement results show the importance of rice production training (RPT) for extension personnel. Effectiveness of imparted trainings was determined on the basis of feedback remarks on different aspects. Most of the trainees expressed positive views about the course content and method of training. However, participants of all the 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 NEED ASSESSMENT

A need assessment session was conducted at the beginning of each batch of training to know the expectation of the trainees. A total of 1,881 responses on different issues were received from the trainees of which 583 from regular batches, 875 from Enhancement of Quality Seed Supply Project (EQSSP), 305 from Mujibnagar Integrated Agricultural Development Project (MIADP) and 38 from Integrated Agricultural Productivity Project (IAPP) (Table 1). Among the responses 1,798 was received from SAAO and 83 from extension agents of NGO. Though the participants were different categories and from different regions and environments of the country, their expectations were very much similar. Specially the SAAO showed high expectation about insect and disease management followed by variety related issues. On the other hand, NGO participants showed the highest interest about seed production followed by variety and fertilizer related issues.

CAPACITY BUILDING AND TECHNOLOGY TRANSFER

One-week rice production training

The main objectives of the course was to train the field level extension workers of DAE and the project staff (SA and scientists). The course curriculum was designed based on the priority of field problems related to rice production and rice based technologies. A total of 804 personnel were trained (170 SAAO from regular batches, 461 SAAO from EQSSP, 40 scientists, SAAO,SA and CF from IAPP and 123 SAAO and NGO personnel from MIADP Project (Table 2).

Knowledge improvement was assessed based on the marks obtained in benchmark and final evaluation of individual participants. Average improvement of the participants from regular, EQSSP, IAPP and MIADP was 235, 310, 295 and 304% respectively (Table 3). Table 4 presents the performance status of 1-week rice production for different categories of participants.

Quality Rice Seed Production and Storage

A total of 32 training programmes on seed production, processing and storage were conducted in 2014-15. The participants of these courses were Upazila Agriculture Officer (UAO) and Agriculture Extension Officer (AEO) of DAE, Assistant Director (AD) and Senior Assistant Director (SAD) of BADC, field level officers of BRAC, SAAO of DAE, Scientific Assistant (SA) of IAPP, BRRI and Community Facilitator (CF) of IAPP, DAE. For these courses funds of EQSSP and IAPP were used. Table 5 presents the details of the training course.

Training Information of BRRI

During the reporting period, 72 training programmes have been conducted by the Training Division of BRRI (Table 6).

Table 1. Expectations by the trainees on different subjects in need during 2014-15.

Subject/issue	Expectation (%)							
	SAAO						NGO	Rank
	Regular	EQSSP	Mujibnagar	IAPP	All	Rank		
Disease	19	18	20	21	20	1	6	5
Insect	18	15	17	15	16	2	4	6
Variety	13	11	10	13	12	3	18	2
Rice growth	6	4	7	5	6	6	3	7
Fertilizer	7	10	6	4	7	5	10	3
Hybrid	8	7	6	5	7	5	5	5
Soil	3	6	5	6	5	7	3	7
Crop management	5	4	6	5	5	7	5	5
IWM	4	2	8	6	5	7	8	4
Seed	10	11	4	12	9	4	30	1
Weed	3	3	4	3	3	8	2	8
Others	4	9	7	8	7	5	13	
Total	100	100	100	100	100		100	
Response (no.)	**583**	**875**	**305**	**35**	**1798**		**83**	

Table 2. One week rice production training conducted by BRRI in 2014-15.

Project	Batch No.	No. of participants			Designation	Organization
		Total	Male	Female		
Regular(GOB)	9	170	162	8	SAAO	DAE
EQSSP	25	471	419	52	SAAO, NGO	DAE, PKSF
IAPP	2	40	34	6	Scientists, SAAO, SA	DAE, BRRI, IAPP
MIADP	6	123	115	8	SAAO, Dip. Agril.	DAE, NGO
Total=		**804**	**730**	**74**		

Table 3. Knowledge gain and improvement through 1-week rice production training during 2014-15.

Project	Evaluation (average mark %)		Improvement (%)
	Benchmark	Final evaluation	
Regular	23.66	76.17	235
EQSSP	17.71	79.50	310
IAPP	24.32	75.76	295
MIADP	19.16	70.83	304
Average	**21.21**	**75.56**	**286**

Table 4. Performance status of 1-week rice production training in 2014-15.

Project	Category of results/ certificates		
	Distinction	Satisfactory	Participatory
Regular	76	86	8
EQSSP	86	334	51
IAPP	26	10	4
MIADP	42	68	13
Average	**58**	**125**	**76**

Table 5. Particulars of quality rice seed production and storage training during 2013-14.

Project	Batch (no.)	Participants (no.)			Designation	Organization
		Total	Male	Female		
EQSSP	24	418	365	53	UAO, AEO, AD, SAD and NGO Off.	BADC, DAE, PKSF
IAAP	8	159	154	5	SAAO, CF	DAE, IAPP
Total=	**32**	**577**	**519**	**58**		

Table 6. Total training conducted by Training Division in 2014-15.

Name	No. of train.	Duration	No. of participants			Designation
			M	F	Total	
Rice production training (Regular)	9	1-week	162	8	170	SAAO/Officers

Integrated rice production (MIADP)	6	1-week	115	8	123	SAAO, NGO Officers
Integrated rice production training and data collection (IAPP)	1	5 days	20	0	20	SAAO/SA/CF
Experimental design and data analysis (IAPP)	1	5 days	20	14	6	Scientists
Rice production training (EQSSP)	25	1-week	419	52	471	SAAO
Quality rice seed production, processing and storage (IAPP)	8	3-day	154	5	159	SAAO/ CF
Rice seed production, processing and storage (EQSSP)	24	3-day	365	53	418	UAO, AEO, AD, SAD, BRAC Officers
Total	**74**		**1,249**	**132**	**1,381**	

EFFECTIVENESS OF IMPARTED RICE PRODUCTION TRAINING

It is important to determine the impact of different aspects of imparted rice production training for its better planning and execution in future. This study was conducted at the end of each batch to collect the relevant information. After the completion of data collection, information were compiled and analyzed. This study reavls that one week RPT course is very much helpful for the trainees to build up their capacity for modern rice production activities.

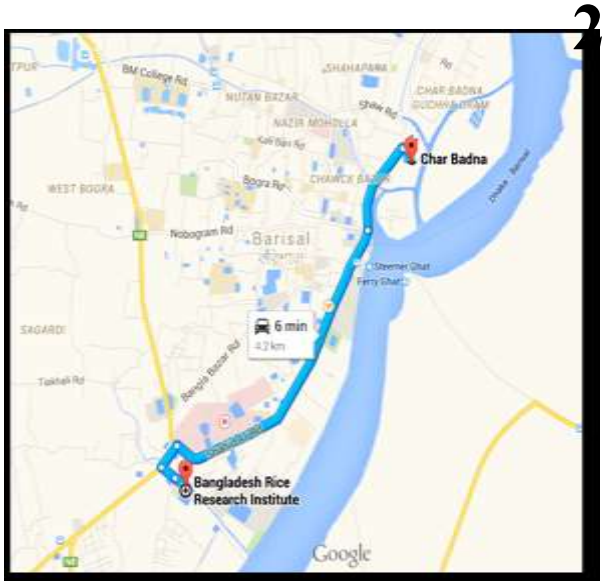
Performance of BRRI speakers

Ten batches of one week RPT were considered for this evaluation. At first, batch wise analysis was done on the basis of five criteria for each speakers. The five criteria were as follows: a. style of presentation; b. question handling; c. use of training materials; d. time management and e. quality and relevance of handout and its timely supply. Average of 5 criteria was used to determine the performance of individual speaker in each batch. The overall performances of BRRI's speakers' were very good (36.82%) to excellent (42.39%) in both long and short courses.

Updating BRKB

Training division is working to develop and update information on all BRRI released technologies in a digital form through Bangladesh Rice Knowledge Bank (BRKB). One of the objectives of this work is to redesign and the BRKB user friendly with latest rice information. During the reporting period seven new fact sheets on newly released rice varieties were prepared and uploaded in BRKB website.

ANNUAL RESEARCH REVIEW WORKSHOP 2014-15



CONTENTS

XXII. REGIONAL STATION, SAGARDI BARISAL

SUMMARY

- A total number of 1016 seeds were selected from the crosses. In F2 population 5 out of 12 selected and confirmed. A total number of 90 progenies were selected from F_2 population. Total number of 67 progenies was selected from F_3 progenies.
- A total number of 51 progenies were selected from F_7 population. Total 15 lines were selected in observational trial (OT). On the basis of maximum yield production and seedling height, only six entries namely: BR8452-5-4-1-1-1**,** BR8470-7-1-1-2-HR1, BR8470-14-2-2-2-HR2, BR8470-17-2-2-3-HR5, BR8469-6-1-3-1-1**,** BR8462-18-1-2-1-HR4 were selected for further evaluation from PYT1.
- On the basis of maximum yield production and seedling height, only two entries namely: BR8472-21-1-1-1-HR2, BR8164-43-2-1-HR2 were selected for further evaluation from PYT2. On the basis of maximum yield production and seedling height, only seven entries namely: BR7941-41-2-2-2-4, BR7941-45-2-2-2-1, BR7941-45-2-2-2-1, BR7844-3-2-2-1-1, BR7847-47-3-3-2-2-2-2-1, BR7849-5-2-2-2-2-4, BR7943-53-1-2-1 were selected for further evaluation from SYT. On the basis of maximum yield production and seedling height, only four entries namely: BR7941-119-1-2-1, BR7941-30-1-1-1, BR7941-116-1-2-1, BR7941-41-2-2-4 were selected for further evaluation from AYT.
- Development of varieties for Aman rice 2014, the proposed variety trial salt tolerant IR7861-B-SATB1-28-3-24 produced higher yield than the check variety BRRI dhan53. The proposed variety in Zn rich rice BR7528-2R-19-HR10 produced higher yield than the check variety BRRI dhan39.
- he proposed variety Rainfed lowland rice BR7622-5-1-1-1 gave higher yield than both checks and BR7472-16-2-1-2-3 gave higher yield than one check BRRI dhan39. The proposed variety PQR BR7357-11-2-4-1-1 produced higher yield than the check variety BRRI dhan37.
- In Boro season, The highest grain yield obtained by the proposed variety BR7671-37-2-2-3-7 followed by BR7833-11-1-1-2-1-2B5. However growth duration of both advanced lines was 2 to 8 days advance than the check variety BRRI dhan64.
- Higher mean %DI and DS were observed in irrigated land (33.9% and 3.3, respectively) than that of rainfed land (16.2% and 1.7). Maximum 70% DI and 7 DS on BRRI dhan62 was recorded in Aman while Maximum 90% DI and 9 DS on BRRI dhan61 was recorded in Barisal region.
- Trooper 75WP and Nativo performed better in reducing leaf and neck blast disease incidence around 80% over control at farmers field under natural field condition.
- Based on premium quality rice grain, higher yield, growth duration and farmers' opinion, BR7781-10-2-3-2 may be considered for further research program.
- Based on micronutrient (Zinc) enriched, higher yield, grain type, growth duration and farmers' opinion, BR7833-11-1-1-3-4 may be considered for further research program.
- Based on higher yield, grain type, growth duration and farmers' opinion, NERICA Mutant may be considered for for further research program.
- Between the two locations and among the six varieties, BRRI dhan58 performed the best and gave the highest mean grain yield (7.54 t/ha) and the lowest yield (5.40 t/ha) was in the BRRI dhan61.

- BRRI Barisal Regional Station conducted 13 farmers' training in different locations of Barisal region during Boro'2015. Total 390 persons (303 males and 87 females) were trained to create awareness for adopting the BRRI rice production technologies and to accelerate the dissemination rate of BRRI varieties in those areas.
- Total six (06) field days were conducted where around 1300 audience of farmers, researchers, extension providers, NGO personnel, administrative peoples, public leaders were sincerely participated.
- The rainwater harvest technique is sufficient to stabilise T.Aman rice yield in drought prone scenarios. The mean grain yield increased by 5.09% under research management compared to farmer's management but range from 3.87% to 6.36%.
- Irrigation water could be saved 15.23% to 31.06% following the AWD method depending on the texture of the soil in Barisal region. AWD method requires about 22.68 % less money compares to farmer's practice when using diesel operated LLP in Boro.
- Proper management with 3-4 supplemental irrigations at early stage could increased yield up to 1-18% compared to farmer's practice in Aus. Average water productivity also increased marginally from 0.42 to 0.43 by following research management practice.
- The highest yield was observed in BRRI Hybrid dhan2 (6.61 t ha^{-1}) followed by BRRI Hybrid dhan3 (6.55 tha^{-1}). The lowest yield was found in BR17 (3.89 tha^{-1}) under Stability analysis of BRRI released boro varieties.
- Under IAPP program the highest average yield was found in BRRI dhan48 (5.19 t/ha) followed by BRRI dhan43 (4.32 t/ha) in Aus. In Aman, BRRI dhan54 produced highest yield on an average of 5.31 t/ha followed by BRRI dhan44 (5.16 t/ha) and BRRI dhan53 (4.99 t/ha). In Boro, the highest average yield was found in BRRI dhan59 (7.39 t/ha) followed by BRRI dhan60 (7.33 t/ha).

- The results of on-station adaptive trial of BRRI dhan44-Sub1 lines reveal that the two lines BR9158-19-9-6-9-17 (3) and BR9158-19-9-6-9-50 (4) gave the highest yield compared to the check however those are not statistically significant.
- Under PGB-IADP program, the highest yield of 5.074 t ha^{-1} was recorded from BRRI dhan48 in Aus. In Aman, the highest yield (5.97 t/ha) was recorded in BRRI dhan49. On the other hand BRRI dhan64 (6.86 t/ha) was the highest grain yielded in Boro.
- Under the program of Harvest Plus Bangladesh, an average yield of 3.92 t/ha was recorded in BRRI dhan62 in Aman season. The average yield of BRRI dhan64 was 6.11 t/ha in Barisal region in Boro 2014-15.
- Many farmers of Barisal region expressed their contentment to the variety BRRI dhan62 in Aman and BRRI dhan64 in Boro due to short growth duration, zinc content and satisfactory grain yield.
- During the reporting year, around 50 plant samples from farmers' field have been diagnosed and necessary solutions have been advocated. In addition, several rice fields have been visited with the request of farmers, DAE personnel and local representatives.

RESEARCH PERSONNEL

A. Scientific personnel and field staff during July 2014-June 2015

Sl. No.	Name and designation	Working days	Remarks
1.	Dr. M. Alamgir Hossain, CSO and Head	148	Joined on the 2nd Feb'15
2.	Dr. Md. Ibrahim, PSO	177	Transferred to HQ
3.	Dr. Mohammod Hossain, PSO	152	Joined on the 28th Jan'15
4.	Dr. Umme Aminun Nahar, PSO	81	Transferred to HQ
5.	Mahfuz Ara Begum, MS, SSO	0	On deputation for higher studies
6.	M. Belal Hossain, MS, SO	124	Transferred to HQ
7.	Sheikh Maniruzzaman, MS, SO	365	
8.	Md. Hannan Ali, MS, SO	214	Transferred to HQ
9.	M. G. Sarwar Jahan, MS, SO	277	
10.	A.B.M. Enamul Hoque, Farm Manager	365	
11.	M. Humaun Kabir, AFM	120	
12.	M. Mokhlesur Rahman, Dip-in Ag., SA	365	
13.	Md. Mahmudul Hasan, Dip-in Ag., SA	365	

B. Scientific personnel and field staff of Integrated Agricultural Productivity Project (IAPP) during July 2014-June 2015

Sl. No.	Name and designation	Working days	Remarks
1	Dr. Md. Monirul Islam, SSO	350	
2	Md. Milon Mia, MS, SO	365	
3.	Md. Jahirul Islam, MS. SO	365	
3	Azizul Haque, Dip-in Ag., SA	365	
4	Md. Safiqul Islam, Dip-in Ag., SA	365	
5	Afjal Hossen, Dip-in Ag., SA	365	
6	Md. Mamunur Rashid, Dip-in Ag., SA	365	
7	Md. Jahangir Haider, Dip-in Ag., SA	365	

8	Md. Safiul Islam, Dip-in Ag., SA	365	

INTRODUCTION

The Bangladesh Rice Research Institute (BRRI) Regional Station, Barisal is establish in 1970 and situated at 22°40′50″ N latitude and 90°21′25″ E longitude, and 3.3 m above the sea level. It has two research farms, Sagardi and Charbadna occupying 8.8 and 32.0 ha of land, respectively. The Charbadna farm is representative for tidal wetland research, situated on the bank of the river Kirtonkhola. Both the farms have tide prone land. Sagardi farm also developed for tidal wet land research. The Station conducts 60% of follow up research which is provided from headquarters with emphasis on local adoptions. The station also conducts 40% of researches which help to solve the specific problems of farmers of the commanding areas.

The tidal wetlands represent a major unfavorable agro-ecological situation in Bangladesh, covering a large area (about 2 M ha) of tidal floodplain land in the Southern especially the Southern-Western region of the country along the coastline. Most of the areas of Barisal regions are under AEZ of 13 (Tidal Floodplain), some parts of that regions covering AEZ 12 (Low Ganges River Floodplain) and AEZ 14 (Gopalganj-Khulna Bills). River water of the Barisal regions is saline (>3 dS/m) except in the months of June-August. In this time, salinity level (1-2 dS/m) declines due to rainfall and flood water.

Soils are loam to clay having soil reaction acidic to neutral in nature. Soil salinity becomes 8-12 dS/m in dry season. The tidal sediment contains 1.98% organic matter, 33 ppm available phosphorus and 0.52 meq/100gm sediment e×changeable potassium was in Sagardi farm. So the soil under tidal submergence becomes rich with NPK. Generally the farmers in this area do not use fertilizer in T.Aman season.

The existence of numerous interconnected tidally active rivers, streams and creeks etc. draining essentially flat basin land is a special feature of this region. The major environmental problems affecting crop production in the tidal wetland situation are: (i) twice daily tidal inundation of land over a period of 4-8 months (April-November), (ii) salinity arising from land inundation by saline tidal water in wet season and capillary rise of saline water from shallow saline ground in the drier months of the year (iii) shortage of sweet irrigation water in dry season. Additionally, socio-economic problems like unfavorable land tenure systems, high cost of inputs, lack of credit facilities, draft power shortage etc., aggravate the situation in the tidal wetlands.

The major objectives of this station are to develop modern varieties (MVs) of rice especially the submergence tolerant rice along with their suitable production technology for the tidal wetland submergence situation. The research activities were executed under different program areas. Production of good quality seeds of newly released and popular rice varieties is also a part of the

regular activities. A reasonable amount of breeder seed was also produced during the reporting season.

PROJECT 1: DEVELOPMENT OF TIDAL SUBMERGENCE TOLERANT RICE IN T.AMAN

Experiment 1: **Hybridization**

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: The tidal wetlands represents a major unfavorable agro-ecological situation in Bangladesh, covering a large area (about 2 M ha) of tidal floodplain land. Development of tidal submergence tolerant rice variety is a crucial need. This study conducted to transfer submergence tolerance and taller seeding height into varieties having intermediate plant height.

Materials and Methods: List of parents is shown in **Table 1**. Parents will be grown in three sets starting from 20th June with an interval of seven days to synchronize flowering times for achieving desired cross combinations. Thirty day old seedlings will be transplanted in a 5.4 m x 2 rows plot with a spacing of 20 x 20 cm. Single seedling will be used for transplanting. Fertilizer doses will be 80: 60: 40: 20 kg NPKS/ha with split application of N (40+20+20). Total amount of P, K and S will be applied at the time of final land preparation. Other cultural practices will be done as and when necessary.

Results: A total number of 1016 seeds were selected from the crosses (Table 1).

Table 1: List of seeds for tidal submergence tolerant rice in T. Aman, 2014 at BRRI regional station Barisal

Sl#	Crossing combination	Amount of Seed
1	BR7528-2R-19-16-HR16/Sadamota	105
2	BR7528-2R-19-16-HR16/Kachamota	65
3	BR7528-2R-19-16-HR16/Lalmota	125
4	BR7528-2R-19-16-HR16/Dudkalam	25
5	BR7528-2R-19-16-HR16/Nakuchimota	110
6	BR7941-1-1-2-1/Kalomota	120
7	BR7941-1-1-2-1/Sadamota	10
8	BR7941-1-1-2-1/Dudkolom	15
9	BR7941-1-1-2-1/Lalmota	35
10	BR7941-1-1-2-1/Chikor	118

11	BR7941-1-1-2-1/Dudkalom	130
12	BR7941-1-1-2-1/Lalmota	158
	Total	**1016**

Experiment 2: **F_1 confirmation**

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: The study was conducted with the objectives **t**o confirm the cross combinations as true F_1s and the use of confirmed F_1s for F_2 populations and in different multiple crosses.

Materials and methods: Twelve crosses will be grown **(Table 2)** in the net house of Breeding Division. The F_1 seeds along with their respective parents will be treated with 0.1% mercuric chloride solution for disinfection. The treated seeds will be germinated in Petri-dishes and seeded in earthen pots. Single seedling of 25 day old will be transplanted in 5.4 m single row plots at a spacing of 20cm x 20cm along with their respective parents. Fertilizer doses will be same as in experiment 1.

Results: 5 out of 12 selected and confirmed (Table 2).

Table 2: List of F_1s selected and confirmed, T. Aman2014

Sl#	Parentage
1	**BR7840-54-1-2-5/Dudkalam**
2	**BR7840-54-1-2-5/Lalswarna**
3	**BR7840-54-1-2-5/Sadamota**
4	**IR75862-208-B-B-HR1/Chikor**
5	**BR7830-16-1-5-3/Sadamota**

Experiment 3: **Selection of F_2 population**

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: The tidal wetlands represents a major unfavorable agro-ecological situation in Bangladesh, covering a large area (about 2 M ha) of tidal floodplain land. Development of tidal submergence tolerant rice variety is a crucial need. This study conducted with the objectives to select progenies giving emphasis on taller seedling, sturdy and strong plant type, large and compact panicle size, more tillering ability with less or no unproductive tiller and lodging resistance.

Materials and methods: Ten F_2 populations with approximately 2500-3000 progenies for each cross were grown in pedigree nursery of BRRI Barisal regional station. Single seedling of 45 days old were transplanted in 5.4 m single row plots at a spacing of 20 cm x 20 cm. Fertilizer doses were 80: 15: 40: 20 kg NPKS/ha with split application of N (40+20+20). Total amount of P, K and S were applied at the time of final land preparation. Other cultural practices were done as necessary. BRRI dhan44, Sadamota, Dudhkolom were planted as standard check.

Results: A total number of 90 progenies were selected from F_2 population (Table 3)

Table 3: List of selected pedigree nursery materials for tidal submergence tolerant rice in T. Aman, 2014 at BRRI regional station Barisal

Sl#	BR NO.	Parentage	Progeny selection
1	BR10523	BR23/Najkochimota	29
2	BR10524	BR22/Moulota	5
3	BR10525	BR22/Chikor	7
4	BR10526	BR22/BR7840-54-6-3-2	9
5	BR10527	BR23/Kachamota	5
6	BR10528	BRRI dhan44/IR83035-TR653-1-2-2-1	11
7	BR10529	BRRI dhan44/Raza-4-5	24
		Total	90

Experiment 4: Selection from F_3 generation at the Pedigree nursery

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: The study was conducted with the objectives to select progenies from the segregating populations with emphasis on height, tolerance to tidal submergence, earliness, plant type, grain type and high yield potential.

Materials and methods: A total of 76progenies from F_3 generations were grown at BRRI Barisal regional station Pedigree nursery. Each progeny were grown in a 5.4 m single row using single seedling for transplanting at a spacing of 20 cm x 20 cm. Forty five days old seedlings were used for transplanting. Fertilizers doses and management were done same as experiment no.1. Other cultural practices were done as and when necessary.

Results: A total number of 67 progenies were selected from F_3 population (Table 4)

Table 4: List of progenies selected from BRRI Barisal pedigree nursery for tidal submergence tolerant rice in T. Aman, 2014

Sl#	BR NO.	Parentages	Progeny rows
F_3 generation			
1.	BR10220	BRRI dhan 44/Sadamota	3
2.	BR10221	BRRI dhan 44/ Dudkalam	12
3.	BR10222	BRRI dhan 44/ Sada Swarna	5
4.	BR10223	BRRI dhan 44/ IR83035-TR653-1-2-2-1	6
5.	BR10224	BRRI dhan 41/ Sadamota	13
6.	BR10225	BRRI dhan 41/ Dudkalam	18
7.	BR10226	BRRI dhan 41/ Sada Swarna	2
8.	BR10227	BRRI dhan 41/ IR83035-TR653-1-2-2-1	3
9.	BR10228	BR23/ Sadamota	3
10.	BR10229	BR23/ Dudkalam	2
		Total	67

Experiment 5: Selection from F_7 generation at the Pedigree nursery

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: The study was conducted with the objectives to select progenies from the segregating populations with emphasis on height, tolerance to tidal submergence, earliness, plant type, grain type and high yield potential.

Materials and methods: A total of 76 progenies from F_7 generations were grown at BRRI Barisal regional station Pedigree nursery. Each progeny were grown in a 5.4 m single row using single seedling for transplanting at a spacing of 20 cm x 20 cm. Forty five days old seedlings were used for transplanting. Fertilizers doses and management were done same as experiment no.1. Other cultural practices were done as and when necessary.

Results: A total number of 51 progenies were selected from F_7 population (Table 5)

Table 5: List of progenies selected from BRRI Barisal pedigree nursery for tidal submergence tolerant rice in T. Aman, 2014

1	BR 8800	BRRI dhan44/Kachamota//Kachamota	2
2	BR 8806	BR7166-4-5-3-Ran1/IR68544-25-21-3-1-2	3
3	BR 8807	IR75017-8-LBN-2-2/IR68544-25-21-3-1-2	11
4	BR 8808	BR10/ IR75017-8-LBN-2-2	30
6	BR 8810	IR68544-25-21-3-1-2/Sada Swarna	1
7	BR 8811	BR10/Sada Swarna	4
		Total	51

Table 6: List of progenies selected from BRRI Barisal pedigree nursery for tidal submergence tolerant rice in T. Aman, 2014

Experiment 6: Observational trial (OT)

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: The study was conducted to select fixed lines with intermediate plant height, heading, grain type, resistance to insect pests and diseases in field conditions.

Materials and methods: A total of 210 entries were grown in BRRI Barisal regional station. Each entry was grown in a 5.4 m x 4 rows plot with a spacing of 20 cm x 20 cm using single seedling per hill. Forty five days old seedlings were used for transplanting. Fertilizers doses and management practices were done same as experiment no.1. Sadamota, Dudhkolom and BRRI dhan44 were used as checks at every after 30 entries. Other cultural practices were done as necessary.

Result: Total 15 lines were selected in observational trial (OT) (Table 6)

Table 6: List of entries selected in observational trial (OT) for tidal submergence tolerant rice in T. Aman 2014 at BRRI regional station Barisal

Sl#	**Designation**
1	**BR8462-18-1-2-1-HR2**

2	**BR8467-10-2-2-1-HR2**
3	**BR8467-10-2-2-1-HR4**
4	**BR8470-21-4-1-1-HR3**
5	**BR8470-22-2-1-1-1**
6	**BR8165-8-1-1-HR5-1**
7	**BR7941-34-1-2-1-3-2**
8	**BR7941-119-2-3-2-1-1**
9	**BR7941-119-2-3-2-4-5**
10	**BR7941-119-2-3-2-5-1**
11	**BR7941-119-2-3-2-5-2**
12	**BR7844-3-2-2-2-1-1-1**
13	**BR7845-3-1-2-2-1-1-1**
14	**BR7847-47-5-2-1-2-1-1**
15	**BR7941-34-1-2-1-1**

Experiment 7: Preliminary yield trial-1 (PYT-1)

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: Preliminary yield trial was done to evaluate the genotypes tolerant for the tidal non-saline and stagnant water condition.

Materials and methods: Thirty genotypes were evaluated in this trial at BRRI regional station Barisal. The trial was conducted using 2-3 seedlings per hill with a spacing of 20 cm x 20 cm. The field layout was RCB design with three replications. The unit plot sizes were 5.4 m x 8 rows. Fertilizers doses and management practices were done same as experiment no.1. Sadamota, Dudhkolom and BRRI dhan44 were used as checks.

Results: On the basis of maximum yield production and seedling height, only six entries namely: BR8452-5-4-1-1-1**,** BR8470-7-1-1-2-HR1, BR8470-14-2-2-2-HR2, BR8470-17-2-2-3-HR5, BR8469-6-1-3-1-1**,** BR8462-18-1-2-1-HR4 were selected for further evaluation (Table 7)

Table 7: Performance of selected entries in preliminary yield trial-1 (PYT-1) for tidal submergence tolerant rice in T. Aman 2014 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	BR8452-5-4-1-1-1	159	41	141	3	**6.47**
2	BR8467-10-2-2-2-1	171	37	113	7	2.46
3	BR8470-12-1-1-1-HR1	165	31	111	7	2.16
4	BR8470-7-1-1-2-HR1	163	40	114	7	**3.59**
5	BR8470-14-2-2-2-HR2	166	33	105	8	**3.18**
6	BR8470-7-3-3-4-HR2	167	32	99	8	1.68
7	BR8470-17-2-2-3-HR5	162	33	116	4	**3.70**
8	BR8470-7-1-1-2-HR3	169	33	104	7	2.16
9	BR8470-7-3-3-1	165	31	106	5	2.33
10	BR8469-6-1-3-1-1	165	32	115	5	**3.60**
11	BR8462-18-1-2-1-HR4	172	34	136	7	**3.60**
12	Sadamota (L. Ck.)	160	51	132	4	3.94
13	Dudkalam (L. Ck.)	151	58	130	5	3.80
14	BRRI dhan44 (Ck)	158	42	112	5	4.44
	LSD at 0.05	**2.56**	**6.74**	**9.30**	**1.79**	**0.95**

Experiment 8: Preliminary yield trial-2 (PYT-2)

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: Preliminary yield trial was done to evaluate the genotypes tolerant for the tidal non-saline and stagnant water condition.

Materials and methods: Thirty genotypes were evaluated in this trial at BRRI regional station Barisal. The trial was conducted using 2-3 seedlings per hill with a spacing of 20 cm x 20 cm. The field layout was RCB design with three replications. The unit plot sizes were 5.4 m x 8 rows.

Fertilizers doses and management practices were done same as experiment no.1. Sadamota, Dudhkolom and BRRI dhan44 were used as checks.

Results: On the basis of maximum yield production and seedling height, only two entries namely: BR8472-21-1-1-1-HR2, BR8164-43-2-1-HR2 were selected for further evaluation (Table 8)

Table 8: Performance of selected entries in preliminary yield trial-2 (PYT-2) for tidal submergence tolerant rice in T. Aman 2014 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	**BR8470-14-3-1-1-HR1**	170	37	108	7	1.93
2	**BR8470-12-2-1-2-HR4**	166	41	104	7	1.70
3	**BR8472-21-1-1-1-HR2**	168	44	143	5	**4.24**
4	**BR8470-22-2-1-1-2**	165	42	117	5	2.73
5	**BR8470-17-2-2-1**	162	38	114	6	2.37
6	**BR8164-43-2-1-HR2**	157	43	109	5	**3.50**
7	**BR8470-16-1-2-HR2**	165	42	120	7	2.31
8	**BR8471-31-2-2-1-HR2**	170	42	111	7	2.54
9	**BR7941-119-2-3-1-2-3**	169	36	128	7	2.18
10	**BR7849-5-2-2-2-2-6-1**	168	43	103	7	1.80
11	**Satadamo**	165	55	136	5	4.18
12	**Dudkalam**	156	58	130	3	3.07
13	**BRRI dhan44**	153	42	116	3	3.84
	LSD at 0.05	**2.75**	**6.08**	**11.97**	**1.23**	**0.90**

Experiment 9: Secondary Yield Trial (SYT)

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: Secondary yield trial was done to evaluate the genotypes in the tidal non-saline and stagnant water condition.

Materials and methods: Eleven genotypes will be evaluated in this trial at BRRI Barisal **(Table 9)**. The trial will be conducted using 2-3 seedlings per hill with a spacing of 20cm x 20cm spacing. The field layout will be RCB design with three replications. The unit plot sizes will be 5.4 m x 8 rows. Fertilizer doses will be 80: 60: 40: 20 kg NPKS/ha with split application of N (40+20+20). Total amount of P, K and S will be applied at the time of final land preparation. Sadamota, Dudkalam and BRRI dhan44 will be used as checks.

Results: On the basis of maximum yield production and seedling height, only seven entries namely: BR7941-41-2-2-2-4, BR7941-45-2-2-2-1, BR7941-45-2-2-2-1, BR7844-3-2-2-1-1, BR7847-47-3-3-2-2-2-2-1, BR7849-5-2-2-2-2-4, BR7943-53-1-2-1 were selected for further evaluation (Table 9)

Table 9: Performance of selected entries in Secondary yield trial-2 (SYT) for tidal submergence tolerant rice in T. Aman 2014 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	**BR8165-8-1-1-HR3**	149	46	141	3	2.91
2	**BR8173-39-1-1-HR1**	143	61	148	3	1.76
3	**BR7941-34-2-2-1-2**	146	63	151	3	2.59
4	**BR7941-41-2-2-2-4**	146	65	159	3	**3.67**
5	**BR7941-45-2-2-2-1**	147	45	154	3	**4.33**
6	**BR7941-45-2-2-2-1**	152	53	152	3	**4.79**
7	**BR7941-19-2-3-1-4**	149	63	162	3	2.08
8	**BR7844-3-2-2-1-1**	139	51	133	3	**4.10**
9	**BR7847-47-3-3-2-2-2-2-1**	146	51	115	3	**4.19**
10	**BR7849-5-2-2-2-2-4**	146	48	118	3	**4.78**
11	**BR7943-53-1-2-1**	169	41	137	5	**3.73**
12	**Sadamota**	162	47	160	5	3.69

13	**Dudkalam**	133	67	149	3	2.04
14	**BRRI dhan44**	137	44	126	3	4.57
	LSD at 0.05	**1.03**	**8.32**	**5.35**	**1.23**	**0.90**

Experiment 10:Advance Yield Trial (AYT)

S Maniruzzaman, H U Ahmed and M Ibrahim

Introduction: Advance yield trial was done to evaluate the genotypes in the tidal non-saline and stagnant water condition.

Materials and methods: Four genotypes will be evaluated in this trial at BRRI Barisal **(Table 10)**. The trial will be conducted using 2-3 seedlings per hill with a spacing of 20cm x 20cm spacing. The field layout will be RCB design with three replications. The unit plot sizes will be 5.4 m x 8 rows. Fertilizer doses will be 80: 60: 40: 20 kg NPKS/ha with split application of N (40+20+20). Total amount of P, K and S will be applied at the time of final land preparation. Sadamota, Dudkalam and BRRI dhan44 will be used as checks.

Results: On the basis of maximum yield production and seedling height, only four entries namely: BR7941-119-1-2-1, BR7941-30-1-1-1, BR7941-116-1-2-1, BR7941-41-2-2-4 were selected for further evaluation (Table 10)

Table 10: Performance of selected entries in Advance yield trial (AYT) for tidal submergence tolerant rice in T. Aman 2014 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling height (cm)	Plant height (cm)	Grain yield (t/ha)	PAcp at Mat
1	**BR7941-119-1-2-1**	**161**	**52**	**134**	**4.38**	**5**
2	**BR7941-30-1-1-1**	**159**	**64**	**147**	**4.96**	**5**
3	**BR7941-116-1-2-1**	**158**	**58**	**143**	**5.06**	**5**
4	**BR7941-41-2-2-4**	**166**	**58**	**141**	**4.52**	**5**

5	**Sadamota (ck)**	**169**	**66**	**151**	**3.96**	**7**
6	**Dudkolom (ck)**	**161**	**58**	**138**	**3.66**	**7**
7	**BRRI dhan44 (ck)**	**150**	**43**	**124**	**5.85**	**5**
	LSD at 0.05	**0.81**	**10.45**	**9.99**	**0.64**	**0.78**

PROJECT 2: REGIONAL YIELD TRIAL (RYT), 2014-15

Experiment 11: Regional yield trial for development of Rainfed Low Land Rice,T. Aman, 2014

H U Ahmed, Partho S Biswas, MA Kader, R R Majumder, H Khatun, T K Hore, T L Aditya,

S Maniruzzaman and M Ibrahim

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for Rainfed lowland Rice on station at Sagardi farm Barisal.

Materials and method: Three advanced lines IR70213-10-CPA 4-2-2-2, B 10533 F-KN-12-2, BR8033-2-2-1-2 along with two checks BRRI dhan32 (ck), BRRI dhan49 (ck) were tested at BRRI Sagardi farm Barisal during T. Aman 2014 with three replications. The unit plot size for each entry was 5.4 x 12 rows. About 49 days old seedling was transplanted at 20 cm x 15 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices was followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence, yield and yield component were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: Both of the advanced lines produced lower yield than standard check BRRI dhan32 but very similar to BRRI dhan49. Growth duration was also closer among the tested materials than BRRI dhan32 (Table 11).

Table 11: Performance of the lines in regional yield trial (RYT), development of Rain fed Low Land

rice, T. Aman, 2013-14 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	IR70213-10-CPA 4-2-2-2	136	39	94	3	4.14
2	B 10533 F-KN-12-2	134	48	109	3	4.26
3	BR8033-2-2-1-2	145	48	104	3	4.42
4	BRRI dhan32 (ck)	135	44	117	4	**5.20**
5	BRRI dhan49 (ck)	145	34	102	4	**4.19**
	CV	**0.19**	**8.27**	**3.75**	**19.36**	**12.75**
	LSD at 0.05	**0.49**	**6.70**	**7.55**	**1.19**	**1.06**

Experiment 12: Regional yield trial for development of Rainfed Low Land Rice,T. Aman, 2014

H U Ahmed, Partho S Biswas, MA Kader, R R Majumder, H Khatun, T K Hore, T L Aditya,

S Maniruzzaman and M Ibrahim

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for Rainfed lowland Rice on station at Sagardi farm Barisal.

Materials and method: Six advanced lines WAS122-IDSA 14-WAS B-FKR 1 (NERICA-L-8), WAS 122-INDSA 1-WAS-2-B-1-TGR132 (NERICA-L-16), WAS 161-B-6-B-1 (NERICA-L-36), WAS 161-B-4-B-1-TGR-51 (NERICA-L-32), WAS 191-4-10 (NERICA-L-54), NERICA Mutant along with two checks BRRI dhan49 (ck), BRRI dhan56 (ck) were tested at BRRI Sagardi farm Barisal during T. Aman 2014 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 15 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices was followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence, yield and yield component were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: All of the advanced lines produced lower yield than standard check BRRI dhan49. Growth duration was lower among the tested materials than BRRI dhan49 (Table 12).

Table 12: Performance of the lines in regional yield trial (RYT), development of Rainfed Low Land

rice, T. Aman, 2013-14 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	WAS122-IDSA 14-WAS B-FKR 1 (NERICA-L-8)	134	29	94	5	3.58
2	WAS 122-INDSA 1-WAS-2-B-1-TGR132 (NERICA-L-16)	130	42	105	3	2.87
3	WAS 161-B-6-B-1 (NERICA-L-36)	132	29	95	5	3.99
4	WAS 161-B-4-B-1-TGR-51 (NERICA-L-32)	133	36	97.33	5	**3.76**
5	WAS 191-4-10 (NERICA-L-54)	137	31	90	5	**3.57**
6	NERICA Mutant	**126**	**40**	**83**	**6**	1.74
7	BRRI dhan56 (ck)	**120**	**34**	**104**	**6**	**1.87**
8	BRRI dhan49 (ck)	**145**	**28**	**101**	**5**	**4.67**
	CV	**0.96**	**13.42**	**6.70**	**10.52**	**12.70**
	LSD at 0.05	**2.23**	**7.89**	**11.28**	**0.93**	**0.7240**

Experiment 13: Regional yield trial for development of Premium Quality Rice,T. Aman, 2014

H U Ahmed, Partho S Biswas, MA Kader, R R Majumder, H Khatun, T K Hore, T L Aditya,

S Maniruzzaman and M Ibrahim

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for Premium Quality Rice on station at Sagardi farm Barisal.

Materials and method: Eight advanced lines BR8226-8-5-2-2, BR8226-11-4-4-3, BR8226-11-4-6-2, BR8294-1-3-2-2, BR8226-13-1-2, BR8226-17-1-2**,** BR8227-6-2-1, BR8515-23-6-3 along with two checks BRRI dhan34 (ck), BRRI dhan37 (ck) were tested at BRRI Sagardi farm Barisal during T. Aman 2014 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 15 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices was followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence, yield and yield component were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: All of the advanced lines except BR8226-11-4-6-2, and BR8515-23-6-3 produced higher yield than standard check BRRI dhan34 and BRRI dhan37 (Table 13).

Table 13: Performance of the lines in regional yield trial (RYT), development of Premium Quality Rice, T. Aman, 2013-14 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	BR8226-8-5-2-2	142	30	101	5	3.89
2	BR8226-11-4-4-3	144	30	83	4	2.95
3	BR8226-11-4-6-2	142	26	88	6	1.97
4	BR8294-1-3-2-2	132	29	106	5	3.78
5	BR8226-13-1-2	143	37	96	4	**5.66**
6	BR8226-17-1-2	145	30	100	**4**	**2.88**
7	BR8227-6-2-1	151	28	110	**5**	**3.44**
8	BR8515-23-6-3	**145**	**33**	**110**	**5**	**1.93**
9	BRRI dhan34 (ck)	**134**	**31**	**128**	**7**	**2.48**
10	BRRI dhan37 (ck)	**143**	**35**	**131**	**7**	**2.69**
	CV	0.30	10.04	6.16	16.38	25.36

	LSD at 0.05	0.73	5.30	11.11	1.46	1.37

Experiment 14: Regional yield trial for development of Micro Nutrient Enrich Rice,T. Aman, 2014

H U Ahmed, Partho S Biswas, MA Kader, R R Majumder, H Khatun, T K Hore, T L Aditya,

S Maniruzzaman and M Ibrahim

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for favorable Boro on station at Sagardi farm Barisal.

Materials and method: Seven advanced lines along with two checks BRRI dhan32 (ck), BRRI dhan39 (ck) were tested at BRRI Sagardi farm Barisal during T. Aman 2014 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 15 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices was followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence, yield and yield component were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: BR7879-17-2-4-HR3-P1, BR7671-37-2-2-3-7-3, BR8143-15-2-1 advanced lines produced higher yield than standard check BRRI dhan32 but other advance lines except BR7840-54-3-2-2 very similar to BRRI dhan39 (Table 14).

Table 14: Performance of the lines in regional yield trial (RYT), development of Micro Nutrient Enrich Rice, T. Aman, 2013-14 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	BR7840-54-3-2-2	136	42	100	7	0.82
2	BR7879-17-2-4-HR3-P1	146	34	140	3	4.88
3	BR7671-37-2-2-3-7-3	138	37	114	3	4.06
4	BR8143-15-2-1	134	37	115	4	**5.31**

5	BR8418-1-3	135	32	84	7	**2.10**
6	IR85850-75-2-2-3-2(IR10M300)	**142**	**30**	**99**	**7**	**3.21**
7	PSBRC82 (IRRI 123)	**138**	**35**	**96**	**4**	**3.69**
8	BRRI dhan32 (ck)	**145**	**36**	**116**	**5**	**4.06**
9	BRRI dhan39 (ck)	**131**	**30**	**102**	**5**	**3.35**
	CV	0.35	8.76	6.36	11.55	15.39
	LSD at 0.05	0.84	5.28	11.55	0.99	0.93

Experiment 15: Regional yield trial for development of Green Super Rice,T. Aman, 2014

H U Ahmed, Partho S Biswas, MA Kader, R R Majumder, H Khatun, T K Hore, T L Aditya,

S Maniruzzaman and M Ibrahim

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for Green Super Rice on station at Sagardi farm Barisal.

Materials and method: Four advanced lines along with two checks BRRI dhan39 (ck), BRRI dhan56(ck) were tested at BRRI Sagardi farm Barisal during T. Aman 2014 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 15 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices was followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence, yield and yield component were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: Both of the advanced lines produced similar yield than standard check BRRI dhan39 but very higher yield than BRRI dhan56 (Table 15).

Table 15: Performance of the lines in regional yield trial (RYT), development of Green Super Rice, T. Aman, 2013-14 at BRRI regional station Barisal

Sl#	**Designation**	**Growth duration (days)**	**Seedling Height (cm)**	**Plant height (cm)**	**PAcp at Mat**	**Grain yield (t/ha)**

1	IR8340-B-28-B	127	42	103	4	3.21
2	IR83142-B-19-B	132	27	102	6	4.05
3	IR83142-B-60-B	130	26	98	6	3.87
4	HHZ5-SAL10-DT1-DT1	140	27	97	5	**3.73**
5	BRRI dhan39 (ck)	139	29	107	6	**3.83**
6	BRRI dhan56 (ck)	**114**	**27**	**102**	**3**	**2.15**
	CV	0.74	10.30	4.34	14.61	8.76
	LSD at 0.05	1.80	5.51	8.02		0.58

Experiment 16: Regional yield trial for premium quality rice in Boro 2014-15

M A Kader, R R Majumder, T K Hore, M A Hossain, S Maniruzzaman and T L Aditya,

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for premium quality rice on station at Sagardi farm BRRI Barisal.

Materials and method: Five advanced lines along with two checks BRRI dhan50 (ck), BRRI dhan63 (ck) were tested at Sagardi farm Barisal during Boro 2014-15 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 20 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices were followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence and yield were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: Advanced lines IR77734-93-2-3-2 and BR8079-52-2-2-2 gave respectively 5.18, 5.64 and 5.83 t/ha yield, respectively, (Table 16) that was higher than standard checks. Based on the yield performance IR77734-93-2-3-2 and BR8079-52-2-2-2 may be recommended for further process.

Table 16: Performance of the lines in regional yield trial (RYT) for premium quality rice in Boro 2014-15 at BRRI regional station Barisal

Sl#	**Designation**	**Growth duration**	**Seedling Height**	**Plant height (cm)**	**PAcp at Mat**	**Grain yield (t/ha)**

		(days)	(cm)			
1	IR77734-93-2-3-2	142	14.97	82.67	4	5.18
2	BR8079-52-2-2-2	150	14.70	83.00	5	5.83
3	BR8096-55-1-9-1	139	18.87	80.00	4	4.63
4	BR8076-1-2-2-3	146	15.53	93.33	4	4.59
5	BR8096-48-2-2-4	144	14.30	83.33	3	4.22
6	BRRI dhan50	145	16.63	75.67	3	5.01
7	BRRI dhan63	137	23.33	73.00	**3**	4.82
	CV	**0.89**	**9.03**	**2.93**	**21.17**	**7.50**
	LSD at 0.05	**2.28**	**2.72**	**4.24**	**1.34**	**2.71**

Experiment 17: Regional yield trial for premium quality rice#com in Boro 2014-15

M A Kader, R R Majumder, T K Hore, M A Hossain, S Maniruzzaman and T L Aditya,

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for premium quality rice#com on station at Sagardi farm BRRI Barisal.

Materials and method: Five advanced lines along with four checks BRRI dhan28 (ck), BRRI dhan50(ck), BRRI dhan60 (ck), BRRI dhan63 (ck), were tested at Sagardi farm Barisal during Boro 2014-15 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 20 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices were followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence and yield were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: Advanced lines BR7986-2-3, BR7986-7-4 and BR7986-29-4 gave respectively 5.17, 5.64 and 5.00 t/ha yield, respectively, (Table 17) that was higher than standard checks. Based on the yield performance BR7986-2-3, BR7986-7-4 and BR7986-29-4 may be recommended for further process.

Table 17: Performance of the lines in regional yield trial (RYT) for premium quality rice#com in Boro 2014-15 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	BR7372-35-3-3-HR9(com)	143	19.84	94.00	4	
2	BR7358-5-3-2-1-HR2(com)	--	-	-		
3	BR7372-18-2-1-HR1-HR6(com)	140	19.13	89.67	4	
4	BR7372-18-3-3-HR3(com)	139	18.57	93.67	4	
5	BR7372-35-3-3-HR5(com)	142	19.43	91.33	5	
6	BRRI dhan28(ck)	134	19.07	83.67	3	
7	BRRI dhan50(ck)	**143**	13.87	79.67	**3**	
8	BRRI dhan60(ck)	**136**	16.77	78.67	**3**	
9	BRRI dhan63(ck)	135	22.30	78.67	**5**	
	CV					
	LSD at 0.05					

Experiment 18: Regional yield trial for short duration rice in Boro 2014-15

M A Kader, R R Majumder, T K Hore, M A Hossain, S Maniruzzaman and T L Aditya,

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for short duration rice on station at Sagardi farm BRRI Barisal.

Materials and method: One advanced line along with two checks BRRI dhan28 (ck), BRRI dhan45 (ck) were tested at Sagardi farm Barisal during Boro 2014-15 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 20 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices were followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence and yield were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: Advanced line NERICA Mutant gave higher yield (Table 18) that was higher than standard checks. Based on the yield performance NERICA Mutant may be recommended for further process.

Table 18: Performance of the lines in regional yield trial (RYT) for short duration rice in Boro 2013-14 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	NERICA Mutant	144	20.20	82.87	3	6.35
2	BRRI dhan28(ck)	135	19.87	85.53	3	5.10
3	BRRI dhan 45(ck)	135	16.87	84.20	3	5.03
	CV	0.30	14.64	5.99	2.77	4.55
	LSD at 0.05	0.92	6.30	11.42		0.57

Experiment 19: Regional yield trial for favorable boro rice in Boro 2014-15

M A Kader, R R Majumder, T K Hore, M A Hssain, S Maniruzzaman and T L Aditya,

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for favourable boro rice on station at Sagardi farm BRRI Barisal.

Materials and method: Ten advanced lines along with two checks BRRI dhan28 (ck), BRRI dhan29 (ck) and BRRI dhan60 were tested at Sagardi farm Barisal during Boro 2014-15 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 20 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices were followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence and yield were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: Advanced lines BR7783-AC12-3, BR7783-AC13-5, BR7783-AC14-5 and BR7783-AC6-3-2-2-1 gave respectively 7.03, 6.45, 6.80 and 6.46 t/ha yield, respectively, (Table 19) that was higher than standard checks. Based on the yield performance BR7783-AC12-3, BR7783-AC13-5, BR7783-AC14-5 and BR7783-AC6-3-2-2-1 may be recommended for further process.

Table 19: Performance of the lines in regional yield trial (RYT) for **premium quality rice** in Boro 2014-15 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	BR7683-30-3-3-4	139	22.40	84.43	4	5.53
2	BR7671-37-2-2-3-7	143	18.57	81.97	4	4.79
3	BR7988-4-5-3-4	144	14.87	77.03	6	5.26
4	BR7783-AC12-3	152	14.92	96.27	3	7.03
5	BR7783-AC13-5	150	12.53	96.53	-	6.45
6	BR7783-AC14-5	151	15.30	97.90	3	6.80
7	BR7783-AC6-3-2-2-1	151	15.87	96.80	**3**	6.46
8	BRRI dhan29-SC3-16-10-8-HR1(com)	138	18.03	81.13	3	4.93
9	BR7988-10-4-1	141	11.53	82.97	**3**	5.12
10	BR7800-63-1-7-3	141	17.67	90.17	**3**	4.92
11	BRRI dhan28(ck)	139	15.17	86.17	**3**	4.73
12	BRRI dhan29(ck)	154	15.37	92.10	**3**	5.85
13	BRRI dhan60(ck)	140	12.53	82.93	3	4.97
	CV	0.81	5.70	2.88	15.32	7.11
	LSD at 0.05	1.98	1.51	4.28	1.00	0.67

Experiment 20: Regional yield trial for micronutrient rice in Boro 2014-15

M A Kader, R R Majumder, T K Hore, M A Hssain, S Maniruzzaman and T L Aditya,

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for micronutrient rice on station at Sagardi farm BRRI Barisal.

Materials and method: Nine advanced lines along with two checks BRRI dhan28 (ck), BRRI dhan29 (ck) were tested at Sagardi farm Barisal during Boro 2014-15 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 20 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15

DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices were followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence and yield were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: All the advanced lines are similar and higher yield than BRRI dhan28 but lower yield than BRRI29. Based on the yield performance BR7833-19-2-3-5 BR8261-19-1-1-3, BR7820-18-1-6-3-P4, BR7881-62-2-3-7-P3 and BR7879-17-2-4-HR3-P1 may be recommended for further process.

Table 20: Performance of the lines in regional yield trial (RYT) for **micronutrient rice** in Boro 2014-15 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	BR7840-54-3-2-1	142	15.57	84.33	3	4.48
2	BR7840-54-3-4-1	137	18.73	98.73	4	4.81
3	BR7840-54-3-4-4	137	13.50	100.17	3	4.49
4	BR8257-37-1-2-2	140	16.40	85.83	4	4.60
5	BR7833-19-2-3-5	142	14.47	98.07	5	5.14
6	BR8261-19-1-1-3	143	15.07	97.43	5	5.41
7	BR7820-18-1-6-3-P4	147	15.30	94.17	3	5.93
8	BR7881-62-2-3-7-P3	150	15.27	101.53	3	6.27
9	BR7879-17-2-4-HR3-P1	146	17.33	113.43	3	5.78
10	BRRI dhan28(ck)	136	15.10	86.30	3	4.78
11	BRRI dhan29(ck)	152	13.33	97.93	3	6.69
	CV	**0.63**	**5.33**	**2.58**	**13.40**	**9.50**
	LSD at 0.05	**1.53**	**1.40**	**4.23**	**0.79**	**0.85**

Experiment 21: Regional yield trial for green super rice in Boro 2014-15

M A Kader, R R Majumder, T K Hore, M A Hssain, S Maniruzzaman and T L Aditya,

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for green super rice on station at Sagardi farm BRRI Barisal.

Materials and method: Five advanced lines along with two checks BRRI dhan29 (ck), BRRI dhan60 (ck) were tested at Sagardi farm Barisal during Boro 2014-15 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 20 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices were followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence and yield were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: Advanced lines HHZ15-SAL13-Y1, HHZ23-DT16-DT1-DT1, HHZ15-DT4-DT1-Y1, HHZ11-DT7-SAL1-SAL1, and HHZ6-SAL3-Y1-SUB2 gave higher yield than standard checks. Based on the yield performance HHZ15-SAL13-Y1, HHZ23-DT16-DT1-DT1, HHZ15-DT4-DT1-Y1, HHZ11-DT7-SAL1-SAL1, and HHZ6-SAL3-Y1-SUB2may be recommended for further process.

Table 21: Performance of the lines in regional yield trial (RYT) for **green super rice** in Boro 2014-15 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	HHZ15-SAL13-Y1	155	18.30	90.27	3	7.19
2	HHZ23-DT16-DT1-DT1	154	13.67	88.63	3	7.22
3	HHZ15-DT4-DT1-Y1	153	12.23	85.23	3	6.93
4	HHZ11-DT7-SAL1-SAL1	149	13.03	81.70	3	6.78
5	HHZ6-SAL3-Y1-SUB2	155	15.43	90.20	3	7.08
6	BRRI dhan29	157	13.50	96.30	3	6.55
7	BRRI dhan60	139	17.83	80.20	**3**	5.35
	CV	**0.21**	**6.43**	**2.54**	**2.77**	**4.48**

	LSD at 0.05	**0.57**	**1.69**	**3.96**	**5.79**	**0.53**

Experiment 22: Regional yield trial for short duration rice in Boro 2014-15

M E Hoque, S Sultana, J Ferdous, R R Roy, M A Hssain, and S Maniruzzaman

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for disease resistant rice on station at Sagardi farm BRRI Barisal.

Materials and method: Four advanced lines along with one check BRRI dhan28 (ck) was tested at Sagardi farm Barisal during Boro 2014-15 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 15 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices were followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence and yield were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: Advanced lines BR8072-AC5-4-2-1-2-1, BR8072-AC7-4-1-2-2-1, BR8072-AC8-1-1-3-1-1 and BR8072-AC11-2-3-2-1-1gave higher yield than standard check. Based on the yield performance BR8072-AC5-4-2-1-2-1, BR8072-AC7-4-1-2-2-1, BR8072-AC8-1-1-3-1-1 and BR8072-AC11-2-3-2-1-1 may be recommended for further process.

Table 22: Performance of the lines in regional yield trial (RYT) for short duration rice in Boro 2014-15 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	Grain yield (t/ha)
1	BR8072-AC5-4-2-1-2-1	139	15.55	84.67	4.81
2	BR8072-AC7-4-1-2-2-1	138	14.88	80.67	4.89
3	BR8072-AC8-1-1-3-1-1	138	20.16	80.00	4.28
4	BR8072-AC11-2-3-2-1-1	138	15.13	85.00	4.76
5	BRRI dhan28(ck)	137	16.08	87.33	4.14
	CV	**0.63**	**5.28**	**3.69**	**6.79**
	LSD at 0.05	**1.53**	**1.62**	**5.79**	**0.58**

Experiment 23: Regional yield trial for high yielding rice in Boro 2014-15

M E Hoque, S Sultana, J Ferdous, R R Roy, M A Hssain, and S Maniruzzaman

Introduction: The regional yield trial (RYT) was conducted to test the yield potential and adaptability of advanced lines for disease resistant rice on station at Sagardi farm BRRI Barisal.

Materials and method: One advanced lines BR6158RWBC2-2-1-1 along with two checks BRRI dhan58 (ck), BRRI dhan29 (ck) were tested at Sagardi farm Barisal during Boro 2014-15 with three replications. The unit plot size for each entry was 5.4 x 12 rows. Transplanted at 20 cm x 15 cm spacing. All fertilizers except urea were applied as basal dose and urea was applied in equal splits at 10-15 DAT, 30-35 DAT and 5-7 days before PI stage. Other standard management practices were followed as necessary. Appropriate measures were taken to control insect pests. Data of seeding, transplanting, flowering, maturity, plant height, lodging tolerance, pest and disease incidence and yield were recorded. For yield estimation, whole unite plot was harvested at maturity and grain yields were adjusted at 14% moisture content.

Results: Advanced lines BR6158RWBC2-2-1-1 gave higher yield than standard checks. Based on the yield performance BR6158RWBC2-2-1-1 may be recommended for further process.

Table 23: Performance of the lines in regional yield trial (RYT) for high yieldin rice in Boro 2013-14 at BRRI regional station Barisal

Sl#	Designation	Growth duration (days)	Seedling Height (cm)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	BR6158RWBC2-2-1-1	152	15.84	108.20	3	6.69
2	BRRI dhan58(ck)	150	12	88.20	3	6.32
3	BRRI dhan 29(ck)	153	15.46	85.00	3	6.45

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PROJECT 3: PROPOSED VARIETY TRIAL (PVT), 2014-15

Experiment 24: Development of varieties for salt tolerant Aman rice, 2014

Md. Ruhul Amin Sarker, H U Ahmed, S Maniruzzaman and M Ibrahim

Introduction: Proposed variety trial (PVT) done at one location of Barisal to evaluate the performance of salt tolerant Aman rice in 2014.

Materials and methods: Two lines were evaluated in this trial at Barisal. The trials were conducted using 2-3 seedlings per hill with a spacing of 25 cm x 15 cm. The field layout was RCB design with three replications. The unit plot sizes were 5 m x 5 m. Fertilizer doses were 120: 20: 60 kg NPK/ha + 100 kg Gypsum/ha + 10 kg $ZnSO_4$ with split application of N (60+30+30). Total amount of P, K, S and $ZnSO_4$ were applied at the time of final land preparation. BRRI dhan47 was used as check.

Results: : The proposed variety IR7861-B-SATB1-28-3-24 produced higher yield than the check variety BRRI dhan53 at both location (Table 24).

Table 24: Performance of the lines in proposed variety trial (PVT), development of varieties for salt tolerant, Aman, 2014-15

Sl#	Designation	Growth duration (days)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	IR7861-B-SATB1-28-3-24	125	118	4	6.08
2	IR7861-B-SATB1-28-3-26	124	116	3	5.35
3	BRRI dhan 53(ck)	126	113	4	5.41

Salinity (ds/m) at 15 days interval:

10.07.14= 0.47 ds/m

25.07.14= 0.578 ds/m

15.08.14= 0.97 ds/m

10.10.14= 1.02 ds/m

13.11.14= 1.92 ds/m

18.11.14= 2.01 ds/m

Experiment 25: Development of varieties for Zinc Enrich Aman rice, 2014

P S Biswas, S Maniruzzaman and M Ibrahim

Introduction: Proposed variety trial (PVT) done at one location of Barisal to evaluate the performance of salt tolerant Aman rice in 2014.

Materials and methods: One lines was evaluated in this trial at Barisal. The trials were conducted using 2-3 seedlings per hill with a spacing of 20 cm x 20 cm. The field layout was RCB design with three replications. The unit plot sizes were 5 m x 5 m. Fertilizer doses were 150: 50: 82:60 kg Urea:TSP:MP:Gypsum/ha + 10 kg $ZnSO_4$ with split application of N. Total amount of P, K, S and $ZnSO_4$ were applied at the time of final land preparation. BRRI dhan39 was used as check.

Results: : The proposed variety BR7528-2R-19-HR10 produced higher yield than the check variety BRRI dhan53 at both location (Table 25).

Table 25: Performance of the lines in proposed variety trial (PVT), development of varieties for Zinc Enrich Aman Rice, 2014

Sl#	Designation	Growth duration (days)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	BR7528-2R-19-HR10	131	116	2	5.65
2	BRRI dhan 39(ck)	127	118	3	5.63

Experiment 26: Development of varieties for Rainfed Low Land Aman rice, 2014

M A Kader, S Maniruzzaman and M Ibrahim

Introduction: Proposed variety trial (PVT) done at one location of Barisal to evaluate the performance of salt tolerant Aman rice in 2014.

Materials and methods: Two lines were evaluated in this trial at Barisal. The trials were conducted using 2-3 seedlings per hill with a spacing of 20 cm x 15 cm. The field layout was RCB design with three replications. The unit plot sizes were 6 m x 5 m. Fertilizer doses were 108: 17.4: 58.5:14:4.3 kg NPKSZn/ha with split application of N (60+30+30). Total amount of P, K, S and $ZnSO_4$ were applied at the time of final land preparation. BRRI dhan39 and BRRI dhan49 were used as check.

Results: : The proposed variety BR7622-5-1-1-1 gave higher yield than both checks and BR7472-16-2-1-2-3 gave higher yield than one check (Table 26).

Table 26: Performance of the lines in proposed variety trial (PVT), development of varieties for RLR, Aman, 2014

Sl#	Designation	Growth duration (days)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)

1	BR7472-16-2-1-2-3	125	121	2	4.6
2	BR7622-5-1-1-1	127	125	2	5.10
3	BRRI dhan 39(ck)	127	106	4	4.50
4	BRRI dhan 49(ck)	130	101	3	4.9

Experiment 27: Development of varieties for Premium Quality Aman rice, 2014

M A Kader, S Maniruzzaman and M Ibrahim

Introduction: Proposed variety trial (PVT) done at one location of Barisal to evaluate the performance of salt tolerant Aman rice in 2014.

Materials and methods: One lines were evaluated in this trial at Barisal. The trials were conducted using 2-3 seedlings per hill with a spacing of 20 cm x 15 cm. The field layout was RCB design with three replications. The unit plot sizes were 6 m x 5 m. Fertilizer doses were 108: 17.4: 58.5:14:4.3 kg NPKSZn/ha with split application of N (60+30+30). Total amount of P, K, S and $ZnSO_4$ were applied at the time of final land preparation. BRRI dhan37 was used as check.

Results: : The proposed variety BR7357-11-2-4-1-1 produced higher yield than the check variety BRRI dhan37 (Table 27).

Table 27: Performance of the lines in proposed variety trial (PVT), development of varieties for PQR Aman Rice, 2014

Sl#	Designation	Growth duration (days)	Plant height (cm)	PAcp at Mat	Grain yield (t/ha)
1	BR7357-11-2-4-1-1	130	123	2	4.32
2	BRRI dhan37 (ck)	147	125	2	2.57

Experiment 28: Development of Boro variety for Zinc Enrich in 2014-15

Partho S Biswas, M A Hossain and S Maniruzzaman

Introduction: Proposed variety trial (PVT) done at Barisal to evaluate the performance for Micro Nutrient Enrich Boro rice in 2013-14**.**

Materials and methods: Two lines were evaluated in this trial at Barisal. The trial was conducted using 2-3 seedlings per hill with a spacing of 20 cm x 20 cm. The field layout was RCB design with

three replications. The unit plot sizes were 5 m x 5 m. Fertilizer doses were 260: 100: 120: 110: 10 Kg Urea: TSP: MP: Gypsum: $ZnSO_4$/ha with split application of Urea (90+90+80 kg/ha). Total amount of P, K, S, $ZnSO_4$ were applied at the time of final land preparation. BRRI dhan28 and BRRI dhan28 were used as checks.

Results: The highest grain yield obtained by the proposed variety BR7671-37-2-2-3-7 followed by BR7833-11-1-1-2-1-2B5. However growth duration of both advanced lines was 2 to 8 days advance than the check variety BRRI dhan64 (Table 28).

Table 28: Performance of the lines in proposed variety trial (PVT), development of varieties for Zinc Enrich, Boro, 2014-15

Sl#	Designation	Growth duration (days)	PAcp at Mat	Grain yield (t/ha)
1	BR7671-37-2-2-3-7	147	3	7.2
2	BR7833-11-1-1-2-1-2B5	141	3	6.0
3	BRRI dhan 64(ck)	149	7	4.3
4	BRRI dhan 28(ck)	145	3	6.1

PROJECT 4: PEST MANAGEMENT

Expt. 2. Survey and epidemiology of rice blast diseases in Barisal region

PI: M. Hossain; **CI:** M. A. Hossain, M. A. Latif

Introduction: Earlier reports indicated that during drought period in Aus and Aman seasons the incidence of rice blast was higher. Deep-water and Boro rice may also be infected (Miah, 1973; Talukdar, 1968). Gradually, incidence and severity of blast disease is increasing especially in the Boro season. In recent years, frequency of blast occurrence has increased with invasion into new areas (north and northwest parts of the country). Reaction of BRRI released rice varieties to blast is little known however, the most popular and mega varieties BRRIdhan29 and BRRIdhan28 and newly introduced BRRI dhan61 are recognized highly susceptible to blast disease (Anonymous, 2014). Moreover, all local and improved aromatic rice varieties grown in wet season are vulnerable to neck blast. Blast outbreaks often occur in AEZ 12 and 13 (Tidal floodplain) and perhaps the pathogen locally penetrate either in alternate host or in seed. Only wet season rice is cultivated in AEZ 13 followed by fallow (Ali and Fukuta, 2010). Therefore, the seasonal occurrence, distribution and severity of blast disease and varietal preference are needed to understand.

Objective: To find out the factors responsible for disease outbreak under diverse climatic conditions for providing preliminary information to develop disease forecasting model as well as management practices.

Materials and Methods: The survey on rice blast was conducted in farmers' fields of Barisal region (AEZ 13 of Tidal Floodplain and some parts of that regions covering AEZ 12 of Low Ganges River Floodplain) of Bangladesh representing Barisal Sadar, Jhalakhati, Patuakhali, Borguna, Pirojpur and Vola Districts. Cropping pattern, rice growing ecosystem and cultivar adoption of the surveyed area were presented in Table 3. The climatic data on rainfall, maximum and minimum temperature, relative humidity of the surveyed area were collected from BRRI, Barisal.

Table 3: Location, cropping pattern, ecosystem and cultivar surveyed for rice blast disease in boro and Transplanted Aman rice, Bangladesh, 2010-11.

Ecosystem	Crop sequence	Major rice cultivar observed
Irrigated	Rice-Rice-Fallow Rice- Wheat/Pulse-Rice/Fallow Rice-Mungbean/Wheat-Rice/Fallow	BRRI dhan61, BRRI dhan64, BRRI dhan47, BRRI hybrid2, Sadavojon, BRRI dhan28, BRRI dhan29,
Rainfed	Rice-Pulse/Fallow Rice-Vegetable-Fallow	BRRI dhan62, BRRI dhan34, BRRI dhan40, BRRI dhan41, BRRI dhan44, BRRI dhan46, Sakkorkhora, Sadamota, Kumragoir

'Rice' in the sequence shown at first to be considered as wet season rice

Disease assessment and Data collection: Data on leaf blast severity (0-9 scale) were collected depending on the predominant lesion type on leaves following the Standard Evaluation System for rice (IRRI, 2013). Where, 0= No lesions observed; 1= Small brown specks of pin-point size or larger brown specks without speculating centre; 2= Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin. Lesions are mostly found on the lower leaves; 3= Lesion type is the same as in scale 2, but a significant number of lesions are on the upper leaves; 4= Typical susceptible blast lesions 3 mm or longer, infecting less than 4% of the leaf area; 5= Typical blast lesions infecting 4-10% of the leaf area; 6= Typical blast lesions infecting 11-25% of the leaf area; 7= Typical blast lesions infecting 26-50% of the leaf area; 8= Typical blast lesions infecting 51-75% of the leaf area and many leaves dead; 9= More than 75% leaf area affected. A zigzag pattern was followed in this study (Savary *et al*., 1996). The disease scoring data were converted into percent disease index (PDI) by using the formula (Greer & Webster, 2001).

$$\text{PDI} = \frac{\text{Sum of scores}}{\text{No. of observation x highest number in rating scale}} \times 100$$

Results: Table 4 represented neck blast severity and incidence in different rice cultivars of Barisal region. The incidence of blast disease was high both in Boro and Transplanted Aman crops (Fig 1). Out of 30 fields visited during Transplanted Aman season the disease was found in 18 fields under surveyed five districts (Table 4). Among the infected fields the DI ranged from 5-70% and the DS from 1-7. Maximum 70% DI and 7 DS on BRRI dhan62 was recorded at Agoiljhara of Barisal district, respectively followed by 55% and 7 on the same cultivar at Taltoli of Borguna district. Other popular cultivars BRRI dhan34 and BRRI dhan44 were also infected by this disease across the location having 20-40% DI and 1-5 DS. Sakkorkhora was one of the popular local Aman cultivars in this region where maximum 25% DI and 3 DS were recorded at Charkhali of Pirojpur district.

Out of 36 fields visited during Boro season, the disease was found in 27 fields under six districts. Among the infected fields the DI ranged from 10-90% and the DS from 1-9. Maximum 90% DI and 9 DS on BRRI dhan61 was recorded at Barisal, respectively followed by 70% and 7 on BRRI dhan47 at the same district. At Jhalakathi district, BRRI dhan28 was observed with 70% DI and 5 DS. Another popular cultivar BRRI dhan29 was also infected by this disease across the location having 25-60% DI and 3-7 DS. Neck blast did not affect BRRI dhan55 and BRRI dhan58 across the locations.

Higher mean %DI and DS were observed in irrigated land (Boro season) (33.9% and 3.3, respectively) than that of rainfed land (Transplanting Aman season) (16.2% and 1.7, respectively) (Fig. 2).

Fig. 1. leaf blast infected plot at Barisal (B) during Boro season, 2014

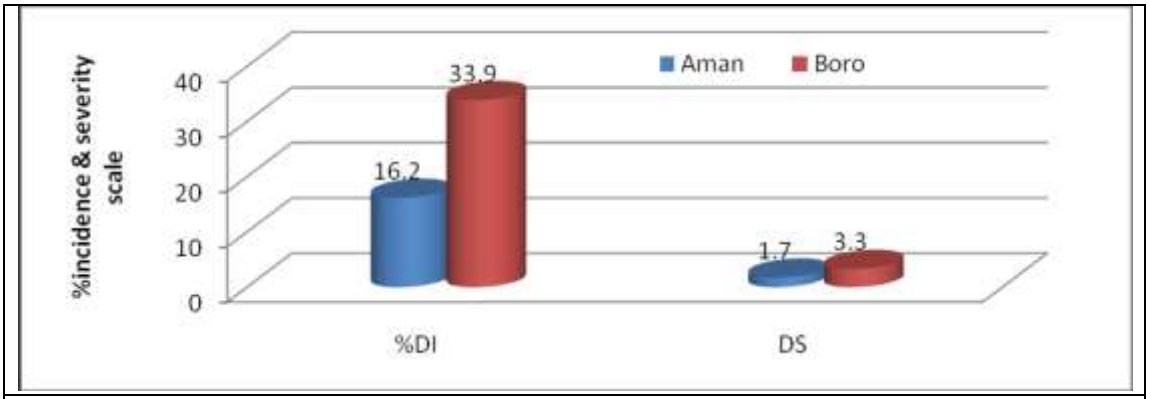

Fig. 2: Mean blast DS and DI in irrigated (Boro, 2014-15) and rainfed (Transplanted Aman, 2014) ecosystems in Barisal region

Table 4: Disease severity and incidence of neck blast in rainfed (Transplanted Aman, 2014) and irrigated (Boro, 2014-15) ecosystems in Barisal region

District	Upazilla/ Village	Plot no.	Aman 2014			Boro 2014-15		
				DI (%)	DS		DI (%)	DS
Barisal	Agoiljhara	1	Sakkorkhora	10	1	BRRI dhan58	0	0
		2	BRRI dhan62	70	7	BRRI dhan29	35	3
	Sadar	3	BRRI dhan44	0	0	BRRI dhan61	90	9
		4	Sadamota	0	0	BRRI dhan47	70	7
	Banaripara	5	BRRI dhan34	20	3	BRRI dhan58	0	0
		6	BRRI dhan62	30	3	BRRI dhan55	0	0
Jhalakathi	Fultala	7	BRRI dhan44	40	5	BRRI dhan47	40	3
		8	BRRI dhan62	0	0	BRRI hybrid2	0	0
	Nolchiti	9	BRRI dhan40	0	0	Sadavojon	0	0
		10	Sadamota	05	1	BRRI dhan28	70	5
	Joykolos	11	Sakkorkhora	0	0	BRRI dhan64	30	3
		12	Sakkorkhora	05	1	BRRI dhan29	60	7
Potuakhali	Sadar	13	BRRI dhan62	25	1	BRRI dhan47	70	7
		14	BRRI dhan62	45	5	BRRI dhan61	40	3
		15	Sakkorkhora	20	3	Sadavojon	0	0
		16	BRRI dhan54	0	0	BRRI dhan28	30	3
		17	BRRI dhan62	25	3	BRRI dhan64	45	5
		18	BRRI dhan62	10	1	BRRI dhan29	55	5
Pirojpur	Najirpur	19	BRRI dhan44	30	1	BRRI dhan28	25	3
		20	BRRI dhan34	40	5	BRRI dhan29	30	3
	Charkhali	21	BRRI dhan40	0	0	BRRI dhan61	50	3
		22	Sakkorkhora	25	3	BRRI dhan28	10	1
	Nasarabad	23	BRRI dhan34	20	1	BRRI dhan64	60	7
		24	BRRI dhan62	10	1	Sadavojon	0	0
Borguna	Amtoli	25	BRRI dhan52	0	0	BRRI dhan64	40	3
		26	BRRI dhan54	0	0	BRRI dhan61	20	3
		27	BRRI dhan53	0	0	BRRI dhan61	55	5
	Taltoli	28	BRRI dhan62	55	7	Sadavojon	0	0
		29	Sakkorkhora	0	0	BRRI dhan29	25	3
		30	BRRI dhan52	0	0	BRRI dhan47	60	7
Vola	Vola Sadar	31	-			BRRI dhan64	50	3
		32	-			BRRI dhan64	25	3
	Borhanuddin	33	-			BRRI dhan55	0	0
		34	-			BRRI dhan64	50	5
	Doulatkhan	35	-			BRRI dhan47	65	7
		36	-			BRRI dhan64	20	3
Standard error				4.16	0.31		4.41	0.45

Local aromatic: Chinigura, Begunbichi, Badshavog, Kaligira

Cultivable lands of Barisal region are mostly low and submerged twice in a day with tidal water during T. Aman season. In this season, farmers of Barisal region mostly grow local varieties and they prefer late transplantation due to avoid high tide during July-August. The daily average rainfall was comparatively high and daily average air temperature was comparatively low during the study period. Climatic factors are the most important components for disease outbreak. Due to high humidity and comparatively low temperature during study period, blast incidence was high in Barisal region. We collected data on the incidence and severity of blast in local and high yielding varieties. HYV showed very high incidence and severity while incidence and severity were

comparatively low in local varieties. This study suggested disease forecasting model would be helpful for blast disease management. An epidemiological study has also been needed on blast disease. Finally, disease control measures of blast need to be developed for sustainable rice production.

Expt. 3. Management of rice blast diseases in Barisal region

PI: M. Hossain; **CI:** M. A. Hossain, M. R. Viuyan

Introduction: The rice blast disease has long been recognized as the most important and potentially damaging rice disease with worldwide distribution (Ou 1985). The humid tropical environments in Asia are highly conducive to blast disease (Mew et al. 2004). Outbreaks often occurs in Boro and T. Aman seasons across the rice growing areas perhaps due to changes in production system, expansion of hybrid rice and intensification with mono crop variety, changes of climatic factors, high input use, etc. The disease causes 11% and 46.4% yield loss under low and medium disease pressure in Bangladesh (Shahjahan *et al.* 1987). For blast disease management at field level chemical control is mainly practiced and other options particularly water management is another practice. Every year rice yield lose is occurred in Barisal region due to this disease. Therefore, field experiments and demonstration on blast disease management practices are needed to enhance rice yield.

Objective: To demonstrate the efficacy of fungicides against blast disease and to introduce manage practices to the farmers.

Materials and Methods: The experiment was conducted at farmers' field of Barisal under natural field condition. Highly susceptible T. Aman variety BRRI dhan61 was used as a test variety while BRRI dhan64 was used in Boro season. Two chemicals viz. Trooper (Tricyclazole) and Nativo (Trifloxystrobin + Tabuconazole) along with an untreated control were used against leaf blast and panicle blast diseases. For leaf blast, fungicides were sprayed twice at maximum tillering stage at 10 days interval. For neck blast, fungicides were sprayed two times; first at heading stage (around 5% flowering) and 2nd at 10 days after the 1st spray. All of the chemicals were sprayed at afternoon. Disease severity data were collected during vegetative stage and harvesting.

Result: The results of fungicides against leaf blast are shown in Table 5. Trooper 75 WP and Nativo performed better in reducing disease incidence >80% over control.

Around 70% panicles of disease control plot were infected by neck blast where disease severity scale varied from 5-9. Trooper 75 WP and Nativo suppressed 76.5% and 80.5% neck blast incidence, respectively over control (Table 6).

Table 5. Efficacy of fungicides against leaf blast disease

Sl. No.	Commercial name	Active ingradient (a.i.)	Application rate	Percent leaf infection (%)
1	Trooper 75 WP	Tricyclazole	400 g/ha	11.5 (80.8*)
2	Nativo	Trifloxytrobin+ Tabuconazole	250 g/ha	10.0 (83.3*)
3	Untreated control			60.0

*Percent reduction of leaf area infection over untreated control.

Table 6: Efficacy of fungicides in controlling neck blast disease of rice, Boro, 2014-15.

Sl. No.	Trade name	Active ingredient	Doses (g or ml/ha)	Disease reduction over control (%)
1	Trooper	Tricyclazole	400 gm	76.5
2	Nativo	Trifloxytrobin + Tabuconazole	250 g/ha	80.5
3	Untreated control	none	Around 70% panicles were infected by neck blast and disease severity scale varied from 5-9	

PROJECT 5: TECHNOLOGY TRANSFER

Expt. Advanced Line Adaptive Research Trial (ALART), Boro 2014-15

CI: G S Jahan, **PI:** Dr. M A Islam & **PL:** Dr. M S I Mamin

Introduction

The Advanced Line Adaptive Research Trial (ALART) was conducted to test the yield potential and adaptability of advanced lines at farmers' field under different agro- ecological conditions of the country and to generate the feedback about the advantages and disadvantages of the lines from extension workers and farmers. This is an important step towards variety development. Three ALART program of Boro 2014-15 were conducted for Premium quality rice(PQR), Micronutrient(MN) and Short duration(SD) at Barisal Sadar upazila.

Objectives:

- To evaluate the yield potential and adaptability of advanced breeding lines at farmers' field in different agro-ecological conditions.
- To get feedback information about the advantages and disadvantages of the advanced lines from farmers and DAE personnel.

ALART, PQR, Boro 2014-15

Materials and method: Three premium quality advanced lines: BR7781-10-2-3-2, BR7369-10-5-2-3 and BR7369-52-3-2-1-1 along with BRRI dhan50 and BRRI dhan63 as checks were tested in Diyapara, Sadar, Barisal during Boro 2015.It was a three replicated trial. The unit plot size for each entry was 20 m^2 (5m × 4m). Seeding time was 13 December, 2014 and Seedling ages were 42 days. Seedlings were transplanted at 25 cm × 15 cm spacing. Fertilizers were applied at 120: 20: 60: 20: 4 kg NPKSZn /ha. All fertilizers except urea were applied as basal and urea was applied in 3 equal splits at 15 DAT, 30 DAT and 45 DAT. Other standard management practices were followed as

and when necessary. Appropriate measures were taken to control insect pests. Date of seeding, transplanting, flowering and maturity, plant height, phenotypic acceptance at vegetative and ripening stage, yield and yield components was recorded. Feedback from farmers and DAE personnel were also recorded. For yield estimation, 10 m^2 sample area from each plot was harvested at maturity and grain yields were adjusted to 14% moisture content.

Results and discussion: Among the advanced lines and check varieties, the check variety BRRI dhan50 gave the highest mean yield (5.68 t/ha) followed by the 2nd highest averaged yield (5.56 t/ha) by the tested entry BR7781-10-2-3-2. The yield difference between BRRI dhan50 & BR7781-10-2-3-2 was statistically insignificant. On an average, all the entries matured within 151-158 days (Table 1). The growth duration of the highest yielder BRRI dhan50 was found to be 154 days which was 2-4 days earlier than the tested entries BR7781-10-2-3-2 and BR7369-10-5-2-3, respectively. BRRI dhan63 matured in 151 days which was the shortest among the entries. 1000-grain weight of BR7781-10-2-3-2 was the lowest (16.8g) among all the tested entries and check varieties, which indicates its fineness. On the other hand, 1000-grain weight (24.2g) of the BR7369-52-3-2-1-1 indicates its boldness which was the highest among all genotypes. The mean plant height of BR7781-10-2-3-2 was 108cm which was highest among the entries followed by BR7369-10-5-2-3 & BR7369-52-3-2-1-1 (102cm). Plant height of these tested lines was quite different from the check varities BRRI dhan50 & BRRI dhan63 (87cm). Panicle/m^2 for different entries ranged from 323-394 which had similarity with the grain yield of the respective entries. Grains/panicle ranged from 78-107 and the highest (107) was found in BR7781-10-2-3-2. The range (20-25%) of sterility was very low and the lowest (20%) was found in BR7781-10-2-3-2 followed by BRRI dhan63 (21%). All the data represented in the below (table 1) here are mean data from replicated entries.

Table 1: Data of ALART PQR Boro 2015

Genotype	GY (t/ha)	GD (Days)	Pl. ht (cm)	Pan/m^2	1000 gr. wt	Gr./pan	Ster. (%)
BR7781-10-2-3-2	5.56	156	108	356	16.8	107	20
BR7369-10-5-2-3	5.21	158	102	328	23.7	83	25
BR7369-52-3-2-1-1	5.23	155	102	323	24.2	78	22
BRRI dhan50 (Ck)	5.68	154	87	394	18.7	85	22
BRRI dhan63 (Ck)	5.24	151	87	325	20.8	91	21
LSD (0.05)	0.53	-	5.74	27.88	0.80	6.28	6.62
CV (%)	5.21	-	3.14	4.28	1.73	3.76	16.12

Phenotypic acceptance

- Compared to other entries, phenotypic acceptability of BR7781-10-2-3-2 and BRRI dhan50 was found to be excellent at vegetative stage due its better crop stand and growth, higher tillering ability, broad leaf and erect leaf. At ripening stage, it was also good due to its higher yield, green flag leaf, fine grain and lodging tolerance.

Farmer's opinion

- Farmers preferred BRRI dhan50 for its higher yield and aroma where as BR7781-10-2-3-2 was also preferred for its more or less higher yield, fine grain and attractive grain colour.

Recommendations

Based on premium quality rice grain, higher yield, growth duration and farmers' opinion, BR7781-10-2-3-2 may be considered for further research program.

ALART, Micronutrient(MN), Boro 2014-15

Materials and method: Two micronutrient dense advanced lines: BR7833-11-1-1-3-4 and BR7830-16-1-5-9-9 along with BRRI dhan28 and BRRI dhan64 as checks were tested in Diyapara, Sadar, Barisal during Boro 2015.It was a three replicated trial. The unit plot size for each entry was 20 m^2 (5m × 4m). Seeding time was 13 December, 2014 and Seedling ages were 41 days. Seedlings were transplanted at 25 cm × 15 cm spacing. Fertilizers were applied at 120: 20: 60: 20: 4 kg NPKSZn /ha. All fertilizers except urea were applied as basal and urea was applied in 3 equal splits at 15 DAT, 30 DAT and 45 DAT. Other standard management practices were followed as and when necessary. Appropriate measures were taken to control insect pests. Date of seeding, transplanting, flowering and maturity, plant height, phenotypic acceptance at vegetative and ripening stage, yield and yield components was recorded. Feedback from farmers and DAE personnel were also recorded. For yield estimation, 10 m^2 sample area from each plot was harvested at maturity and grain yields were adjusted to 14% moisture content.

Results and discussion: Among the advanced lines and check varieties, the check variety BRRI dhan28 gave the highest mean yield (6.30 t/ha) followed by the 2nd highest averaged yield (6.24 t/ha) by the micronutrient rich tested entry BR7833-11-1-1-3-4.The yield difference between these two genotypes was statistically insignificant. On an average, all the entries matured within 140-154 days (Table 2). The growth duration of the highest yielder BRRI dhan28 was found to be 140 days which was 11-14 days earlier than the tested entries and other check variety but BRRI dhan28 is not micronutrient enrich rice. Micronutrient enrich tested entries BR7830-16-1-5-9-9 & BR7833-11-1-1-3-4 were similar with the micronutrient enrich check variety BRRI dhan64. 1000-grain weight of BR7833-11-1-1-3-4 was the highest (30.6g) among all the tested entries and check varieties, which indicates its boldness. On the other hand, 1000-grain weight (23.1g) of the highest yielder BRRI

dhan28 indicates its fineness which was the lowest among all genotypes. The mean plant height of BR7830-16-1-5-9-9 was similar to that of BRRI dhan28 & BRRI dhan64 (97-99 cm) but plant height of BR7833-11-1-1-3-4 was comparatively lower (84 cm) than the other entries. Panicle/m^2 for different entries ranged from 254-321 which had similarity with the grain yield of the respective entries. Grains/panicle ranged from 75-102 and the highest (109) was found in BR7833-11-1-1-2-1-2B5 (Table 47). The range (16-21%) of sterility was very low and the lowest (13%) was found in BRRIdhan28 followed by BR7830-16-1-5-9-9 (16%)). The highest sterility % and lower yield of BRRI dhan64 was due to attack of Neck Blast during ripening stage. All the data represented in the below (table 2) here are mean data from replicated entries.

Table 2: Data of ALART MN Boro 2015

Genotype	GY (t/ha)	GD (Days)	Pl. ht (cm)	Pan/m^2	1000 gr. wt	Gr./pan	Ster. (%)
BR7830-16-1-5-9-9	5.80	154	98	279	26.6	86	16
BR7833-11-1-1-3-4	6.24	151	84	294	30.6	75	18
BRRIdhan28(Ck)	6.30	140	97	321	23.1	87	13
BRRIdhan64(Ck)	5.65	152	99	254	25.1	102	21
LSD (0.05)	2.02	-	5.64	30.75	1.16	11.58	6.18
CV (%)	16.82	-	2.98	5.36	2.20	6.59	17.92

Phenotypic acceptance

- Compared to other entries, phenotypic acceptability of BR7833-11-1-1-3-4 was found to be excellent at vegetative stage due its better crop stand and growth, higher tillering ability, broad leaf and erect leaf. At ripening stage, it was also good due to its higher yield, green flag leaf, bold grain and lodging tolerance du to its lower plant height but it was late compared to BRRI dhan28.

Farmer's opinions

- BR7833-11-1-1-3-4 was preferred by the farmers for its higher yield, bold grains and lodging tolerant, green erect flag leaf and freeness from insect and disease attack.
- Farmers also preferred BRRI dhan28 for its higher tiller no., yield and less amount of unfilled grains.

Recommendations

Based on micronutrient (Zinc) enriched, higher yield, grain type, growth duration and farmers' opinion, BR7833-11-1-1-3-4 may be considered for further research program.

ALART, Short Duration (SD), Boro 2014-15

Materials and method: One short duration advanced line NERICA Mutant along with BRRI dhan28 and BRRI dhan45 as checks were tested in Diyapara, Sadar, Barisal during Boro 2015.It

was a three replicated trial. The unit plot size for each entry was 20 m^2 (5m × 4m). Seeding time was 13 December, 2014 and Seedling ages were 41 days. Seedlings were transplanted at 25 cm × 15 cm spacing. Fertilizers were applied at 120: 20: 60: 20: 4 kg NPKSZn /ha. All fertilizers except urea were applied as basal and urea was applied in 3 equal splits at 15 DAT, 30 DAT and 45 DAT. Other standard management practices were followed as and when necessary. Appropriate measures were taken to control insect pests. Date of seeding, transplanting, flowering and maturity, plant height, phenotypic acceptance at vegetative and ripening stage, yield and yield components was recorded. Feedback from farmers and DAE personnel were also recorded. For yield estimation, 10 m^2 sample area from each plot was harvested at maturity and grain yields were adjusted to 14% moisture content.

Results and discussion: Among the advanced line and check varieties, the tested entry NERICA Mutant gave the highest yield (6.95 t/ha). Having the 2nd highest averaged yield (5.91 t/ha), the check variety BRRI dhan28. On an average, all the entries matured within 141-144 days. 1000-grain weight of BRRI dhan28 was the lowest (23.5g) among all the tested entry and check varieties, which indicates its fineness (Table). On the other hand, 1000-grain weight (25.3g) of the highest yielder NERICA Mutant indicates its boldness. The mean plant height of NERICA Mutant was higher (108cm) than check (91& 95 cm) Panicle/m^2 for different entries ranged from 322-370 which had similarity with the grain yield of the respective entries (Table). Grains/panicle ranged from 80-108 and the highest (108) was found in NERICA Mutant. The range (15-18) of sterility % was very low and the lowest (15%) was found in NERICA Mutant followed by BRRI dhan28. All the data represented in the below (table 3) here are mean data from replicated entries.

Table 3: Data of ALART SD Boro 2015

Genotype	GY (t/ha)	GD (Days)	Pl. ht (cm)	Pan/m^2	1000 gr. wt	Gr./pan	Ster. (%)
NERICA Mutant	6.95	144	108	370	25.3	108	15
BRRI dhan28 (Ck)	5.91	141	95	358	23.5	93	16
BRRI dhan45 (Ck)	5.76	140	91	322	29.1	80	18

Phenotypic acceptance

- Compared to other entries, phenotypic acceptability of NERICA Mutant was found to be excellent at vegetative stage due its better crop stand and growth, higher tillering ability, broad leaf and erect leaf. At ripening stage, it was also good due to its higher yield, green flag leaf, long bold grain and lodging tolerance but it was 4 days late compared to others..

Farmer's opinions

- Although the growth duration was longer (4 days) than the check varieties BRRI dhan28 and BRRI dhan45, farmer preferred NERICA Mutant for its higher yield and bold grain.

Recommendations

Based on higher yield, grain type, growth duration and farmers' opinion, NERICA Mutant may be considered for for further research program.

Expt: Adaptive trials of different BRRI released rice varieties during Boro 2014-15 under IAPP

CI: G S Jahan, **PI:** Dr. M A Islam & **PL:** Dr. M S I Mamin

Introduction: Adaptive trial is one of the most important trials for the farmers in which they may be able to choose the appropriate variety for their area as per local demand. In adaptive trial a combination of some varieties were cultivated together in the farmers' field with one or two local standard checks. Through this trial farmers are able to compare the cultivated varieties in their local condition and it will help the farmers to choose one or two or more varieties on the basis of local demand and ago-ecological condition of that location.

Objectives: The objectives of the Adaptive trials were to

1. To evaluate the adaptability of modern rice varieties at farmers' field in southern and northern districts of Bangladesh.
2. To get feedback information about the advantages and disadvantages of the varieties from farmers and DAE personnel.
3. Motivate farmers to cultivate modern rice varieties.

Materials & Methods: Two Adaptive trials were conducted in two upazila's of Barisal district (Barisal Sadar & Agailjhara) under IAPP during Boro 2014-15. BRRI dhan47, BRRI dhan55, BRRI dhan58, BRRI dhan59, BRRI dhan61 and BR8 (Farmer's seed as local check) were used as cultivar in Barisal Sadar while BRRI dhan47, BRRI dhan55, BRRI dhan58, BRRI dhan59, BRRI dhan61 and BRRI dhan29 (Farmer's seed as local check) were used in Agailjhara. Randomized Complete Block Design (RCBD) with three replications was followed in the trials for both the locations. Unit plot size was 72 m^2. Fertilizers were applied @ 40, 14, 16, 09 and 01 kg/bigha, Urea, TSP, MoP, Gypsum and $ZnSO_4$ respectively. TSP, MoP, Gypsum and $ZnSO_4$ were applied basally during the final land preparation. Urea was top dressed in three equal splits at 15, 30 and 45 days after transplanting (DAT). Forty to forty six days old seedlings were transplanted with 25 × 15 cm spacing at the rate of 2-3 seedlings per hill. Uniform crop management practices were followed in each location. The data were analyzed by the Statistix9 software.

Results & Discussion: Between the two locations and among the six varieties, BRRI dhan58 performed the best and gave the highest mean grain yield (7.54 t/ha) and the lowest yield (5.40 t/ha) was in the BRRI dhan61. At Sadar Barisal the highest grain yield (7.25 t/ha) was obtained in BRRI

dhan58 followed by BRRI dhan59 (6.76 t/ha) while at Agailjhara the highest grain yield (7.83 t/ha) was also obtained in BRRI dhan58 followed by BRRI dhan47 (6.53 t/ha). Irrespective of the location and variety, the highest growth duration (158 days) was recorded for the check variety BRRI dhan29 at Agailjhara, Barisal that followed by BRRIdhan58 (156 days). In general, growth duration was higher in Agailjhara, Barisal compared to Sadar of Barisal. It was happened might due to the location effect. Delayed transplanting at Raipasha, Sadar, Barisal perhaps the cause for lower duration. Based on grain yield and growth duration BRRI dhan58 and BRRI dhan47 were found suitable for Barisal region (Table 1).

Table 1. Grain yield of modern rice varieties in adaptive trials during Boro 2014 in southern region under IAPP

Variety / Location	Grain Yield (t/ha)		
	Sadar (Mean)	Agailjhara (Mean)	Mean
BRRI dhan47	6.26	6.53	6.40
BRRI dhan55	5.66	6.32	5.99
BRRI dhan58	7.25	7.83	7.54
BRRI dhan59	6.76	5.21	5.99
BRRI dhan61	5.40	-	5.40
Local Check	6.55	5.30	5.93
LSD (0.05)	0.46	0.40	GM=6.21
CV(%)	3.99	3.44	

*BRRI dhan61 was fully damaged by the Leaf Blast during vegetative stage at Agailjhara Upazila.

Table. Growth duration of modern rice varieties in adaptive trials during Boro 2015 in Barisal under IAPP

Variety / Location	Growth Duration (days)		
	Sadar (Mean)	Agailjhara (Mean)	Mean
BRRI dhan47	150	152	151
BRRI dhan55	146	150	148
BRRI dhan58	155	156	156
BRRI dhan59	150	152	151
BRRI dhan61	148	-	148
Local Check	155	158	157
LSD (0.05)	1.03	0.88	GM=152
CV(%)	0.34	0.30	

Farmers' comments on the tested modern rice varieties

- BRRI dhan58 found suitable variety for both the location of Barisal district in Boro season
- Most farmers preferred BRRI dhan58 for higher yield and good crop stand.

Farmers prefer to choose BRRI dhan47 for bold grain in Barisal

FARMERS' TRAINING

Farmer's training is an important tool to train up farmers on updated modern rice cultivation technologies and to encourage them to adopt modern rice varieties and associated technologies for increasing rice yield at reduced cost of production.

Methodology: Farmers' training is a day long program where generally 30-35 farmers participate. This training program was conducted at different locations of Barisal region with the collaboration of DAE. The farmers were selected with the assistance of local SAAO from different villages of the above mentioned locations. The training module was developed considering modern rice production techniques, appropriate rice cultivar for tidal non-saline ecosystem, pest, disease, irrigation and fertilizer management for better rice production. The training courses were delivered using colorful slides and videos through multimedia projector for easy understanding to the trainees.

Result: BRRI Barisal Regional Station conducted 13 farmers' training in different locations of Barisal region during Boro'2015. These training programs were conducted at Borhanuddin, Bhola(02); Barguna Sadar, Barguna(03); Nolcity, Jhalokati(02); Babuganj, Barisal(02) & at Baufal, Patuakhali(01) under EQSS project; at Nazirpur, Pirojpur(02) under PGB project and one at Baufal, Patuakhali under Harvest plus project. Total 390 persons (303 males and 87 females) were trained. These programs certainly helped the farmers to create awareness for adopting the BRRI rice production technologies and to accelerate the dissemination rate of BRRI varieties in those areas. And confidently increase the farmers' income as well as improve the livelihood through practicing the farming systems approach.

FIELD DAY

This event is very useful tool for generating consciousness and interest among the farmers and concerned extension agent about the modern rice production technologies. This aided in wide publicity and familiarity of the institute, BRRI technologies as well as the contributions of BRRI towards the nation.

Methodology: Field day was conducted with the collaboration of DAE at different locations of Barisal region. Farmers, researchers, extension providers, NGO personnel, administrative peoples, public leaders were sincerely participated in this program. Firstly, the participants gathered and visited the rice field together. A sample area of 10 m^2 was harvested followed by threshing, weighting by the presence. Later, a fruitful discussion was held among the participants. It was perceive that a noticeable number of farm-female was also present and participate these field days.

Results: Total six (06) field days were conducted with the collaboration of DAE under EQSS (Bhola-02, Barguna Sadar-01 and Babuganj-01), PGB (Nazirpur-01) and Harvest Plus (Barguna Sadar-01) project at Barisal region. Around 1300 audience of farmers, researchers, extension providers, NGO personnel, administrative peoples, public leaders were sincerely participated on these programs. It was perceived that a noticeable number of farm-female was also present and participated these field days. In these events, BRRI developed varieties and farm machineries were demonstrated. The participating farmers' explained their experiences. The gatherings were showed attention about the cultivated varieties and their production technique. They showed their interest to cultivate the demonstrated varieties in the next season. This program also generated much enthusiasm about modern rice production technologies for increased production

PROJECT 6: CROP-SOIL-WATER MANAGEMENT

Experiment: Demonstration of water management technologies at farmer's field in Barisal region during T. Aman 2014.

a) Supplemental irrigation application for terminal drought mitigation (AWD).
b) Rainwater harvesting by levee management

Objectives:

1. To mitigate terminal drought by applying supplemental irrigation.
2. To increase rice production by rainwater harvesting after rainfall.

Materials & Method: Barisal region covers an area of tidal saline and non-saline wetlands of about 1.9 million hectares under different land types. T-aman is one of the promising cropping patterns in Barisal region. Ten demonstrations were conducted at Amtoli, Barguna; Barguna sadar; Betagi, Barguna; kalapara, Patuakhali and Jhalokathi sadar. Due to high tidal pressure no supplemental irrigation was applied at research plot whereas farmer's plot were considered as rain fed. In the rainwater harvesting demonstration, research plot was adopted 15 cm. levee height for sufficient rainwater conservation under rain fed condition whereas farmer's plot was followed farmer's practice. Rainfall was measured in the experimental site with a rain gage. BRRI dhan52 was the test variety for the selected farmer's field.

Results & Discussion: BRRI dhan52 was transplanted in the selected locations at proper time. Table-1 & 2 summarized the yield of BRRI dhan52 under rain fed and supplemental irrigation in T.Aman/14. Table-1 shows the comparative grain yield by rainwater harvesting by levee management (research management) and farmer's management. In 15 cm. levee management plot can hold water much longer time compare to that of farmer's field, consequently conserve more

moisture to mitigate 7-10 days drought. The rainwater harvest technique is sufficient to stabilize T.Aman rice yield in drought prone scenarios. The mean grain yield increased by 5.09% under research management compared to farmer's management but range from 3.87% to 6.36%.

Table-1 : Increasing yield by rainwater harvesting at the farmer's field by maintaining 15 cm. levee.

Location	No. of demo	Variety	Tiller/m^2		Yield t/h		Yield increase for 15 cm. levee mangt. (%)
			RM	FM	RM	FM	
Amtali Borguna	1	BRRI dhan52	467	417	5.85	5.50	6.36
Kalapara Potuakhali	1		421	377	5.09	4.90	3.87
Jhalokathi Sadar	1		425	396	4.98	4.79	3.96
Barguna Sadar	1		442	398	5.10	4.84	5.37
Betagi Barguna	1		389	378	5.20	4.91	5.90
Average =							**5.09**

Table-2 : Increasing yield by supplemental irrigation (though no SI applied) at the farmer's field by proper management.

Location	No. of demo	Variety	Tiller/m^2		Yield t/h		% Yield increase over FP
			RM	FM	RM	FM	
Amtali Borguna	1	BRRI dhan52	412	387	5.58	5.34	4.49
Kalapara Potuakhali	1		449	378	5.50	5.35	2.80
Jhalokathi Sadar	1		420	391	5.10	4.80	6.25
Barguna Sadar	1		472	404	5.21	4.93	5.67
Betagi Barguna	1		413	382	5.31	4.84	9.71
Average =							**5.78**

Conclusion: In Barisal region during T.Aman no drought scenario occurred. So supplemental irrigation is not essential. In levee management practice, preparing higher levee than normal practice around the rice field to conserve rainwater during rainy season. It can harvest rainwater which is subjected to waste, serve rice water demand during T.Aman season.

Table: Demonstration of Water Management Technologies at Farmer's field (AWD & Levee Management at Rain fed condition) at Barisal, Aman Result 2014.

Location	No. of demo	Plot area (bigha)	Variety	Number of Supplemental Irrigation		Date of Harvesting	Yield (t/ha)	
							Farmer Method	Research Method
Amtali Borguna	1	1	BRRI dhan52	-	Supplemental Irrigation	15/11/2014	5.34	5.58
	1	1	BRRI dhan52	-	Rain fed condition	15/11/2014	5.50	5.85
Kalapara Potuakhali	1	1	BRRI dhan52	-	Supplemental Irrigation	20/11/2014	5.35	5.50
	1	1	BRRI dhan52	-	Rain fed condition	30/11/2014	4.91	5.09
Jhalokathi Sadar	1	1	BRRI dhan52	-	Supplemental Irrigation	29/11/2014	4.80	5.10
	1	1	BRRI dhan52	-	Rain fed condition	29/11/2014	4.79	4.98
Barguna Sadar	1	1	BRRI dhan52	-	Supplemental Irrigation	-	-	-
	1	1	BRRI dhan52	-	Rain fed condition	-	-	-
Betagi Barguna	1	1	BRRI dhan52	-	Supplemental Irrigation	02/12/2014	4.84	5.31
	1	1	BRRI dhan52	-	Rain fed condition	02/12/2014	4.91	5.20

Experiment: Adoption and Demonstration of Water Saving Technologies at farmer's fields in Barisal region during Boro season, 2014-15

Objectives:

1. To save irrigation water

2. To reduce irrigation cost, and

3. To increase water productivity

Materials and Method: The adoption and demonstration program of water saving technology was conducted at 5 upazillas of Barisal region. Sadar and Betagi upazila of Borguna, Sadar and Kolapar

upazilla of Patuakhali and Syedpur and Nolcity upazilla of Jhalokathi districts were selected in Boro 2014-15. All demonstration plots were selected as diesel operated LLP. AWD tools were installed in the research plots whereas farmer's plots were followed the farmer's practice. BRRI dhan28 and BRRI dhan47 were the test variety during the demonstration.

Results and Discussion: Irrigation water could be saved 15.23% to 31.06% following the AWD method depending on the texture of the soil in Barisal region (Table 1). Table 1 also shows that average 23.05 % water could be saved by using AWD method than farmer's practice. About 3 to 5 number of irrigation could be saved by adopting AWD method in this region. Average diesel cost required for irrigating per hectare of land by using AWD method was Tk.9300.4 whereas this amount for farmer's practice was Tk. 12031 which was about Tk. 2731 could be saved through AWD method (Table 2). So, AWD method requires about 22.68 % less money compares to farmer's practice when using diesel operated LLP.

Water productivity was estimated and presented in Table 3. The highest water productivity was 0.85 kg/m^3 of BRRI dhan28 at Nolcity upazilla of Jhalokati district and the lowest was 0.55 kg/m^3 of BRRI dhan47 at Kolapara upazilla of Patuakhali district under AWD method. The highest water productivity by farmer's practice was 0.62 kg/m^3 and the lowest was 0.43 kg/m^3 at Betagi upazilla of Borguna and Nolcity upazilla of Jhalokati district, respectively. The average water productivity under AWD and farmer's practice were 0.69 kg/m^3 and 0.51 kg/m^3 respectively. But there was no significant yield difference between AWD and farmer's practice.

Table 1: Saving irrigation water through AWD method in Boro 2013-14

Location	Demo no.	Variety	No. of irrigation		No. of irrigation saved in AWD	Amount of irrigation (mm)		% of water saved over Farmer's practice
			AWD	Farmer		AWD	Farmer	
Betagi, Borguna	1	BRRI dhan28	15	19	4	1025	1435	28.57
	2	BRRI dhan28	14	18	4	996	1320	24.54
Nolcity, Jhalokati	1	BRRI dhan28	11	15	4	770	997	22.76
	2	BRRI dhan28	12	15	3	864	1044	17.24
Borguna Sadar	1	BRRI dhan47	14	17	3	985	1162	15.23
	2	BRRI dhan47	14	18	4	980	1182	17.1
Patuakhali, Sadar	1	BRRI dhan47	16	21	5	1003	1364	26.47
	2	BRRI dhan47	17	22	5	1105	1463	24.47
Kolapara, Patuakhali	1	BRRI dhan47	13	18	5	910	1320	31.06
	2	BRRI dhan47						
Average								**23.05**

Table 2: Irrigation cost saved for diesel operated STW in AWD method

Location	Demo no.	Avg. fuel /ha (liter)		Fuel cost (Tk/ha)		% saved fuel cost over farmer's practice
		AWD	Farmer	AWD	Farmer	
Betagi, Borguna	1	145.47	184.26	9964.70	12621.95	21.05
	2	135.77	174.56	9300.38	11957.63	22.22
Nolcity, Jhalokati	1	106.67	145.47	7307.44	9964.70	26.67
	2	116.37	145.47	7971.75	9964.70	20.00
Borguna Sadar	1	135.77	164.87	9300.38	11293.32	17.65
	2	135.77	174.56	9300.38	11957.63	22.22
Patuakhali, Sadar	1	155.16	203.66	10629.01	13950.57	23.81
	2	164.86	213.36	11293.32	14614.89	22.73
Kolapara, Patuakhali	1	126.07	174.56	8636.06	11957.63	27.78
	2					
Average				**9300.4**	**12031.5**	**22.68**

Table 3: Crop-water productivity

Location	Demo no.	Variety	Yield (t/ha)		Water productivity (Kg m^{-3})	
			AWD	Farmer	AWD	Farmer
Betagi, Borguna	1	BRRI dhan28	6.55	6.21	0.64	0.43
	2	BRRI dhan28	6.25	6.09	0.63	0.46
Nolcity, Jhalokati	1	BRRI dhan28	6.53	6.21	0.85	0.62
	2	BRRI dhan28	6.68	6.23	0.77	0.60
Borguna Sadar	1	BRRI dhan47	6.69	6.13	0.68	0.53
	2	BRRI dhan47	6.21	5.7	0.63	0.48
Patuakhali, Sadar	1	BRRI dhan47	7.56	6.96	0.75	0.51
	2	BRRI dhan47	6.13	5.82	0.55	0.40
Kolapara, Patuakhali	1	BRRI dhan47	6.76	6.78	0.74	0.51
	2	BRRI dhan47	damaged	damaged		
Average					**0.69**	**0.51**

Experiment: Demonstration of Supplemental irrigation application to mitigate early drought effected during T. Aus 2014

Objectives:

1. To apply supplemental irrigation for timely transplanting of T. Aus crop
2. To increase Aus rice production by mitigation of early drought occurrence through supplemental irrigation
3. To increase water productivity

Materials & Method: In Barisal region vast area is affected by tidal surge and salt whereas huge land remains fallow in three different seasons. In aus season only some areas are under cultivations. The demonstrations were executed at Amtoli, Barguna; Barguna sadar; Patuakhali sadar and Rajapur, Jhalokathi. Four demonstrations were performed in the year 2014 in Barisal region. Farmer's land was divided into two plots. One was selected as research plot and another plot was considered as farmer's plot. Research plot followed the research management and farmer's plot followed farmer's management. BRRI dhan48 was the test variety for the selected farmer's field.

Results & Discussion: Due to insufficient rainfall in April - May, land preparation was done by applying irrigation both the research and farmer's plots. Sufficient amount of supplemental irrigations were applied in the research practice and the plot of farmer practice was applied deficit irrigation i.e. depended on rainfall. In the panicle initiation stage, irrigation was applied due to two week of drought to mitigate the early drought of T-Aus. During flowering, sufficient rainfall occurred over the rest of going period. In research management plots, highest yield was obtained at Patuakhali sadar which was 5.27 t/h and the lowest yield was obtained at Barguna sadar which was 4.53 t/h (Table-1). In farmer's management plots, the highest and the lowest yields were 5 t/h and 4.33 t/h respectively found at Patuakhali sadar and Rajapur, Jhalokathi. Proper management with 3-4 supplemental irrigations at early stage could increased yield up to 1-18% compared to farmer's practice (Table-2). Average water productivity also increased marginally from 0.42 to 0.43 by following research management practice.

Table 1: Location, no. of irrigation and yield of BRRI dhan48.

Location	Tiller /m^2		Filled Grain		Unfilled Grain		No. of Irri.		1000 grain wt. (gm)	Yield (t/h)		% Sterility	
	RM	FM	RM	FM	RM	FM	RM	FM	27	RM	FM	RM	FM
Amtoli, Barguna	487	480	115	110	16	17	2	-		5.16	4.89	10.88	11.80
Barguna sadar	477	429	111	108	22	23	4	-	27	4.53	4.47	14.19	14.94
Patuakhali sadar	479	470	110	107	21	23	5	-	27	5.27	5.00	13.82	15.03
Rajapur, jhalokathi	459	445	114	108	19	22	3	-	26	5.12	4.33	16.00	20.00

Table : 2 Supplemental Irrigation and water productivity of Aus/14 in Barisal Region.

Location	Demo No.	Rainfall (mm)	No. of suppl. Irri. (mm)		Amount of irri. (mm)		Total Water (mm)		Yield t/h		% increase	W.P (kg/m^3)	
			R	F	R	F	RM	F	R	FM		R	FM

			M	M	M	M		M	M			M	
Amtoli, Barguna	01	1145	2	-	17	-	1162	-	5.16	4.89	5.52	0.44	0.42
Barguna sadar	01	1117	4	-	32	-	1149	-	4.53	4.47	1.34	0.39	0.40
Patuakhali sadar	01	1112	5	-	40	-	1152	-	5.27	5.00	5.40	0.45	0.44
Rajapur, jhalokathi	01	1125	3	-	24	-	1149	-	5.12	4.33	18.24	0.44	0.45
Average :												**0.43**	**0.42**

Conclusion : In Barisal region, yield performance of BRRI dhan48 is promising. At early stage it is required to establish the crop by supplemental irrigation which is depend on rainfall.

Experiment 17: Stability analysis of BRRI released variety in T. Aman 2014 and Boro at 2014-15

Introduction: Bangladesh Rice Research Institute (BRRI) has been trying to develop high yielding rice cultivars to address the on-farm demand in different agro-climatic condition since 1970. Accordingly, BRRI has released a series of high yielding rice cultivars. It is necessary to know the adaptability of the cultivars those were suited under a particular environment. Therefore, study should be conducted for finding out the suitable rice cultivars in Barisal region.

Objective: to find out the suitable rice cultivars in Barisal region.

Methodology: Study was accomplished at BRRI regional station Sagardi, Barisal during Boro 2014-15 seasons. Different BRRI released varieties were grown. Three replications with RCB design were followed. Size of unit plot was 5.4 m × 2 m. In Boro season 62 days old seedlings were transplanted. Crop management practices were done according to BRRI recommended practice.

Result:

Boro: The highest yield was observed in BRRI Hybrid dhan2 (6.61 t ha^{-1}) followed by BRRI Hybrid dhan3 (6.55 tha^{-1}). The lowest yield was found in BR17 (3.89 tha^{-1}) (Table 1). Most of the cases yield was low compared to standard yield because of higher seeding ages (62 days) than recommended one.

Table 1: **Stability analysis of BRRI released variety in Boro at 2014-15**

Variety	Growth duration (days)	Standard Growth duration (days)	Yield (t/ha)	Standard Yield (t/ha)
BR1	159	150	4.12	5.5
BR2	158	160	4.23	5
BR3	165	170	4.29	6.5
BR6	150	140	5.26	4.5
BR7	163	155	5.03	4.5

BR8	162	160	5.13	6
BR9	164	155	5.66	6
BR12	163	170	4.58	5.5
BR14	158	160	5.1	6
BR15	162	165	5.12	5.5
BR16	165	165	4.99	6
BR17	155	155	4.05	6
BR18	162	170	4.94	6
BR19	164	170	4.34	6
BR26	151	140	4.47	3.5
BRRI dhan27	157	122	5.04	4.5
BRRI dhan28	149	140	5.51	6
BRRI dhan29	162	160	5.12	7.5
BRRI dhan35	161	155	5.3	5
BRRI dhan36	152	140	4.28	5
BRRI dhan45	146	145	4.56	6.5
BRRI dhan47	150	152	5.47	6
BRRI dhan50	159	155	4.56	6
BRRI dhan55	155	145	4.32	7
BRRI dhan58	157	155	5.22	7
BRRI dhan59	155	153	5.17	7.1
BRRI dhan60	152	151	5.77	7.3
BRRI dhan61	152	150	5.71	6.3
BRRI dhan64	157	152	4.78	6.5
BRRI Hybrid dhan1	163	155	5.8	8.50
BRRI Hybrid dhan2	154	145	6.61	8.00
BRRI Hybrid dhan3	157	145	6.55	9.00
LSD (5%)			0.99	
CV			12.1	

PROJECT 7: INTEGRATED AGRICULTURAL PRODUCTIVITY PROJECT (IAPP)

- **Validation Trial of BRRI Modern Varieties in Barisal regions**
- **Varietals Dissemination Program in Barisal regions**
- **Field day and Farmer's training**
- **Breeder seed production**

The project is focused on specific agro-ecological areas including the salt-affected tidal surge areas in the south (approx. 2 million hectares) part of Bangladesh. Agricultural production in these areas is severely constrained. At present farmers can cultivate only one season rice crop per year in the tidal surge areas. Crop production is highly vulnerable to weather conditions (with typical yield losses between 20-40%). Productivity is also low because of available (mainstream) technology and agronomic practices are not adapted to these field conditions. Consequently, livelihood options are limited and household level poverty and food insecurity is high. Thus the IAPP project is working with the following specific objectives:

- To enhance the productivity of agriculture in the salt-affected and tidal surge areas in the south.
- To increase productivity of rice crops through increased cropping/production intensity and diversified production and food consumption based on targeted households.
- To release improved/adapted rice varieties, increase availability of quality rice seed, better agronomic and husbandry practices.

Experiment 1: Demonstration of BRRI modern Aus varieties in different locations of Barisal region during Aus 2014

M M Islam, M Milon-Mia, J Islam M R Islam and K M Iftekharuddaula

Introduction: IAPP conducted several demonstration trials to the farmer's field with modern Aus rice varieties to demonstrate yield performance and to obtain the farmers opinion

Methodology: Twelve demonstration trials were conducted in Bakerganj, Barisal, Rajapur, Jhalokati and Amtali, Barguna to demonstrate three modern Aus varieties viz. BRRI dhan27, BRRI dhan48 and BRRI dhan43 in Aus 2014 season. Seed sowing was done at the second week of April and transplantation was completed within the month of May. Seed and fertilizer gave the selected LFS (Livelihood Farmers School) farmer's and they followed the cultivation practices according to the BRRI recommended production technologies. Plot size was one bigha (33 decimal) for each farmer.

Results: In the selected area the average yield of all the BRRI varieties were found more than 4.0 t/ha. The highest average yield of BRRI dhan48 (5.19 t/ha) was found followed by BRRI dhan43 (4.32 t/ha) (Table 1) in all the demonstrated locations. The longest maturity days were found in BRRI dhan27 (114) followed by BRRI dhan48 (110). Two field days were conducted during the Aus season, 2014 in Barisal region. One location was Bakerganj, Barisal and another Amtali, Barguna. All the attendee's farmers choose the BRRI dhan48 for high yielding and no lodging at harvesting period.

Table 1: Mean grain yield and growth duration of different Aus rice varieties in Barisal region in Aus 2014 season

Variety	Locations	Duration (Days)	Yield (t/ha)
BRRI dhan27	Bakerganj, Barisal	115	4.35
	Rajapur, Jhalokati	116	4.68
	Amtali, Barguna	111	3.23
Average		**114**	**4.09**
BRRI dhan43	Bakerganj, Barisal	105	4.67
	Rajapur, Jhalokati	106	3.76
	Amtali, Barguna	102	4.52

Average		**104**	**4.32**
BRRI dhan48	Bakerganj, Barisal	111	5.05
	Rajapur, Jhalokati	109	4.94
	Amtali, Barguna	109	5.59
Average		**110**	**5.19**

Farmers Opinion: Maximum farmers were motivated to grow BRRI dhan48 in Aus season and they wish to store seed of BRRI dhan48 for next year cultivation.

Experiment 2: Adaptive trial for newly introgressed BRRI dhan44-Sub1 lines to evaluate their performance in tidal submergence prone areas, T. Aman 2014

M M Islam, M Milon-Mia, J Islam, M Ibrahim, U M Naher and K M Iftekharuddaula

Introduction: In Barisal region vast area was affected by the tidal where much land remains fallow in three different seasons due to various constraints. This ecosystem includes both saline and non-saline ecologies. Mostly T. Aman rice is grown in the non-saline area, and MVs cover only 5-10 percent of this area. Bangladesh Rice Research Institute released many modern T. Aman varieties some of those are location specific. In 2005 BRRI dhan44 released for southern non saline tidal region where transplantation period 50-60 cm tidal water standing. Sometimes this tidal effect holds 7-14 days, thus BRRI scientist introgressed the submergence genes to the BRRI dhan44 for sustain the crops during both tidal and submergence situation. IAPP-BRRI Barisal conducted several adaptive trials in T. Aman season to the farmer's field as well as on station to evaluate the yield and other performance with the checks.

Materials and method: Twelve newly introgressed BRRI dhan44-Sub1 lines were evaluated in this experiment along with two standard check varieties. The experiment was laid out in RCB design with three replications. The seed bed management was done in order to raise healthy seedlings. Around thirty days old seedlings were transplanted using 2-3 seedlings per hill with the spacing of 25 X 15 cm. The unit plot size was 5.4 m x 12 rows. Fertilizers were applied @ 20 kg urea, 7 kg TSP, 11 kg MP, 8 kg Gypsum and 1.5 kg Zinc Sulphate/bigha. Total amount of TSP, MOP, Gypsum and Zinc Sulphate were applied at the time of final land preparation. Urea was applied in three splits at 10, 30 and 45 days after transplanting. Other crop management practices were done as recommen12ded for modern rice cultivation for T. Aman season. Seedling height and tidal length also measured during transplantation period.

Results:

In the selected areas two entries viz. BR9158-19-9-6-9-93 (6) and BR9158-19-9-6-9-60 (5) were found slightly higher yield (Table 2) although are not statistically significant with the checks.

Maturity days and tiller per plant as like same with the check. Number of grains per plant a little higher some lines.

Table 2: Mean data of some agronomic and yield contributing characters of five adaptive trials at different location for develop submergence line in T.Aman, 2014

SL #	Entries	Parameters						
		MD (Days)	T/pl (No.)	Pl.ht. (cm)	Pl.lg. (cm)	Gr./pl. (No.)	TGW (gm)	Yield (t/ha)
1	BR9158-19-9-6-7-94	145	13	129	26	155	29.74	5.13
2	BR9158-19-9-6-9-9	145	13	125	25	143	30.08	5.18
3	BR9158-19-9-6-9-17	145	13	126	26	156	29.40	5.18
4	BR9158-19-9-6-9-50	144	13	127	26	154	30.48	5.19
5	**BR9158-19-9-6-9-60**	145	13	125	26	153	30.08	**5.41**
6	**BR9158-19-9-6-9-93**	145	14	124	26	148	29.40	**5.55**
7	BR9158-19-9-6-9-101	146	14	127	27	156	29.98	5.17
8	BR9158-19-9-6-9-103	146	13	128	26	154	29.54	5.16
9	BR9158-19-9-7-8-3	147	13	126	26	148	30.20	5.07
10	BR9158-19-9-7-8-21	146	14	127	26	151	29.94	5.28
11	BR9158-19-9-7-8-38	145	13	128	26	142	29.88	5.23
12	BR9158-19-9-7-8-51	143	13	128	27	159	28.54	5.30
13	BRRI dhan44 (Ck)	146	14	125	26	138	29.54	5.28
14	BRRI dhan52 (Ck)	144	13	120	27	149	28.48	5.12
CV		2.93	2.87	3.01	2.93	6.63	2.87	4.15
LSD		2.06	1.28	4.81	0.97	12.67	1.08	0.28

Legend: MD= Maturity Days; T/pl=Tiller per plant; pl.ht.= plant height; pl.lg=panicle length; Gr/pl=Grains per plant; TGW=Thousand grains weight; Yield (t/ha) = Yield for ton per hactor.

One adaptive trial conducted at on-station, BRRI, Barisal for compare with the farmers' field experiment. The on-station adaptive trial results reveal that the two lines BR9158-19-9-6-9-17 (3) and BR9158-19-9-6-9-50 (4) were found with highest yield (Table 3) with the check however those are not statistically significant.

Table 3: Mean data of some agronomic and yield contributing characters of regional station, BRRI, Barisal for develop submergence line in T.Aman, 2014

SL #	Entries	Parameters						
		MD (Days)	T/pl (No.)	Pl.ht. (cm)	Pl.lg. (cm)	Gr./pl. (No.)	TGW (gm)	Yield (t/ha)
1	BR9158-19-9-6-7-94	143	15	124	26.33	160	31.67	5.91
2	BR9158-19-9-6-9-9	140	12	121	26.00	156	31.00	5.89
3	**BR9158-19-9-6-9-17**	142	15	129	26.00	162	30.67	**6.17**
4	**BR9158-19-9-6-9-50**	144	13	118	26.33	161	29.33	**6.25**
5	BR9158-19-9-6-9-60	141	14	126	26.00	150	28.67	5.63
6	BR9158-19-9-6-9-93	144	13	123	26.00	166	29.33	5.80
7	BR9158-19-9-6-9-101	145	13	126	26.66	152	32.67	5.89
8	BR9158-19-9-6-9-103	145	12	122	28.00	147	30.33	5.78
9	BR9158-19-9-7-8-3	146	14	119	27.00	148	30.33	5.65
10	BR9158-19-9-7-8-21	145	14	125	27.00	155	29.67	5.84
11	BR9158-19-9-7-8-38	143	15	123	26.67	150	30.00	5.26
12	BR9158-19-9-7-8-51	145	14	127	27.00	154	30.67	5.35

13	BRRI dhan44 (Ck)	142	14	127	27.00	163	31.67	6.18
14	BRRI dhan52 (Ck)	139	12	117	25.33	147	29.33	5.35
CV		3.55	9.56	2.36	3.55	3.31	6.06	10.69
LSD		1.06	2.17	1.58	1.58	8.60	3.09	1.03

Legend: MD= Maturity Days; T/pl=Tiller per plant; pl.ht.= plant height; pl.lg=panicle ength; Gr/pl=Grains per plant; TGW=Thousand grains weight; Yield (t/ha)= Yield for ton per hector.

Experiment 3: Demonstration of BRRI modern T. Aman varieties in different locations of Barisal region during T. Aman 2014

M M Islam, M Milon-Mia, J Islam M Ibrahim, U M Naher and K M Iftekharuddaula

Introduction: IAPP conducted several demonstration trials to the farmer's field with modern T. Aman rice varieties for demonstrate yield performance and obtain the farmers opinion.

Methodology: Eleven demonstration trials were conducted in different upazilas of Barisal region for demonstrate five modern T. Aman varieties viz. BRRI dhan44, BRRI dhan62, BRRI dhan53 and BRRI dhan54 in T. Aman, 2014. Seed sowing was done two split dated on 08.07.13 and 26.07.13 and transplantation were completed within the first and second week of August. Seed and fertilizer gave the selected LFS (Livelihood Farmers School) farmers and they followed the cultivation practices according to the BRRI recommended production technologies. Plot size was one bigha (33 decimal) for each farmer. Total selected farmers were thirteen.

Results: Out of eleven demonstration trials, BRRI dhan62 and BRRI dhan53 were conducted in three locations. BRRI dhan54 produced highest yield on an average of 5.31 t/ha (Table 4) followed by BRRI dhan44 (5.16 t/ha) and BRRI dhan53 (4.99 t/ha). Maturity date were found higher in BRRI dhan44 (148) and lowest were BRRI dhan62 (99).

Table 4: Yield and Maturity Data of Demonstration trials in Barisal region at different location T. Aman, 2014

Sl #	Location	Variety	Maturity (Days)	Yield (t/ha)	Average
1	Babugonj, Barisal	BRRI dhan44	148	5.29	5.16
2	Nalcity, Jhalokathi	BRRI dhan44	139	5.03	
3	Babugonj, Barisal	BRRI dhan62	105	2.97	3.90
4	Nalcity, Jhalokathi	BRRI dhan62	105	4.52	
5	Kalapara,Patuakhali	BRRI dhan62	99	4.20	
6	Uzirpur, Barisal	BRRI dhan52	140	4.22	4.93
7	Amltali,Bargona	BRRI dhan52	140	5.63	
8	Taltoli,Bargona	BRRI dhan53	124	5.06	4.99
9	Amltali,Bargona	BRRI dhan53	124	5.01	
10	Kalapara, Patuakhali	BRRI dhan53	122	4.91	
11	Taltoli,Bargona	BRRI dhan54	133	5.31	5.31

Experiment 4: Validation of BRRI modern Boro varieties in different locations of Barisal region during Boro 2014-15 seasons

M M Islam, M Milon-Mia, J Islam, A. Hossain and K M Iftekharuddaula

Introduction: IAPP conducted several validation trials to the farmer's field with modern Boro rice varieties to observe yield performance and obtain the farmers opinion

Methodology: Six validation trials were conducted in Aguiljara,Barisal; Banaripara,Barisal; Nalcity, Jhalokathi; kalaparah, Patuakhali; Betagi, Barguna and Sadar, Barguna to evaluate five modern Boro rice varieties viz. BRRI dhan59, BRRI dhan60, BRRI dhan61 , BRRI dhan64 and BRRI dhan68 in Boro 2014-15 season. Seed sowing was done at 07.12.14 for the locations of Agailjara and Banaripara; 01.12.14 for nalchiti, Jhalokathi; 24.12.14 for kalapara, patuakhali; 21.12.14 for Betagi, Barguna and 04.01.15 for Sadar, Barguna. Seed and fertilizer gave the selected LFS (Livelihood Farmers School) farmer's and they followed the cultivation practices according to the BRRI recommended production technologies. Plot size was 10 decimal for each farmer.

Results: In the selected area the average yield of all the BRRI varieties were found more than 7 t/ha. The highest average yield was found in BRRI dhan59 (7.39 t/ha) followed by BRRI dhan60 (7.33 t/ha) (Table 5). The longest maturity days were found in BRRI dhan59 (149) followed by BRRI dhan60 (148) and BRRI dhan61 (148). Two field days were conducted during the season. One location was Banaripara, Barisal and another was Betagi, Barguna. Most of the attendee's farmers choose BRRI dhan60 for fine grain and BRRI dhan64 for rich in zinc and medium bold grain.

Table 5: Grain yield and plant height of some BRRI varieties during Boro 2014-2015

Location	Variety	Yield (t/ha)	Height (cm)	Maturity days
Nalchhiti, Jhalokathi	BRRI dhan59	8.16	90	150
	BRRI dhan60	7.76	95	148
	BRRI dhan61	7.73	97	149
	BRRI dhan64	7.04	104	148
	BRRI dhan68	7.31	101	146
Banaripara ,Barisal	BRRI dhan59	7.94	83	153
	BRRI dhan60	7.85	95	152
	BRRI dhan61	8.44	97	153
	BRRI dhan64	8.92	99	149
	BRRI dhan68	6.16	91	150
Aguiljara,Barisal	BRRI dhan59	7.79	92	150
	BRRI dhan60	**8.35**	92	148
	BRRI dhan61	7.71	90	148
	BRRI dhan64	7.15	107	146
	BRRI dhan68	8.25	96	147
Kalapara, Patuakhali	BRRI dhan59	**8.16**	92	146
	BRRI dhan60	7.76	99	144

	BRRI dhan61	7.73	93	143
	BRRI dhan64	7.04	106	145
	BRRI dhan68	7.31	97	147
Barguna, Sadar	BRRI dhan59	5.64	88	147
	BRRI dhan60	5.65	94	147
	BRRI dhan61	4.61	95	147
	BRRI dhan64	6.11	104	145
	BRRI dhan68	**6.30**	94	146
Betagi, Barguna	BRRI dhan59	6.60	92	146
	BRRI dhan60	6.59	96	146
	BRRI dhan61	6.43	97	146
	BRRI dhan64	6.41	108	146
	BRRI dhan68	**6.66**	97	146
Average	BRRI dhan59	**7.39**	89.50	148.67
	BRRI dhan60	7.33	95.17	147.50
	BRRI dhan61	7.10	94.83	147.50
	BRRI dhan64	7.12	**104.67**	146.50
	BRRI dhan68	6.99	96	147.00

PROJECT 8: PIROJPUR-BAGERHAT-GOPALGANJ (PGB) INTEGRATED GRICULTURAL DEVELOPMENT PROJECT (IADP): BRRI COMPONENT

Experiment: Production program of high yielding Aus varieties

The dominant cropping pattern of Mollarhat upazila, Bagerhat district and some parts of Najirpur upazila, Pirojpur district is T. Aus - Boro. Generally farmers are producing low yielding rice varieties as well as they do not follow the standard crop production procedure thus the production level is very low. Integrated agricultural development project (IADP) initiated different research and development activities to maximize yield by adopting BRRI technologies. The project introduced high yielding BRRI Aus varieties in existing cropping pattern to demonstrate the production technology and to increase the yield at farmers field.

Objective: To increase the productivity of T. Aus rice through high yielding BRRI Aus cultivars

Materials and Methods: The study was conducted at Najirpur, Pirojpur and Mollarhat, Bagerhat district during Aus 2014 season. BRRI dhan27, BRRI dhan43 and BRRI dhan48 were grown at Najirpur upazila where BRRI dhan27 and BRRI dhan48 were grown at Mollahat upazila. About one bigha of land for each cultivar was taken under this production program. Crop management practices adopted in this study were shown in Table 1. Crop management practices were followed as per BRRI recommendation practice (BRRI, 2013).

Results: The results of Aus production program were presented in Table 2. The highest yield of 5.074 t ha^{-1} and 4.68 t ha^{-1} was produced from BRRI dhan48 in both of the demonstration sites. The yield of BRRI dhan27 was 3.87 t ha^{-1}in Mollarhat upazila. The higher yield was mainly associated with the higher number of panicle number per unit area.

Table 1: Crop management adopted in the field trail in Mollarhat, Bagerhat and Najirpur, Pirojpur district during Aus, 2014

Management factor	Mollarhat, Bagerhat	Najirpur, Pirojpur
Date of seeding		
Date of transplanting		
Spacing (cm x cm)	20 × 20	20 × 15
Seedling /hill	3-5	3-5
Fertilizer (kg/ha): N (USG)-P-K	50-10-30	50-10-30
Basal (kg/ha): P-K	10-30	10-30
USG application (DAT)	10-12	10-12
Weeding (times)	2	2
Pest control	01	01
Maturity Date		

Table 2: Yield of BRRI dhan27, BRRI dhan43 and BRRI dhan48 during Aus, 2014 at Mollarhat, Bagerhat and Najirpur, Pirojpur district.

Farmers Name	Village	Variety	Yield (t/ha)
Siddikur Rahaman	Nazirpur	BRRI dhan27	3.43
Siplu Sheikh	Nazirpur	BRRI dhan48	4.68
Sontos Mojumdar	Nazirpur	BRRI dhan43	3.42
Mrinal Kanti	Nazirpur	BRRI dhan27	3.75
Askandar Ali	Mollahat	BRRI dhan27	3.87
Askandar Ali	Mollahat	BRRI dhan48	5.07

Experiment: Yield performance of high yielding Aman rice at Bagerhat and Pirojpur district

Generally farmers are producing low yielding rice varieties as well as they do not follow the standard production technology. Integrated Agricultural Development Project (IADP) is trying to maximize the yield by adopting BRRI recommended production practices. The project introduced high yielding Aman rice in existing cropping pattern to demonstrate the production technology and to increase the yield at farmers' field.

Objectives: i) To increase the productivity of Aman rice

ii) To demonstrate the production technology to the farmer

Materials and Methods: The study was conducted at Fakirhat, Bagerhat and Najirpur, Pirojpur districts during T. Aman, 2014 season. BRRI dhan33, BRRI dhan39, BRRI dhan41, BRRI dhan44, BRRI dhan49, BRRI dhan52, BRRI dhan57 and BRRI dhan62 were grown under different

locations of those districts. Approximately one bigha of land was taken under cultivation. Thirty five days old seedlings were used for transplanting. Crop management practices were followed as per BRRI recommendation practice (BRRI, 2013).

Results: The result of the study is presented in Table 1. The highest yield (5.97 t/ha) was recorded in BRRI dhan49 at Najirpur, Pirojpur followed by the same variety in different locations of Najirpur. BRRI dhan44 produced 5.38 t/ha at Fakirhat, Bagerhat district. Newly introduced BRRI dhan62 gave 3.71-3.85 t/ha grain yield in different locations. The farmers' of that locality expressed their contentment to the variety BRRI dhan62 due to short growth duration, zinc content and satisfactory grain yield.

Table 1: Yield of BRRI promising T. Aman varieties at Fakirhat, Bagerhat and Najirpur, Pirojpur district.

Farmers Name	Village	Variety	Yield (t/ha)
Ab. Mojid Sheikh	Fakirhat	BRRI dhan41	4.40
		BRRI dhan44	5.38
		BRRI dhan52	4.65
Md. Aziz Sheikh	Nazirpur	BRRI dhan33	4.47
		BRRI dhan39	4.31
		BRRI dhan49	5.65
		BRRI dhan57	4.14
		BRRI dhan62	3.78
Md. Shohidul Islam	Nazirpur	BRRI dhan33	4.47
		BRRI dhan39	4.60
		BRRI dhan49	5.97
		BRRI dhan57	4.32
		BRRI dhan62	3.71
Shuzid Bissas	Nazirpur	BRRI dhan33	4.38
		BRRI dhan39	4.08
		BRRI dhan49	5.83
		BRRI dhan57	4.07
		BRRI dhan62	3.74
Abu Taleb	Nazirpur	BRRI dhan33	4.41
		BRRI dhan39	4.38
		BRRI dhan49	5.80
		BRRI dhan57	4.09
		BRRI dhan62	3.85

Experiment: Yield performance of high yielding Boro rice at Bagerhat and Pirojpur district

Bangladesh Rice Research Institute (BRRI) has developed a series of Boro rice varieties. However all of them are not suitable in all over the country. It is necessary to find out the suitable cultivar for a specific location. This study was under taken to identify the suitability of newly released Boro rice varieties at PGB site through Integrated agricultural development project (IADP).

Objectives:

i) To identify the appropriate Boro rice cultivar

ii) To increase the productivity of Boro rice

iii) To demonstrate the production technologies to the farmer

Materials and Methods: The study was conducted at Nazirpur, Pirojpur, Mollarhat and Fakirhat in Bagerhat district during Boro, 2014-15 season. BRRI dhan64 was grown in all the selected locations. Approximately, one bigha of land was taken under cultivation for the tested variety.

Forty to fifty three days old seedlings were used for transplanting. Standard crop management practices were followed (BRRI, 2013) (Table 1).

Results: The result of the tested variety was presented in Table 2. The highest grain yield of BRRI dhan64 (6.86 t/ha) was recorded at Mollahat and lowest at Najirpur (6.71 t/ha). Average grain yield of BRRI dhan64 in these areas was 6.67 t/ha. The farmers' of that locality expressed their contentment to this variety due to zinc content and satisfactory grain yield.

Table 1: Crop management practices adopted in different cropping pattern, Boro 2014-15

Management factor	**Mollarhat, Bagerhat**	**Fakirhat, Bagerhat**	**Najirpur, Pirojpur**
Date of seeding			
Date of transplanting			
Spacing (cm x cm)	20 × 20	20 × 20	20 × 15
Seedling /hill	3-5	3-5	3-5
Fertilizer (kg/ha): N (USG)-P-K	50-10-30	50-10-30	50-10-30
Basal (kg/ha): P-K	10-30	10-30	10-30
USG application (DAT)	10-12	10-12	10-12
Weeding (times)	2	2	2
Pest control	01	01	01
Maturity Date			

Table 2: Grain yield (t ha^{-1}) of BRRI dhan64 during Boro 2014-15.

Farmers Name	Village	Variety	Area (dec.)	Yield (t/ha)
Lavlu Forazi	Mollahat	BRRI dhan64	33	6.86
Choci Forzi	Mollahat	BRRI dhan64	33	6.47
Onath Gosh	Fakirhat	BRRI dhan64	33	6.72
Shefat Sheikh	Nazirpur	BRRI dhan64	33	6.85
Deloar hossain	Nazirpur	BRRI dhan64	33	6.47
Sattar Boyati	Nazirpur	BRRI dhan64	33	6.71
Aftab Boyati	Nazirpur	BRRI dhan64	33	6.58
			Average	6.67

PROJECT 9: HARVEST PLUS, BANGLADESH

Expt: Demonstration of BRRI dhan62 under Harvest Plus Bangladesh project during T. Aman, 2014.

Introduction: In Barisal region vast area was affected by the tidal where much land remains fallow in three different seasons due to various constraints. This ecosystem includes both saline and non-

saline ecologies. Mostly long duration local T. Aman rice is grown in the non-saline area. A short duration T. Aman variety is needed to fit into the existing cropping pattern. Therefore, Demonstration of BRRI dhan62 under Harvest Plus Bangladesh project was conducted during T. Aman, 2014.

Objective: Dissemination of zinc rich BRRI dhan62 in southern part of Bangladesh

Materials and Methods: Eleven demonstrations of BRRI dhan62 were conducted at Najirpur and Fakirhat. Interested farmers were selected with the help of DAE personnel. Four kilogram of seed of BRRI dhan62 was provided free of cost to the selected farmers. BRRI recommended practices for crop production were followed (BRRI, 2013). After 80% maturity of the rice crop yield data was taken from 5 m2 area and yield was converted to ton/hector at 14% moisture.

Result: Yield data of BRRI dhan62 from demonstration result was presented in Table 1. The highest yield (3.92 t/ha) was recorded at two spots of Najirpur, Pirojpur while the lowest yield was observed at the field of Debdas Buddo, Najirpur, Pirojpur. The average yield of BRRI dhan62 was 3.74 t/ha in Barisal region in T. Aman 2014 (Table 1).

Table 1: Yield data under Harvest Plus project in different places of Barisal Region during T. Aman, 2014.

Sl.no.	Farmers Name	Village	Variety	% Moisture	Yield (kg/5m^2)	Yield (t/ha)
1	Gurango Bala	Nazirpur	BRRI dhan62	21.5	2.05	3.74
2	Debdas Buddo	Nazirpur	BRRI dhan62	23.0	1.90	3.40
3	Laeak Sheikh	Nazirpur	BRRI dhan62	21.5	2.15	3.92
4	Krisno Das Buddo	Nazirpur	BRRI dhan62	21.0	2.10	3.85
5	Monirul Islam	Nazirpur	BRRI dhan62	22.0	1.90	3.44
6	Usuf Ali	Nazirpur	BRRI dhan62	22.0	2.15	3.90
7	Zinnat Ali	Nazirpur	BRRI dhan62	21.0	1.95	3.58
8	Nahid Sheikh	Nazirpur	BRRI dhan62	22.5	2.17	3.92
9	Jalal Sheikh	Nazirpur	BRRI dhan62	21.5	2.05	3.74
10	Shopon Mojumdar	Nazirpur	BRRI dhan62	22.0	2.15	3.90
11	Kanai Pal	Fakirhat	BRRI dhan62	21.0	2.05	3.76
					Average	3.74

Expt: Demonstration of BRRI dhan64 under Harvest Plus Bangladesh project during Boro 2014-15.

Introduction: In Barisal region vast area was affected by the tidal where much land remains fallow in three different seasons due to various constraints. This ecosystem includes both saline and non-saline ecologies. Mostly Boro remains fallow in this region. People here prefer bold grain rice. For Boro a bold grain rice variety such as BRRI dhan64 which is also zink rice could be introduced here. Therefore, Demonstration of BRRI dhan64 under Harvest Plus Bangladesh project was conducted during Boro, 2014-15.

Objective: Dissemination of zinc rich BRRI dhan64 in southern part of Bangladesh

Materials and Methods: Twenty five demonstrations of BRRI dhan64 were conducted at different locations of Barisal and Vola districts during Boro 2014-15 under Harvest Plus project. Interested farmers were selected with the help of DAE personnel. Four kilogram of seed of BRRI dhan64 was provided free of cost to the selected farmers. BRRI recommended practices for crop production were followed (BRRI, 2013). After 80% maturity of the rice crop yield data was taken from 10 m2 area and yield was converted to ton/hector at 14% moisture.

Result: Yield data of BRRI dhan62 from demonstration result was presented in Table 2. The highest yield (8.01 t/ha) was recorded at Banaripara, Barisal while the lowest was observed at Bhola sadar, Bhola. The average yield of BRRI dhan64 was 6.11 t/ha in Barisal region in Boro

2014-15 (Table 2). Some fields were heavily infected by leaf blast and neck blast as well. Grain yield was low in those fields.

Table 2: Yield data of BRRI dhan64 under Harvest Plus project in different places of Barisal Region during Boro season 2014-15.

Sl No.	Farmer's name	Location	Mobile	Variety	Yield (ton/ha)
1	Md. Jobed Ali Shorif	Banaripara, Barisal	01916922968	BRRI dhan64	8.01
2	Md. Khalilur Rahman	Banaripara, Barisal	01720437400	,,	7.69
3	Md. Dulal Mia	Borguna Sadar	01703629000	,,	6.9
4	Md. Younus Ali	Borguna Sadar	01703629000	,,	7.01
5	Md. Jahangir Mia	Borguna Sadar	01703629000	,,	6.76
6	Md. Ali Hossain	Borguna Sadar	01703629000	,,	6.88
7	Md. Ismail Hossain	Borguna Sadar	01703629000	,,	7.1
8	Md. Nasim Uddin	Borguna Sadar	01703629000	,,	6.97
9	Md. Shahid Forazi	Borhanuddin, Bhola	01729798682	,,	7.28
10	Md. Humayan Kabir	Bhola sadar, Bhola	01722465473	,,	4.01
11	Md.Jamal Hossain	Bhola sadar, Bhola	01703528932	,,	2.98
12	Md. Kalam	Daulotkhan, Bhola	01915940170	,,	6.80
13	Md. Abdus Sobhan	Daulotkhan, Bhola	01766822684	,,	6.43
14	Md. Sikandar Howladar	Gournodi, Barisal	01940894073	,,	6.80
15	Md. Haidar Munshi	Gournodi, Barisal	01713868335	,,	5.30
16	Md. Monirul Islam	Gournodi, Barisal	01927885893	,,	4.23
17	Md. Ripon Sordar	Gournodi, Barisal	01712369341	,,	5.10
18	Md. Riaj Sonnamot	Agailjhara, Barisal	01742344371	,,	4.29
19	Mohim Sorkar	Agailjhara, Barisal	01738649759	,,	-
20	Md. Mokbul Hosen	Ujirpur, Barisal	01925841070	,,	6.10
21	Md. Dulal Talukdar	Ujirpur, Barisal	01795507837	,,	7.85
22	Md. Mosarrof Hossain	Nolcity, Jhalokati	01673737480	,,	6.76
23	Md. Mobarok Hossain	Nolcity, Jhalokati	01673737480	,,	6.35
24	Md. Jahangir Mredha	Nolcity, Jhalokati	01824240163	,,	4.18
25	Md. Motaleb Howlader	Nolcity, Jhalokati	01794938764	,,	4.74
				Average	6.11

PROJECT 10: DEMONSTRATION OF BRRI TECHNOLOGIES UNDER EQSSP

ADVISORY AND CLINICAL SERVICES

The BRRI Barisal has provided advisory and clinical services to farmers, DAE personnel and NGOs in identifying the diseases, insect pests and nutritional disorders along with necessary prescriptions. During the reporting year, around 50 samples from farmers' field have been diagnosed and necessary solutions have been advocated. In addition, several rice fields have been visited with the request of farmers, DAE personnel and local representatives.

ANNUAL RESEARCH REVIEW WORKSHOP

2014-15

BRRI REGIONAL STATION

BHANGA, FARIDPUR

BANGLADESH RICE RESEARCH INSTITUTE

GAZIPUR 1701

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Dr. Partha Sarathi Biswas**	Principal Scientific Officer & Head	149
Shah Asadul Islam**	Senior Scientific Officer & Head	129
Md. Tanbir Rubayet**	Scientific Officer	110
Kazi Md. Tareq Aziz*	Scientific Officer	86
Md. Ishak Bhuiyan*	Assistant Farm Manager	192
Md. Mozzaem Hossain**	Assistant Accounts Officer	320
Md. Mujibar Rahman	Scientific Assistant	365
Md. Anowar Hossen**	UDA cum Accountant	49
Md. Kaium Mian	Office Assistant	365
Md. Anwar Hossain	Pump Operator	365
Md. Ruhul Quddus	Cattle Keeper	365
H M Gias Uddin*	Security Guard	296
Md. Farid Mian Sheikh **	Security Guard	365
K M Mrinal*	Store Attendant	216

*Transferred at BRRI R/S, Bhanga
** Released from BRRI R/S, Bhanga

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Name and designation	Designation	Man-days
Ajoy Kundu	Scientific Officer (Agricultural Engineering)	365
Md. Alamin Hossain***	Mechanic	140
Md Humayun Kabir***	Mechanic	112

*** Joined at BRRI R/S, Bhanga

SUMMARY

1. Varietal development

A total of 1221 individual progenies were selected from segregating population. Thirty four uniform entries were selected from observational trial of 265 genotypes considering yield advantage over check varieties having similar or less growth duration, amylose and grain zinc content for further evaluation in replicated trial. Seventeen promising lines were selected from SYT based on yield advantage and growth duration similar to or than the check varieties, amylose content and brown rice zinc content.

In Regional Yield Trial (RYT) for B. Aus, BR7699-2B-3-13-3 produced significantly 0.43 t higher grain yield (2.03 t/ha) with 5 days longer growth duration, followed by BR7587-2B-3 (1.85 t/ha) with 3 days longer growth duration than the check variety BRRI dhan43. In case of RYT for

T. Aus, BR7708-62-1-1 produced 0.69 t significantly higher grain yield than the check variety BRRI dhan43 with 4 days earlier growth duration. In RYT of T. Aman, BR8143-15-2-1 produced 2.37 t higher grain yield than the check variety BRRI dhan32 with similar growth duration. While the line BR7840-54-3-2-2 produced 2.4 t higher yield than the check BRRI dhan39 with almost similar growth duration. For Boro season in RYT-FB, BR7988-10-4-1 produced the highest grain yield (7.85 t/ha) followed by BR7783-AC12-3 (7.80 t/ha) which was statistically non-significant than the check variety BRRI dhan29 but having significant earlier growth duration than the check. In case of RYT-PQR, BR8079-52-2-2-2 produced about 0.5 t higher yield than the check variety BRRI dhan50 with similar growth duration. In RYT-PQR(COM), BR7372-18-3-3-HR3(Com) produced the highest grain yield (6.63 t/ha) which was significantly higher than BRRI dhan50 with 4 days longer growth duration. In RYT-GSR, HHZ15-DT4-DT1-Y1 produced the highest grain yield (6.72 t/ha) followed by HHZ6-SAL3-Y1-SUB2 (6.44 t/ha) which were significantly higher than that of BRRI dhan60 with 4 days longer growth duration. In case of RYT-MER, the lines BR8261-19-1-1-3 (6.91 t/ha) and BR8257-37-1-2-2 (6.77 t/ha) over-yielded BRRI dhan28 by 1 t/ha with statistically similar growth duration. In RYT-SD, NERICA Mutant produced 6.64 t/ha grain yield which was statistically similar to that of the check varieties of BRRI dhan45 and BRRI dhan28 with 2-3 days longer growth duration. In RYT-SD (Bio), BR8072-AC8-1-1-3-1-1 produced the highest grain yield (5.44 t/ha) followed by BR8072AC11-2-3-2-1-1 (5.36 t/ha) which were statistically identical to that of BRRI dhan28 (5.29 t/ha) with almost similar growth duration. In case of RYT-Biotech, BR6158RWBC2-2-1-1 produced the highest grain yield (6.87 t/ha) which was statistically similar to that of check varieties BRRI dhan29 (6.55 t/ha) with almost similar growth duration.

In Proposed Variety Trial (PVT) for T. Aman, the promising genotype BR7528-2R-19-HR10 produced 0.34 t/ha higher grain yield than the check variety BRRI dhan39 with 8 days longer growth duration. In case of PVT for Boro, the promising line BR7671-37-2-2-3-7 significantly out-yielded the check variety BRRI dhan64 by about 1.5 t/ha with almost similar growth duration. In INGER trial, most of the materials were late maturing. No suitable entries could be selected for further trial or even as parents for future hybridization. In Stability Analysis of BRRI released Aman varieties, BR25 gave the highest grain yield (5.4 t/ha) followed by BRRI dhan52 (4.72 t/ha). In Stability Analysis of BRRI released modern rice varieties for Boro season, BRRI dhan60 and BRRI hybrid dhan1 gave the highest grain yield (8.3 t/ha) followed by BR8 (8.27 t/ha). BR17, BR18, BR19 and also BR8 lodged at maturity.

2. Agronomic management

From an experiment to determine seed rate in dry seed bedcondition in T. Aman season, the interaction and seed bed management gave insignificant yield and panicle production. However, grain yield among the entries were significant. Therefore farmers of Faridpur region could practice the dry seed bed condition to grow seedlings instead of buying that from neighbouring districts.

3. Farm machinery and post harvest technology

There were some activities under FMTD (Farm Machinery Technology Development and Dissemination) Project under BRRI Regional Station, Bhanga, Faridpur during 2014-15. The main activities under the project at BRRI R/S Bhanga were to sell agricultural machineries to the farmers with 60% government subsidy and setting uo demonstration trial in the farmers' field by the use of machines. The agricultultural machineries sold under the project were BRRI Paddy-Wheat Thresher, BRRI Paddy Thresher, BRRI Winnower, BRRI Prilled Urea Applicator, BRRI Weeder and BRRI Rice-Wheat Reaper.

4. Technology Transfer

Validation and adoption trial of BRRI dhan62 and BRRI dhan33 at Gopalgong district under PGB-IADP conducted in 22 farmers' plot showed slightly higher grain yield of BRRI dhan62 (4.75 t/ha) than BRRI dhan33 (4.67 t/ha) with 15-19 days early maturity. Farmers showed interest to grow BRRI dhan62 for its early maturing ability and slender type grain. BRRI released modern rice varieties viz. BRRI dhan50, BRRI dhan58, BRRI dhan60, BRRI dhan63, BRRI dhan64 and BRRI dhan68 were distributed among nineteen farmers in Gopalgonj Sadar, Kashiani, Muksudpur, Tungipara and Kotalipara upazillas of Gopalganj district to validate the performance of the newly released Boro rice varieties. For slender grain type and high yield potential, farmers preferred BRRI dhan50, BRRI dhan58, BRRI dhan60 and BRRI dhan63.

Seed production at BRRI R/S Bhanga farm was about 36.5 tons during Boro season in 2014-15. Enhanced Quality Seed Supply Project provided support to produce about 16.0 tons of breeder seed of BRRI dhan28 and BRRI dhan29. Under HarvestPlus project support around 2.5 tons quality seed of the promising line BR7833-11-1-1-2-1-2B5 (as proposed variety) was produced. Also, around 18 tons of TLS of different varieties was produced in this farm using GOB fund. About 9 tons of good quality seed of BRRI dhan50, BRRI dhan55, BRRI dhan58, BRRI dhan60, BRRI dhan63, BRRI dhan64 and BRRI dhan68 were produced in ten farmers' fields in greater Faridpur region under EQSS project. BRRI Bhanga organized 13 training program to educate 385 farmers.

INTRODUCTION

BRRI Regional Station Bhanga, Faridpur is involved in varietal development program of high yielding modern rice varieties with fortification of micronutrient. The development of shallow deepwater rice research is also conducted in this station. Evaluation of promising advance breeding lines of different rice variety development programs in regional yield trial and study on stability of grain yield of T. Aman and Boro varieties are regular programs of this regional station. The farm land of this station gets inundated with seasonal flooding every year during a period of around 4 months starting usually from 1st week of July to last week of October with maximum water depth of 1.5 m. In the reporting year (2014-15), flood water entered into the farm land on 25/06/2015 and retained up to 25/10/2015. To realize potential yield, promising breeding lines or new varieties under varietal development trials and agronomic research are being conducted here. Research on rice based cropping pattern under farmers' field condition, demonstration trial of new varieties and crop management, 'Field Days' and motivational training are given to farmers regularly to improve their livelihood in the greater Faridpur region.

CHAPTER 1: VARIETAL DEVELOPMENT PROGRAM

Experiment 1. Pedigree nursery

Investigators : Partha S. Biswas and M Amir Hossain

Specific objectives: To select progenies with emphasis on modern plant type, large panicle, more grains in panicle, lodging resistance and acceptable grain quality and earlier growth duration genotypes.

Materials and Methods: Under the project of Development of Micronutrient enriched rice (MER), a total of 1531 segregating progenies comprising F5 to advanced generations were grown. Thirty five to 45 day-old seedlings were transplanted at 25 ×15 cm using single seedling per hill along with the check varieties BRRI dhan28 and BRRI dhan29. Fertilizer was applied at the rate of 80:60:40:100:10 kg NPK, Gypsum and $ZnSO_4$/ha. Nitrogen was applied in three splits @ 30:25:25 kg/ha at 15 days after transplanting (DAT), 30 DAT and at maximum tillering stage. Total amount of P, K, and Gypsum applied at final land preparation and $ZnSO_4$ was applied along with first topdressing of urea.

Table 1. List of progenies selected from pedigree nurseries, Bhanga, Boro, 2014-15

Pedigree Nurseries	No. of crosses	No of plant selected

F5 Generation	13	501
F6 Generation	16	338
F7 Generation	30	382
Total	59	1221

Results and discussion: A total of 1221 individual progenies comprising 501 F5, 338 F6 and 382 F7 were selected from pedigree nurseries (**Table 1**). Seeds from selected progenies were dried and preserved in the cold room.

Experiment 2. Observational Trial (OT)

Investigators : P.S. Biswas and M Amir Hossain

Specific Objective: To select genetically fixed lines with desirable agronomic characters with less or no unproductive tiller, intermediate plant height, short growth duration, acceptable grain quality and high yield potential.

Materials and methods: A total of 265 fixed lines were grown along with BRRI dhan28 and BRRI dhan29 as standard check varieties. Forty five-day-old seedlings of each genotype were transplanted in 5.4 m × 4 rows plot using single seedling at a spacing of 25×15 cm. All the check varieties were transplanted at every after twenty entries. Fertilizer doses and management were the same as in experiment no. 1.1. Date of seeding, transplanting, flowering, maturity, plant height, phenotypic acceptance, disease infestation score, yield per plot of the selected entries along were collected and grain sample were supplied to BRRI HQ to analyze Zn content in the brown rice.

Results and discussion: A total of 34 uniform lines were selected and harvested based on visual field performance.

Experiment 3. Secondary Yield Trial (SYT)

Investigators: P. S. Biswas and M Amir Hossain

Specific Objective: To evaluate initial yield potential in replicated trial

Materials and methods: A total of 36 advanced breeding lines were evaluated in four sets. BRRI dhan28 and BRRI dhan29 were used standard check varieties. In transplanting, 35 days old seedlings were used. Single seedling was transplanted at 20 x 20cm spacing in 5.4 m X 12 rows plots with 3 replication following RCB design. Fertilizer doses and management were the same as in experiment no. 1.1. Data of plant height (cm), days to flowering, days to maturity, phenotypic acceptance (PAcp), tiller per m^2, panicle per m^2, spikelet sterility%, 1000 seed weight and yield per plot of the selected entries along with checks were recorded.

Results and discussion: Out of 36 tested entries, 17 entries were selected based on yield potential, considerably higher amylose content and high zinc content.

Experiment 4. Regional Yield Trial in B. Aus, 2014

Investigators: Dr. H U Ahmed, M. R. A. Sarker and S. A. Islam

Specific Objectives: To evaluate specific and general adaptability of the genotypes under R/S Bhanga.

Materials and methods: Supplied seven advance lines were grown along with standard check variety BR26. Sprouted seeds were broadcast with 20 cm line spacing in 5.4 m × 10 rows plot on 17 April, 2014 following RCB design. Fertilizer doses and management practices were applied as per BRRI recommendation. Data of plant height (cm), days to flowering, days to maturity, phenotypic acceptance (PACP), tiller per m^2, panicle per m^2, spikelet sterility% and yield per plot of the selected entries were recorded and described in **Table 2**.

Results: Among the seven advance breeding lines, BR7699-2B-3-13-3 produced significantly 0.43 t higher grain yield (2.03 t/ha) with 5 days longer growth duration, followed by BR7587-2B-3 (1.85 t/ha) with 3 days longer growth duration than the check variety BRRI dhan43 (1.60 t/ha) in B. Aus, 2014 season (**Table 2**).

Table 2. Grain yield and ancillary characters of RYT in B. Aus, 2014 at BRRI R/S, Bhanga

Entries	Plant height (cm)	Tiller/ m^2	Panicle/ m^2	Grains/ panicle	PACP	Growth duration (days)	Grain yield (t/ha)	Sterility %
BR7698-2B-1-9-1	92	256	175	40	5	106	1.58	40.69
BR7698-2B-1-9-2	85	315	250	23	6	105	1.31	61.80
BR7699-2B-3-13-3	98	271	196	49	3	110	2.03	29.35
BR7992-2B-5-2	102	298	273	24	5	107	1.85	54.88
BR7992-2B-5-4	92	321	188	38	4	108	1.44	27.65
BR7383-2B-23	95	265	238	23	5	103	1.43	61.52
BR7587-2B-3	111	215	171	35	5	105	1.85	36.45
BRRI dhan43 (Ck)	101	252	202	31	5	105	1.60	58.32
CV%	4.4	14.6	14.3	20.6	-	1.0	14.1	18.1
LSD (0.05)	7.50	70.1	52.9	11.79	1.05	1.91	0.40	14.67

Experiment 5. Regional Yield Tria in T. Aus, 2014

Investigators: Dr. H U Ahmed, M. R. A. Sarker and S. A. Islam

Specific Objectives: To evaluate specific and general adaptability of the genotypes under R/S Bhanga.

Materials and methods: Supplied seven advance lines were grown along with standard check varieties BR26 and BRRI dhan48. Twenty seven days old seedlings were transplanted with 20 cm × 20 cm spacing in 5.4 m × 10 rows plot on 17 May, 2014 following RCB design. Fertilizer doses and managements were applied as per BRRI recommendation. Data of plant height (cm), days to flowering, days to maturity, phenotypic acceptance (PACP), tiller per m^2, panicle per m^2, spikelet sterility% and yield per plot of the selected entries were recorded and described in **Table 3**.

Results: Among the seven advance breeding lines, BR7708-62-1-1 produced 0.69 t significantly higher grain yield than the check variety BRRI dhan43 with 4 days earlier growth duration which was followed by BR7922-45-2-2-1 (2.34 t/ha) producing almost similar grain yield with 3 days longer growth duration than the check variety BRRI dhan48.

Table 3. Grain yield and ancillary characters of RYT in T. Aus, 2014 at BRRI R/S, Bhanga

Entries	Plant height (cm)	Growth duration (days)	Tiller/ m^2	Panicle /m^2	Grains/ panicle	PACP	Grain yield (t/ha)	Sterility%
BR8113-21-3-1	92	111	217	162	55	6	2.01	30.88
BR7922-45-2-2-1	104	110	223	153	53	4	2.34	31.37
IR71866-3R-3-1	98	110	217	165	54	5	1.80	22.55
BR7708-62-1-1	96	108	245	188	81	5	2.60	25.28
BR7718-56-3-1	95	107	277	203	48	4	1.97	33.18
BR7716-49-1-3	102	108	215	172	79	6	2.16	27.02
BR7718-55-1-3	98	108	233	180	56	5	2.04	31.77
BR26 (Ck)	92	112	237	175	47	5	1.91	32.22
BRRI dhan48 (Ck)	104	107	235	167	78	4	2.31	27.15
CV%	3.3	0.5	10.0	10.1	12.3	-	12.4	17.2
LSD (0.05)	5.56	0.98	40.4	30.3	13.04	-	0.37	8.65

Experiment 6. Regional Yield Trial (RYT), T. Aman, 2014

Investigators: Dr. H U Ahmed and P. S. Biswas

Specific Objectives: To evaluate specific and general adaptability of the genotypes under R/S Bhanga.

Materials and methods: Supplied seven advance lines were grown along with standard check varieties BRRI dhan32 and BRRI dhan39. Thirty nine days old seedlings were transplanted @2-3 seedlings with a spacing of 20 cm × 20 cm in 5.4 m × 10 rows plot following RCB design on 12 August, 2014. Fertilizer doses and managements were applied as per BRRI recommendation. Data on seedling height, date of seeding and transplanting, days to flowering and maturity, phenotypic

acceptance at vegetative and reproductive stages, plant height, lodging tolerance and yield per plot of the selected entries were recorded and described in **Table 4**.

Results: Among the seven advance breeding lines, BR8143-15-2-1 produced 2.37 t higher grain yield than the check variety BRRI dhan32 with similar growth duration. While the line BR7840-54-3-2-2 produced 2.4 t higher yield than the check BRRI dhan39 with almost similar growth duration.

Table 4. Grain yield and ancillary characters of RYT in T. Aman, 2014 at BRRI R/S, Bhanga

Entries	Plant height (cm)	Growth Duration	PACP	Grain yield (t/ha)
BR7840-54-3-2-2	126.6	133	4	6.92
BR7879-17-2-4-HR3-P1	152.27	143	3	6.91
BR7671-37-2-2-3-7-3	110.4	151	3	5.73
BR8143-15-2-1	115.13	139	4	7.99
BR8418-1-3	96.53	127	6	3.79
IR85840-75-2-2-3-2-(IR10M300)	106.07	134	3	5.92
PSBRC 82(IRRI 123)	106.93	132	3	4.81
BRRI dhan32(ck)	121.47	139	3	5.62
BRRI dhan39(ck)	106.4	132	4	4.52

Experiment 7. Regional Yield Trial in Boro Season, 2014-15

Investigators: M. A. Hossain, P. S. Biswas, M. A. Kader, M. R. A. Sarker and M. E. Hoque

Specific Objective: To evaluate specific and general adaptability of the genotypes at BRRI R/S Bhanga.

Materials and method: Thirty nine advance breeding lines comprising 10 of Favorable Boro Rice, 5 of Premium Quality Rice, 4 Premium Quality Rice (Com), 5 of Green Super Rice, 9 of Micronutrient Enriched Rice, 1 short duration, 4 short duration (Biotech) and 1 advance line (Biotech) were evaluated in eight sets of Regional yield trial against standard check varieties of BRRI dhan28, BRRI dhan29, BRRI dhan45, BRRI dhan50, BRRI dhan58, BRRI dhan60 and BRRI dhan63. Forty three to 48 days old seedlings were transplanted at 20 x 20cm spacing in 5.4 m x 12 rows plot with 3 replications following RCB design. Transplanting was done on 18 December, 2014 and 8, 18 and 19 January, 2015 in different RYTs. Fertilizer doses and managements were applied as per BRRI recommendation. Data on plant height (cm), days to flowering, days to maturity, phenotypic acceptance (PACP), no. of tiller per m^2, no. of panicle per m^2, spikelet sterility%, 1000 seed weight and yield per plot of the selected entries along with checks were recorded and described in **Tables 5-12.**

Results and discussion:

Favorable Boro (FB): Among the ten advanced breeding lines, BR7988-10-4-1 produced the highest grain yield (7.85 t/ha) followed by BR7783-AC12-3 (7.80 t/ha) which was statistically non-significant than the check variety BRRI dhan29 but having significant earlier growth duration than the check **(Table 5)**.

Table 5. Grain yield and ancillary characters of RYT-FB in Boro, 2014-15 at BRRI R/S, Bhanga

Entries	Plant height	Tiller/m^2	Panicle/m^2	Growth duration	Yield (t/ha)
BR7683-30-3-3-4	91	392	342	149	6.82
BR7671-37-2-2-3-7	88	358	333	153	7.11
BR7988-4-5-3-4	76	367	342	152	7.17
BR7783-AC12-3	102	292	253	156	7.80
BR7783-AC13-5	103	317	277	165	7.66
BR7783-AC14-5	105	317	281	163	7.54
BR7783-AC6-3-2-2-1	106	275	246	162	7.75
BRRI dhan29-SC3-28-16-10-8-HR1(Com)	87	358	320	146	7.74
BR7988-10-4-1	87	342	317	152	7.85
BR7800-63-1-7-3	95	267	242	148	7.15
BRRI dhan28(Ck)	102	358	326	147	7.92
BRRI dhan29(Ck)	104	325	296	157	7.82
BRRI dhan60(Ck)	89	350	325	149	7.46
CV%	3.1	10.77	10.89	0.36	3.93
LSD (0.05)	4.97	60.24	55.04	0.94	0.49

Premium Quality Rice (PQR): Among the seven advance breeding lines, BR8079-52-2-2-2 produced about 0.5 t higher yield than the check variety BRRI dhan50 with similar growth duration, but had 10 days longer growth duration than the check BRRI dhan63 with statistically identical yield in Boro, 2014-15 **(Table 6)**.

Table 6. Grain yield and ancillary characters of RYT-PQR in Boro, 2014-15 at BRRI R/S, Bhanga

Entries	Plant height(cm)	Tiller/m^2	Panicle/m^2	Growth duration	Yield (t/ha)
IR77734-93-2-3-2	94	350	340	153	6.89
BR8079-52-2-2-2	88	367	342	161	7.28
BR8096-55-1-9-1	86	308	282	154	7.09
BR8076-1-2-2-3	99	342	315	154	6.9
BR8096-48-2-2-4	95	317	284	154	6.32

BRRI dhan50(Ck)	83	375	345	161	6.82
BRRI dhan63(Ck)	76	283	258	151	7.17
CV%	2.53	13.47	14.54	0.38	3.74
LSD (0.05)	2.53	81.01	80.03	1.06	0.46

Premium Quality Rice {PQR-(COM)}: Among the four advanced breeding lines, BR7372-18-3-3-HR3(Com) produced the highest grain yield (6.63 t/ha) which was significantly higher than BRRI dhan50 with 4 days longer growth duration, but it produced statistically almost similar yield than the checks BRRI dhan28 and BRRI dhan60. No entry could not produce higher grain yield than BRRI dhan63 **(Table 7)**.

Table 7. Grain yield and ancillary characters of RYT-PQR(COM) in Boro, 2014-15 at BRRI R/S, Bhanga

Entries	Plant height (cm)	Tiller/m^2	Panicle/m^2	Growth Duration	Yield (t/ha)
BR7372-35-3-3-HR9(Com)	93.3	310	286	148	6.37
BR7372-18-2-1-HR1-HR6(Com)	97.2	290	259	153	6.46
BR7372-18-3-3-HR3(Com)	92.3	278	254	148	6.63
BR7372-35-3-3-HR5(Com)	96.3	296	265	151	6.42
BRRI dhan28(Ck)	93.3	342	310	149	6.52
BRRI dhan50(Ck)	82.9	382	336	152	5.88
BRRI dhan60(Ck)	90.3	297	277	151	6.39
BRRI dhan63(Ck)	78.5	320	289	151	7.16
CV%	2.95	4.86	5.89	0.49	3.67
LSD (0.05)	4.68	26.75	29.37	1.3	0.42

Green Super Rice (GSR): Among the five advance breeding lines, HHZ15-DT4-DT1-Y1 produced the highest grain yield (6.72 t/ha) followed by HHZ6-SAL3-Y1-SUB2 (6.44 t/ha) which were significantly higher than that of BRRI dhan60 with 4 days longer growth duration. But no entry could not produce the highest grain yield than BRRI dhan29 (6.88 t/ha) **(Table 8)**.

Table 8. Grain yield and ancillary characters of RYT-GSR in Boro, 2014-15 at BRRI R/S, Bhanga

Designation	Plant height (cm)	Tiller/m^2	Panicle/m^2	Growth duration	Yield (t/ha)
HHZ15-SAL13-Y1	91	267	240	155	6.64
HHZ23-DT16-DT1-DT1	88	275	240	156	6.28
HHZ15-DT4-DT1-Y1	88	242	219	155	6.72
HHZ11-DT7-SAL1-SAL1	86	258	230	147	6.07
HHZ6-SAL3-Y1-SUB2	89	267	243	154	6.44

BRRI dhan29(Ck)	91	258	234	161	6.88
BRRI dhan60(Ck)	84	300	276	151	5.43
CV%	2.48	13.98	15.24	0.22	2.62
LSD (0.05)	3.89	66.3 (NS)	65.15 (NS)	0.59	0.30

Micro nutrient Enriched Rice (MER): Among the nine advance breeding lines, BR7881-62-2-3-7-P3 produced the highest grain yield (7.32 t/ha), but lower than BRRI dhan29 (8.87 t/ha) with statistically identical growth duration. But, the lines BR8261-19-1-1-3 (6.91 t/ha) and BR8257-37-1-2-2 (6.77 t/ha) over-yielded BRRI dhan28 by 1 t/ha with statistically similar growth duration **(Table 9)**.

Table 9. Grain yield and ancillary characters of RYT-MER in Boro, 2014-15 at BRRI R/S, Bhanga

Designation	Plant height (cm)	Tiller/m^2	Panicle/m^2	Growth duration	Yield (t/ha)
BR7840-54-3-2-1	97.7	325	292	150	6.49
BR7840-54-3-4-1	96.7	258	233	144	5.69
BR7840-54-3-4-4	95.4	325	250	142	6.24
BR8257-37-1-2-2	90.2	283	258	141	6.77
BR7833-19-2-3-5	107.3	300	250	147	6.2
BR8261-19-1-1-3	102.7	292	233	144	6.91
BR7820-18-1-6-3-P4	96.5	383	342	147	6.32
BR7881-62-2-3-7-P3	102.7	358	317	154	7.32
BR7879-17-2-4-HR3-P1	130.7	308	283	149	6.31
BRRI dhan28(Ck)	96.3	300	275	144	5.77
BRRI dhan29(Ck)	96.4	342	283	151	8.87
CV%	3.29	12.98	12.97	0.47	6.06
LSD (0.05)	5.67	20.72	18.79	3.39	0.67

Short Duration (SD): NERICA Mutant produced 6.64 t/ha grain yield which was statistically similar to that of the check varieties of BRRI dhan45 and BRRI dhan28 with 2-3 days longer growth duration **(Table 10)**.

Table 10. Grain yield and ancillary characters of RYT-SD in Boro, 2014-15 at BRRI R/S, Bhanga

Entries	Plant height(cm)	Tiller/m^2	Panicle/m^2	Growth duration	Yield (t/ha)
NERICA Mutant	92	292	265	148	6.64
BRRI dhan28(Ck)	93.9	292	267	146	6.76
BRRI	90.9	292	267	145	6.79

dhan45(Ck)					
CV%	3.1	10.97	10.89	0.36	3.93
LSD (0.05)	4.97	60.24	55.04	0.94	0.49

Short Duration (SD)-Biotech: Among the four advance breeding lines, BR8072-AC8-1-1-3-1-1 produced the highest grain yield (5.44 t/ha) followed by BR8072AC11-2-3-2-1-1 (5.36 t/ha) which were statistically identical to that of BRRI dhan28 (5.29 t/ha) with almost similar growth duration in Boro, 2014-15 **(Table 11)**.

Table 11. Grain yield and ancillary characters of RYT-SD (Bio) in Boro, 2014-15 at BRRI R/S, Bhanga

Entries	Plant Height (cm)	Tiller/m^2	Panicle/m^2	Growth duration	Yield (t/ha)
BR8072-AC5-4-2-1-2-1	86	258	233	146	5.18
BR8072-AC7-4-1-2-2-1	86	267	241	146	4.88
BR8072-AC8-1-1-3-1-1	85	267	242	144	5.44
BR8072AC11-2-3-2-1-1	85	275	252	145	5.36
BRRI dhan28(Ck)	88	258	228	145	5.29
CV%	2.83	6.89	8.09	0.31	2.62
LSD (0.05)	NS	14.37	16.38	0.84	0.26

RYT-Biotech: The entry BR6158RWBC2-2-1-1 produced the highest grain yield (6.87 t/ha) which was statistically similar to that of check varieties BRRI dhan29 (6.55 t/ha) with almost similar growth duration and BRRI dhan58 (5.39 t/ha) with 10 days longer growth duration in Boro, 2014-15 **(Table 12)**.

Table 12. Grain yield and ancillary characters of RYT (Bio) in Boro, 2014-15 at BRRI R/S, Bhanga

Entries	Plant height (cm)	Tiller/m^2	Panicle/m^2	Growth duration	Yield (t/ha)
BR6158RWBC2-2-1-1	104	258	233	157	6.87
BRRI dhan58(Ck)	86	258	221	147	5.39
BRRI dhan29(Ck)	106	300	227	155	6.55
CV%	1.94	12.81	13.56	0.44	1.33
LSD (0.05)	4.34	79.03 (NS)	75.11 (NS)	1.51	1.51

Experiment 8. Zn enriched Proposed Variety Trial (PVT), T. Aman, 2014

Specific objective: On-farm evaluation of proposed line by the NSB (National Seed Board) team for T. Aman, 2014

Materials and methods: Promising genotype BR7528-2R-19-HR10 was evaluated in comparison with the check variety BRRI dhan39 in farmer's field under the supervision of BRRI Regional station, Bhanga, Faridpur. The entry was seeded in the seedbed on 09/07/2014 at BRRI Regional station, Bhanga, Faridpur and transplanted on 31/07/14 at Majikanda, Bhanga, Faridpur. The experiment was laid out in randomized complete block design with three replications. Urea was top dressed on15/08/14, 30/08/14 and 15/09/14. Additional TSP and MoP and Thiovit were applied on 05/09/14, Virtako was sprayed before panicle initiation and supplemental irrigation was applied in research plots which made significant impact on phenotypic expression as well as on grain yield. National Seed Board (NSB) field evaluation team visited and evaluated the trial during flowering and harvesting period.

Results: The promising genotype BR7528-2R-19-HR10 produced 0.34 t/ha higher grain yield than the check variety BRRI dhan39 with 8 days longer growth duration (**Table 13**).

Table 13. Grain yield and growth duration of PVT material, Zn enriched T. Aman in T. Aman, 2014 at Majikanda, Bhanga, Faridpur

Advance line/Variety	Grain yield (t/ha)				Growth duration (days)
	R1	R2	R3	Mean	
BR7528-2R-19-HR10	6.70	7.16	7.42	7.09	132
BRRI dhan39 (Ck)	5.97	7.21	7.09	6.75	124

Experiment 9. Zn enriched Proposed Variety Trial (PVT), Boro, 2014-15

Specific objective: On-farm evaluation of proposed line by the NSB (National Seed Board) team for the Boro, 2014-15

Investigators : M A Hossain and M H Uddin

Materials and methods: The proposed variety BR7671-37-2-2-3-7 and BR7833-11-1-1-2-1-2B5 were evaluated with check varieties BRRI dhan28 and BRRI dhan64 in farmer's field under the supervision of BRRI R/S, Bhanga. Forty two days old seedlings were transplanted at a spacing of 20 x 20 cm using 2/3 seedlings per hill in 5 m x 10 rows plot at Purba Sadardi, Bhanga, Faridpur on 7 January, 2015. The experiment was laid out in RCB design with 3 replications. The experiment plots were top dressed with Urea at 15 days after transplanting (DAT) and 90 DAT. Furadan was applied in maximum tillering stage and Virtako was sprayed before panicle initiation. Supplemental irrigation was applied as and when necessary. The experimental plots were evaluated by the field evaluation team of National Seed Board (NSB) at flowering and harvesting.

Results: The promising line BR7671-37-2-2-3-7 significantly out-yielded the check variety BRRI dhan64 by about 1.5 t/ha with almost similar growth duration, while the line BR7833-11-1-1-2-1-2B5 produced statistically almost similar yield and growth duration as compared to BRRI dhan28 (**Table 14**).

Table 14. Grain yield of PVT in Boro-2014-15 at Purbo Sadardi, Bhanga, Faridpur

Entries	Growth Duration (days)	Grain yield (t/ha)
BR7833-11-1-1-2-1-2B5	149	7.09
BR7671-37-2-2-3-7	159	8.25
BRRI dhan28 (ck)	152	7.22
BRRI dhan64 (ck)	161	6.80
CV%	0.67	7.14
LSD (0.05)	2.08	1.05

Experiment 10. International Network for Genetic Evaluation of Rice (INGER) trial

The 40th International Irrigated Rice Observational Nursery- Module 2 (IIRON- 2014) was set up at BRRI R/S Bhanga with 49 entries and local check. The materials were received on mid December, 2015 and seeding and transplanting were done on 19-12-15 and 01-02-15, respectively. Growth of seedlings was poor due to cold. The materials matured late while there was no other crop in the field, thereby infested heavily by insects. Most of the materials were late maturing. No suitable entries could be selected for further trial or even as parents for future hybridization.

Experiment 11. Stability of yield of BRRI releasedAman varieties
Investigators : S A Islam and M S Kabir

Specific Objective: Stability Analysis of BRRI released modern rice variety in Boro Season at BRRI R/S Bhanga, Faridpur.

Materials and methods: A total of 29 BRRI released modern rice varieties supplied by Statistics Division, BRRI, Gazipur were grown at BRRI R/S, Bhanga farm. Thirty eight days old seedlings were transplanted at a spacing of 20 x 20 cm with 2/3 seedlings per hill in 5 m x 10 rows plot on 13 August, 2014. The experiment was laid out in RCB design with 3 replications. Fertilizer doses and field managements were the same as in experiment no. 1.1. Date on date of seeding, transplanting, flowering, maturity, plant height, disease infestation score and yield per plot of the selected entries along with checks were recorded.

Results and Discussions: The grain yield (t/ha) and days to maturity (DTM) were given in **Table 15**. BR25 gave the highest grain yield (5.4 t/ha) followed by BRRI dhan52 (4.72 t/ha).

Table 15. Grain yield and days to maturity of BRRI released T. Aman varieties in T. Aman, 2014 at BRRI R/S, Bhanga, Faridpur

Entries	Growth duration	Yield (t/ha)
BR3	141	3.14
BR4	151	4.49
BR5	155	3.26
BR10	150	4.32

BR11	145	4.03
BR22	135	3.96
BR23	155	4.49
BR25	142	5.40
BRRI dhan30	153	4.35
BRRI dhan31	151	3.74
BRRI dhan32	140	3.78
BRRI dhan33	130	3.60
BRRI dhan34	151	3.80
BRRI dhan37	153	3.32
BRRI dhan38	155	3.34
BRRI dhan39	133	3.95
BRRI dhan40	153	3.34
BRRI dhan41	117	4.05
BRRI dhan44	155	3.65
BRRI dhan46	155	4.05
BRRI dhan49	148	4.28
BRRI dhan51	116	3.82
BRRI dhan52	154	4.72
BRRI dhan54	140	4.05
BRRI dhan53	137	3.51
BRRI dhan56	130	3.58
BRRI dhan57	124	2.22
BRRI dhan62	130	2.32
BRRI hybrid dhan4	124	3.65

Experiment 12. Stability of yield of BRRI released Boro varieties

Investigators : M A Hossain and P S Biswas

Specific Objective: Stability Analysis of BRRI released modern rice varieties in Boro Season at BRRI R/S Bhanga, Faridpur.

Materials and methods: A total of 32 BRRI released modern Boro rice varieties supplied by Statistics division, BRRI, Gazipur were grown at BRRI R/S, Bhanga farm. Fifty days old seedlings were transplanted at a spacing of 20 x 20 cm using 2/3 seedlings per hill in 5 m x 10 rows plot on 14 January, 2015. The experiment was laid out in RCB design with 3 replications. Fertilizer doses and field managements were the same as in experiment no. 1.1. Data on date of seeding,

transplanting, flowering, maturity, plant height, disease infestation score and yield per plot of the selected entries along with checks were recorded.

Results and Discussions: Grain yield and some yield contributing characters were given in **Table 16**. BRRI dhan60 and BRRI hybrid dhan1 gave the highest grain yield (8.3 t/ha) followed by BR8 (8.27 t/ha). BR17, BR18, BR19 and also BR8 lodged at maturity.

Table 16. Grain yield and ancillary characters of BRRI released Boro varieties in Boro, 2014-15 at BRRI R/S, Bhanga, Faridpur

Entries	Growth duration	Plant height (cm)	Tiller/m^2	Panicle/m^2	Yield (t/ha)
BR1	157	79.40	525	500	7.47
BR2	165	118.53	275	275	7.98
BR3	176	84.20	275	250	6.36
BR6	157	83.13	375	350	7.81
BR7	164	113.27	325	300	7.27
BR8	163	108.13	325	300	8.27
BR9	162	113.80	225	225	7.10
BR12	162	83.47	375	350	6.76
BR14	163	110.40	300	275	6.40
BR15	163	99.13	325	300	7.81
BR16	168	87.13	350	325	6.99
BR17	162	137.33	350	325	6.28
BR18	169	123.60	325	300	7.97
BR19	171	117.60	300	275	7.63

BR26	153	90.00	350	325	7.14
BRRI dhan27	163	131.33	250	250	6.16
BRRI dhan28	153	90.53	275	275	7.60
BRRI dhan29	169	96.93	300	275	7.37
BRRI dhan35	165	102.93	225	200	7.61
BRRI dhan36	155	79.33	300	300	6.60
BRRI dhan45	152	91.40	275	250	6.66
BRRI dhan47	153	98.40	275	275	7.33
BRRI dhan50	157	77.40	300	275	6.20
BRRI dhan55	151	86.27	250	250	6.83
BRRI dhan58	160	89.87	350	325	7.87
BRRI dhan59	159	75.93	300	300	7.47
BRRI dhan60	153	82.20	300	275	8.30
BRRI dhan61	159	77.93	300	300	7.94
BRRI dhan64	156	97.13	225	225	6.34
BRRI Hybrid dhan1	157	96.13	250	250	8.30
BRRI Hybrid dhan2	156	94.93	250	250	7.38

BRRI Hybrid dhan3	156	94.60	250	250	8.18

CHAPTER 2. AGROMONIC MANAGEMENT

Experiment 13. Determination of seed rate in dry seed bed condition in T. Aman season

The experiment was conducted at BRRI farm, Bhanga during T. Aman 2014 to find out suitable seed rate for dry seed bed condition as well as to motivate farmers for growing their own seedling on their nearby homestead. Four seed bed treatments as $\mathbf{S_1}$ = 100 g/m^2 in dry seed bed; $\mathbf{S_2}$ = 200 g/m^2 in dry seed bed; $\mathbf{S_3}$ = 300 g/m^2 in dry seed bed and $\mathbf{S_4}$ = 100 g/m^2 in wet seed bed were applied on BRRI dhan33, BRRI dhan39 and BRRI dhan62. The experiment was laid out in split plot design with placement of variety in the main plot and seedlings grown from different seed rates as treatment in subplots with three replications. Twenty eight days old seedling were planted on 15 August 2014 and BRRI recommended fertilizer and other intercultural management were applied. The interaction and seed bed management gave insignificant yield and panicle production. However, grain yield among the entries were significant. Therefore farmers of Faridpur region could practice the dry seed bed condition to grow seedlings instead of buying that from neighbouring districts **(Table 17).**

Table 17. Grain yield and yield component of different seed rate in dry seed bed condition in T. Aman season

Variety	Seed bed management	Tiller no/m^2	Panicle no/m^2	Grain yield (t/ha)
BRRI dhan33	100 g/m^2 in dry seed bed	325	316	5.87
	200 g/m^2 in dry seed bed	384	344	5.73
	300 g/m^2 in dry seed bed	350	332	5.99
	100 g/m^2 in wet seed bed	351	331	6.17
BRRI dhan49	100 g/m^2 in dry seed bed	367	317	6.76
	200 g/m^2 in dry seed bed	317	299	6.74
	300 g/m^2 in dry seed bed	329	288	6.54
	100 g/m^2 in wet seed bed	334	297	7.03
BRRI dhan62	100 g/m^2 in dry seed bed	340	304	4.54
	200 g/m^2 in dry seed bed	363	281	4.56
	300 g/m^2 in dry seed bed	377	282	4.43
	100 g/m^2 in wet seed bed	361	270	4.81
$LSD_{0.05}$		34	41	0.88
	100 g/m^2 in dry seed bed	378	312	5.72
	200 g/m^2 in dry seed bed	355	308	5.67
	300 g/m^2 in dry seed bed	352	300	5.65
	100 g/m^2 in wet seed bed	349	299	6.00
CV%		20.5	25.5	9.1
$LSD_{0.05}$		71	75	0.51

CHAPTER 3. FARM MACHINERY

There were some activities under FMTD (Farm Machinery Technology Development and Dissemination) Project under BRRI Regional Station, Bhanga, Faridpur. During 2014-15, the project activities under R/S Bhanga were carried out by Engr. Ajoy Kundu, Scientific Officer and assisted by Md. Alamin Hossain and Md. Humayun Kabir, Mechanic of the project.

The main activities under the project at BRRI R/S Bhanga were to sell agricultural machineries to the farmers with 60% government subsidy and setting uo demonstration trial in the farmers' field by the use of machines. The agricultultural machineries sold under the project were BRRI Paddy-Wheat Thresher, BRRI Paddy Thresher, BRRI Winnower, BRRI Prilled Urea Applicator, BRRI Weeder and BRRI Rice-Wheat Reaper. Detailed have been given as follows.

Activity 1. Dissemination of newly released T. Aman variety at Gopalganj region (PGB-IADP project)

The experiment was conducted at 22 farmers' field in T.Aman season at Gopalganj areas under PGB-IADP project to disseminate newly released T. Aman variety. BRRI recommended basal fertilizer of P, K, S and Zn were applied on the basis of Agro ecological Zone in the plots and urea were applied in three equal splits. BRRI dhan62 gave almost similar grain yield as BRRI dhan33 and matured about two weeks earlier than BRRI dhan33 (**Table 18**). Farmers can easily grow pulse, sunflower and other vegetable crops as next crops successfully and also save some irrigation cost.

Table 18. Yield advantage of BRRI dhan62 at farmers field of Gopalganj district

Location	No of trials	Variety	Grain Yield (t/ha)	% Yield increase over BRRI dhan33	Field duration (days) saved over BRRI dhan33
Gopalgonj	22	BRRI dhan62	4.75	2%	15-19 days
		BRRI dhan33	4.67		

Activity 2. Validation of modern rice varieties in Gopalgong district under PGB-IADP (BRRI part)

Introduction: In low lying areas, single rice production is still vulnerable due to natural calamities like cyclone (e.g. mohashen), continuous rainfall that results into flooding and stagnation at the time of harvesting, thus ripening grains get sprouted and are damaged. For all these reasons, farmers are showing interest to grow short duration Boro rice with high yield potential. BRRI released modern rice varieties viz. BRRI dhan50, BRRI dhan58, BRRI dhan60, BRRI dhan63, BRRI dhan64 and BRRI dhan 68 were distributed among nineteen farmers in Gopalgonj Sadar, Kashiani, Muksudpur, Tungipara and Kotalipara upazillas to validate the performance of the newly released rice varieties.

Materials and Method: The experimental sites of all Upazilas of Gopalganj district fall under the agro-ecological zone 12 (Low Ganges River Floodplain) and were situated in low lying areas. The study was conducted during Boro season, 2014-15 through participatory appraisal in farmers plot selected by the Agricultural Officer and SAAOs of DAE. Rice seedlings of 40-57 days were transplanted in December - January, 2014-15. Fertilizers were applied as per BRRI recommended dose. The participating farmers conducted all the field operations. Data on grain yield was recorded from the harvest area of 10 m^2 per plot and converted into ton per ha. The grain yield was converted into t ha^{-1} at 14% moisture.

Result and discussion: Mean grain yield with growth duration of different varieties were as follows: 6.97 t/ha with 153 days of BRRI dhan50, 8.18 t/ha with 154 days for BRRI dhan58, 7.24 t/ha with 149 days of BRRI dhan60, 6.98 t/ha with 146 days for BRRI dhan63, 8.42 t/ha with 150 days of BRRI dhan64, and 7.30 t/ha with 148 days for BRRI dhan68 (**Table 19**). Farmers showed their interest to grow these newly released Boro varieties for their early maturing ability which may escape the risk of flooding at harvesting time of Boro. For slender grain type, BRRI dhan50, BRRI dhan58, BRRI dhan60 and BRRI dhan63 were preferred by the farmer. Seeds were preserved by the farmers for their own use and neighbouring farmers showed their interest to exchange seeds from the seed growing farmers to grow these varieties in the next season.

Table 19. Grain yield and growth duration of newly released Boro varieties at Farmers' Fields of Gopalganj district under PGB-IADP, Boro 2014-15

Variety	Location	Grain yield (t/ha)	Mean yield	Growth duration (days)	Mean duration
BRRI dhan50	Gopalganj Sadar	6.76	6.97	150	153
	Kashiani	7.29		157	
	Muksudpur	6.76		156	
	Tungipara	7.16		152	
	Kotalipara	6.88		149	
BRRI dhan58	Muksudpur	8.61	8.18	156	154
	Tungipara	7.74		152	
BRRI dhan60	Kashiani	8.09	7.24	149	149
	Muksudpur	7.06		151	
	Kotalipara	6.58		146	
BRRI dhan63	Kashiani	7.02	6.98	146	146
	Muksudpur	6.86		148	
	Tungipara	7.26		145	
	Kotalipara	6.78		146	
BRRI dhan64	Kashiani	8.20	8.42	150	150
	Tungipara	8.25		149	
	Kotalipara	8.82		152	
BRRI dhan68	Gopalganj Sadar	7.85	7.30	149	148
	Tungipara	6.74		147	

Activity 3. Seed production and dissemination in BRRI Farm

A total of 16,000 Kg breeder seed of BRRI dhan28 and BRRI dhan29 were produced at BRRI farm under financial support of Enhancement of Quality Seed Supply Project during Boro, 2014-15. Under HarvestPlus project support around 2.5 tons quality seed of the promising line BR7833-11-1-1-2-1-2B5 (as proposed variety) was produced. In total 20,503 kg TLS of different varieties was produced to meet local demand for quality seeds of Aus, T.Aman and Boro seasons. Breeder seeds

were supplied to GRS division at BRRI HQ for further processing. In total, about 36.5 tons of quality seed were produced in BRRI R/S, Bhanga during Boro, 2014-15 (**Table 20)**.

Table 20. Breeder seed and TLS production at BRRI R/S, Bhanga in Boro season2014-15

Variety	Breeder Seed	TLS	Total Seed
BRRI dhan28	9,000 kg	5,239 kg	14,239 kg
BRRI dhan29	7,000 kg	5,314 kg	12,314 kg
BRRI dhan39	-	730 kg	730 kg
BRRI dhan48	-	508 kg	508 kg
BRRI dhan50	-	175 kg	175 kg
BRRI dhan55	-	419 kg	419 kg
BRRI dhan57	-	335 kg	335 kg
BRRI dhan58	-	948 kg	948 kg
BRRI dhan60	-	559 kg	559 kg
BRRI dhan62	-	310 kg	310 kg
BRRI dhan63	-	676 kg	676 kg
BRRI dhan64	-	1,579 kg	1,579 kg
BRRI dhan65	-	611 kg	611 kg
BRRI dhan68	-	563 kg	563 kg
BR7833-11-1-1-2-1-2B5	-	2,537 kg	2,537 kg
Total	16,000 kg	20,503 kg	36,503 kg

Activity 4. Seed production and dissemination in farmers fields supported by EQSS project

Quality seed in the most important input in agricultural production and can solely contribute to increase about 15% yield in farmer's plot. Enhanced Quality Seed Supply project provided partial support to ensure quality seed production in ten farmer's field in Boro, 2014-15. BRRI Bhanga supplied quality seeds to farmers and shouldered cost of fertilizers, insecticides and training under this project. At maturity of the crop one field day at each site was arranged with the help of DAE. During Field Day the trial farmers shared their experience to neighboring farmers, which built interest among them to these varieties in their own plots and thereby a demand for quality seed was generated. Upazila and variety wise seed production is shown in **Table 21** and about 9.21 tons seeds were produced in farmers' fields to meet the local demand (**Table 22**).

Activity 5. Demonstration trials of BRRI dhan64 in farmers' fields supported by HarvestPlus project

Demonstration trials of BRRI dhan64 were set up in 16 farmers' fields during Boro, 2014-15 in greater Faridpur region. BRRI Bhanga supplied quality seeds to farmers and shouldered cost of fertilizers, insecticides and training under this project. At maturity of the crop one field day was arranged with the help of DAE. During Field Day the trial farmers shared their experience to neighboring farmers, which built interest among them to these varieties in their own plots and thereby a demand for quality seed was generated. Upazila wise seed production is shown in **Table 23.**

Table 21. Upazilla and variety-wise seed production and area at Gopalganj and Faridpur District in Boro, 2014-15

N	Upazila	Variety	Date of seeding	Date of transplanting	Area (acre)	Date of maturity	Growth duration (days)	Grain yield (t/ha)
1	Muksudpur	BRRI dhan64	4/12/14	14/1/15	0.33	8/5/15	155	6.18
2	Bhanga	BRRI dhan58	23/11/14	8/1/15	0.33	2/5/15	159	7.17
3	Muksudpur	BRRI dhan68	22/11/14	27/12/14	0.33	25/4/15	153	6.60
4	Kashiani	BRRI dhan68	22/11/14	2/1/15	0.33	1/5/15	158	6.30
5	Muksudpur	BRRI dhan55	29/11/14	15/1/15	0.33	4/5/15	155	6.56
6	Muksudpur	BRRI dhan60	26/11/14	16/1/15	0.33	22/4/15	148	7.70
7	Kashiani	BRRI dhan68	6/12/14	19/1/15	0.33	13/5/15	158	6.00
8	Kashiani	BRRI dhan55	6/12/14	21/1/15	0.33	26/4/15	141	7.83
9	Kashiani	BRRI dhan50	3/12/14	20/1/15	0.33	12/5/15	160	6.27
10	Bhanga	BRRI dhan63	30/11/14	3/1/15	0.33	22/04/15	144	8.25

Table 22. Farmers' address and the amount of produced seed supported by EQSS project in Boro, 2014-15

SN	Farmer's Name	Variety	Village	Block	Upazilla	District	Seed production (ton)
1	Abu Kalam Mollah	BRRI dhan64	Sagolchhira	Sagolchira	Muksudpur	Gopalganj	0.83
2	Rasul Fakir	BRRI dhan58	Purba Sadardi	Purba Sadardi	Bhanga	Faridpur	0.96
3	Fazle Mollah	BRRI dhan68	Sagolchhira	Sagolchira	Muksudpur	Gopalganj	0.88
4	Tepa Pal	BRRI dhan68	Jonasur	Jonasur	Kashiani	Gopalganj	0.84
5	Md.Hannan Sheikh	BRRI dhan55	Padmakanda	Padmakanda	Muksudpur	Gopalganj	0.88
6	Md. Shfiqul Bepari	BRRI dhan60	Ragdi	Ragdi	Muksudpur	Gopalganj	1.03
7	Nitai Biswas	BRRI dhan68	Bhadulia	Bhadulia	Kashiani	Gopalganj	0.80
8	Ananda Bhowmik	BRRI dhan55	Ramdia	Ramdia	Kashiani	Gopalganj	1.05
9	Siddik Mollah	BRRI dhan50	Bagjapa	Bagjapa	Kashiani	Gopalganj	0.84
10	Rasul Fakir	BRRI dhan63	Purba Sadardi	Purba Sadardi	Bhanga	Faridpur	1.10
Total quality of seed production in farmers' fields (tons)							**9.21**

Table 23. Result of Demonstration Trials of BRRI dhan64 under BRRI R/S Bhanga during Boro 2014-15

Father's name	Village	Upazila	District	D/S	D/T
Lalu Matabbar	Purba Sadardi	Bhanga	Faridpur	29/11/14	09/01/15
Alamgir	Purba Sadardi	Bhanga	Faridpur	29/11/14	09/01/15
Abul Kashem Sheikh	Boalia	Muksudpur	Gopalganj	04/12/14	14/01/15
Israel Sheikh	Boalia	Muksudpur	Gopalganj	04/12/14	14/01/15
Azimuddin Sheikh	Padmakanda	Muksudpur	Gopalganj	04/12/14	14/01/15
Shamsuddin Bepari	Ragdi	Muksudpur	Gopalganj	05/12/14	16/01/15
Nizamul Haque	Baro Parulia	Kashiani	Gopalganj	06/12/14	19/01/15
Khoti Mia Munshi	Uttar Charbhatpara	Kashiani	Gopalganj	07/12/14	20/01/15
Salam Shikder	Dahisara	Kashiani	Gopalganj	06/12/14	19/01/15
Fonindranath Biswas	Dirail	Kashiani	Gopalganj	06/12/14	19/01/15
Anawar Mia	Boalia	Gopalganj Sadar	Gopalganj	06/12/14	12/02/15
Awal Sharif	Gopinathpur	Gopalganj Sadar	Gopalganj	06/12/14	12/02/15
Anawar Mia	Gopinathpur	Gopalganj Sadar	Gopalganj	06/12/14	15/01/15
Atiar Rahman Mia	Boalia	Gopalganj Sadar	Gopalganj	29/11/14	12/01/15
Tayab Ali Khan	Shingipara	Tungipara	Gopalganj	30/11/14	17/01/15
Asad Khan	Shingipara	Tungipara	Gopalganj	30/11/14	17/01/15

D/S: Date of seeding, D/T: Date of transplanting

*Failed to irrigate the crop during active to maximum tillering stage due to inoperative condition of deep tubewale (excluded for making average)

Activity 5. Training /Agricultural Fair

BRRI Regional Station, Bhanga participated in a 'Three-day Agricultural Fair' at Tungipara, 'Three-day Agriculture Technology Fair' Gopalganj Sadar of Gpalganj district and a 'Three- day Fruit Tree Fair' at Bhanga of Faridpur district during 2014-15.

One Day Rice Production Farmer's Training was conducted at Tungipara of Gopalganj district from BRRI fund. Enhanced quality seed supply (EQSS) project also funded to conduct 10 farmers training at Kashiani, Muksudpur and Gopalganj Sadar upazillas of Gopalganj district; Sibchar upazilla of Madaripur district; Gosairhat upazilla of Shariatpur district; Faridpur Sadar and Bhanga upazillas of Faridpur district and Pangsha upazilla of Rajbari district. One farmers' training was conducted at Gopalganj Sadar upazila of Gopalganj district under Pirojpur Gopalganj Bagerhut - Integrated Agricultural Development Project (PGB-IADP) (BRRI part). One farmers' training was conducted at Bhanga of Faridpur district under HarvestPlus project. A total of 385 farmers were trained through these trainings (**Table 24)**.

Table 24. Farmers' Training conducted by BRRI R/S, Bhanga in 2014-15

Sl#	Fund source	No of Training	Participant farmers
1	GOB	1	30
2	EQSS project	10	300
3	PGB-IADP (BRRI part)	1	30
4	HarvestPlus	1	25
Total		**13**	**385**

BRRI Annual Report for 2014-2015

Bangladesh Rice Research Institute, Regional Station, Comilla

Research Personnel of the reporting year, July 2014 - June 2015

Full name and designation	**Status**
Helal Uddin Ahmed, *PhD* *Chief Scientific Officer*	310 working days
Dr. Abijit Saha, *PhD* *Principal Scientific Officer*	Full time
Md. Salim Mian, *PhD* *Senior Scientific Officer*	Full time
Mst. Selima Zahan, *MS* *Senior Scientific Officer*	Full time
Md. Adil, *MS* *Scientific Officer*	Full time
Farzana Alam, *MS* *Scientific Officer*	

CONTENTS

SUMMARY

Altogether 37 crosses were made and 34 crosses were confirmed during T. Aman and Boro at BRRI Regional Station, Comilla. Nine hundred and ninety two (992), 653, 1187, 257 and 107 plant progenies with desirable plant type and high yield potential were selected from F_2, F_3, F_4, F_5 and F_6 generations, respectively. Eight homozygous lines were bulked under the varietal development programme. Three (3) genotypes were selected from Observational Trial (OT) for uniformity in desirable characters and high yield potential. Sixteen genotypes (16) and twenty genotypes with diverse genetic background having earliness, good grain type, compact panicle, lodging resistance, disease and insect resistance and high yield potential were selected from IRLON and IIRON, respectively during T. Aman and Boro season.

During T. Aus, considering the yield (4.6 t/ha) and good phenotypic performance BR7718-55-1-3 was selected from RYT#1.

During T. Aman, in PYT#1 (Com) IR08L181, 08FAN1, IRRI 132 and IR09L305 were selected for their satisfactory yield performance (4.6-5.1 t/ha) as compared with standard checks (4.1-5.5 t/ha). In PYT#2 (Com) BR7357-11-2-4-1-1-HR3, BRC245-4-19-2-1 and BR7369-16-5-2-3-1 were selected for their satisfactory yield performance (4.7-5.3 t/ha) as compared with standard checks (5.5 t/ha). BRC316-1-1-1 and BRC316-2-2-1 were selected from PYT#3 for high yield potentiality (4.4-5.2 t/ha) as compared with standard checks (3-4.6 t/ha).

From Boro, BRC297-15-1-1-was selected in PYT#1 for high yield performance (6.5 t/ha) and 7 days earliness as compared with standard checks (6.2-6.7 t/ha and 145 days growth duration). From RYT#2 BRC270-2-1-1-2, BRC319-9-1-5 and BRC319-9-1-4 were selected for giving 0.5-1.4 t/ha higher yield than standard checks (5.4- 5.6 t/ha). Considering yield (5.3-5.7 t/ha) and growth duration (143-146 days) BRC298-2-1-2-2 and BRC297-12-3-1-1 were selected as compared with standard checks (5.3- 6.7 t/ha and 146-160 days).

IRRI NILs lines IR64-NIL5{IR64(qTSN4.4-YP9)} and IR101686-1-1{NSIC 158(qTSN4.1-YP4)} gave satisfactory yield (5.3- 5.7 t/ha) as compared with Checks (5.7-6.0 t/ha). This experiment is needed to further evaluate for late showing.

In T. Aman season, IR70213-10-CPA4-2-2-2 and B10533F-KN-12-2 were selected RYT#1 (RLR) for earliness (10 days) and satisfactory yield potential (5.6 t/ha) as compared with standard checks

(5.8 6.1 t/ha and 130 days growth duration). Considering yield (5.6 t/ha) and growth duration (121 days) WAS122-IDSA14-WASB-FK1 (NERICA-L-8) was selected from RYT#2 (RLR). In RYT#3 (PQR), BR8226-8-5-2-2, BR8226-11-4-4-3, BR8227-6-2-1 and BR8226-17-1-2 were selected for high yield potential (5-5.7 t/ha) as compared with standard checks (2.8-3.1 t/ha). BR7840-54-3-2-2 and BR8418-1-3 were selected for giving 1 t/ha higher yield and showing 11-14 days earlier than standard check BRRI dhan32 (4.2 t/ha yield and 132 days growth duration) and performed similar yield and growth duration as compared with standard check BRRI dhan39 from RYT#4 (MER). From RYT#5 (GSR), considering yield performance (4.5-4.7 t/ha) IR83340-B-28-B and HHZ5-SAL10-DT1-DT1 were selected as compared with standard checks.

In RYT#3 ((Short duration), NERICA Mutant was selected for giving higher yield (6.1 t/ha) than standard checks (5.1 t/ha). In RYT#4 (Favorable Boro) BR7683-30-3-3-4 was selected for its yield potential (6.0 t/ha) and similar growth duration (145 days) as compared with standard checks (5.6-5.7 t/ha) BRRI dhan28 and BRRI dhan60. Considering high yield performance (6.2- 7.1 t/ha) genotypes BR8257-37-1-2-2, BR7833-19-2-3-5, BR8261-19-1-13 and BR7879-17-2-4-HR3-P1 were selected from RYT#5 (Micronutrient) as compared with BRRI dhan28 (5.3 t/ha). In RYT#6 (GSR) HHZ23-DT16-DT1-DT1 and HHZ15-SAL13-Y1 were selected for giving 0.5-1.5 t/ha higher yield than all checks (6-6.4 t/ha). In RYT#1 (Biotech) BR4909-R1-R2 was selected for high yield potential than BRRI dhan28 (4.2 t/ha). From RYT#2 (Biotech) genotype BR6158RWBC2-2-1-1 was selected for higher yield (8.3 t/ha) as compared with standard checks (5.8-7.6 t/ha).

For T. Amman, in AYT#1 (PQR), BR7697-15-4-4-2-1 and BR7697-15-4-4-2-2 were selected for high yield potential (4.8-5.1 t/ha) as compared with Standard checks (2.7-4.1 t/ha). In AYT#2 (RLR) considering the yield performance (5.2-5.6 t/ha) genotypes BR7638-7-2-5-2 and AL-29 were selected as compared with Standard checks (3.9-5.5 t/ha).

From Boro, in AYT#Com, BR7781-10-3-2-2, BR7358-35-2-1-1 and HHZ23-DT16-DT1-DT1 were selected for high yield potential (5.7-6.5 t/ha) and good phenotypic appearance as compared with Standard checks (4.5- 7.0 t/ha).

In AYT#Regional, BR7800-63-1-7-3, BR7781-10-2-3-2, BR7812-19-1-6-1-P4 and BR8245-2-1-4 were selected for high yield potential (6.5-7.1 t/ha), good phenotypic appearance as compared with Standard checks (6.0-6.3 t/ha).

In T. Aus, 750 kg BRRI dhan48 breeder seeds were produced. In T.Aman 6150 kg BRRI dhan49, 825 kg BRRI dhan57 and 1800 kg BR10 breeder seeds were produced. In Boro, 9975 kg BRRI

dhan28, 11250 kg BRRI dhan29, 980 kg BRRI dhan50, 2775 kg BRRI dhan58 and 6825 kg BRRI dhan69 breeder seeds were produced.

In Boro, both BRRI dhan28 and BRRI dhan62 produced highest yield on 01 December seeding and BRRI dhan62 yielded higher (8.22 t/ha) than BRRI dhan28 (7.34) having growth duration 140days and 137days respectively. In Aman, All the varieties gave higher yield on 01 July seeding and yield decreased with the advent of time.

In Aman season, among the diseases false smut was the most prevalent and found in most of the varieties/lines of BRRI-Comilla farm. Incidence (27%) and severity of false smut disease was more in BRRIdhan49 compared to other varieties/ lines. The varieties BR11, BR22, BRRIdhan32 and BRRIdhan46 showed highly susceptible to Tungro disease with 20-55% incidences and 5-9 severity scale. In Boro season, the highest incidence (25%) of neck blast disease was recorded in BRRIdhan64 and lowest in BRRIdhan58.

In Aman, among the 27 varieties, varieties gave yield ranged from 2.8- 5.33 t/ha and showed growth duration ranged from 105-149 days. Considering yield, top five varieties were BRRI hybrid dhan4 (5.33 t/ha), BRRI dhan49 (5.25 t/ha), BRRI dhan44 (5.06 t/06), BRRI dhan46 (4.98 t/ha), and BRRI dhan31 (4.92 t/ha). In Boro, among the 32 varieties, the top most five varieties were BRRI hybrid dhan3 (8.79 t/ha), BRRI hybrid dhan2 (8.48 t/ha), BRRI dhan55 (7.31t/ha), BRRI dhan60 (7.23 t/ha) and BRRI dhan58 (7.15 t/ha) and showed growth duration ranged from 145-147 days.

The advantage in RCM plots over farmers' was 0.38 t/ha. On average farmers used 229 kg TSP and 72 kg MOP per hectare which was 179 kg and 30 kg higher TSP and MOP, respectively than the RCM recommendation. On average farmers used 68 kg less urea than the RCM recommendation which was 252 kg/ha. Farmers did not use any Gypsum while the RCM recommendation was 42 kg/ha.

In Aus, average yield of BRRI dhan48 was 4.78 t/ha having duration108 days. Number of motivated farmer were 500 and amount of produced seed was 6.6 t/ha. In Aman, 10 demonstrations and in Boro 10 demonstrations were conducted through EQSS and 25 demonstration were conducted in Boro through Harvest plus. Twenty eight farmers' training (day long), three SAAO training (day long), fifteen field days were conducted on rice production technologies by BRRI comilla during the reporting year. BRRI Comilla also participated in two numbers three three day long agriculture and tree fairs, one day long seed fair and three motivational tour.

Prorgram area: Varietal Development

T. Aus

Regional Yield Trial (RYT)

Eleven genotypes were evaluated in RYT#1 and RYT#2 at BRRI R/S Comilla against the standard checks BRRI dhan48 and BR26 to evaluate the advanced breeding lines for development of variety suitable at Comilla region. Twenty five to thirty days old seedlings were transplanted using 2-3 seedlings per hill with the spacing of 20 cm x 15 cm. The unit plot size was 5.4m x 10 rows. The experiment was laid out in RCB design with three replications. Fertilizer doses were 60:15:40:10 kg/ha NPKS with all amounts of P, K and S was applied at the time of final land preparation. N was

applied in two splits at 10 and 30 days after transplanting. Crop management such as weeding, disease and insect pests control were done in time. In RYT#1, BR7718-55-1-3 gave (4. 6 t/ha) higher yield as compared with BR26 and similar with BRRR dhan48 and showed uniformity at flowering and maturity stage and 127 days growth duration. So, considering the yield and phenotypic performance genotype BR7718-55-1-3 was selected from RYT#1.

Note: This experiment plot has been submerged for 8-10 days after one week transplanting and 18-20 days water logged during maturity due to heavy rainfall.

Table 1. Yield and agronomic performance of breeding materials of Regional Yield Trial (RYT), T.Aus 2014-15, BRRI R/S, Comilla

Sl No	Designation	SH (cm)	PH (cm)	GD (days)	Yield (t/ha)	LD Score (%)	Remarks
RYT#1							
7	BR7718-55-1-3	35	103	127	4.6	50	FSm-2%,uniform at flowering and maturity
8	BR26 (CK)	37	99	126	4.1	40	Low growth
9	BRRI dhan48 (CK)	34	96	124	4.6	20	Zinc deficiency
D/S: 21.04.14					D/T: 29.05.14		

Rainfed Lowland Rice (RLR) Ecosystem (T. Aman)

Hybridization

Thirty seven crosses were made using thirty nine parents for development of improved genotypes with high yield potential along with earliness, photoperiod sensitivity, acceptable grain quality and resistance to diseases and insect pests.

F_1 confirmation

Nine crosses and their respective parents were grown. Out of 9 crosses, all crosses were confirmed and registered in BRRI Comilla cross list with station code BRC456 to BRC464.

Growing of F_2 population

F_2 seeds of 15 crosses along with their parents were grown for selection of progenies with emphasis on earliness, plant type, grain type, number of effective tiller and high yield potential than the standard varieties. Five hundred and seventy eight plant progenies were selected from population of fifteen crosses.

Pedigree Nursery (F_3, F_4 , F_5 and F_7 generations)

Three hundred and sixty two (362) F_3, 499 F_4, 111 F_5 and 14 F_7 progenies were grown for selection of desirable progenies from the segregating populations with emphasis on plant type, earliness, grain type and grain color, tolerance to lodging and better phenotypic acceptance over the standard varieties. Four hundred and eighty (480), 486 and 156 plant were selected from F_3, F_4 & F_5 generation, respectively and 8 breeding lines were bulked from F_7 generation.

Observational Trial (OT)

One observational trial containing 7 genotypes were grown along with standard checks viz BRRI dhan49, BRRI dhan56, BRRI dhan57, BINA dhan7 and BINA dhan13 for selection of genetically fixed lines with uniform plant height, heading, plant type, and grain type along with high yield potential. Each genotype was grown in a 5.4 m × 4 rows plot with a spacing of 20 cm ×15 cm using single seedling per hill for transplanting. Thirty days old seedlings were used for transplanting. Thirty-day-old seedlings were used for transplanting. Fertilizer doses were 100:20:50 kg/ha NPK with all amounts of P and K applied at the time of final land preparation. N was applied in three splits at 15, 30 and 45 days after transplanting. Gypsum and Zinc sulphate @ 100 and 10 kg/ha were applied during land preparation. Other cultural operations were done as and when necessary. Three genotypes BRC308-1-1-1-6, BRC315-14-2-3-4, BRC316-26-2-2-1 were selected from OT.

Preliminary Yield Trial (PYT)

In total, 25 genotypes were evaluated in PYT#1 (Com), PYT#2 (Com) and PYT#3 (Com) at BRRI, Comilla against standard checks BRRI dhan39, BRRI dhan44, BRRI dhan49, BRRI dhan56, BRRI dhan57, BINA dhan7 and IR64 for initial yield evaluation and selection of desirable lines. Thirty days old seedlings per hill of each genotype were transplanted @ single seedling per hill with a spacing of 20 cm ×15 cm. The unit plot size was 5 m × 1.6 m. The field layout was RCBD with two replications. Recommended fertilizer doses were applied with a usual split application of urea in three times at 15, 30 and 45 days after transplanting. Other cultural operations were done as and when necessary. In PYT#1 (Com) genotypes IR08L181, 08FAN1, IRRI 132 and IR09L305 were selected for their satisfactory yield performance (4.6-5.1 t/ha) as compared with standard

checks (4.1-5.5 t/ha). In PYT#2 (Com) BR7357-11-2-4-1-1-HR3, BRC245-4-19-2-1 and BR7369-16-5-2-3-1 were selected for their satisfactory yield performance (4.7-5.3 t/ha) as compared with standard checks (5.5 t/ha). In PYT#3 genotypes BRC316-1-1-1 and BRC316-2-2-1 for their high yield potentiality (4.4-5.2 t/ha) as compared with standard checks (3-4.6 t/ha)..

Regional Yield Trial (RYT)

Five RYTs from Plant Breeding Division of BRRI HQ consisting of 23 genotypes were evaluated in RYT#1 (RLR), RYT#2 (RLR), RYT#3 (PQR), RYT#4 (MER) and RYT#5 (GSR) at BRRI R/S Comilla against the standard checks BR11, BRRI dhan33, BRRI dhan34, BRRI dhan37, BRRI dhan39, BRRI dhan49 and BINA dhan7 for evaluation of specific and general adaptability of the genotypes in on-station condition. Twenty five to thirty days old seedlings were transplanted using 2-3 seedlings per hill with the spacing of 20 cm x 15 cm. The unit plot size was 5.4m x 12 rows. The experiment was laid out in RCB design with three replications. Fertilizer doses were 92 (200 Kg Urea): 15 (74 Kg TSP): 50 (100 Kg MP): 12 (67 Kg Gypsum): 3.6 (10 Kg Zn SO_4) Kg NPKSZn/ha. All amounts of P, K, S and Zn were applied at the time of final land preparation. Nitrogen was applied in 3 equal splits at 10-15 DAT, maximum tillering and before PI stage. Crop management such as weeding, disease and insect pests control were done in time. In RYT#1 (RLR) genotypes IR70213-10-CPA4-2-2-2 and B10533F-KN-12-2 were selected for earliness (10 days) and satisfactory yield potential (5.6 t/ha) as compared with standard checks (5.8 6.1 t/ha and 130 days growth duration). Considering yield (5.6 t/ha) and growth duration (121 days) genotype WAS 122-IDSA14-WASB-FK1 (NERICA-L-8) was selected from RYT#2 (RLR). In RYT#3 (PQR) genotypes BR8226-8-5-2-2, BR8226-11-4-4-3, BR8227-6-2-1 and BR8226-17-1-2were selected for high yield potential (5-5.7 t/ha) as compared with standard checks (2.8-3.1 t/ha). From RYT#4 (MER) genotypes BR7840-54-3-2-2 and BR8418-1-3 were selected for giving 1 t/ha higher yield and showing 11-14 days earlier than standard check BRRI dhan32 (4.2 t/ha yield and 132 days growth duration) and performed similar yield and growth duration as compared with standard check BRRI dhan39. In RYT#5 (GSR) considering yield performance (4.5-4.7 t/ha) genotypes IR8340-B-28-B and HHZ5-SAL10-DT1-DT1 were selected as compared with standard checks (Table 2).

Table 2. Yield and agronomic performance of breeding materials of Regional Yield Trial (RYT), T. Aman, 2014-15, BRRI R/S, Comilla

Sl No	Designation	SH (cm)	PH (cm)	GD (days)	Yield (t/ha)	LD Score (%)	Remarks

RYT#1 (RLR)							
1	IR70213-10-CPA4-2-2-2	49	109	121	5.6		FSm- Score 3, ShB- Score 3, grain spoted
2	B10533F-KN-12-2	41	107	119	5.6		ShB- Score 3-5
3	BRRI dhan32 (CK)	41	124	130	5.8	55	
4	BRRI dhan49 (CK)	41	104	131	6.1		FSm- Score 7, ShB- Score 3-5
D/S: 14.07.14					D/T: 16.08.14		
RYT#2 (RLR)							
1	WAS 122-IDSA14-WASB-FK1 (NERICA-L-8)	42	101	121	5.6		FSm- Score 1-3, Uniform flowering
2	BRRI dhan56 (CK)	51	115	115	4.5		leaf droopy
3	BRRI dhan49 (CK)	44	103	131	6.7		FSm- Score 3
D/S:14.07.14					D/T:17.08.14		
RYT#3 (PQR)							
1	BR8226-8-5-2-2	36	109	135	5.0		
2	BR8226-11-4-4-3	37	99	135	5.0		Plant HYV type
3	BR8226-17-1-2	41	11	133	5.7		panicle reside under the flag leaf
4	BR8227-6-2-1	43	123	133	5.4		Uneven tillering, panicle reside under the flag leaf
5	BRRI dhan34 (CK)	41	135	131	2.8	100	
6	BRRI dhan37 (CK)	50	129	136	3.1	83	
D/S: 14.07.14					D/T: 18.08.14		
RYT#4 (MER)							
1	BR7840-54-3-2-2	40	117	121	5.5		FSm- score <1, small bold grain
2	BR8418-1-3	31	101	118	5.3		FSm- score 1-3, Uniform flowering
3	BRRI dhan32 (CK)	36	113	132	4.2	12	
4	BRRI dhan39 (CK)	34	107	123	5.4		FSm- score 1-3
D/S:16.07.14					D/T: 21.08.14		
RYT#5 (GSR)							
1	IR8340-B-28-B	38	104	115	4.5		ShB- score 3-5, BB- score 3-5
4	HHZ5-SAL10-DT1-DT1	36	111	117	4.7		ShB- score 3-5
3	BRRI dhan39 (CK)	34	114	118	4.6		ShB- score 3-5
4	BRRI dhan56 (CK)	40	113	112	4.1		ShB- score 5, BB- score 5, RTV score 1-3

D/S:16.07.14	D/T:16.08.14

* FSm- False Smut, ShB- Sheath Blight, BB- Bacterial Leaf Blight, RTV- Rice Tungro Virus, RD- Rat damage

* SH- Seedling Height, PH- Plant Height, GD- Growth duration, LD- Lodging

Advanced Yield Trial (AYT)

Nine genotypes were evaluated in AYT#1 (PQR) and AYT#2 (RLR) against the standard checks BRRI dhan33, BRRI dhan34, BRRI dhan37, BRRI dhan39, BRRI dhan49 and BINA dhan7 to evaluate the advanced breeding lines for development of variety suitable at Comilla region. Thirty days old seedlings were transplanted in a 5.4 m x 12 rows plot following RCB design with three replications using single seedling per hill at a spacing of 20 x 15cm. Recommended fertilizer doses were applied with a usual split application of urea in three times at 15, 30 and 45 days after transplanting. Other cultural operations were done as and when necessary. Crop management such as weeding, disease and insect pests control were done in time. In AYT#1 (PQR) genotypes BR7697-15-4-4-2-1 and BR7697-15-4-4-2-2 were selected for high yield potential (4.8-5.1 t/ha) as compared with Standard checks (2.7-4.1 t/ha). In AYT#2 (RLR) considering the yield performance (5.2-5.6 t/ha) genotypes BR7638-7-2-5-2 and AL-29 were selected as compared with Standard checks (3.9-5.5 t/ha) (Table 3).

Table 3. Yield and agronomic performance of breeding materials of Advanced Yield Trial (AYT), T. Aman, 2014-15, BRRI R/S, Comilla

Sl No	Designation	SH (cm)	PH (cm)	GD (days)	Yield (t/ha)	Remarks
1	BR7697-15-4-4-2-1		117	129	4.8	FSm-1, BB-5
2	BR7697-15-4-4-2-2		112	127	5.1	BB-5
3	BRRI dhan39 (Ck)		104	124	2.7	RD-50%
4	BRRI dhan37 (Ck)		131	134	4.1	
5	BRRI dhan34 (Ck)		137	130	3.7	Ldg-95%
	LSD 5%		4.56	1.15	1.20	
D/S:17.07.2014					D/T:22.08.2014	
	AYT#2					
1	BR7638-7-2-5-2		110	131	5.6	
2	AL-29		105	128	5.2	FSm-1
3	BRRI dhan33 (CK)		108	127	3.9	RD-15%

4	BRRI dhan39 (CK)		109	122	3.8	RD-10%, FSm-1
5	BRRI dhan49 (CK)		99	131	5.5	FSm-7
6	BINA dhan7 (CK)		98	121	2.7	BB-5-7, RD-30%
	LSD 5%		7.2	1.08	1.65	
D/S:17.07.2014 D/T:22.08.2014						

* SH- Seedling Height, PH- Plant Height, GD- Growth duration, LD- Lodging

Irrigated Rice Ecosystem (Boro)

Hybridization

Thirty four crosses were made using 37 parents for development of improved rice varieties with high yield potential along with earliness, resistance to diseases and insect pests and suitable for Comilla region.

F_1 confirmation

Twenty seven crosses and their respective parents were grown. Out of 27 crosses, 27 crosses were confirmed and registered in BRRI, Comilla cross list with station code BRC465 to BRC492.

Growing of F_2 population

F_2 seeds of 9 crosses along with their parents were grown for selection of progenies with desirable plant type and high yield potential. Four hundred and fourteen (414) plant progenies were selected from population of nine crosses.

Pedigree Nursery (F_3, F_4 , F_5 and F_6 generations)

A total of 1481 progenies (178 F3, 950 F4, 182 F5 and 171 F6) were grown for selection of desirable segregates with emphasis on earliness, strong culm, high yield potential and disease and insect resistance at field condition. One hundred and seventy three (173), 701, 101 and 107 plant progenies were selected from F3, F4, F5 and F6 generations, respectively.

Preliminary Yield Trial (PYT)

In total, 25 genotypes from OT# Comilla were evaluated in PYT#1, PYT#2 and PYT#3 at BRRI Comilla against standard checks BR16, BRRI dhan29, BRRI dhan50, BRRI dhan58, BRRI dhan59 and BRRI dhan60 for initial yield evaluation and selection of desirable lines compared to standard checks. Forty to forty five days old seedlings of each genotype were transplanted @ 2-3 seedling

with a spacing of 20 cm × 20 cm. The unit plot size was 5.4 m × 8 rows. The field layout was RCBD with two replications. Recommended fertilizer doses were applied with a usual split application of urea in three times at 15, 30 and 45 days after transplanting. Other cultural operations were done as and when necessary. In PYT#1 genotype BRC297-15-1-1-was selected for high yield performance (6.5 t/ha) and 7 days earliness as compared with standard checks (6.2-6.7 t/ha and 145 days growth duration) (Table 6). From RYT#2 genotypes BRC270-2-1-1-2, BRC319-9-1-5 and BRC319-9-1-4 were selected for giving 0.5-1.4 t/ha higher yield than standard checks (5.4- 5.6 t/ha). Considering yield (5.3-5.7 t/ha) and growth duration (143-146 days) genotypes BRC298-2-1-2-2 and BRC297-12-3-1-1 were selected as compared with standard checks (5.3- 6.7 t/ha and 146-160 days).

Evaluation of Spike gene lines

Two genotypes were evaluated at BRRI Comilla against standard checks IR64, NSIC158 and BRRI dhan28 for initial yield evaluation and selection of desirable lines compared to standard checks. Twenty eight days old seedlings of each genotype were transplanted @ 2-3 seedling with a spacing of 20 cm × 15 cm. The unit plot size was 5 m × 12 rows. The field layout was RCBD with three replications. Recommended fertilizer doses were applied with a usual split application of urea in three times at 15, 30 and 45 days after transplanting. Other cultural operations were done as and when necessary. Genotypes IR64-NIL5{IR64(qTSN4.4-YP9)}and IR101686-1-1{NSIC 158(qTSN4.1-YP4)} gave satisfactory yield (5.3- 5.7 t/ha) as compared with Checks (5.7-6.0 t/ha). This experiment is needed to further evaluate for late showing (Table 4).

Table 4. Yield and agronomic performance of Spike gene lines, Boro 2014-15, BRRI R/S, Comilla

Sl No	Designation	SH (cm)	PH (cm)	Pl. /m2	D/F (50%) (days)	GD (days)	Yield (t/ha)	Remarks
Spike gene								
1	IR64	27	87	373	85	118	5.7	
2	IR64-NIL5 {IR64(qTSN4.4-YP9)}	23	92	365	88	116	5.3	
3	NSIC158	20	89	407	92	122	5.6	
4	IR101686-1-1 {NSIC 158(qTSN4.1-YP4)}	22	93	357	92	121	5.7	
5	BRRI dhan28 (CK)	23	100	315	84	109	6.0	
	5%LSD 8DF	1.58	1.82		0.91	1.93	0.85	

D/S: 27/1/2015 D/T: 24/02/2015

Regional Yield Trial (RYT)

Six RYTs from Plant Breeding Division of BRRI HQ consisting of 35 genotypes were evaluated in RYT#1 (PQR), RYT#2 (PQR), RYT#3 (Short duration), RYT#4 (Favorable Boro), RYT#5 (Micronutrient) and RYT#6 (GSR) at BRRI R/S Comilla against the standard checks BRRI dhan28, BRRI dhan29, BRRI dhan45, BRRI dhan50, BRRI dhan60 and BRRI dhan63 and another two RYTS from Biotechnology Division consisting 5 genotypes were evaluated in RYT# 1 (Biotech) and RYT#2 (Biotech) for evaluation of specific and general adaptability of the genotypes in on-station condition. Forty day old seedlings of each genotype were transplanted @ 2-3 seedlings with a spacing of 25 X 15 cm. The unit plot size was 5.4m x 12 rows. The field layout was RCB with three replications. Fertilizers @ 120:20:60:20:36 kg NPKSZn/ ha with all amount of P and K were applied at the time of final land preparation. Nitrogen was applied in 3 equal splits at 10-15 DATs, maximum tillering and before PI stage. Gypsum and Zinc sulphate @ 20 and 4 kg/ha were applied during land preparation. Crop management such as weeding, controlling disease and insect pests was done in time. In RYT#3 ((Short duration), genotype NERICA Mutant was selected for giving higher yield (6.1 t/ha) than standard checks (5.1 t/ha). In RYT#4 (Favorable Boro) genotype BR7683-30-3-3-4 was selected for its yield potential (6.0 t/ha) and similar growth duration (145 days) as compared with standard checks (5.6- 5.7 t/ha) BRRI dhan28 and BRRI dhan60. Considering high yield performance (6.2- 7.1 t/ha) genotypes BR8257-37-1-2-2, BR7833-19-2-3-5, BR8261-19-1-13 and BR7879-17-2-4-HR3-P1 were selected from RYT#5 (Micronutrient) as compared with BRRI dhan28 (5.3 t/ha). In RYT#6 (GSR) genotypes HHZ23-DT16-DT1-DT1 and HHZ15-SAL13-Y1 were selected for giving 0.5-1.5 t/ha higher yield than all checks (6-6.4 t/ha) (Table 5). In RYT#1 (Biotech) genotype BR4909-R1-R2 was selected for high yield potential than BRRI dhan28 (4.2 t/ha). From RYT#2 (Biotech) genotype BR6158RWBC2-2-1-1 was selected for higher yield (8.3 t/ha) as compared with standard checks (5.8-7.6 t/ha) (Table 6).

Table 5. Yield and agronomic performance of breeding materials of Regional Yield Trial (RYT), Boro 2014-15, BRRI R/S, Comilla

SL#	Designation	SH (cm)	PH (cm)	D/F (50%) (days)	GD (days)	Yield (t/ha)	Remarks
RYT#3 (Short duration)							
1	NERICA Mutant	25	88	117	144	6.1	
2	BRRI dhan28 (CK)	28	90	115	140	5.1	
3	BRRI dhan45 (CK)	24	90	116	142	5.1	
	D/S: 01.12.2014		D/T: 19.01.2015				
RYT#4 (Favorable Boro)							

1	BR7683-30-3-3-4	26	85	116	145	6.0	Long & medium bold grain, some panicles have white sterile spikelet
11	BRRI dhan28 (CK)	21	91	116	145	5.7	
12	BRRI dhan29 (CK)	18	91	129	146	7.7	
13	BRRI dhan60 (CK)	24	84	117	146	5.6	Uneven panicle, some panicles have white sterile spikelet
	D/S: 03.12.2014		D/T: 24.01.2015				
RYT#5 (Micronutrient)							
1	BR8257-37-1-2-2	23	92	113	143	6.2	
2	BR7833-19-2-3-5	22	107	119	147	6.5	
3	BR8261-19-1-13	26	105	119	150	7.1	
4	BR7879-17-2-4-HR3-P1	24	119	121	149	6.9	Grain color BRRI dhan56 type
5	BRRI dhan28 (CK)	23	95	116	142	5.3	
6	BRRI dhan29 (CK)	17	94	124	157	7.7	
	D/S: 03.12.2014		D/T: 21.01.2015				
RYT#6 (GSR)							
1	HHZ15-SAL13-Y1	19	88	122	150	6.9	Plant type long, panicle reside the leave
2	HHZ23-DT16-DT1-DT1	15	92	125	152	7.5	Plant type short
3	BRRI dhan29 (CK)	18	97	127	158	6.7	
4	BRRI dhan60 (CK)	24	93	116	143	5.8	
	D/S: 03.12.2014		D/T: 22.01.2015				

*M- Medium, MS- Medium Selender,

* SH- Seedling Height, PH- Plant Height, D/F- Days to 50% Flowering , GD- Growth duration, Pl/m^2- panicle/ m^2

Table 6. Yield and agronomic performance of breeding materials of Regional Yield Trial (RYT) (Biotech), Boro 2014-15, BRRI R/S, Comilla

SL#	Designation	SH (cm)	PH (cm)	GD (days)	Pl./ m^2	Sterility (%)	Yield (t/ha)	Remarks
RYT#1 (Biotech)								
1	BR4909-R1-R2	25	110	150	317	19	6.6	Tall at veg. phase, short bold grain
2	BRRI dhan28 (CK)	25	95	143	354	30	4.2	RD-30%, ShB-1-3
	D/S: 30.11. 2014			D/T: 18.01.2015				
RYT#2 (Biotech)								
1	BR6158RWBC2-2-1-1	22	105	157	313	12	8.3	
2	BRRI dhan58 (CK)	22	89	149	303	12	5.8	RD-3-4%
3	BRRI dhan29 (CK)	19	87	155	308	13	7.6	

** ShB- Sheath blight, RD- Rat damage, M- Medium, MS- Medium Selender

* SH- Seedling Height, PH- Plant Height, D/F- Days to 50% Flowering , GD- Growth duration, Pl/m^2- panicle/ m^2

Advanced Yield Trial

Nine genotypes were evaluated in AYT#Com against standard checks BRRI dhan28, BRRI dhan29, BRRI dhan50, BRRI dhan55, BRRI dhan58 and BRRI dhan60 to evaluate the advanced breeding lines for development of variety suitable at Comilla region. Forty days old seedlings of each genotype were transplanted @ 2-3 seedling with a spacing of 20 cm × 20 cm. The unit plot size was 5.4 m × 12 rows. The field layout was RCBD with two replications. Recommended fertilizer doses were applied with a usual split application of urea in three times at 15, 30 and 45 days after transplanting. Other cultural operations were done as and when necessary. BR7781-10-3-2-2, BR7358-35-2-1-1 and HHZ23-DT16-DT1-DT1 were selected for high yield potential (5.7-6.5 t/ha) and good phenotypic appearance as compared with Standard checks (4.5- 7.0 t/ha) from this trial (Table 7).

Table 7. Yield and agronomic performance of breeding materials of Advanced Yield Trial (AYT)# Com, Boro 2014-15, BRRI R/S, Comilla

Sl No	Designation/ Treatment	SH (cm)	PH (cm)	Pl. /m2	D/F (50%) (days)	GD (days)	Yield (t/ha)	Remarks
AYT#Com								
3	BR7781-10-3-2-2	16	100	340	106	137	5.7	Grain tip- red colored, VSMB grain (BR5 type)
6	BR7358-35-2-1-1	17	88	370	111	137	6.2	Uniform flowering, dwarf plant
7	HHZ23-DT16-DT1-DT1	15	92	350	109	139	6.5	dwarf plant, Having awn
10	BRRI dhan28 (CK)	19	95	293	101	127	4.6	
11	BRRI dhan29 (CK)	15	90	288	115	145	7.0	
12	BRRI dhan50 (CK)	17	77	355	109	135	5.2	
13	BRRI dhan55 (CK)	18	87	190	100	127	5.7	
14	BRRI dhan58 (CK)	14	91	228	103	132	6.0	
15	BRRI dhan60 (CK)	19	89	285	119**	144**	4.5	
	5%LSD 14DF	1.54	4.97	74.25	2.14	2.08	1.80	

D/S: 22/12/2014 D/T: 27/01/2015

*= Data from one replication, **= BRRI dhan60 D/S=3/12/2014

* SH- Seedling Height, PH- Plant Height, D/F- Days to 50% Flowering , GD- Growth duration, Pl/m^2- panicle/ m^2

Advanced Yield Trial (Regional)

In this experiment, five genotypes were evaluated in four locations of Comila districts against standard checks BRRI dhan28 and BRRI dhan50 to evaluate the advanced breeding lines for development of variety suitable at Comilla region. Forty days old seedlings of each genotype were transplanted @ 2-3 seedling with a spacing of 20 cm × 20 cm. The unit plot size was 5.4 m × 12 rows. The field layout was RCBD with two replications. Recommended fertilizer doses were

applied with a usual split application of urea in three times at 15, 30 and 45 days after transplanting. Other cultural operations were done as and when necessary. From this trial genotypes BR7800-63-1-7-3, BR7781-10-2-3-2, BR7812-19-1-6-1-P4 and BR8245-2-1-4 were selected for high yield potential (6.5-7.1 t/ha), good phenotypic appearance as compared with Standard checks (6.0-6.3 t/ha) (Table 8).

Table 8. Yield and agronomic performance of breeding materials of Advanced Yield Trial (AYT)#Regional, Boro 2014-15, BRRI R/S, Comilla

Sl No	Designation/ Treatment	Phenotypic acceptance		GD (days)	Yield (t/ha)	Remarks
		veg.	Mat.			
1	BR7800-63-1-7-3	4	5	134	7.0	grain- bold
2	BR7781-10-2-3-2	4	4	139	6.5	grain tip- red colored, size- very short (BR5 type), mild scented
3	BR7812-19-1-6-1-P4	5	5	136	7.1	M bold & M long grain
4	BR8245-2-1-4	3	3	143	6.8	Uniform flowering, M slender grain
6	BRRI dhan28 (Ck)	5	5	131	6.3	
7	BRRI dhan50 (Ck)	4	5	140	6.0	
	5% LSD 18DF			2.65	0.752	

D/S:22/12/2014 D/T: 27/1/2015-3/02/2015

* GD- Growth duration

Breeder Seed Production

For T. Aus BRRI dhan48 were grown in 0.60 ha land for breeder seed production following the standard management practices. Due to heavy rain fall creating water stagnation 0.32 ha land of BRRI dhan48 was fully damaged. In total, 750 kg BRRI dhan48 breeder seeds were produced. For T .Aman, BRRI dhan49, BRRI dhan57, BRRI dhan 62 and BR10 were grown in 4 ha land for breeder seed production following the standard management practices. Due to heavy rain fall creating water stagnation 0.70 ha land BRRI dhan57 and 1.0 ha land of BRRI dhan62 were fully damaged. In total, 6150 kg BRRI dhan49, 825 kg BRRI dhan57 and1800 kg BR10 breeder seeds were produced. For Boro, BRRI dhan28, BRRI dhan29, BRRI dhan50, BRRI dhan58 and BRRI dhan69 were grown in 5.70 ha land for breeder seed production following the standard management practices. In total, 9975 kg BRRI dhan28, 11250 kg BRRI dhan29, 980 kg BRRI dhan50, 2775 kg BRRI dhan58 and 6825 kg BRRI dhan69 breeder seeds were produced and were sent to GRS division, BRRI Gazipur.

Programme Area : Pest Management

Experiment 1: Survey on the occurrence of diseases in the BRRI - Comilla farm, some part of Comilla district during Aman and Boro season 2014-15..

During Aman and Boro seasons, a survey was conducted in BRRI- Comilla farm and some part of comilla district to record the incidence and severity of the diseases. All seed production and experimental plots were observed for recording the disease data on variety wise. It was also observed few villages of Sadar Dhakkin, Laksham and Baurura Adarshaw sadar, Buringchang, Chandina and Nangolkot upzilla of Comilla. The name of all varieties was shown in the table 1. From each plot, randomlly 20 hills were selected for recording the disease incidence and severity on data sheet. Recorded major diseases were false smut, tungro, sheath blight and blast.

In Aman season, among the diseases false smut was the most prevalent and found in most of the varieties/lines of BRRI-Comilla farm. Incidence (27%) and severity of false smut disease was more in BRRIdhan49 compared to other varieties/ lines. Tungro disease was also found in BR11, BRRIdhan56, BRRIdhan57 and BRRIdhan62 with high severity index (DI) ranged from 7-9 as per SES. Incidence of neck blast disease was 5%, 18%, 4%, 12% and 7% in BR5, BRRIdhan34, BRRIdhan37, BRRIdhan38 and IR64 respectively with medium severity index ranged from 3-5. The lower incidence and severity of sheath blight disease was observed in BR4, BR10, BR11, BR22, BR25, and BRRIdhan30. It was ranged from 5-12% incidence and 3-5 DI. Outside of BRRI-Comilla farm, the rice fields of Sadar Dhakkin, Laksham and Baurura upzilla of Comilla district were severely affected by tungro disease at maximum tillering stage. The varieties BR11, BR22, BRRIdhan32 and BRRIdhan46 showed highly susceptible to tungro disease with 20-55% incidences and 5-9 severity scale. It was also observed medium severity of sheath blight disease ranged from 3-7 as per SES.

In Boro season, the highest incidence (25%) of neck blast disease was recorded in BRRIdhan64 and lowest in BRRIdhan58. The BRRIdhan28 and BRRIdhan29 were infected by 7-8% neck blast incidence with 5-7 severity indexes.

Experiment 2: Integrated rice false smut disease management, T. Aman-2014

The experiment was conducted with BRRIdhan49 against false smut disease under natural condition at BRRI Regional station Comilla farm (AEZ17, land type- MHL) during T. Aman

season, 2014. Land preparation and other agronomic managemnt were followed as per BRRI recimmended practices. Recommended fertilizer doses were applied with a usual split application of urea in three times at 15, 30 and 45 days after transplanting. The experiment was laid out in split-splitl RCB design with three replications. Thirty days old seedlings were transplanted with spacing of 25 cm x 15 cm. Each plot size was 3 m x 3 m. Three fungicides, Nativo (T1), Azoxystrobin (T2), Azoxystrobin+ Propiconazole (T3) with control (T4) were tested under three N-level (N1= 1/3rd higher than optimum dose, N2 = 1/3rd less than optimum Optimum dose, N3= optimum dose) and three planting time (15 June, 30 June and 15 July). The first spray was done at booting stage and second spray was applied 15 days after first spray. The data of disease severity, incidence false smut on panicla, yield and yield components were recorded.

The incidence of false smut disease (% panicle infection) was significantly higher in 3rd planting time (15 July) than planting 1st and 2nd time (15 June and 30 June). But there was no significant difference of percent panicle infection between 1st and 2nd planting time. The incidence of false smut disease was increased in late planting i.e after month of June, but it is needed to test further (Table 9). The effect of N-level on the incidence of false smut disease showed significant difference between high N-level and less N-level. But high N-level and less N-level demonstrated statistical similar result compared to optimum N-level. It appears from the result that percent panicle infection was increased with the increasing of N-level (Table 10).

Table 9: Effect of planting time on the incidence of false smut disease in BRRI dhan49, T. Aman-2014.

Planting time	Panicle infection (%)
1st Planting time (15 June)	0.2685b
2nd Planting time (30 June)	0.2165b
3rd planting time (15 July)	0.9756a

Table 10: Effect of N-level on the incidence of false smut disease in BRRI dhan49, T. Aman-2014.

N-level	Panicle infection (%)
N1= 1/3rd higher than optium dose	0.7160a
N2= 1/3rd less than optium dose	0.2721b
N3= Optium dose	0.4698ab

Programme Area: Crop –Soil-Water management

Expt.1: Effect of seeding time on growth and yield of BRRI dhan62 in Boro season.

The study was undertaken to find the potentiality of BRRI dhan62 as Boro variety and tolerance to cold. Forty day-old seedlings of BRRI dhan62 were transplanted during 01 October to 16 February at 15-days interval and compared with BRRI dhan28 (ck). Seedlings were transplanted at 20- x 20-cm spacing and unit plot size was 5m x 4.4m. The treatments were distributed in a split-plot design, placing planting date in the main plots and varieties in the sub-plots. Fertilizers were applied @ 120-35-16-2 kg/ha N-P-K-S-Zn as urea, triple super phosphate, muriate of potash and gypsum. Fertilizers other than Urea and MoP were applied as basal during final land preparation. Nitrogen was applied as top dress in three equal splits at active tillering (AT), maximum tillering (MT) and 5-7 days before panicle initiation (PI) stages. 2/3 Mop was applied as basal and rest during 3rd top dressing of urea. Other management practices were done according to requirement. 1st and 2nd were damaged by tungro and 10th set was destroyed by the outsider just before two days of planting.

Result showed that all the traits were significant with respect of seeding time except 1000 seed weight. Grain yield was significant for seeding date and variety interaction. Both the variety gave highest yield on 01 December seeding i.e 10 January planting. BRRI dhan62 yielded higher (8.22 t/ha) than BRRI dhan28 (7.34) having growth duration 140days and 137days respectively (Table 12). Plant height was significant for variety, seeding time and variety seeding time interaction. Both the variety produced highest plant height on 01 December seeding and BRRI dha28 (108.2cm) was taller than BRRI dhan62 (98.9cm). BRRI dhan62 was a little bit tolerant to lodging. The traits panicle/m^2, grains per panicle and sterility were significant for seeding time irrespective of variety (Table-13).01 December seeding gave higher yield due to higher number of grains per panicle and less sterility.

Table 12: Effect of seeding time on yield, growth duration, and plant height

Seeding time	Grain yield(t/ha)		Growth duration (days)		Plant height(cm)	
	BRRI dhan28	BRRI dhan62	BRRI dhan28	BRRI dhan62	BRRI dhan28	BRRI dhan62
01.11.14	4.36	3.49	151	155	89.3	80.5
16.11.14	4.56	4.90	145	149	99.3	85.6
01.12.14	7.34	8.22	137	140	108.2	98.9
16.12.14	6.33	6.74	132	135	94.3	88.2
01.01.15	4.47	4.38	129	132	82.2	89.4
16.01.15	5.71	5.19	124	127	100.2	98.6
01.02.15	5.15	4.65	120	123	97.1	97.7
CV(%)	3.67				2.71	
LSD(0.05)	0.3458				4.451	

Table 13: Effect on tiller number, panicle number, grains per panicle, 1000 seed weight and sterility

Seeding time	Tiller number/m^2	Panicle number/m^2	Grains/panicle	1000 seed weight(g)	Sterility (%)
01.11.14	738	684	77	20.72	44
16.11.14	729	617	87	21.96	36
01.12.14	520	450	105	21.14	24
16.12.14	550	470	74	20.36	28
01.01.15	375	338	79	21.0	17
16.01.15	346	300	89	21.94	17
01.02.15	313	258	71	21.03	33
CV (%)	18.41	18.83	14.51	5.2	21.42
LSD	164.5	32.26	21.05	NS	10.32

Expt.2: Effect of time of planting on growth and yield of some BRRI released varieties in Aman season.

In Aman BRRI released variety BRRI dhan49, BRRI dhan56 and BRRI dhan57 were tested and compared with BRRI dhan46 (ck.) to determine suitable time of planting and photoperiod sensitivity of the varieties. . Thirty day-old seedlings were transplanted during 01 July to 16 August at 15-days interval. Seedlings were transplanted at 20- x 20-cm spacing and unit plot size was 5m x 4.4m. The treatments were distributed in a split-plot design, placing planting date in the main plots and varieties in the sub-plots. Fertilizers were applied @ 104-15-12-1 kg/ha N-P-K-S-Zn as urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate. Fertilizers other than Urea and MoP were applied as basal during final land preparation. Nitrogen was applied as top dress in three equal splits at active tillering (AT), maximum tillering (MT) and 5-7 days before panicle initiation (PI) stages. 2/3 Mop was applied as basal and rest during 3rd top dressing of urea. Management practices were done according to requirement.

Difference in grain yield was significant for both variety and planting time and nonsignificant for variety and planting time interaction. BRRI dhan46 (ck) produced the highest grain yield (4.59 t/ha) irrespective of planting time. All the varieties gave higher yield on 01 July seeding and yield decreased with the advent of time (Table 14). Growth duration of the varieties increased when planted earlier.

Table 14: Effect of planting time on yield (t/ha)and duration (days) (in parenthesis)

Variety	Seeding time			
	01 July	16 July	01Augst	16 Augst
BRRI dhan46(ck)	5.89(145)	5.63(137)	5.20(125)	5.36(114)
BRRI dhan49	5.37(132)	5.04(125)	4.8(120)	3.22(124)

BRRI dhan56	4.02(112)	3.91(113)	3.31(108)	2.61(108)
BRRI dhan57	3.10(108)	3.06(103)	3.09(100)	2.42(98)
CV (%)	7.95			
LSD(0.05)	NS			

Programme Area: Socio-Economics and Policy

Expt.1: Stability analysis of BRRI developed Aman varieties (T. Aman 2014-15)

Twenty seven varieties were evaluated at BRRI, Comilla farm. The experiment was laid out in RCB design with three replications. Fourty days old seedlings were transplanted with spacing of 20 cm x 20 cm. Each plot size was 6.6 m x 2 m. Recommended fertilizer doses were applied with a usual split application of urea in three times at 15, 30 and 45 days after transplanting.

Among the 27 varieties, varieties gave yield ranged from 2.8- 5.33 t/ha and showed growth duration ranged from 105-149 days. Considering yield performance the top five varieties were BRRI hybrid dhan4 (5.33 t/ha), BRRI dhan49 (5.25 t/ha), BRRI dhan44 (5.06 t/06), BRRI dhan46 (4.98 t/ha), and BRRI dhan31 (4.92 t/ha) but they are statistically similar. Over aged seedling, water logged condition and lodging results the lower yield of the variety.

Expt.: Stability analysis of BRRI developed Boro varieties, Boro, 2014-15

Thirty two varieties were evaluated at BRRI, Comilla farm. The experiment was laid out in RCB design with three replications. Forty four days old seedlings were transplanted with spacing of 20 cm x 20 cm. Each plot size was 6.8 m x 1.8 m. Recommended fertilizer doses were applied with a usual split application of urea in three times at 15, 30 and 45 days after transplanting.

Results showed that grain yield for the varieties were statistically significant. Among the 32 varieties, the top most five varieties were BRRI hybrid dhan3 (8.79 t/ha), BRRI hybrid dhan2 (8.48 t/ha), BRRI dhan55 (7.31t/ha), BRRI dhan60 (7.23 t/ha) and BRRI dhan58 (7.15 t/ha) and showed growth duration ranged from 145-147 days. Rest of the varieties gave yield ranged from 4.26- 6.87 t/ha and showed growth duration ranged from 138- 160 days.

Programme Area: Rice Farming System

Expt.: Evaluation of Rice Crop Manager RCM) in farmers' field during *Boro* 2014-15

Evaluation of RCM was done in 8 farmers' fields in Jagannathpur and Panchthubi blocks of Comilla Sadar Upazila. Newly released Boro variety, BRRIdhan58 was used in both RCM and

farmers' treatments. The average yield in RCM plot was 6.61t/ha and the yield advantage in RCM plots over farmers' was 0.38 t/ha. Farmers used extremely higher dose of TSP which had no impact on yield. On average farmers used 229 kg TSP and 72 kg MOP per hectare which was 179 kg and 30 kg higher TSP and MOP, respectively than the RCM recommendation. On average farmers used 68 kg less urea than the RCM recommendation which was 252 kg/ha. Farmers did not use any Gypsum while the RCM recommendation was 42 kg/ha.

TECHNOLOGY TRANSFER

Demonstration and dissemination of BRRI dhan48 in Aus season (EQSS Project).

The demonstration of this variety was conducted in twenty five farmer's field of four upazila (Barura, Debidar, Muradnagar, Adarsha sadar) of Comilla district during Aus 2014-15 with the help of DAE. Among twenty five demonstrations twenty three was done successfully and the rest two was damaged due to drought. BRRI Comilla supplied 1kg seeds and fertilizers only. Rest of the management practices were done by the farmers. For each demonstration plot size was 15(fifteen) decimal. Average yield and growth duration of BRRI dhan48 over the locations were 4.78 t/ha and 108 days respectively. A total of 6660 kg of quality seed was produced.

Demonstration and Dissemination of quality seed production of different Aman varieties through EQSS project

The demonstration of this variety was conducted in ten locations of Comilla, B. Baria and Chandpur districts during Aman, 2014-15 seasons with the help of DAE. BRRI Comilla supplied seeds, fertilizer and sign board. Rest of the management practices was done by the farmers. Unit plot size of each demonstration was 33 decimal. Yield and location was shown in Table 15.

Table 15. Grain yield (t/ha) and growth duration of different varieties at different locations of Comilla region, Aman, 2014-15

Sl No	Locations (Upazila)	Variety	Growth duration (Days)	Yield (t/ha)	Remarks
1	Nangolkot, Comilla	BRRI dhan46	138	6.13	

2	Sadar Dhakkin, Comilla	BRRI dhan46	148	4.18	
3	Adarsha Sadar, Comilla	BRRI dhan46	160	3.1	
4	Devidar, Comilla	BRRI dhan46	140	4.25	
5	Muradnagar, Comilla	BRRI dhan49	134	5.39	
6	Sadar, Chadpur	BRRI dhan46	143	4.5	
7	Faridganj, Chadpur	BRRI dhan46	152	4.42	
8	Sadar, B. Baria	BRRI dhan46	-	-	Damaged due to flood
9	Sarail, B. Baria	BRRI dhan46	145	3.00	Flood affected
10	Kasba, B. Baria	BRRI dhan46	163	4.3	

Demonstration, Dissemination and quality seed production of different Boro varieties through EQSS project

The demonstration of this variety was conducted in ten locations of Comilla, B. Baria and Chandpur districts during Aman, 2014-15 seasons with the help of DAE. BRRI Comilla supplied seeds, fertilizer and sign board. Rest of the management practices was done by the farmers. Location and yield was shown in Table 16.

Table 16. Grain yield (t/ha) and growth duration of different varieties at different locations of Comilla region, Boro, 2014-15

Sl No	Locations (Upazila)	Variety	Growth duration (Days)	Yield (t/ha)
1	Sadar, B.Baria	BRRI dhan69	158	7.26
2	Sadar, B. Baria	BRRI dhan58	150	6.6
3	Nasirnagar, B. Baria	BRRI dhan69	151	8.10
4	Ashuganj, B. Baria	BRRI dhan69	150	6.00
5	Titas, Comilla	BRRI dhan58	144	7.50
6	Homna, Comilla	BRRI dhan69	147	8.83
7	Sadar Dakkhin, Comilla	BRRI dhan69	148	9.2
8	Brahmanpara, Comilla	BRRI dhan69	157	5.5
9	Chowddagram, Comilla	BRRI dhan58	145	6.21
10	Kachua, Comilla	BRRI dhan69	158	6.5

Demonstration and dissemination of Zn rich BRRI dhan64 in Boro season

The demonstration of this variety was conducted in Twenty five locations of five upazila ofComilla district during Boro, 2014-15 seasons with the help of DAE. BRRI Comilla supplied seeds,

fertilizer and sign board. Rest of the management practices was done by the farmers. Location and yield was shown in Table 17.

Table 17. Grain yield (t/ha) of BRRI dhan64 at different locations of Comilla , Boro, 2014-15

Location	Yield(t/ha)	Comment
Adarsha Sadar Upazila		
Amratoli	7.39	Neck blast infestation(NB)
Amratoli	7.07	NB
Piaratoli	6.71	NB
Elaspur	6.35	NB
Elaspur	6.36	NB
Burichong Upazila		
Mahismara	5.28	NB
Paruara	5.4	NB
Etbarpur	5.67	NB
Korpai	6.28	NB
Rajapur	5.27	NB
Sadar Daxin Upazila		
Hirapur	6.26	NB
Banipur	6.15	NB, Mixture
Baropara	6.31	NB
Sreemantapur	5.30	NB
Uttar Rampur	5.74	NB
Barura Upazila		
Murithaba	4.8	Severe NB
Chandipur	5.1	Severe NB
Amratoli	6.0	NB
Digalgao	7.06	NB
Lagnosar	5.59	NB
Chandina Upazila		
Harong	3.44	Severe NB
Pihor	4.69	Severe NB
Gobindpur	5.57	NB
Vagurapara	6.55	NB
Tatera	4.72	NB

Mean	**5.80**	

Training /Agricultural Fair/Field Day/ Motivational tour

Day long twenty eight training program on rice production technologies were conducted by BRRI comilla during the reporting year through EQSS project. Eight hundred and ten farmers (776 male and 34 female) were trained on these three training program. Day long two SAAO (53 male and 2 female) training was conducted through EQSS project. Besides, BRRI Comilla conducted one SAAO and one farmers' training. Fifteen field days were conducted in the demonstration area in the reporting year through EQSS project. BRRI Comilla also participated in three day long two agriculture and tree fairs, one day long seed fair and three motivational tour.

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PERSONNEL

Sl. no.	Name and designation	Man days
1	ASM Masuduzzaman, PhD, CSO	365
2	Md. Humayun Kabir, PhD, SSO	365
3	Fahmida Rahman, PhD, SSO*	90
4	ATM Sakhawat, MS, SSO*	285
5	Md. Mahbubur Rahman Dewan, MS, SSO**	285
6	M M Emam Ahmed, MS, SO	365
7	Md. Ibrahim, Dip. in Ag., FM	365
8	Shadat Hossain, Dip. in Ag., AFM***	185
9	Md. Shamsul Alam, Dip. in Ag., SA	365

*Transferred from BRRI Gazipur, **Transferred to BRRI Kushtia,
*** Transferred from BRRI Comilla

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SUMMARY

Varietal Development: In B. Aman season four tested entries yielded higher than local check Hbj.A.IV (2.75 tha^{-1}) in OT. In RYT, among the tested entries, BR224-2B-2-5(2.94 tha^{-1}), BR5915-B-7 (2.78 tha^{-1}), and Lal-khama (2.80 tha^{-1}) yielded higher than Hbj.A.IV (2.75 tha^{-1}). In RYT, T. Aman 2014, BR8143-15-2-1 (5.7 tha^{-1}) yielded higher than BRRI dhan32 (5.5 tha^{-1}) and BRRI dhan39 (5.2 tha^{-1}) with similar growth duration. In PVT, BR7357-11-2-4-1-1 (5.33 tha^{-1}) yielded higher than BRRI dhan37 (4.06 tha^{-1}) with shorter growth duration. In Boro season, fifteen F_8 plants were selected from F_7 population with desirable characters for the development of varieties suitable for haor Areas. In PYT#1, BR8625-14-7-4-1 (7.5 tha^{-1}) yielded similar to BRRI dhan29 (7.7 tha^{-1}) with shorter growth duration. In PYT#2, none of the tested entries, yielded higher than BRRI dhan29 (7.8 tha^{-1}). In SYT, NERICA L-22 (6.1 tha^{-1}) yielded similar to BRRI dhan28 (6.1 tha^{-1}) with longer growth duration. In RYT, no entry yielded higher than BRRI dhan28 (6.2 tha^{-1}). In RYT#1, BR8096-55-1-9-1 (5.9 tha^{-1}) and BR8076-1-2-2-3 (5.9 tha^{-1}) yielded higher than BRRI dhan50 (5.3 tha^{-1}). In RYT#2, BR7372-18-2-1-HR1-HR6 (Com) (6.1 tha^{-1}) and BR7372-18-3-3-HR3 (Com) (6.0 tha^{-1}) yielded higher than BRRI dhan28 (5.6 tha^{-1}) and BRRI dhan60 (5.4 tha^{-1}) with longer growth duration than BRRI dhan28. In RYT#3, NERICA mutant (4.8 tha^{-1}) yielded lower than BRRI dhan28 (5.2 tha^{-1}) and BRRI dhan45 (4.9 tha^{-1}), In RYT#4 BR7988-10-4-1 (6.2 tha^{-1}) yielded higher than BRRI dhan28 (5.4 tha^{-1}) with similar growth duration. BR7783-AC12-3 (6.6 tha^{-1}) yielded higher than BRRI dhan29 (6.3 tha^{-1}) and BR7671-37-2-2-3-7 (6.6 tha^{-1}) yielded higher than BRRI dhan60 (6.5 tha^{-1}). In RYT# 5**,** BR7840-54-3-2-1 (6.2 tha^{-1}) yielded higher than BRRI dhan28 (5.6 tha^{-1}) with longer growth duration and BR8261-19-1-1-3 (6.3 tha^{-1}) yielded similar to BRRI dhan29 (6.3 tha^{-1}). In RYT# 6, HHZ23-DT16-DT1-DT1 (6.8 tha^{-1}) and HHZ6-SAL3-Y1-SUB2 (6.7 tha^{-1}) yielded higher than BRRI dhan29 (6.4 tha^{-1}) and BRRI dhan60 (6.6 tha^{-1}). In MLT, BR7358-5-3-2-1-HR2 (Com) (5.7 tha^{-1}) yielded similar to BRRI dhan28 (5.8 tha^{-1}) with shorter growth duration. In RYT#1&2 (Biotech), BR8072-AC5-4-2-1-2-1 (7.1 tha^{-1}) yielded higher than BRRI dhan28 (6.7 tha^{-1}) and BR6158-RWBC2-2-1-1 (7.9 tha^{-1}) yielded higher than BRRI dhan58 (7.6 tha^{-1}) and BRRI dhan29 (7.8 tha^{-1}).

Crop-Soil-Water Management: In the missing element balanced fertilization with complete treatment can gave more than 8 tha^{-1} grain yield at Habiganj farm. Omission of P and S has no effect on decreasing grain yield over the complete treatment but omission of N drastically decreased grain yield. Now a day K also became a great concern for decreasing grain yield in this single cropped area.

Rice Farming System: The recommended patterns (BRRI dhan46 – BRRI dhan29 - Fallow) gave 15% higher grain yield and gross margin over existing farmers' patterns. The recommended cropping pattern gave the yield of 11.72 t/ha and gross margin of Tk. 222,680/ha. It was because of higher yield advantage between recommended and farmers' practice in both T. Aman and Boro season of newly released variety BRRI dhan46 which allow accommodating BRRI dhan29 in the pattern instead of BRRI dhan28. In Boro season, normal transplanting gave significantly higher grain yield than the double transplanting and delay planting. Significantly highest grain yield was obtained from normal planting (T_1=8.90 t/ha and T_2=8.80 t/ha) and lowest grain yield was observed from delayed transplanting of 75 days old seedlings (7.59 t/ha). DT gave significantly higher grain yield (8.32 t/ha) than the delay planting. Crop duration of delay planting was comparatively higher than the Normal and DT.

Technology transfer and other activities: Total TLS seed production of different popular rice varieties was 35,021 kg during 2013-14. A total of 11,250 kg Breeder seed of three popular rice

varieties were produced and sent to BRRI Breeder Seed Unit. Seven training programs and 46 field demonstrations (Boro & Aus) were also conducted in the reporting year.

USEFUL SCIENTIFIC INFORMATION

VARIETAL DEVELOPMENT

Deep Water Rice (B. Aman)

Project: Improvement of Deep Water Rice for Deep Flooded Environment

Expt: Observational Trial (OT)

Principal Investigators: MM E Ahmed

Co-Investigators: ASM Masuduzzaman and M M R Dewan

Objective: To evaluate yield and ancillary characters in deep flooded condition.

Materials and Methods: Seventeen homozygous genotypes were grown in the Regional station, BRRI, Habiganj during DWR, 2014. The materials were direct seeded in May after first shower in dry field in a 5m-row plot with 25cm spacing between rows. Fertilizers at the rate of 60:40:40:10 Kg ha^{-1} NPKS were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed twice (after seedling establishment and before flood water enter in the field). All other cultural management was done as and when necessary.

Results and discussion: Out of 17, BR7730-2B (2.87 tha^{-1}), BR7731-2B (2.97 tha^{-1}), BR7735-2B(2.78 tha^{-1}) yielded higher than local check Hbj.A.IV (2.75 tha^{-1}) (Table 1).

Table 1: List of the bulked homozygous materials from OT, DWR'2014

SL #	Designation	Yield (tha^{-1})	SL #	Designation	Yield (tha^{-1})
1	BR7730-2B	2.87	10	BR7739-2B	2.24
2	BR7731-2B	2.97	11	BR7740-2B	2.10
3	BR7732-2B	2.13	12	BR7741-2B	2.43
4	BR7733-2B	2.65	13	BR7742-2B	2.11
5	BR7734-2B	2.34	14	BR7743-2B	2.17
6	BR7735-2B	2.78	15	BR7744-2B	2.13
7	BR7736-2B	2.58	16	BR7745-2B	2.01
8	BR7737-2B	2.71	17	BR7746-2B	2.10
9	BR7738-2B	2.48	18	Hbj.A.IV (local check)	2.75

D/S: 04/06/2014

Expt: Regional Yield Trial (RYT)

Principal Investigator: MM E Ahmed

Co-Investigators: ASM Masuduzzaman and M M R Dewan

Objective: To evaluate promising genotypes in natural deep flooded condition.

Materials and Methods: Five advanced genotypes with check Hbj. A. (IV) and Birpala were grown in the Regional station, BRRI, Habigonj during B. Aman, 2014. The materials were direct seeded in May after first shower in dry field in a 5m-10-row plot with 25cm spacing between rows. One meter spacing was maintained between each entry. Fertilizers at the rate of 60:40:40:10 Kg ha^{-1} NPKS were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea were top dressed twice (after seedling establishment and before flood water enter in the field). All other cultural management was done as and when necessary.

Results and discussion: Among the tested entries, BR224-2B-2-5(2.94 tha^{-1}), BR5915-B-7 (2.78 tha^{-1}), Lal-khama (2.80 tha^{-1}) yielded higher than Hbj. A. IV (2.75 tha^{-1}) (Table 2).

Table 2: List of the DWR lines with yield (tha^{-1}) from RYT (Repeated), DWR'2014

Sl. no.	Designation	Yield (tha^{-1})
1	BR224-2B-2-5	2.94
2	BR5915-B-7	2.78
3	Bazail-65	2.65
4	Gabura	2.59
5	Lal-khama	2.80
6	Hbj.A.IV (local check)	2.75
7	Birpala (local check)	2.40

D/S: 04/06/2014

Season: Transplant Aman (T. Aman)

Expt: Regional Yield Trial (RYT)

Principal Investigator: PS Biswas

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: To evaluate the breeding lines for yield potentials and adaptability test in different agro climate condition of Bangladesh.

Materials and Methods: Seven advanced breeding lines along with BR26 and BRRI dhan48 as check were planted in a 5.4m-10-row plot with 20 cm spacing between rows. Fertilizers at the rate of 60:40:40:10 Kg ha^{-1} NPKS were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed twice, 10 and 30 days after transplanting. All other cultural management practices were done as and when necessary.

Results and Discussion: BR8143-15-2-1 (5.7 tha^{-1}) yielded higher than BRRI dhan32 (5.5 tha^{-1}) and BRRI dhan39 (5.2 tha^{-1}) with similar growth duration. BR7840-54-3-2-2 (5.1 tha^{-1}) and BR8418-1-3 (4.9 tha^{-1}) yielded higher than BRRI dhan56 (4.8 tha^{-1}) with longer growth duration (Table 3).

Table 3: Yield and ancillary characters of the advanced breeding lines, RYT, T. Aman' 2014

SL.	Designation	Pl. ht. (cm)	PACP*		Maturity (days)	Yield (tha^{-1})
			Veg.**	Mat.***		
1	BR7840-54-3-2-2	111	5	5	115	5.1
2	BR7879-17-2-4-HR3-P1	130	4	4	121	4.3
3	BR7671-37-2-2-3-7-3****	98	5	5	116	4.8
4	BR8143-15-2-1	114	5	5	120	5.7
5	BR8418-1-3	90	5	5	115	4.9
6	IR85850-75-2-2-3-2 (IR 10M 300)	103	5	5	115	4.8
7	PSBRC 82(IRRI 123)	102	5	5	120	5.8
8	BRRI dhan32(ck)	116	6	6	122	5.5
9	BRRI dhan39(ck)	103	5	5	120	5.2
10	BRRI dhan56(ck)	110	5	5	112	4.8
	LSD (5%)	2.69			1.55	0.26
	CV(%)	1.4			0.8	2.9

D/S: 21/7/14, D/T: 17/8/14

*PACP = Phenotypic acceptability Veg.**= Vegetative stage, Mat.***= Maturity stage

****Tungro infected while others were completely resistant

Expt: Proposed Variety Trial (PVT)

Principal Investigator: PS Biswas

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: On farm evaluation of proposed line by the NSB team for the T. Aman 2014-15

Materials and Methods: Two advanced breeding lines along with BRRI dhan39 as check was planted in a 5 m X 6 m plot with 20 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 $Kgha^{-1}$NPKSZn were applied. All fertilizers were applied at final land preparation except N. N in the form of Urea was top dressed thrice, 15 days after Transplanting (DAT), 30 DAT and 60 DAT. All other cultural management practices were done as and when necessary.

Results and Discussion: BR7528-2R-19-HR10 (6.28 tha^{-1}) yielded higher than BRRI dhan39 (6.03 tha^{-1}) with longer growth duration (Table 4).

Table 4: Yield data of Proposed Variety Trial, Zn Enriched Rice, T aman 2014-15

Sl. no.	Designation	Growth duration (days)	Yield (tha^{-1})
1	BR7528-2R-19-HR10	138	6.28
2	BRRI dhan39 (Ck)	133	6.03

D/S: 15/7/15 D/T: 16/8/15

Expt: Proposed Variety Trial (PVT)

Principal Investigators: MA Kader, HU Ahmed

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: On farm evaluation of proposed line by the NSB team for the season T. Aman 2014-15

Materials and Methods: Two advanced breeding lines along with BRRI dhan39 and BRRI dhan49 as checks was planted in a 5 m X 6 m plot with 20 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 $Kgha^{-1}$NPKSZn were applied. All fertilizers were applied at final land preparation except N. N in the form of Urea was top dressed thrice, 15 days after Transplanting (DAT), 30 DAT and 60 DAT. All other cultural management practices were done as and when necessary.

Results and Discussion: None of the entries yielded higher than the check varities (Table 5).

Table 5: Yield data of Proposed Variety Trial, RLR, T aman 2014-15

Sl. no.	Designation	Growth duration (days)	Yield (tha^{-1})
1	BR7472-16-2-1-2-3	128	4.57
2	BR7622-5-1-1-1	132	5.42
3	BRRI dhan39 (Ck)	130	4.10
4	BRRI dhan49 (Ck)	133	6.36

D/S: 16/7/15 D/T: 14/8/15

Expt: Proposed Variety Trial (PVT)

Principal Investigators: MA Kader, HU Ahmed

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: On farm evaluation of proposed line by the NSB team for the season T. Aman 2014-15

Materials and Methods: One advanced breeding line along with BRRI dhan37 as check was planted in a 5 m X 6 m plot with 20 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 $Kgha^{-1}$NPKSZn were applied. All fertilizers were applied at final land preparation except N. N in the form of Urea was top dressed thrice, 15 days after Transplanting (DAT), 30 DAT and 60 DAT. All other cultural management practices were done as and when necessary.

Results and Discussion: BR7357-11-2-4-1-1 (5.33 tha^{-1}) yielded higher than BRRI dhan37 (4.06 tha^{-1}) with shorter growth duration (Table 6).

Table 6: Yield data of Proposed Variety Trial, PQR, T. Aman 2014-15

Sl. no.	Designation	Growth duration (days)	Yield (tha^{-1})
1	BR7357-11-2-4-1-1	134	5.33
2	BRRI dhan37 (Ck)	139	4.06

D/S: 15/7/15 D/T: 15/8/15

IRRIGATED RICE (BORO)

Project: Development of Boro Varieties for Haor Areas
Expt: F_8 population
Principal Investigator: MM E Ahmed
Co-Investigators: ASM Masuduzzaman and M M R Dewan
Objective: To select F_8 progenies from F_7 population for the development of Boro varieties for haor areas.
Materials and Methods: Five F_7 s were grown in the regional station, Habiganj during Boro' 2014-15 season. The F_7 seedlings were planted in a 2.7m-row plot with 25 cm spacing between rows. Fertilizers at the rate of 80:60:60:10 Kg ha^{-1} NPKS were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15, 30 and 45 days after transplanting. All other cultural management practices were done as and when necessary.
Results and Discussion: Fifteen F_8 plants were selected from F_7 population with desirable characters for the development of varieties suitable for haor areas (Table 5).

Table 7: List of the F_8 materials, Boro'2015

Sl. no.	Parentages	Selected Plants No.
1	AS996/BR19	4
2	AS996/BRRI dhan45	4
3	IR7390-53-2-2/BRRI dhan29	3
4	IR7390-53-2-2/BRRI dhan45	2
5	BR19/AS996	2
Total selected plant		15

Expt : Preliminary Yield Trial (PYT)
Principal Investigator: MM E Ahmed
Co-Investigators: ASM Masuduzzaman and M M R Dewan
Objective: Verification of yield and other agronomic characters through Observational Trial of breeding lines for haor areas with growth duration close to BRRI dhan29.
Materials and Methods: Four advanced breeding lines along with BRRI dhan29 as check was planted in a 5.4m-10-row plot with 25cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kg NPKS and Zn were applied. All fertilizers were applied at final land preparation except N. N in the form of Urea was top dressed thrice, 15, 30 and 45 days after transplanting. All other cultural management practices were done as and when necessary.
Results and Discussion: One tested entry BR8625-14-7-4-1 (7.5 tha^{-1}) yielded similar to BRRI dhan29 (7.7 tha^{-1}) with shorter growth duration (Table 8).

Table 8: List of the homozygous lines with yield (tha^{-1}) from PYT#1, Boro'2015

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		

1	BR8621-13-5-7-3	98	5	5	146	5.8
2	BR8623-12-6-3-2	106	4	5	148	6.3
3	BR8624-9-5-3-1	107	5	5	149	5.5
4	BR8625-14-7-4-1	106	3	3	147	7.5
5	BRRI dhan29 (Ck)	90	3	3	161	7.7

D/S: 20/11/14 D/T: 30/12/14

Expt : Preliminary Yield Trial (PYT)

Principal Investigator: MM E Ahmed

Co-Investigators: ASM Masuduzzaman and M M R Dewan

Objective: Verification of yield and other agronomic characters through Observational Trial of breeding lines for Haor areas with growth duration closed to BRRI dhan29.

Materials and Methods: Four advanced breeding lines along with BRRI dhan29 as check was planted in a 5.4m-10-row plot with 25cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kg NPKS and Zn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15, 30 and 45 days after transplanting. All other cultural management practices were done as and when necessary.

Results and Discussion: None of the entries, yielded higher than BRRI dhan29 (7.8 tha^{-1}) (Table 9).

Table 9: List of the homozygous lines with yield (tha^{-1}) from PYT#2, Boro'2015

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	BRH1-14-3-4-2	123	5	4	152	6.5
2	BRH2-12-3-6-2	127	5	5	151	6.2
3	BRH3-15-2-4-1	133	5	5	150	6.3
4	BRH4-9-2-4-3-1	118	5	5	149	6.3
5	BRRI dhan29 (Ck)	98	3	3	161	7.8

D/S: 20/11/14 D/T: 31/12/14

Expt : Secondary Yield Trial (SYT)

Principal Investigator: MM E Ahmed

Co-Investigators: ASM Masuduzzaman and M M R Dewan

Objective: Verification of yield and other agronomic characters through Preliminary Yield Trial of breeding lines for haor areas with growth duration close to BRRI dhan28.

Materials and Methods: Three advanced breeding lines along with BRRI dhan28 as check was planted in a 5.4m-10-row plot with 25cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kg NPKS and Zn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15, 30 and 45 days after transplanting. All other cultural management practices were done as and when necessary.

Results and Discussion: One tested entry, NERICA L-22 (6.2 tha^{-1}) yielded similar to BRRI dhan28 (6.1 tha^{-1}) with longer growth duration (Table 10).

Table 10: Yield and ancillary characters of the advanced breeding lines, SYT, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	NERICA L-1	73	5	5	150	5.8
2	NERICA L-22	94	4	3	151	6.2
3	NERICA L-32	84	5	4	152	5.9
4	BRRI dhan28 (Ck)	99	3	3	147	6.1
	LSD (5%)	5.39			1.28	0.71
	CV(%)	3.1			0.4	5.7

D/S: 20/11/14 D/T: 30/12/14

Expt : Regional Yield Trial (RYT)
Principal Investigator: MM E Ahmed
Co-Investigators: ASM Masuduzzaman and M M R Dewan
Objective: Verification of yield and other agronomic characters through preliminary Yield Trial of breeding lines for haor areas with growth duration close to BRRI dhan28.

Materials and Methods: Six advanced breeding lines along with BRRI dhan28 as check was planted in a 5.4m-10-row plot with 25cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kg NPKS and Zn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15, 30 and 45 days after transplanting. All other cultural management practices were done as and when necessary.

Results and Discussion: The tested entry PR33993-B-15-2-1 (6.0 tha^{-1}) yielded lower than BRRI dhan28 (6.2 tha^{-1}) with similar growth duration (Table 11).

Table 11: Yield and ancillary characters of the advanced breeding lines, RYT#Habiganj, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	PR33993-B-15-2-1	89	5	4	148	6.0
2	BRRI dhan28 (Ck)	96	3	3	146	6.2

D/S: 20/11/14 D/T: 31/12/14

Expt : Regional Yield Trial (RYT), High Yield
Principal Investigator: ASM Masuduzzaman

Co-Investigators: MM E Ahmed and H Kabir

Objective: Verification of yield and other agronomic characters through preliminary Yield Trial of breeding lines for haor areas with growth duration close to BRRI dhan28.

Materials and Methods: One advanced breeding line along with BRRI dhan28 as check was planted in a 5.4m-10-row plot with 25cm spacing between rows. Fertilizers at the rate of

100:60:60:10:10 Kg NPKS and Zn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15, 30 and 45 days after transplanting. All other cultural management practices were done as and when necessary.

Results and Discussion: The tested entry BRH11-9-11-4-5B (6.0 tha^{-1}) yielded higher than BRRI dhan 28 and BRRI Dhan29 in all the 5 locations.

Table 12:Yield and ancillary characters of the advanced breeding lines, RYT#High Yield, Boro'15

Designation	Pnicl/ plt	Panicl Len	Duran	Yield/ha (tons)					
				Gaz	Ron	Nil	Hbg	She	Valuk
BRH11-9-11-4-5B	14	25.5	147	7.1	7.9	7.3	8.3	7.6	8.5
BRRI dhan28	13	25.0	145	7.0	6.1	6.0	7.2	6.5	6.7
BRRI dhan29	16	28.5	161	7.3	7.3	7.1	7.5	6.9	7.2

Expt: RYT#1(HQ), Premium Quality Rice

Principal Investigator: M A Kader

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: Evaluation of specific and general adaptability under on station condition

Materials and Methods: Five advanced breeding lines along with BRRI dhan50 and BRRI dhan63 as checks were planted in a 5.4m-10-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 $Kgha^{-1}$NPKSZn were applied. All fertilizers were applied at final land preparation except N. N in the form of Urea was top dressed thrice, 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Results and Discussion: BR8096-55-1-9-1 (5.9 tha^{-1}) and BR8076-1-2-2-3 (5.9 tha^{-1}) yielded higher than BRRI dhan50 (5.3 tha^{-1}) but yielded similar to BRRI dhan63 (5.9 tha^{-1}) with longer growth duration (Table 13).

Table 13: Yield and ancillary characters of the advanced breeding lines, RYT#1, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	IR77734-93-2-3-2	93	5	3	153	5.4
2	BR8079-52-2-2-2	84	5	3	155	5.5
3	BR8096-55-1-9-1	84	6	5	153	5.9
4	BR8076-1-2-2-3	94	6	4	155	5.9
5	BR8096-48-2-2-4	92	3	4	151	5.5
6	BRRI dhan50 (Ck)	85	3	4	154	5.3
7	BRRI dhan63 (Ck)	81	3	3	148	5.9
	LSD (5%)	3.85			1.19	0.56

CV(%)	2.5	0.4	5.6

D/S: 6/12/14 D/T: 17/1/15, *V= Vegetative stage, **M= Maturity stage

Expt: RYT#2(HQ), Premium Quality Rice#Com

Principal Investigator: M A Kader

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: Evaluation of specific and general adaptability under on station condition

Materials and Methods: Five advanced breeding lines along with BRRI dhan28, BRRI dhan50, BRRI dhan60 and BRRI dhan63 as checks were planted in a 5.4m-10-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kgha^{-1}NPKSZn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Results and Discussion: BR7372-18-2-1-HR1-HR6 (Com) (6.1 tha^{-1}) and BR7372-18-3-3-HR3 (Com) (6.0 tha^{-1}) yielded higher than BRRI dhan28 (5.6 tha^{-1}) and BRRI dhan60 (5.4 tha^{-1}) with longer growth duration than BRRI dhan28. But none of the tested entry yielded higher than BRRI dhan60 (6.3 tha^{-1}) and BRRI dhan63 (6.1 tha^{-1}) (Table 14).

Table 14: Yield and ancillary characters of the advanced breeding lines, RYT#2, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	BR7372-35-3-3-HR9 (Com)	92	5	5	147	5.2
2	BR7358-5-3-2-1-HR2 (Com)	88	5	3	144	5.6
3	BR7372-18-2-1-HR1-HR6 (Com)	91	3	5	149	6.1
4	BR7372-18-3-3-HR3 (Com)	92	3	5	150	6.0
5	BR7372-35-3-3-HR5 (Com)	87	5	5	148	5.5
6	BRRI dhan28 (Ck)	93	3	3	145	5.6
7	BRRI dhan50 (Ck)	80	3	3	154	5.4
8	BRRI dhan60 (Ck)	96	3	3	149	6.3
9	BRRI dhan63 (Ck)	83	3	3	149	6.1
	LSD (5%)	4.38			1.04	0.48
	CV(%)	2.9			0.40	4.8

D/S: 6/12/14 D/T: 18/1/15

Expt: RYT#3 (HQ), Short duration

Principal Investigator: M A Kader

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: Evaluation of specific and general adaptability under on station condition

Materials and Methods: NERICA Mutant along with BRRI dhan28 and BRRI dhan45 as checks were planted in a 5.4m-10-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kgha^{-1}NPKSZn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Results and Discussion: The tested entry NERICA mutant (4.8 tha^{-1}) yielded lower than BRRI dhan28 (5.2 tha^{-1}) and BRRI dhan45 (4.9 tha^{-1}) with longer growth duration with BRRI dhan28 (Table 15).

Table 15: Yield and ancillary characters of the advanced breeding lines, RYT#3, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	NERICA Mutant	96	4	4	148	4.8
2	BRRI dhan28 (Ck)	91	4	4	146	5.2
3	BRRI dhan45 (Ck)	90	4	4	141	4.9
	LSD (5%)	6.85			1.50	1.21
	CV(%)	3.3			0.5	10.9

D/S: 6/12/14 D/T: 27/1/15

Expt: RYT#4 (HQ), Favorable Boro

Principal Investigator: M A Kader

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: Evaluation of specific and general adaptability under on station condition

Materials and Methods: Ten advanced breeding lines along with BRRI dhan28, BRRIdhan29 and BRRI dhan60 as check was planted in a 5.4m-10-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kgha^{-1}NPKSZn were applied. All fertilizers were applied at final land preparation except N. N in the form of Urea was top dressed thrice, 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Results and Discussion: The tested entry BR7988-10-4-1 (6.2 tha^{-1}) yielded higher than BRRI dhan28 (5.4 tha^{-1}) with similar growth duration. BR7783-AC12-3 (6.6 tha^{-1}) yielded higher than BRRI dhan29 (6.3 tha^{-1}) and BR7671-37-2-2-3-7 (6.6 tha^{-1}) yielded higher than BRRI dhan60 (6.5 tha^{-1}) with similar growth duration (Table 16).

Table 16: Yield and ancillary characters of the advanced breeding lines, RYT#4, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	BR7683-30-3-3-4	89	5	4	150	6.0
2	BR7671-37-2-2-3-7	88	5	5	151	6.6
3	BR7988-4-5-3-4	80	6	5	155	6.2
4	BR7783-AC12-3	97	4	3	159	6.6

5	BR7783-AC13-5	97	4	3	160	6.3
6	BR7783-AC14-5	100	6	4	159	5.9
7	BR7783-AC6-3-2-2-1	100	6	5	159	6.3
8	BRRI dhan29-SC3-28-16-10-8-HR1 (Com)	81	5	5	146	5.5
9	BR7988-10-4-1	84	5	5	146	6.2
10	BR7800-63-1-7-3	92	5	5	151	5.2
11	BRRI dhan28 (Ck)	94	4	4	145	5.4
12	BRRI dhan29 (Ck)	96	4	4	161	6.3
13	BRRI dhan60 (Ck)	98	4	3	150	6.5
	LSD (5%)	4.77			0.88	0.89
	CV(%)	3.1			0.3	8.7

D/S: 6/12/14 D/T: 25/1/15

Expt: RYT#5(HQ), Micronutrient

Principal Investigator: M A Kader

Co-Investigator: ASM Masuduzzaman and MM E Ahmed

Objective: Evaluation of specific and general adaptability under on station condition

Materials and Methods: Five advanced breeding lines along with BRRI dhan28 and BRRI dhan29 as checks were planted in a 5.4m-10-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kgha^{-1}NPKSZn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Results and Discussion: BR7840-54-3-2-1 (6.2 tha^{-1}) yielded higher than BRRI dhan28 (5.6 tha^{-1}) with longer growth duration and BR8261-19-1-1-3 (6.3 tha^{-1}) yielded similar to BRRI dhan29 (6.3 tha^{-1}) with shorter growth duration (Table 17).

Table 17: Yield and ancillary characters of the advanced breeding lines, RYT#5, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	BR7840-54-3-2-1	94	4	5	149	6.2
2	BR7840-54-3-4-1	94	6	6	145	5.5
3	BR784054-3-4-4	97	6	6	145	5.1
4	BR8257-37-1-2-2	84	6	5	147	5.4
5	BR7833-19-2-3-5	105	5	3	151	5.5
6	BR8261-19-1-1-3	105	6	4	152	6.3
7	BR7820-18-1-6-3-P4	98	5	4	154	5.7
8	BR7881-62-2-3-7-P3	104	3	3	157	5.7
9	BR7879-17-2-4-HR3-P1	115	3	3	152	5.4
10	BRRI dhan28 (Ck)	94	3	3	146	5.6
11	BRRI dhan29 (Ck)	98	3	3	159	6.3
	LSD (5%)	3.39			1.15	0.52

CV(%)	2.0	0.4	5.4

D/S: 6/12/14 D/T: 19/1/15

Expt: RYT#6 (HQ), Green Super Rice

Principal Investigator: M A Kader

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: Evaluation of specific and general adaptability under on station condition

Materials and Methods: Five advanced breeding lines along with BRRI dhan28, BRRI dhan29 and BRRI dhan55 as checks were planted in a 5.4m-10-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kgha^{-1}NPKSZn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Results and Discussion: HHZ23-DT16-DT1-DT1 (6.8 tha^{-1}) and HHZ6-SAL3-Y1-SUB2 (6.7 tha^{-1}) yielded higher than BRRI dhan29 (6.4 tha^{-1}) and BRRI dhan60 (6.6 tha^{-1}) with comparatively shorter growth duration than BRRI dhan29 (Table 18).

Table 18: Yield and ancillary characters of the advanced breeding lines, RYT#6, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	HHZ15-SAL13-Y1	86	4	3	158	6.6
2	HHZ23-DT16-DT1-DT1	85	3	3	157	6.8
3	HHZ15-DT4-DT1-Y1	84	3	4	156	6.5
4	HHZ11-DT7-SAL1-SAL1	83	4	4	160	6.4
5	HHZ6-SAL3-Y1-SUB2	90	3	4	159	6.7
6	BRRI dhan29 (Ck)	96	3	3	161	6.4
7	BRRI dhan60 (Ck)	97	3	3	153	6.6
	LSD (5%)	2.36			1.24	0.84
	CV(%)	1.5			0.4	7.3

D/S: 6/12/14 D/T: 26/1/15

Expt: MLT (CSISA)

Principal Investigator: TL Aditya

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: Evaluation of specific and general adaptability under on station condition

Materials and Methods: Two advanced breeding lines along with BRRI dhan28, BRRI dhan29 and BRRI dhan55 as checks were planted in a 5.4m-10-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kgha^{-1}NPKSZn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Results and Discussion: BR7358-5-3-2-1-HR2 (Com) (5.7 tha^{-1}) yielded similar to BRRI dhan28 (5.8 tha^{-1}) with shorter growth duration. (Table 19).

Table 19: Yield and ancillary characters of the advanced breeding lines, MLT (CSISA), Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	BRRI dhan29-SC3-28-16-10-8-HR1 (Com)	92	3	3	146	5.6
2	BR7358-5-3-2-1-HR2 (Com)	90	5	4	142	5.7
3	BRRI dhan28 (Ck)	94	3	3	144	5.8
	LSD (5%)	2.71			2.19	0.18
	CV(%)	1.3			0.7	1.4

D/S: 5/12/14 D/T: 16/1/15

Expt: RYT#1 (BIO-TECH)

Principal Investigator: M E Hoque

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: Evaluation of specific and general adaptability under on station condition

Materials and Methods: Five advanced breeding lines along with BRRI dhan28 as check were planted in a 5.4m-10-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kgha^{-1}NPKSZn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Results and Discussion: BR8072-AC5-4-2-1-2-1 (7.1 tha^{-1}) yielded higher than BRRI dhan28 (6.7 tha^{-1}) shorter growth duration than BRRI dhan28 (Table 20).

Table 20: Yield and ancillary characters of the advanced breeding lines, RYT#1, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	BR8072-AC5-4-2-1-2-1	108	3	3	151	7.1

2	BR8072-AC7-4-1-2-2-1	84	5	4	145	5.2
3	BR8072-AC8-1-1-3-1-1	86	4	4	146	5.7
4	BR8072-AC11-2-3-2-1-1	85	5	6	145	5.3
5	BR4909-R1-R2	84	5	6	145	5.2
6	BRRI dhan28 (Ck)	92	3	3	142	6.7
	LSD (5%)	3.95			1.39	0.90
	CV(%)	2.4			0.5	8.5

D/S: 25/11/14 D/T: 01/1/15

Expt: RYT#2 (BIOTECH)
Principal Investigator: M E Hoque

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: Evaluation of specific and general adaptability under on station condition

Materials and Methods: One advanced breeding line along with BRRI dhan29 and BRRI dhan58 as checks were planted in a 5.4m-10-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kgha^{-1}NPKSZn were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed thrice, 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Results and Discussion: BR6158-RWBC2-2-1-1 (7.9 tha^{-1}) yielded higher than BRRI dhan58 (7.6 tha^{-1}) and BRRI dhan29 (7.8 tha^{-1}) with comparatively shorter growth duration than BRRI dhan29 (Table 21).

Table 21: Yield and ancillary characters of the advanced breeding lines, RYT#2, Boro'15

SL No.	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	BR6158-RWBC2-2-1-1	98	3	3	159	7.9
2	BRRI dhan58 (Ck)	93	3	3	156	7.6
3	BRRI dhan29 (Ck)	98	3	3	161	7.8
	LSD (5%)	6.62			2.26	0.29
	CV(%)	3.0			0.6	1.7

D/S: 25/11/14 D/T: 01/1/15

Expt: Proposed Variety Trial (PVT)

Principal Investigator: PS Biswas

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: On farm evaluation of proposed line by the NSB team for the Boro 2014-15

Materials and Methods: Two advanced breeding lines along with BRRI dhan28 as check was planted in a 5.4m-12-row plot with 25 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 Kgha^{-1}NPKSZn were applied. All fertilizers were applied at final land preparation except N. N in the form of Urea was top dressed thrice, 15 days after Transplanting (DAT), 30 DAT and 60 DAT. All other cultural management practices were done as and when necessary.

Results and Discussion: Both entries gave higher yield than BRRI dhan64 (6.28 tha^{-1}) and BRRI dhan28 (6.48 tha^{-1}) with shorter growth duration (Table 22).

Table: 22. Yield data of Proposed Variety Trial, Boro 2014-15

Sl. no.	Designation	Growth duration (days)	Yield (tha^{-1})
1	BR7671-37-2-2-3-7	146	7.05
2	BR7833-11-1-1-2-1-2B5	141	6.78
3	BRRI dhan64 (Ck)	147	6.28
4	BRRI dhan28 (Ck)	144	6.48

D/S: 6/12/14 D/T: 16/1/15

Season: Transplant Aus (T. Aus)

Expt: Regional Yield Trial (RYT)

Principal Investigator: M Khatun

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: To evaluate the breeding lines for yield potentials and adaptability test in different agro climate condition of Bangladesh.

Materials and Methods: Seven advanced breeding lines along with BR26 and BRRI dhan48 as check were planted in a 5.4m-10-row plot with 20 cm spacing between rows. Fertilizers at the rate of 60:40:40:10 Kg ha^{-1} NPKS were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed twice, 10 and 30 days after transplanting. All other cultural management practices were done as and when necessary.

Results and Discussion: BRRI dhan29-SC3-28-16-10-6-HR6 (Com) (4.8 tha^{-1}) and BRRI dhan29-SC3-28-16-10-8-HR1 (Com) (4.4 tha^{-1}) yielded similar to BRRI dhan48 (4.8 tha^{-1}) and BR26 (4.4 tha^{-1}) respectively with shorter growth duration (Table 23).

Table 23: Yield and ancillary characters of the advanced breeding lines, RYT#1, T. Aus 2015

SL#	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	BRRI dhan29-SC3-28-	89	3	3	106	4.4

	16-10-8-HR1 (Com)					
2	BRRI dhan29-SC3-28-16-10-6-HR6 (Com)	89	3	3	102	4.8
3	BRRI dhan29-SC3-28-16-10-2-HR3-HR9 (Com)	86	3	4	102	3.5
4	BRRI dhan29-SC3-8-HR1 (Com)	104	4	4	124	3.7
5	BRRI dhan29-SC3-28-16-15-HR2 (Com)	103	4	4	126	3.6
6	BR6848-3B-12	108	5	4	119	3.1
7	NERICA MUTANT	102	5	4	106	3.9
8	BRRI dhan48 (Ck)	101	3	3	107	4.8
9	BR26 (Ck)	108	3	3	110	4.4
	LSD (5%)	2.71			0.95	0.40
	CV(%)	1.6			0.5	5.7

D/S: 10/4/15 D/T: 6/5/15,

Expt: Regional Yield Trial (RYT)

Principal Investigator: M Khatun

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: To evaluate the breeding lines for yield potentials and adaptability test in different agro climate condition of Bangladesh.

Materials and Methods: Six T. Aus varieties along with BR26 and BRRI dhan48 as check were planted in a 5.4m-10-row plot with 20 cm spacing between rows. Fertilizers at the rate of 60:40:40:10 Kg ha^{-1} NPKS were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed twice, 10 and 30 days after transplanting. All other cultural management practices were done as and when necessary.

Results and Discussion: BRRI dhan58 (4.2 tha^{-1}) and BRRI dhan60 (4.2 tha^{-1}) yielded higher than BR26 (4.0 tha^{-1}) with similar growth duration. BRRI dhan65 (4.5 tha^{-1}) yielded similar to BRRI dhan48 (4.6 tha^{-1}) with shorter growth duration (Table 24).

Table 24: Yield and ancillary characters of the advanced breeding lines, RYT#2, T. Aus 2015

SL#	Designation	Plant height (cm)	PACP		Growth duration (days)	Yield (t/ha)
			Veg.	Mat.		
1	BRRI dhan42	103	5	5	102	3.9
2	BRRI dhan43	100	4	4	101	3.7
3	BRRI dhan65	82	4	4	102	4.5
4	BRRI dhan58	92	3	4	110	4.2
5	BRRI dhan60	93	4	5	108	4.2
6	BRRI dhan28	94	3	3	107	3.8
7	BR26 (Ck)	101	3	3	108	4.0
8	BRRI dhan48 (Ck)	98	3	3	106	4.6

LSD (5%)	4.43	1.00	0.71
CV(%)	2.7	0.5	9.9

D/S: 10/4/15 D/T: 7/5/15,

Season: Transplant Aus (T. Aus)

Expt: Regional Yield Trial (RYT), Direct Seeding

Principal Investigator: RA Sarker

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: To evaluate the breeding lines for yield potentials and adaptability test in different agro climate condition of Bangladesh.

Materials and Methods: Five advanced breeding lines along with BRRI dhan43 and BRRI dhan65 as checks were direct seeded in 5.4m-10-row plot with 20 cm spacing between rows. Fertilizers at the rate of 60:40:40:10 Kg ha^{-1} NPKS were applied. All fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea was top dressed twice, 10 and 30 days after transplanting. All other cultural management practices were done as and when necessary.

Results and Discussion: BR7992-2B-5-2 (4.1 tha^{-1}) yielded similar to BRRI dhan65 (4.2 tha^{-1}) with longer growth duration (Table 25).

Table 25: Yield and ancillary characters of the advanced breeding lines, RYT, T. Aus 2015

SL #	Designation	Plant height (cm)	PACP		Panicle/m^2	Sterility (%)	Growth duration (days)	Yield (t/ha)
			Veg	Mat.				
1	BR7698-2B-1-9-2	99	5	5	238	21.9	96	3.9
2	BR7992-2B-5-2	113	5	4	221	23.2	98	4.1
3	BR7383-2B-23	104	5	4	252	27.9	95	3.3
4	BR7587-2B-3	116	3	3	212	26.6	96	3.6
5	BR6855-3B-13	117	6	6	221	33.6	98	3.5
6	BRRI dhan43 (Ck)	105	3	3	313	27.6	98	4.4
7	BRRI dhan65 (Ck)	92	3	3	296	24.5	95	4.2
	LSD (5%)	3.30			74.02	1.12	1.48	0.72
	CV(%)	1.7			16.6	2.4	0.9	10.5

D/S: 12/5/15

Expt: Proposed Variety Trial (PVT)

Principal Investigator: TL Aditya

Co-Investigators: ASM Masuduzzaman and MM E Ahmed

Objective: On farm evaluation of proposed line by the NSB team for the Boro 2013-14

Materials and Methods: One advanced breeding line NERICA Mutant along with BRRI dhan48 as check was planted in a 6 m X 5 m plot with 20 cm spacing between rows. Fertilizers at the rate of 100:60:60:10:10 $Kgha^{-1}$NPKSZn were applied. All fertilizers were applied at final land preparation except N. N in the form of Urea was top dressed thrice, 15 days after Transplanting

(DAT), 30 DAT and 60 DAT. All other cultural management practices were done as and when necessary.

Results and Discussion: NERICA Mutant (4.3 tha^{-1}) yielded lower than BRRI dhan48 (4.6 tha^{-1}) (Table 26).

Table 26: Yield data of Proposed Variety Trial, T. Aus 2015

Sl. no.	Designation	Growth duration (days)	Yield (tha^{-1})
1	NERICA Mutant	108	4.3
2	BRRI dhan48 (Ck)	105	4.6

D/S: 1/5/15 D/T: 18/5/15

CROP-SOIL-WATER MANAGEMENT

Expt. Long-term missing element trial for diagnosing the limiting nutrient in soil

Principal Investigators: U A Naher and A T M Sakhawat Hossain

Co-investigators: M M R Dewan, MM E Ahmed and ASM Masuduzzaman

Objective: To identify the limiting nutrient if any in the soils of BRRI Habiganj farm.

Materials and Methods: The experiment was initiated in a permanent layout at the BRRI RS farm Habiganj in 2007-08 Boro season viewing missing element approach using 8 treatments in RCB design with 3 replications (Table 18). Boro 2013-14 is the 7th year continuation of this experiment. There was a complete treatment consisting of the application of soil test based (STB) N, P, K and S fertilizer and other treatments "missing" the nutrient elements such as -N, -P, -K, -S. In Boro season NPKS @ 85-38-50-9 kg ha^{-1} were used. Urea N was applied in equal 3 splits i.e., one-third at 7-10 days after transplanting, one third at active tillering stage and one third at 5-7 days before panicle initiation stage. Other fertilizers were applied during final land preparation. Tested cropping pattern was Boro-Fallow-Fallow. BRRI dhan29 was used as a test crop. The unit plot size was 5m × 3m. Forty days old 2-3 seedlings $hill^{-1}$ was transplanted in 20 cm × 20 cm spacing. Irrigation and other management practices were done as per needed. The crop was harvested from 5 m^2area at the centre of each plot and rice grain yield was adjusted to 14% moisture content and straw yield was oven dry basis.

Table: 18. Treatment details of the long-term missing element experiment, Boro'15

Treatments	Nutrient element (kg ha^{-1})
T_1	NPKS (Complete)
T_2	PKS (-N)
T_3	NKS (-P)

T_4	NPS (-K)
T_5	NPK (-S)
T_6	KS (-NP)
T_7	PS (-NK)
T_8	All missing (-NPKS)

Results and Discussion: Balanced fertilization with complete treatment significantly increased the grain yield of rice (Table 19). The highest rice yield of 8.40 tha^{-1} was obtained with T_1 treatment where complete fertilizer was used followed by T_3 (P omission) and T_5 (K omission). The lowest grain yield (4.29 tha^{-1}) was obtained with all nutrient missing treatment. Without P and S application, yield losses were insignificant but N and K missing have significant effect on yield decrease. The grain yield of K missing plot was 7.76 tha^{-1}. In Boro 2014 season, the N missing treatment gave the lowest grain yield (T_2=4.66 tha^{-1}, T_6=4.36 tha^{-1} and T_7= 4.57 tha^{-1}) that is identical with all nutrient missing treatment (T_8=4.29 tha^{-1}). A similar result was also obtained in case of straw yield. From this experimental result, it was observed that N is the most limiting nutrient followed by K in the BRRI Habiganj farm soil.

Table: 19. Effects of nutrient element omission from the complete treatment on grain yield of BRRI dhan29. Boro'2014-15

Treatments	Grain yield (tha^{-1})	Straw yield (tha^{-1})
T1	8.40	7.55
T2	4.66	4.45
T3	8.36	7.33
T4	7.76	6.73
T5	8.17	7.25
T6	4.36	3.77
T7	4.57	3.95
T8	4.29	3.18
$LSD_{0.05}$	0.715	0.467
CV (%)	6.5	4.8

RICE FARMING SYSTEM

1. Expt. Multi-location testing of BRRI dhan46-BRRIdhan29-Fallow cropping pattern in different locations of Bangladesh

Principal Investigator: M M R Dewan

Co-investigator: ASM Masuduzzaman and MM E Ahmed

Introduction

In medium highland phase II, farmers usually grow local/old T. Aman varieties after recession of floodwater in T. Aman-Boro-Fallow cropping pattern. But the yield of T. Aman is very low due to use of local/old varieties or delayed planting in September and the total system productivity

become very low. To address the situation, BRRI has developed photosensitive HYVs like, BR22, BR23 and BRRI dhana46. Recently developed BRRI dhana46 could be transplanted safely up to 25 September with at least 1 t/ha yield advantage over local varieties/old ones. In Boro season, the performance of BRRIdhan29 in the said pattern is very promising. Therefore, multi-location testing of BRRI dhan46-BRRIdhan29-Fallow cropping pattern was undertaken to increase the system productivity.

Materials and Methods

Multi-location testing of BRRI dhan46-BRRIdhan29-Fallow cropping pattern in medium highland phase II was undertaken at Madhabpur Upazila of Habiganj district. Block demonstration was done on five bigha of land in five different farmers field. BRRI recommended management practices adopted in both the T. Aman and Boro seasons. Recommended and farmers practices are presented in Table 20 & 21. Yield and gross margins of the recommended and farmers patterns are presented in Table 22 & 23.

Table: 20. Crop management practices followed in T. Aman rice under T. Aman-Boro-Fallow cropping pattern, in Habiganj, 2015

Crop management practices	Recommended practice	Farmers practice
Variety	BRRI dhan46	BR22
Date of sowing	20-21 July, 13	15-16 July, 13
Seedling age (days)	39-40	43-44
Date of transplanting	29-30 August, 13	29-30 August, 13
Row x hill spacing (cm x cm)	20 x 15	20-21 x 15-17
No. of seedlings/hill	2-3	4-5
Fertilizer rate (kg/ha): N-P-K-S-Zn	92-12-42-10	90-24-25-0
No. of weeding	1-2	1-2
No. of irrigation	0	0
No. of pesticide applied	1-2	1-2
Date of harvest	10-11 Dec. 13	11-12 Dec. 13

Table: 21. Crop management practices followed in Boro rice under T. Aman-Boro-Fallow cropping pattern, in Habiganj, 2014-15

Crop management practices	Recommended practice	Farmers practice
Variety	BRRI dhan29	BRRI dhan28
Date of sowing	5-6 Dec. 14	3-5 Dec. 14
Seedling age (days)	43-46	45-47
Date of transplanting	13-15 Jan.15	13-14 Jan. 15
Row x hill spacing (cm x cm)	20 x 20	20-21 x 20-22
No. of seedlings/hill	2-3	4-5
Fertilizer rate (kg/ha): N-P-K-S-Zn	137-17-62-10-1	114-46-37-0
No. of weeding	2	2
No. of irrigation	7	6
No. of pesticide applied	2	2
Date of harvest	16 May, 15	27-28 April, 15

Results and Discussion

The recommended patterns gave 15% higher grain yield and gross margin over existing farmers' patterns. The recommended cropping pattern gave of 11.72 t/ha grain yield and gross margin of Tk. 222,680/ha (Table 22 & 23). It was because of higher yield advantage between recommended and farmers' practice in both the T. Aman and Boro season of newly released variety BRRI dhan46 which allow to accommodate BRRI dhan29 in the pattern instead of BRRI dhan28.

Table: 22. Grain yield of T. Aman-Boro-Fallow cropping pattern in Habiganj 2014-15

Management	Cropping pattern	Grain yield of T. Aman (t/ha)	Grain yield of Boro (t/ha)	Total grain yield (t/ha)	Yield increased than FP
Recommended practice	BRRI dhan46-BRRI dhan29-Fallow	4.80	6.92	11.72	15.12
Farmers practice	BR22-BRRI dhan28-Fallow	4.30	5.88	10.18	

Table: 23. Gross return of T. Aman-Boro-Fallow cropping pattern in Habiganj, 2014-15

Management	Cropping pattern	Gross return of T. Aman (Tk./ha)	Gross return of Boro (Tk./ha)	Total gross return (Tk./ha)	Return increased (%)
Recommended practice	BRRI dhan46-BRRI dhan29-Fallow	91,200	131,480	222,680	15.12
Farmers practice	BR22-BRRI dhan28-Fallow	81,700	111,720	193,420	

Price of paddy Tk. 18/kg, and Straw Tk. 1/kg.

2. Expt. Evaluation of double transplanting at Low lying area (Haor area) under Boro-Fallow-Fallow cropping systems

Principal Investigator: M M R Dewan
Co-investigator: ASM Masuduzzaman and MM E Ahmed

Introduction

Transplanting of T. Aman rice delays very often due to late recession of flood water or delayed harvesting of previous crop or for some other reasons while Boro establishment is delayed mainly for delayed harvesting of previous crop. Due to delayed transplanting, rice yield declined which ultimately reduces the system productivity. Farmers sometimes practice double transplanting to overcome this problem. Double transplanting (DT) in Boro season give the opportunity to escape crop from early flash flood and also to extend Boro cultivation in low lying areas. Therefore, the present study was undertaken with the following objectives:

(i) To evaluate the performance of double transplanted rice at low lying area

(ii) To maximize the farmers productivity

Materials and Methods

The study was conducted at BRRI R/S, Habiganj during Boro 2014-15 seasons. The design of the experiment was RCB with three replications and BRRI dhan29 were grown in Boro season. The treatments: T_1- Normal transplanting (45 days old seedling) with 20 cm x 20 cm spacing; T_2- Normal transplanting (45 days old seedling) with 20 cm x 10 cm spacing; T_3- Double transplanting (first transplanting of 45-day old seedlings & 2nd transplanting with tillers of 30-day old crop of 1st planting from the T_2 treatment Plots); T_4-Delayed transplanting (75 days old seedlings) were evaluated.

Management practices were adopted in main fields for the different treatments are shown in Table 24.

Table: 24. Management practices adopted for Boro rice under double transplanting at BRRI, Habiganj, 2014-15

Management practice	Normal planting (T_1)	Normal planting (T_2)	DT (T_3)	Delay planting (T_4)
Seed rate (kg/ha)	30	45	30	30
Date of seeding	01 Dec, 14	01 Dec, 14	01 Dec, 14	01 Dec, 14
Date of first transplanting	-	-	15 Jan, 15	-
Seedling age (days)	45	45	45	75
Date of main field planting	15 Jan, 15	15 Jan, 15	15 Feb,15	15 Feb,15
Age of 1st planted crop (days)	-	-	30	-
Seedlings/hill at 2nd Planting (no.)	-	-	6-8	-
Spacing (cm)	20x20	20x10	20x20	20x20
Fertilizer:N,P,K,S,Zn (kg/ha)	142-19-59-6-0	142-19-59-6-0	95-19-59-6-0	142-19-59-6-0
Basal:N,P,K,S, Zn (kg/ha)	0-19-59-6-0	0-19-59-6-0	0-19-59-6-0	47-19-59-6-0
N top dress(DAT)	15-35-50	15-35-50	15-30	15-30
Weeding (times)	2	2	1	1
Pest control (times)	2	2	2	2
Maturity	10 May,15	11 May,15	14 May,15	22 May,15

Results and Discussion

Boro 2014-15:

In Boro season, normal transplanting gave significantly higher grain yield than the DT and delay planting (**Table 25)**. Significantly the highest grain yield was obtained from Normal planting (T_1=8.90 t/ha and T_2=8.80 t/ha) and lowest grain yield was observed from delayed transplanting of 75 days old seedlings (7.59 t/ha). DT gave significantly higher grain yield (8.32 t/ha) than the delay planting. Crop duration of delay planting was higher than the Normal and DT. In double transplanted crop the growth duration was one week shorter than delay planting and four days longer than normal transplanting which is an opportunity for Boro rice to escape from early flash flood in haor area.

Table: 25.Yield and yield contributing characters of Boro rice at BRRI, Habiganj, 2014-15

Treatments	Panicle/m^2 (no.)	Filled grain /pan (no.)	1000- grain wt (g)	Yield (t/ha)	Duration (days)
T_1:Normal transplanting (45 days old seedling) with 20 cm x 20 cm spacing	366.33	121.83	21.09	8.90a	161
T_2:Normal transplanting (45 days old seedling) with 20 cm x 10 cm spacing	351.00	116.90	20.78	8.80a	162
T_3:Double transplanting (45 days SB + 30 days 1st TP)	350.33	117.90	21.64	8.32b	165
T_4:Delay transplanting (75 days old seedling)	315.67	109.87	21.69	7.59c	173

In a column, means followed by different letters differ significantly at 5% by DMRT

SOCIO-ECONOMIC

Project: Stability analysis

Expt: Yield and adaptability test of BRRI developed rice varieties.

Principal Investigator: MM E Ahmed

Co-investigator: ASM Masuduzzaman and ATM S Hossain

Objectives: To observe the general and specific adaptability and stability of the BRRI released rice varieties at BRRI Regional Station, Habiganj.

Materials and Methods: Twenty five BRRI released rice varieties were tested in a RCB design with three replications. The unit plot size was 5.4 × 4 m with 20 × 20 cm spacing. Fertilizers at the rate of 100:60:60:10:10 Kg ha^{-1} NPKS and Zn were applied. All the fertilizers were applied at final land preparation except N. Nitrogen in the form of Urea were top dressed thrice, 15, 30 and 45 days after transplanting. All other cultural management practices were done as and when necessary.

Results and Discussion: Among the inbreed varieties, BR16 (6.5 tha^{-1}), BRRI dhan29 (6.6 tha^{-1}), BRRI dhan36 (6.4 tha^{-1}), BRRI dhan58 (6.6 tha^{-1}), BRRI dhan60 (7.1 tha^{-1}), and BRRI dhan61(6.5 tha^{-1}) yielded higher with the growth duration 156, 155, 150, 152, 147, and 151 days respectively. Among the three hybrids BRRI Hybrid dhan2 (7.8 tha^{-1}) yielded higher than the other hybrids.

Table: 26. Yield and ancillary characters of Stability Analysis, Boro'2014-15

Sl. no	Designation	Maturity (Days)	Yield (tha^{-1})
1	BR1	150	5.8
2	BR2	150	5.2
3	BR3	155	5.5
4	BR6	149	5.7
5	BR7	155	5.2
6	BR8	154	4.7
7	BR9	154	4.8
8	BR12	155	5.5
9	BR14	148	6.3
10	BR15	155	5.8
11	BR16	156	6.5
12	BR17	153	5.3
13	BR18	155	5.4
14	BR19	154	5.5
15	BR26	148	6.2
16	BRRI dhan27	150	5.8
17	BRRI dhan28	148	5.9
18	BRRI dhan29	155	6.6
19	BRRI dhan35	152	6.1
20	BRRI dhan36	150	6.4
21	BRRI dhan45	147	5.9
22	BRRI dhan47	148	5.6
23	BRRI dhan50	151	5.4
24	BRRI dhan55	150	5.7
25	BRRI dhan58	152	6.6
26	BRRI dhan59	148	5.7
27	BRRI dhan60	147	7.1
28	BRRI dhan61	151	6.5
29	BRRI dhan64	152	5.9
30	BRRI Hybrid dhan1	156	6.5
31	BRRI Hybrid dhan2	150	7.8
32	BRRI Hybrid dhan3	151	7.2
	LSD(5%)	1.73	0.68
	CV(%)	0.7	7.0

D/S: 03/01/2014, D/T: 09/02/2014

TECHNOLOGY TRANSFER & OTHER ACTIVITIES

Principal Investigator: Dr. Md. Humayun Kabir SSO BRRI R/S Habiganj

Advanced line Adaptive Research trial (ALART) in T. aman, 2014

Objectives:

1. To evaluate the yield potential and adaptability of advanced breeding lines at famers' field in different agro-ecological conditions.

2. To get feedback information about the advantages and disadvantages of the advanced lines from farmers and DAE personnel.

1. Advanced line Adaptive Research trial (ALART) for Rainfed Lowland Rice (RLR) in T. aman, 2014

Materials and methods: Three advanced line i.e., BR7468-12-1-1-1-1, BR7472-16-2-1-2-1 and BR7638-7-2-5-2 along with BRRI dhan32 and BRRI dhan49 as checks were tested in sadar, Sylhet during T, aman 2014. The plot size for each entry was 5m x 4m. Seeding time was 07-07-2014 and seedling age was 30 days. Fertilizers were applied at 90:15:50:12:3.6 kg/ha for NPKSZn. Other standard management practices were followed as and when necessary.

Result and discussion: Grain yield and other ancillary characters varied significantly among the genotypes. The highest yield was observed in BR7638-7-2-5-2 line having average yield of 5.56 (t/ha) which was differed significantly from check varieties. However, BR7638-7-2-5-2 line has the highest growth duration among the tested entries.

Farmer's opinion: Farmer like BR7638-7-2-5-2 and BRRI dhan49due to its higher yield.

SAAO's opinion: As a new rice line SAAO like BR7638-7-2-5-2.

Table1: Yield and ancillary characters of the ALART (RLR), T. aman, 2014

Line\Variety	Grain yield (t/ha)	Growth duration (days)	Panicles/ m^2	Filled grains/panicle	Unfilled grains/panicle	Plant height (cm)
BR7468-12-1-1-1-1	4.32 b	133 cd	279a	84 ab	49.3 a	111.7 bc
BR7472-16-2-1-2-1	4.07 b	132 d	272 a	75 b	49 a	109.13 c
BR7638-7-2-5-2	5.56 a	140 a	285 a	89 ab	44 b ab	113.87 b
BRRI dhan32 (ck)	5.35 a	134 c	290 a	94 a	36 b	123.8 a
BRRI dhan49 (ck)	5.55 a	138 b	295 a	97 a	39.3 b	104.6 d
LSD0.05	1.24	8.44	0.53	26.38	18.77	3.37

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2. Advanced line Adaptive Research trial (ALART) for Premium quality rice (PQR) in T. aman, 2014

Materials and methods: Four advanced line i.e., BR7697-15-4-4-2-1, BR7697-15-4-4-2-2, BR7697-16-2-2-1-1, and BR7369-52-3-2-1-1 along with BRRI dhan37 as check were tested in sadar, Sylhet during T, aman 2014. The plot size for each entry was 5m x 4m. Seeding time was 07-07-2014 and seedling age was 30 days. Fertilizers were applied at 90:15:50:12:3.6 kg/ha for NPKSZn. Other standard management practices were followed as and when necessary.

Result and discussion: Among the advanced lines the highest grain yield was observed in BR7697-15-4-4-2-2 having average yield of 4.25(t/ha) which was 0.22 (t/ha) lower than than the check variety (BRRI dhan37). Other ancillary characters also varied significantly among the genotypes. However, BRRI dhan37 has the highest growth duration among the tested entries.

Farmer's opinion: Farmer like BR7697-15-4-4-2-2 due to its higher yield and short duration.

SAAO's opinion: The best one is BR7697-15-4-4-2-2 in terms of yield and duration.

Table2: Yield and ancillary characters of the ALART (PQR), T. aman, 2014

Line\Variety	Grain yield (t/ha)	Growth duration (days)	Panicles/m2	Filled grains/panicle	Unfilled grains/ panicle	Plant height (cm)
BR7697-15-4-4-2-1	3.66 b	132 c	271 bc	69 b	36	113.06 b
BR7697-15-4-4-2-2	4.25 a	132 c	281 abc	83 b	35	112 b
BR7697-16-2-2-1-1	3.98 ab	137 b	284 ab	79 b	36	115.6 b
BR7369-52-3-2-1-1	4.04 ab	133 c	268 c	75 b	34	110.47 b
BRRI dhan37 (ck)	4.47 a	144 a	294 a	94 a	30	127.13 a
LSD0.05	0.57	1.05	15.85	10.86	NS	5.29

3. Advanced line Adaptive Research trial (ALART) for Premium Quality Rice (PQR) in Boro, 2015

Materials and methods: Three advanced line i.e., BR7781-10-2-3-2, BR7369-10-5-2-3 and BR7369-52-3-2-1-1 along with BRRI dhan50 and BRRI dhan63 as check were tested in Sadar, Habiganj during Boro, 2015. The plot size for each entry was 5m x 4m. Seeding time was 25-11-2014 and seedling age was 40 days. Fertilizers were applied at 120:20:60:20:4 kg/ha for NPKSZn. Other standard management practices were followed as and when necessary.

Result and discussion: Among **t**he tested entries the highest grain yield was observed in BR7781-10-2-3-2 having average yield of 6.14 (t/ha) which was significantly higher than the check varieties (BRRI dhan50 and BRRI dhan63). Other ancillary characters also varied significantly among the genotypes. However, the growth duration of BR7781-10-2-3-2 is intermediate among the tested entries.

Farmer's opinion: Farmer like BR7781-10-2-3-2 due to its higher yield and its small grain size.

SAAO's opinion: The best one is BR7781-10-2-3-2 in terms of yield and duration.

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Table3: Yield and ancillary characters of the ALART (PQR), Boro, 2015

Line\Variety	Grain yield (t/ha)	Growth duration (days)	Panicles/ m2	Filled grains/panicle	Unfilled grains/panicle	Plant height (cm)
BR7781-10-2-3-2	6.14	162	375	110	16	101.6
BR7369-10-5-2-3	5.42	165	322	81	24	110.6
BR7369-52-3-2-1-1	5.86	162	338	87	18	98.4
BRRI dhan50 (ck)	5.53	157	349	84	21	81.5
BRRI dhan63 (ck)	5.39	155	326	79	27	86.5

4.Advanced line Adaptive Research trial (ALART) for Micronutrient enriched rice (MN) in Boro, 2015

Materials and methods: Two advanced line i.e., BR7833-11-1-1-3-4 and BR7830-16-1-5-9-**9** along with BRRI dhan28 and BRRI dhan64 as check were tested in Sadar, Habiganj during Boro, 2015. The plot size for each entry was 5m x 4m. Seeding time was 25-11-2014 and seedling age was 45 days. Fertilizers were applied at 120:20:60:20:4 kg/ha for. All amounts of TSP, MP, Gypsum and Zinc sulphate were applied at the time of final land preparation. Urea was applied in 3 equal splits at 15 DAT, 30 DAT and 45 DAT. BRRI recommended practice were followed as and when necessary.

Result and discussion: Significantly the highest grain yield was observed in BR7830-16-1-5-9-9 having average yield of 6.68 (t/ha) among **t**he tested entries and average growth duration is 156 days. Other ancillary characters also varied significantly among the genotypes.

Farmer's opinion: Farmers like BR7830-16-1-5-9-9 due to its highest yield and its small grain size.

SAAO's opinion: The best one is BR7830-16-1-5-9-9 in terms of yield and duration.

Table4: Yield and ancillary characters of the ALART (MN) in Boro, 2015

Line\Variety	Grain yield (t/ha)	Growth duration (days)	Panicles/m^2	Filled grains/panicle	Unfilled grains/panicle	Plant height (cm)
BR7833-11-1-1-3-4	6.31	153	311	81	23	83.93
BR7830-16-1-5-9-9	6.68	156	319	85	21	103.54
BRRI dhan28 (ck)	5.97	144	306	89	27	90.44

BRRI dhan64 (ck)	6.12	151	303	79	26	108.35

5.Advanced line Adaptive Research trial (ALART) for Short duration Boro rice (SD) in Boro, 2015

Materials and methods: Nerica Mutent was tested along with BRRI dhan28 and BRRI dhan45 as check in sadar, Habiganj during Boro, 2015. The plot size for each entry was 5m x 4m. Seeding time was 25-11-2014 and seedling age was 45 days. Fertilizers were applied at 120:20:60:20:4 kg/ha for. All amounts of TSP, MP, Gypsum and Zinc sulphate were applied at the time of final land preparation. Urea was applied in 3 equal splits at 15 DAT, 30 DAT and 45 DAT. BRRI recommended practice were followed as and when necessary.

Result and discussion: Nerica mutant (6.22 t/ha) yielded higher than the checks varieties BRRI dhan28 (5.84 t/ha) and BRRI dhan45 (6.03 t/ha) with a bit higher growth duration.

Farmer's opinion: Farmers like Nerica mutant due to its highest yield**.**

SAAO's opinion: Nerica mutant also choosed by SAAO.

Table 5: Yield and ancillary characters of the ALART (SD) in Boro, 2015

Line\Variety	Grain yield (t/ha)	Growth duration (days)	Panicles/m2	Filled grains/panicle	Unfilled grains/Panicle	Plant height
Nerica mutant	6.22	143	302	89	36	93.26
BRRI dhan28 (ck)	5.84	141	291	87	42	91.38
BRRI dhan45 (ck) (ck)	6.03	139	296	81	40	100.43

6.Advanced line Adaptive Research trial (ALART) for Cold tolerance (CT) in Boro, 2015

Materials and methods: Three advanced lines i.e., IR77496-31-2-1-3-1, BR7812-19-1-6-1-P4 and BR7813-1-1-3-1 were tested along with BRRI dhan28 and BRRI dhan36 as checks in Srimonghol upzilla of Moulovibazar in Boro, 2015. The plot size for each entry was 5m x 4m. Seeding time was 25-11-2014 and seedling age was 45 days. Fertilizers were applied at 120:20:60:20:4 kg/ha for. All amounts of TSP, MP, Gypsum and Zinc sulphate were applied at the time of final land preparation. Urea was applied in 3 equal splits at 15 DAT, 30 DAT and 45 DAT. BRRI recommended practice were followed as and when necessary.

Result and discussion: Significantly the highest grain yield was observed in BR7812-19-1-6-1-P4 among **t**he tested entries having average yield of 6.96 (t/ha) and average growth duration is 150 days. Other ancillary characters also varied significantly among the genotypes.

Table 6: Yield and ancillary characters of the ALART (CT) in Boro, 2015

Line\Variety	Grain yield (t/ha)	Growth duration (days)	Panicles/m2	Filled grains/panicle	Unfilled grains/panicle	Plant height (cm)

IR77496-31-2-1-3-1	6.59	145	312	79	33	86.65
BR7812-19-1-6-1-P4	6.96	150	320	93	28	90.39
BR7813-1-1-3-1	5.93	149	299	75	37	90.52
BRRI dhan28 (ck)	6.20	145	308	90	35	91.55
BRRI dhan36 (ck)	5.66	144	293	78	25	90.21

Farmer's opinion: Farmers like IR77496-31-2-1-3-1 and BR7812-19-1-6-1-P4 due to their higher yield and short duration

SAAO's opinion: The best one is BR7812-19-1-6-1-P4, but duration is a bit higher than BRRI dhan28 (ck) and BRRI dhan36 (ck)

7.Name of expt.: Performance of Boro rice under different time of transplanting in *haor* region

Principal Investigator: **Dr. Md. Humayun Kabir SSO BRRI R/S Habiganj**

Co-Investigator: ASM Masuduzzaman,

Objectives: 1. To find out the optimum time of transplanting of BRRI dhan28 and BRRIdhan29 for *haor* areas. 2. To protect BRRI dhan28 and BRRIdhan29 from natural hazards like cold and early flood.

Materials and methods: 40 days-old seedlings of BRRI dhan28 and BRRI dhan29 were transplanted in the 5 different transplanting date in Boro 2015 season i.e., 15 December, 2014; 25 December, 2014; 05 January, 2015; 15 January, 2015; 25 January, 2015 at BRRI Habiganj farm. The experiment was conducted in a unit plot size of 5m x 3m with spacing of 20 cm X 15 cm and 3 replications. Fertilizers were applied at the rate of 100:60:60:10:10 $Kgha^{-1}$ of NPKSZn. All fertilizers were applied at the final land preparation except nitrogen. Nitrogen in the form of Urea was top dressed 3 times i.e., 15 DAT, 30 DAT and 5 days before PI stage. All other cultural management practices were done as and when necessary.

Table 1. Yield and yield components of BRRI Dhan28 as influenced by different time of transplanting.

Date of seeding	Yield (t/ha)	Duration (days)	Plant height (cm)	Tiller no./m^2	Filled grain/Panicles	Unfilled grain/Panicles
T1= 15-12-14	5.03	147	92.2	320	76	24
T2= 25-12-14	5.35	145	91.8	332	82	20
T3= 05-01-15	5.58	142	91.1	341	86	17
T4= 15-01-15	4.82	141	91.2	313	72	31
T5= 25-01-15	4.37	140	90.4	306	68	38
LSD (5%)	0.2	1.05	NS	11.48	8.8	5.8

Table 2. Yield and yield components of BRRI Dhan29 as influenced by different time of transplanting.

Date of Transplanting	Yield (t/ha)	Duration (days)	Plant height (cm)	Tiller no./m^2	Filled grain/Panicles	Unfilled grain/Panicles
T1= 15-12-14	7.05	165	96.5	358	112	27
T2= 25-12-14	7.56	163	96.8	378	119	18
T3= 05-01-15	7.28	162	95.9	367	104	22
T4= 15-01-15	6.57	161	96.2	350	95	33
T5= 25-01-15	5.79	159	95.3	341	86	39
LSD (5%)	0.21	1.07	NS	13.27	12.2	6.25

Result and discussion: Transplanting time influenced significantly on yield and yield components both of BRRI dhan28 and BRRI Dhan29. The highest yield was found 5.58 t/ha for BRRI dhan28 and 7.56 t/ha for BRRI dhan29 on transplanting date of 05 January and 25 December respectively. The lowest yield was found in the late transplanting both for BRRI Dhan28 and BRRI Dhan29. Growth duration also varied due to differences of transplanting time. However, plant height was not

differed significantly due to changes of transplanting date. Tiller no./m^2, filled grains/panicles, unfilled grains/panicles were also differed significantly over different time of transplanting. The highest tiller no./panicle and filled grains/panicles were observed at T3 (05-01-15) which didn't differ significantly with T2 (25-12-14) for BRRI dhan28. But, in case of BRRI Dhan29 the highest tiller no./panicle and filled grains/panicles were observed at T2 (25-12-14) which didn't differ significantly with T3 (05-01-15). Moreover, the lowest tiller no./panicle and filled grains/panicles were observed in T5 treatment (25-01-15) both for BRRI Dhan28 and BRRI Dhan29. Therefore, the best time of transplanting for BRRI Dhan28 and BRRI Dhan29 are 05 January and 25 December respectively for Habiganj region.

8. Demonstration of BRRI released Rice Varieties (Rice garden)

Principal Investigator: ASM Masuduzzaman

Co-investigators: M M R Dewan and MM E Ahmed

Objectives: Field demonstration of the BRRI released varieties for farmers, the trainees and visitors.

Materials and Methods: Fifty five BRRI released varieties were grown at BRRI regional station, Habiganj farm area. The unit plot size was 5.4 × 2.5 m with spacing of 25 cm× 15 cm. Fertilizers were applied @ 100:60:60:10:10 Kg ha^{-1} NPKS and Zn per hectare. All fertilizers except N were applied as basal during final land preparation. N in the form of Urea was applied as top dress in three splits at 15, 30 and 45 days after transplanting. Irrigation, weeding, insecticides and other cultural practices were done as and when necessary.

Results and Discussion: These varieties were used as demonstration for farmers, SAAOs and visitors to acquaint with the BRRI developed varieties that facilitated rapid dissemination. Pure seeds were preserved for future use. List of these varieties are shown in Table 27.

Table: 27. List of the varieties grown in the rice garden, Boro'2015

Sl. no.	Variety	Sl. no.	Variety	Sl. no.	Variety
1	BR1 (Chandina)	19	BR20(Niamat)	37	BRRI dhan37
2	BR2 (Mala)	20	BR21(Nizami)	38	BRRI dhan40
3	BR3 (Biplob)	21	BR22(Kiron)	39	BRRI dhan41
4	BR4(Brrisail)	22	BR23 (Dishari)	40	BRRI dhan42
5	BR5 (Dula bhog)	23	BR25(Naya pajam)	41	BRRI dhan44
6	BR6	24	BR26 (Sraboni)	42	BRRI dhan45
7	BR7 (BRRI balam)	25	BRRI dhan27	43	BRRI dhan46
8	BR8 (Asha)	26	BRRI dhan28	44	BRRI dhan47
9	BR9 (Shufala)	27	BRRI dhan29	45	BRRI dhan48

10	BR10	28	BRRI dhan30	46	BRRI dhan49
11	BR11 (Mukta)	29	BRRI dhan31	47	BRRI dhan50
12	BR12 (Moyna)	30	BRRI dhan30	48	BRRI dhan51
13	BR14 (Gazi)	31	BRRI dhan31	49	BRRI dhan52
14	BR15 (Mohini)	32	BRRI dhan32	50	BRRI hybrid dhan1
15	BR16 (Shahi balam)	33	BRRI dhan33	51	BRRI hybrid dhan2
16	BR17 (Hashi)	34	BRRI dhan34	52	Hbj. B. II
17	BR18 (Shahjalal)	35	BRRI dhan35	53	Hbj. B. IV
18	BR19 (Mongol)	36	BRRI dhan36	54	Hbj. B. VI

D/S : 18/11/2013 D/T : 29/12/2014

9. Seed production and distribution: About 35,021 kg of seeds of different popular varieties was produced and sold to the farmers during 2014-15 (Table 28 and 29). About 11,250 kg Breeder's seeds of three popular varieties (BR16, BRRI dhan28, BRRI dhan29 and BRRI dhan48) were produced and sent to BRRI Breeder's Seed Unit (Table 30).

Table: 28. Seed production (TLS) of popular rice varieties during Aman'2014-15

Sl. no	Varieties	Production (Kg)
1	BR11	258
2	BR22	91
8	BRRI dhan46	2125
9	BRRI dhan49	756
10	BRRI dhan52	124
12	BRRI dhan57	125
13	Hbj. A.I	84
14	Hbj. A.II	480
15	Hbj. A.IV	321
16	Hbj. A.VIII	85
17	BR224	123
Total		**4,572**

Table: 29. Seed production (TLS) of popular rice varieties during Boro'2014-15

Sl. no.	Varieties	Production (Kg)
1	BR3	120
2	BR14	220

4	BR18	600
5	BR19	1575
7	BRRI dhan28	1294
8	BRRI dhan29	24966
9	BRRI dhan55	645
10	BRRI dhan58	900
14	Hbj. B.II	05
15	Hbj.B.VI	185
Total		**30,510**

Table: 30. Variety wise Breeder's seed production during Boro & Aus, 2014-15

Sl. no.	Variety	Production (Kg)	Season
1	BR16	1350	Boro 2013-14
2	BRRI dhan28	8000	
3	BRRI dhan29	1200	
4	BRRI dhan48	700	Aus 2014
Total		**11,250**	

10. Training program and field demonstration: A number of training programs and field demonstrations were conducted with the active participation of farmers, SAAOs and other concerned extension personnel from Department of Agricultural Extension (DAE) (Table 31 & 32).

Table: 31. Training Programs

Sl. no.	Title	No. of Training	Fund	Participants
1	Farmers Training on Modern Rice Production Technologies	1	GOB	40
2	Modern Rice Production Technologies	6	EQSS	180

Table: 32. Field Demonstrations

Sl. no.	Name of the Program	Variety	No. of demonstration	Season
1	Field demonstration of modern Aus rice variety on farmers field	BRRI dhan48	36	T. Aus, 2015

2	Field demonstration of Modern Boro rice varieties on farmers field	BRRI dhan28 and BRRI dhan29	10	Boro, 2014-15

11.Linkage with related departments and farmers: Scientists of BRRI, R/S Habiganj, attended different meeting with DAE, GO, NGO and farmers gathering to disseminate the latest technologies and to get feedback information. Scientist also visited farmers' fields to identify field problems and to advise them for necessary measures.

12. Weather data collection: Weather data on rainfall, maximum and minimum temperature, sunshine hours were collected during the year and the collected data were sent to the Plant Physiology Division, BRRI, Gazipur. Graphical representation of temperature, rainfall and flooding pattern are shown in Fig 1, Fig. 2 and Fig. 3.

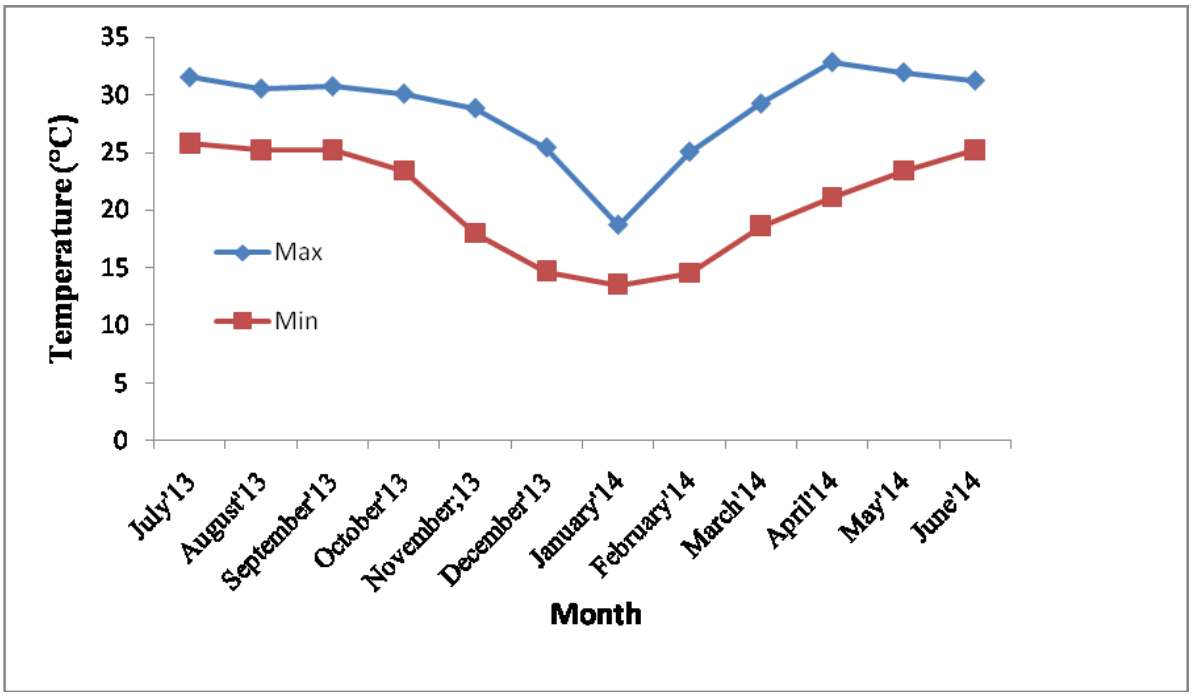

Figure 1. Monthly maximum and minimum temperature (°C) at BRRI R/S, Habiganj, 2014-15

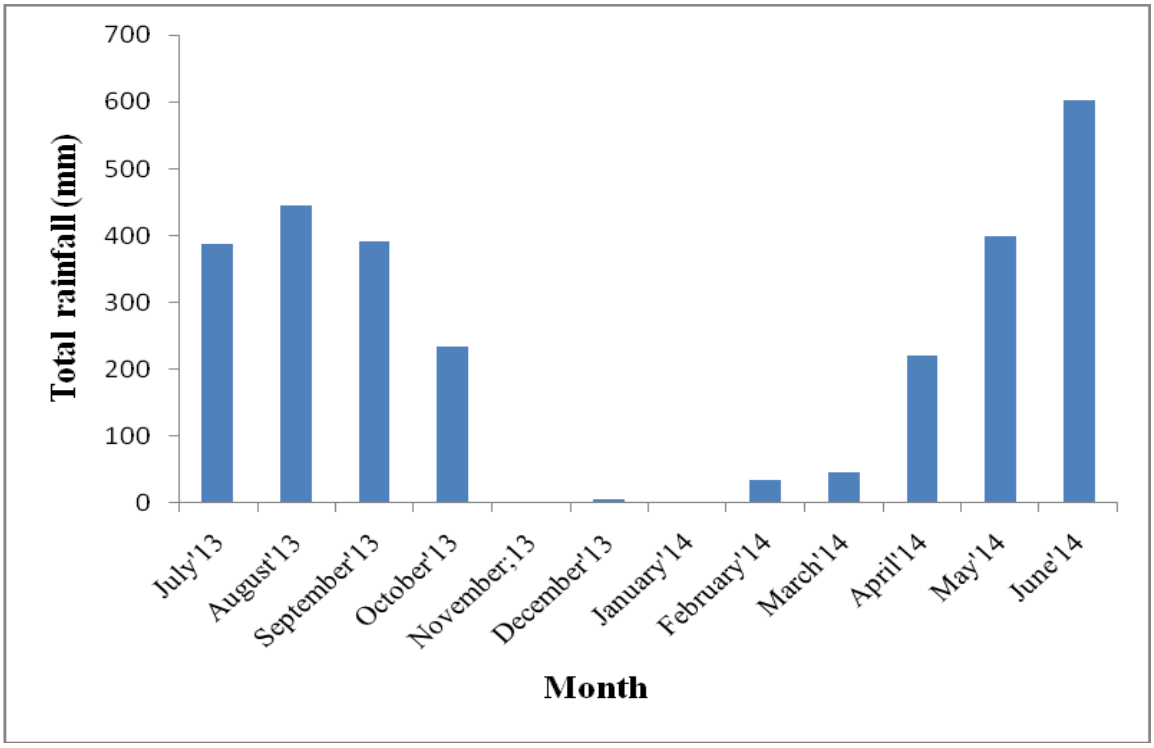

Figure 2. Monthly total rainfall (mm) at BRRI R/S, Habiganj, 2014-15

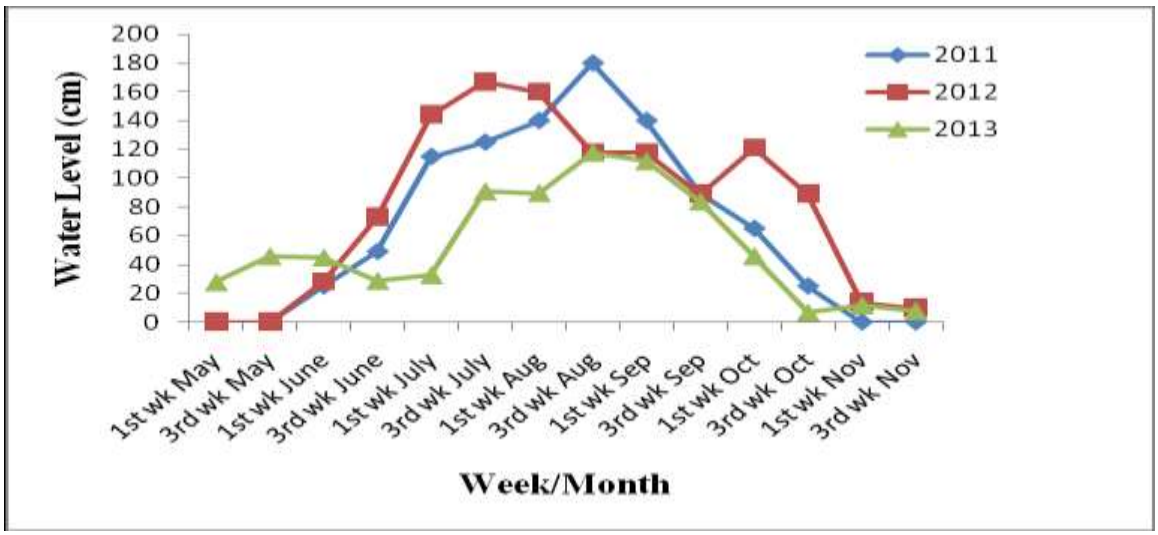

Figure 3. Weekly flooding pattern of last four years at BRRI, Habiganj

ANNUAL REPORT
2014- 2015

BRRI Regional Station Rajshahi

Summary

Varietal Development

Crop Soil Water Management

Pest Management

Rice Farming Systems

WORKING PERSONNEL

Md. Mostafa Kamal, PhD, Chief Scientific Officer & Head

Md. Nazmul Bari, PhD, Senior Scientific Officer

Md. Shafiqul Alam, BSc. Ag. (Hons.), Senior Scientific Officer

Md. Harun-Al-Rashid, MS, Senior Scientific Officer*

Md. Abu Syed, PhD, Scientific Officer*

Montasir Ahmed, BSc. Ag. (Hons.), Scientific Officer

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* Joined after higher studies during the reporting year

SUMMARY

Four out of eight B. Aus-RYT entries produced higher yield (3.27-4.0 t/ha) than BRRI dhan43 (3.07 t/ha) of them BR7383-2B-23 produced the highest.

Three out of nine T. Aus-RYT entries produced higher yield (4.26-4.67 t/ha) than BR26 and BRRI dhan48 (3.07-4.18 t/ha). Among them BR7718-55-1-3 produced the highest.

Two out of eight somacloned entries BRRI dhan29-SC3-28-16-10-6-HR3 and BRRI dhan29-SC3-28-16-10-4-HR6 produced better yield (3.50-3.68 t/ha) in T. Aus-RYT.

Only one of five anther cultured T. Aman-RYT entries; BR7082-AC9-1-1-2-1-1 produced slightly higher yield (3.20 t/ha) than BRRI dhan48 (3.15 t/ha).

Only one of five T. Aman-RYT(RLR) genotypes; IR70213-10-CPA 4--2-2-2 gave higher yield (4.84 t/ha) than BRRI dhan49 and BRRI dhan32 (3.90-4.68 t/ha).

Nine of 10 T. Aman-RYT(PQR) entries gave higher yield (3.0-4.28 t/ha) than BRRI dhan37 and BRRI dhan34 (1.82-2.95 t/ha). Among them BR8226-17-1-2 produced the highest.

Only two of nine T. Aman-RYT(MER) genotypes; BR7840-54-3-2-2 and PSBRC 82(IRRI1 23) gave higher yield (5.13-4.92 t/ha) than BRRI dhan32 and BRRI dhan39 (4.71-4.82 t/ha).

Thirty five of 55 OYT-GSR genotypes produced higher yield (3.04-4.92 t/ha) than BRRI dhan39 and BRRI dhan56 (2.31-2.97 t/ha).

Only HHZ5-DT20-DT3-Y2 from 19 SYT-1 genotypes produced more yield in Godagari (5.04 t/ha) and on-station (5.67 t/ha) than BR11, BRRI dhan32, BRRI dhan39 and HUA565 (5.00-5.39 t/ha).

Only HHZ17-Y16-Y3-Y2, HHZ23-DT16-DT1-DT1 and PSBRC68 from 16 T. Aman-SYT2(GSR) genotypes produced higher yield (4.90-4.94 t/ha) than BRRI dhan39 and BRRI dhan56 (4.28-4.74 t/ha) in on-station, whereas HUANG HUA ZHAN and PSBRC68 produced higher yield (5.05-5.28 t/ha) in Godagari and nine genotypes (4.49-5.50 t/ha) in Tanore.

Only HHZ5-SAL10-DT1-DT1 from six T. Aman-RYT genotypes produced more yield (4.29 t/ha) than BRRI dhan39 and BRRI dhan56 (3.30-3.86 t/ha) in Tanore.

Only BR8076-1-2-2-3 from seven Boro-RYT(PQR) genotypes gave higher yield (5.82 t/ha) than BRRI dhan50 and BRRI dhan63 (4.67-5.17 t/ha).

Only BR7372-18-2-1-HR1-HR6 (Com) from nine RYT-PQR (Com) genotypes produced higher yield (6.75 t/ha) than BRRI dhan28, BRRI dhan50, BRRI dhan60 and BRRI dhan63 (4.85-5.92 t/ha) in Boro.

Seven of 13 Boro-RYT(FB) genotypes produced higher yield (6.11-6.97 t/ha) than BRRI dhan28, BRRI dhan29 and BRRI dhan60 (5.07-6.01 t/ha).

Three from 11 Boro-RYT(MER) genotypes produced higher yield (6.00-6.80 t/ha) than BRRI dhan28 (5.98 t/ha) but none out yielded BRRI dhan29 (7.18 t/ha).

All the five Boro-RYT(GSR) genotypes produced higher yield (6.37-7.15 t/ha) than BRRI dhan60 (6.08 t/ha) but none out yielded BRRI dhan29 (7.56 t/ha).

Three out of 27 Boro-OYT(GSR) materials GSR IR1-9-D15-Y1, GSR IR1-12-Y8-D2 and GSR IR1-9-D13-S2 produced comparable yield (6.11-6.44 t/ha) than BRRI dhan59 and BRRI dhan47 (5.93-6.13 t/ha) in on-farm.

Three out of 22 Boro-PYT(GSR) genotypes; HHZ5-DT20-DT3-Y2, HHZ5-Y7-Y2-SUB1, HHZ5-DT20-DT2-DT1 from produced higher yield (5.90-6.25 t/ha) than BRRI dhan59 (5.89 t/ha). Two genotypes; HHZ5-Y7-Y2-SUB1 and HHZ5-DT20-DT2-DT1 produced (5.92-6.25 t/ha) higher than BRRI dhan28 (5.91) in on-farm.

Only IR84678-25-5-B from eight Boro-SYT(GSR) genotypes produced higher yield (7.02 t/ha) than BRRI dhan28 and BRRI dhan59 (6.21-6.35 t/ha) in on-farm.

Four out of seven Boro-RYT1 materials; HHZ15-SAL13-Y1, HHZ15-DT4-DT1-Y1, HHZ23-DT16-DT1-DT1 and HHZ11-DT7-SAL1-SAL1 produced higher yield (6.65-7.64 t/ha) than BRRI dhan29 and BRRI dhan60 (6.12-6.62 t/ha) in on-farm.

Only BR4909-R1-R2 out of six anther cultured RYT-1 materials produced higher yield (6.36 t/ha) than BRRI dhan28 (5.94 t/ha).

The tested genotype BR6158RWBC2-2-1-1 from Biotechnology Division produced higher yield (9.23 t/ha) than BRRI dhan29 and BRRI dhan58 (7.34-8.67 t/ha).

Five out of 16 T. Aman hybrids produced >6 t/ha yield. Among Among them H993 produced the highest (53.76 kg/day).

Seven out of 19 hybrids of A set produced >8 t/ha yield. Out of them H1046 produced the highest (59.27 kg/day). Ten out of 19 hybrids of B set produced >8 t/ha yield. Among them H1007 produced the highest (59.48 kg/day). Nine out of 18 hybrids of C set produced >9 t/ha yield. Among them H1036 produced the highest (61.03 kg/day) in Boro.

The proposed genotype; BR7357-11-2-4-1-1 produced significantly higher yield (3.49 t/ha) than BRRI dhan37 (1.68 t/ha) in PQR.

Both the proposed genotypes IR83377-B-B-93-3 and IR82589-B-B-84-3 produced higher yield (4.49-5.84 t/ha) than BRRI dhan56 (3.48-4.47 t/ha) in different drought prone areas.

Both the proposed genotypes IR83140-B-36-B-B and IR83140-B-71-B-B produced significantly higher yield (6.10-6.12 t/ha) than BRRI dhan28 (5.39 t/ha) with less water supply.

Twelve out of 88 OYT-STRASA materials gave >3 t/ha yield those out yielded BRRI dhan56, IRRI 123, MTU 1010 (0.90-2.95 t/ha) in controlled condition. Of them IR95836 produced the highest yield (4.46 t/ha) even narrowly higher than the best check IR64 (4.33 t/ha).

Eight out of 55 AYT-STRASA genotypes gave >4.50 t/ha yield in controlled condition that was higher than the yield of Sambha Mahsuri, MTU 1010, Swarna, BINA dhan7 and BRRI dhan56 (2.55-3.62 t/ha). Out of them IR87656-21-1-14 produced the highest (4.88 t/ha). Whereas five produced >4.00 t//ha yield in stressed condition that was also higher than the yield of checks (2.80-3.88 t/ha). Among them IR88903-8-1-1-3 produced the highest (4.34 t/ha).

All of the 14 PVS-STRASA genotypes gave >4 .00 t/ha yield irrespective of site and conditions except stressed at Paba where only IR88864-2-1-1-3, IR88966-45-2-1-4, IR10L282, IR10L276 and

IR87761-53-1-1-1 gave >4.00 t/ha yield. Out of them IR87761-53-1-1-1 produced the highest yield (4.24-4.59 t/ha) in stressed and 5.60 t/ha in controlled condition.

The abundance of different insects were found in the light trap. Among them GLH was the highest followed by BPH and YSB. Peak of GLH and WLH observed in November whereas YSB and BPH in October.

Among the natural enemies staphylinid beetle population was found the highest followed by earwig and green mirid bug. Peak of STB and EW was observed in March and June respectively.

The highest number of grasshopper, GLH and rice leaf roller were found in fully controlled plots (9.5, 17.0 and 2.25/20 complete sweep) but the incidence was below the economic threshold level.

The highest number of natural enemies; spider, damsel fly, lady bird beetle and long horned grasshopper were found in 1m away from the flowering plants of rice bund.

Four times insecticide (Carbofuran 5G @ 10 kg/ha) used plots gave the highest yield but similar to that of 1 m and 4 m away nectar-rich flowering plants grown in bunds sarrounded rice crops.

The highest natural enemies and parasitism by *Trichogramma zahiri* were observed in rice field nearby nectar-rich flowering plants. However, the least natural enemies and parasitism were found in four times insecticides applied plots. Moreover, no yield reduction was noticed between rice fields surrounded by flowering plants and insecticide treated plots.

On an average 0.80-1.20 YSB were caught per pheromone trap during September and 1.19 to 1.80 during October. The RLR caught was less than that of YSB, which was 0.73-0.93 and 0.54-0.59 during September and October respectively.

About 14 tons truthfully leveled seeds of two T. Aus, 11 T. Aman and five Boro varieties from 2013-2014 fiscal year produce were distributed and sold to the Researchers and local farmers according to their demand.

More than 15 tons TLS were produced from three T. Aus, 12 T. Aman and seven Boro varieties during the reporting year. About 20 tons Breeders seeds (BS) were produced from four T. Aman and three Boro varieties and sent to the Genetic Resource and Seed Division.

USEFUL SCIENTIFIC INFORMATION

VARIETAL DEVELOPMENT

Regional yield trial (RYT), B. Aus, 2014

Eight genotypes including the check BRRI dhan43 were used to evaluate them for yield potential and adaptability. Dry seeding of the genotypes was done in moist soil in a unit plot size 5.4 m × 12 rows with 25 cm row spacing. Genotypes in the field lay out was distributed following RCB design with three replications. Fertilizers PKS and Zn were applied @ 10:30:18:3.6 kg/ha respectively

from TSP, MOP, gypsum and zinc sulphate during final land preparation and N @ 60 kg/ha from urea in three splits at 15, 30 and 45 days after seed emergence. Hand weeding was done three times but no herbicide was applied. Plant protection measures were taken as and when necessary. Data were taken on date of flowering and maturity, number of panicles and yield/m^2.

Four tested entries produced higher yield (3.27-4.0 t/ha) than the check (3.07 t/ha) (Table 1). BR7383-2B-23 produced the highest yield (4.0 t/ha) followed by BR7587-2B-3 (3.78 t/ha) and were selected for further advancement.

Regional yield trial (RYT), T. Aus 2014

Nine entries including two checks BR26 and BRRI dhan48 were used to evaluate them for yield potential and adaptability. Seedlings of 26 days were transplanted with 2-3 seedlings/hill. The hill spacing was 25 cm × 15 cm and unit plot size was 5.4 m × 2.0 m. Fertilizers PKS and Zn were applied @ 60:40:40:10 kg/ha respectively from TSP, MOP, gypsum and zinc sulphate during final land preparation and N in two equal splits at 10 and 30 days interval starting after transplanting. Crop management practices such as cultural operations and pest management activities were done in time. Data were recorded on flowering and maturity, plant height, lodging tolerance, phenotypic acceptability and yield.

Three tested entries produced higher yield (4.26-4.67 t/ha) than the checks (3.07-4.18 t/ha) (Table 2). BR7718-55-1-3 produced the highest yield (4.67 t/ha) followed by BR7718-55-1-3 (4.53 t/ha) and selected for further advancement.

Regional yield trial (RYT-Soma clone), T. Aus 2014

Eight entries including three checks WK1, Parija and BRRI dhan48 were evaluated for their yield potential and adaptability. Seedlings of 24 days were transplanted with 2-3 seedlings/hill. The hill spacing was 25 cm × 15 cm and unit plot size was 5.4 m × 2.0 m. Fertilizers PKS and Zn were applied @ 60:40:40:10 kg/ha respectively from TSP, MOP, gypsum and zinc sulphate during final land preparation and N in two equal splits at 10-and-30-day after transplanting. Crop management practices such as cultural operations and pest management activities were done in time. Data were recorded on flowering and maturity, plant height, lodging tolerance, phenotypic acceptability and yield.

Two tested entries BRRI dhan29-SC3-28-16-10-6-HR3 and BRRI dhan29-SC3-28-16-10-4-HR6 performed better (3.50-3.68 t/ha) than the checks (1.52-3.45 t/ha) (Table 3) and were selected for further advancement. Rat badly damaged Parija, Nerica10 and the check BRRI dhan48.

Regional yield trial (RYT-Biotechnology), T. Aus 2014

Five entries including the check BRRI dhan48 were evaluated for their yield potential and adaptability. Seedlings of 20 days was transplanted with 2-3 seedlings/hill. The hill spacing was 25 cm × 15 cm and unit plot size was 5.4 m × 2.0 m. Fertilizers PKS and Zn were applied @ 60:40:40:10 kg/ha respectively from TSP, MOP, gypsum and zinc sulphate during final land preparation and N in two equal splits at 10 and 30 days after transplanting. Crop management practices such as cultural operations and pest management activities were done in time. Data were recorded on flowering and maturity, plant height, lodging tolerance, phenotypic acceptability and yield.

Only one tested entry BR7082-AC9-1-1-2-1-1 produced slightly higher yield (3.20 t/ha) than the check BRRI dhan48 (3.15 t/ha) and was selected for further advancement.

Regional Yield Trial (RYT), T. Aman 2014

Three regional yield trials for rain-fed lowland rice (RLR), premium quality rice (PQR) and micronutrient (MN) were conducted to evaluate specific and general adaptability of the genotypes. Seedlings of 21-23 days were transplanted in 5.4 m × 12 rows plot with 20 × 15 cm spacing using 2-3 seedlings/hill. The experimental design was RCB with three replications. Fertilizers PKS and Zn were applied @ 17.4:58.5:14:4.3 kg/ha from triple super phosphate, muriate of potash, gypsum and zinc sulphate during final land preparation and N @ 108 kg/ha in three equal splits at 15 days interval starting from 10 days after transplanting (DAT). Crop management practices were done as and when necessary. Supplemental irrigation was given when necessary. Data were recorded on date of flowering and maturity, plant height, lodging tolerance, phenotypic acceptability at vegetative and maturity stage and yield/plot.

Hybrid rice trial for T. Aman 2014

The trials were conducted with 16 genotypes to evaluate specific and general adaptability of the genotypes in on-station condition. Seedlings of 23 days were transplanted in 5 × 6 m plot with 20 × 15 cm spacing using single seedling/hill. The experimental design was RCB with three replications. Fertilizers NPKS and Zn were applied @ 120:26:60:13:3.6 kg/ha from urea. Full doses of TSP, gypsum, zinc sulphate, 1/8th urea 2/3rd MOP were applied during final land preparation. The rest of MOP at 50 days after transplanting (DAT) and rest of urea in two equal splits at 15 and 50 DAT were top dressed. Crop management practices were done as and when necessary. Data were

recorded on date of flowering and maturity, plant height, lodging tolerance, phenotypic acceptability and yield/plot.

Five genotypes produced >6 t/ha yield. The genotype H993 produced the highest yield (53.76 kg/day) followed by H994 (51.26 kg/ha) (Table 14).

Hybrid rice trial for A, B and C set, Boro 2014-15

The trials were conducted with 19 genotypes each of A and B set and 18 genotypes of C set to evaluate specific and general adaptability of the genotypes in on-station condition. Seedlings of 35 days were transplanted in 5 × 6 m plot with 20 × 15 cm spacing using single seedlings/hill. The experimental design was RCB with three replications. Fertilizers NPKS and Zn were applied @ 124:26:60:13:3.6 kg/ha from urea. Full doses of TSP, gypsum, zinc sulphate, 1/8th urea 2/3rd MOP were applied during final land preparation. The rest of MOP at 50 days after transplanting (DAT) and rest of urea in two equal splits at 15 and 50 DAT were top dressed. Crop management practices were done as and when necessary. Data were recorded on date of flowering and maturity, plant height, lodging tolerance, phenotypic acceptability and yield/plot.

In the A set seven genotypes produced >8 t/ha yield. The genotype H1046 produced the highest yield (59.27 kg/day) followed by H998 (56.89 kg/ha) (Table 15). In the B set 10 genotypes produced >8 t/ha yield. The genotype H1007 produced the highest yield (59.48 kg/day) followed by H1015 (55.81 kg/ha) (Table 16). In the C set nine genotypes produced >9 t/ha yield. The genotype H1036 produced the highest yield (61.03 kg/day) followed by H1021 (57.70 kg/ha) (Table 17).

PEST MANAGEMENT

Monitoring of pest and natural enemy incidence by using light trap

Rice insect pests and their natural enemies were monitored throughout the year by Pennsylvanian light traps from July 2014 to June 2015 to study the pests and their natural enemies' incidence pattern in light trap and to create a database. The traps were operated with 100 WATT white fluorescent tube light from dusk to dawn and the tube was operated from the nearest electricity sources of the light traps. Insect pests and natural enemies those were attracted to the light of the light trap slipped into the hole of the trap and caught behind in a pot which was attached with the hole of the trap. Then the insect pest and natural enemies were collected, sorted, counted and recorded in the data sheet every day.

The abundance of green leafhopper (GLH), white leafhopper (WLH), brown plant hopper (BPH), white-backed plant hopper (WBPH), yellow stem borer (YSB), pink borer (PB), leaf roller (LR), caseworm (CW), grasshopper (GH), mole cricket (MC), field cricket (FC), rice bug (RB) and stink bug (SB) were found in the light trap during the reporting period. Among the insect pests, GLH populations were found the highest followed by BPH and YSB. Peak of GLH and WLH observed

in November whereas YSB and BPH in October rather than a small peak of BPH found in May (Fig. 1).

Among the natural enemies; staphylinid beetle (STB) populations was found the highest followed by earwig (EW) and green mirid bug (GMB). Peak of STB and EW was observed in March and June respectively whereas, BPH showed two peak in November and May (Fig. 2).

Conservation of natural enemies through ecological engineering approaches, T. Aman 2014

The experiment was conducted with BRRI dhan52 in a large field divided into three blocks and each block into four plots to conserve natural enemies through different ecological engineering approaches. Nectar-rich flowering plants (Cosmos) were planted on bunds of each four plots of the first block to provide food and shelter for different parasitoids. Normal cultivation was done in the second block with no insecticide. Prophylactic use of insecticide was done (Carbofuran 5G @ 10 kg/ha) at 15 days interval (5 times) in the 3rd block after 1st top dressing of urea. Twenty complete sweeps were taken from all the blocks at every 15 days interval up to flowering. Number of insect pest and natural enemies for all the sweeps from different blocks were counted and recorded separately. Parasitism was determined through retrieval method.

The results showed that the highest number of grasshopper (GH), green leafhopper (GLH) and rice leaf roller (RLR) were found in T_4 (9.5, 17.0 and 2.25/20 complete sweep, respectively). But the incidence was below the economic threshold level (Fig. 3). Incase of natural enemies the highest number of spider, damsel fly (Dam. fly), lady bird beetle (LBB) and long horned grasshopper (LHG) (5.75, 11.5, 2.25 and 2.75/20 complete sweep, respectively) were found in T_1 (Fig. 4). In T_3 four time used insecticide (Carbofuran 5G @ 10 kg/ha) but yield was similar to that of T_1 and T_2 where nectar-rich flowering plants grown in bunds sarrounded rice crops. Lower yield was observed in T_4 where no insectiside was applied and no flowering plants were grown in rice bunds. Moreover the lowest parasitism occurred by *Trichogramma zahiri* where continuously insectiside was used (Fig. 5).

The highest natural enemies and parasitism by *Trichogramma zahiri* were observed in rice field nearby nectar-rich flowering plants. However, the least natural enemies and parasitism were found in rice field where four times (continuous/prophylactic) insecticides were applied. Moreover, there was no yield reduction in rice field surrounded by flowering plants compared with insecticide application. So, farmers can avoid the toxic and hazardous insecticides to control the insect pests by growing nectar-rich flowering plants on the bunds of surrounded rice crops.

Table 1. Yield contributing parameters and yield of RYT genotypes, B. Aus 2014

Sl#	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	BR7698-2B-1-9-1	98.0	107	2.91
2	BR7698-2B-1-9-2	98.3	106	3.47
3	BR7699-2B-3-13-3	114.3	110	3.07
4	BR7692-2B-5-2	114.7	104	2.16
5	BR7692-2B-5-4	105.7	109	2.59
6	BR7383-2B-23	107.0	103	4.0
7	BR7587-2B-3	126.7	105	3.78
8	BRRI dhan43 (Ck.)	121.3	104	3.07
LSD at 5%		6.73	0.36	0.78

D/S: 25.04.2014

Table 2. Yield contributing parameters and yield of RYT genotypes, T. Aus 2014

Sl#	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	BR8113-21-3-1	102.7	118	3.61
2	BR7922-45-2-2-1	115.7	114	3.53
3	IR7866-BR-3-1	104.0	110	3.89
4	BR7708-62-1-1	110.3	113	4.26
5	BR7718-56-3-1	106.7	110	4.04
6	BR7718-55-1-3	108.7	110	4.67
7	BR7718-55-1-3	108.7	82	4.53
8	BR26 (Ck.)	110.7	85	4.19
9	BRRI dhan48 (Ck.)	99.3	88	4.12
LSD at 5% level		4.26	0.86	0.76

D/S: 20.04.2014 D/T: 15.05.2014

Table 3. Yield contributing parameters and yield of RYT (Somaclone) genotypes, T. Aus 2014

Sl#	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	BRRI dhan29-SC3-28-16-10-8-HRI	95.7	79	2.99
2	BRRI dhan29-SC3-28-16-10-6-HR3	107.3	80	3.68
3	BRRI dhan29-SC3-28-16-10-4-HR5	109.3	80	3.31
4	BRRI dhan29-SC3-28-16-10-4-HR6	104.7	80	3.50
5	WK1 (Ck.)	81.0	80	3.45
6	Parija (Ck.)	96.7	80	1.52
7	Nerica10	89.3	103	0.57

8	BRRI dhan48 (Ck.)	95.3	85	2.25
LSD at 5% level		3.88	-	0.59

D/S: 01.05.2014 D/T: 25.05.2014

Table 4: Yield and ancillary characters of RYT#3 (PQR), T. Aman 2014

SL #	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	BR8226-8-5-2-2	108.6	135	3.00
2	BR8226-11-4-4-3	93.8	131	3.83
3	BR8226-11-4-6-2	98.2	128	3.86
4	BR8294-1-3-2-2	112.6	106	3.61
5	BR8226-13-1-2	101.4	128	4.24
6	BR8226-17-1-2	106.2	132	4.28
7	BR8227-6-2-1	109.5	126	3.97
8	BR8515-23-6-3	111.5	114	1.83
9	BRRI dhan34 (Ck.)	105.2	128	2.95
10	BRRI dhan37 (Ck.)	128.6	137	1.82
LSD at 5% level		4.76	-	0.86

D/S: 12.07.14 D/T: 02.08.14

Table 5. Yield and ancillary characters of 22 OYT (GSR) materials, T. Aman 2014

Sl. #	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	HHZ8-Y7-DT2-SAL1	103.2	107	4.09
2	HHZ9-DT12-DT1-SUB1	88.4	113	3.70
3	HUANGHUAZHAN	93	113	3.53
4	KCD1	97.8	109	3.99
5	SAGC-02	100.6	109	4.05
6	WEED TOLERANT RICE1	92.6	109	4.36
7	HHZ18-Y3-Y1-Y1	88.6	110	4.92
8	HHZ11-DT10-SAL1-SUB1	86.2	107	3.56
9	HHZ9-DT2-SAL1	88	114	4.13
10	HHZ9-DT7-Y3HHZ12-Y8-DT1	85.8	113	4.25
11	HHZ12-Y8-DT1	91	109	3.92
12	HHZ12-SAL11-Y1	86.8	115	4.46
13	IR75416-R-R-R-R-152-2	139.8	134	3.78
14	IR75416-R-R-R-R-152-4	134.2	134	3.58
15	IR75416-R-R-R-R-156-2	142	129	3.82
16	IR75416-R-R-R-R-176-3	150	116	3.56
17	IR75416-R-R-R-R-56-4	140.6	116	3.87
18	IR75416-R-R-R-R-57-1	141.8	116	3.35
19	IR75416-R-R-R-R-60-4	135.6	115	4.10
20	IR75416-R-R-R-R-69-1	139.8	115	3.62
21	IR75417-R-R-R-R-247-4	138.4	115	3.79
22	IR75417-R-R-R-R-319-3	146	119	3.90
23	BRRI dhan39 (Ck.)	96.8	113	2.31
24	BRRI dhan56 (Ck.)	104.4	107	2.97

D/S: 07.07.14 D/T: 05.08.14

Table 6. Yield and growth duration of SYT#2 (GSR) materials, T. Aman 2014

Sl#	Designation	Growth duration (days)			Yield (t/ha)		
		Goda	Tan	OS	Goda	Tan	OS
1	HHZ5-DT1-DT1	101	113	119	4.19	4.49	4.20
2	HHZ11-DT7-SAL1-SAL1	99	102	113	3.14	3.38	3.06
3	HHZ15-DT4-DT1-Y1	104	113	119	4.62	4.67	4.57
4	HHZ17-DT6-Y1-DT1	104	113	117	4.59	4.54	4.33
5	HHZ17-Y16-Y3-Y2	104	113	117	4.74	4.16	4.91
6	HUANG HUA ZHAN	104	113	117	5.05	5.05	4.96
7	HHZ23-DT16-DT1-DT1	104	117	117	4.47	5.04	4.90
8	HHZ12-Y12-Y1-DT1	103	112	117	4.36	4.73	4.57
9	HHZ6-SAL3-Y1-SUB2	104	114	123	4.30	4.69	5.57
10	HHZ12-SAL2-Y3-Y2	104	112	118	4.44	4.79	4.56
11	D4098	110	117	124	4.49	3.96	5.33
12	926	110	117	123	4.17	4.14	4.59
13	ZX115	100	112	117	2.98	4.03	3.55
14	PSB RC68	128	134	137	5.28	5.50	4.94
15	BRRI dhan39 (Ck.)	113	124	124	4.55	4.40	4.28
16	BRRI dhan56 (Ck.)	109	117	119	4.69	4.22	4.74
LSD at 5% level		0.11	0.62	0.57	0.72	0.55	0.52

D/S: 03.07.2014 D/T: 25.07.2014

Table 7. Yield and ancillary characters of RYT#4 (FB) materials, Boro 2014-15

SL #	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)

1	BR7683-30-3-3-4	91.4	147	6.23
2	BR7671-37-2-2-3-7	90.6	153	6.35
3	BR7988-4-5-3-4	78.5	156	6.48
4	BR7783-AC12-3	99.5	165	6.64
5	BR7783-AC13-5	97.9	165	5.66
6	BR7783-AC14-5	100.6	165	6.27
7	BR7783-AC6-3-2-2-1	103.7	164	6.97
8	BRRI dhan29-SC3-28-16-10-8-HR1(Com)	85.0	147	5.49
9	BR7988-10-4-1	86.6	148	6.11
10	BR7800-63-1-7-3	93.9	149	5.75
11	BRRI dhan28 (Ck.)	91.1	146	5.26
12	BRRI dhan29 (Ck.)	98.1	166	6.01
13	BRRI dhan60 (Ck.)	84.6	148	5.07
LSD at 5% level		3.91	1.15	0.96

D/S: 10.12.2014 D/T: 01.02.2015

Table 8. Yield and ancillary characters of RYT#5 (MER) materials, Boro 2014-15

SL #	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	BR7840-54-3-2-1	94.9	154	4.82
2	BR7840-54-3-4-1	99.2	147	5.08
3	BR8257-37-1-2-2	87.4	148	5.06
4	BR7833-19-2-3-5	101.7	155	5.27
5	BR8261-19-1-1-3	103.7	154	6.00
6	BR7820-18-1-6-3-P4	100.5	161	5.62
7	BR7881-62-2-3-7-P3	106.9	164	6.80
8	BR7879-17-2-4-HR3-P1	127.5	161	6.71
9	BRRI dhan28 (Ck.)	96.1	147	5.98
10	BRRI dhan29 (Ck.)	96.7	165	7.18
LSD at 5% level		3.30	1.30	0.42

D/S: 10.12.2014 D/T: 01.02.2015

Table 9. Yield and ancillary characters of RYT#6 (GSR) materials, Boro 2014-15

SL #	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	HHZ15-SAL13-Y1	95.4	161	7.15
2	HHZ23-DT16-DT1-DT1	96.1	162	6.37
3	HH15-DT4-DT-Y1	89.7	160	6.86
4	HHZ11-DT7-SAL1-SAL1	88.7	149	6.52
5	HHZ6-SAL3-Y1-SUB2	94.4	161	6.89
6	BRRI dhan29 (Ck.)	98.8	165	7.56
7	BRRI dhan60 (Ck.)	88.8	148	6.08
LSD at 5% level		2.74	1.45	1.02

D/S: 10.12.2014 D/T: 01.02.2015

Table 10. Yield and ancillary characters of 11 OYT materials, Boro 2014-15

Sl #	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	GSR IR1-9-D13-S3	96.2	156	5.55
2	GSR IR1-12-Y9-Y3	96.8	150	5.78
3	GSR IR1-9-S9-Y1	95.4	152	5.66
4	GSR IR1-11-Y10-D3	95.2	157	5.61
5	GSR IR1-12-Y7-D1	92.2	157	5.68
6	GSR IR1-9-D15-Y1	94.8	158	6.44
7	GSR IR1-12-Y8-D2	97	156	6.27
8	GSR IR1-12-Y77-D2	93.2	156	5.53
9	GSR IR1-9-D12-D2	93	148	5.65
10	GSR IR1-9-D13-S2	105.8	161	6.11
11	GSR IR1-11-D10-S3	91.6	158	5.92
12	BRRI dhan28 (Ck.)	103.8	139	6.55
13	BRRI dhan47 (Ck.)	104.4	151	6.13
14	BRRI dhan58 (Ck.)	95.6	148	5.72
15	BRRI dhan59 (Ck.)	81.2	150	5.93
16	BRRI dhan60 (Ck.)	80.2	145	5.42

D/S: 18.12.2014 D/T: 26.01.2015

Table 11. Yield and ancillary characters of 13 PYT materials, Boro 2014-15

Sl. #	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	WANXIAN7777-P3	100.1	150	5.79
2	WANXIAN7777-P8	102.1	150	5.70
3	WANXIAN7777-P9	102.7	150	5.48
4	WANXIAN7777-P10	102.8	150	5.21
5	WANXIAN7777-P11	98.9	150	5.59
6	WANXIAN7777-P40	103.0	150	5.34
7	WANXIAN7777-P68	102.1	155	5.50
8	HHZ12-SAL2-Y3-Y1	89.2	153	5.14
9	HHZ12-SAL2-Y3-Y2	100.3	153	5.75
10	HHZ5-DT20-DT2-DT1	100.2	156	6.25
11	HHZ5-DT20-DT3-Y2	100.2	158	5.90
12	HHZ5-Y7-Y2-SUB1	100.0	151	5.92
13	IR78581-12-3-2-2	99.5	151	5.76
14	BRRI dhan28 (Ck.)	99.0	141	5.92
15	BRRI dhan29 (Ck.)	101.8	160	6.96
16	BRRI dhan59 (Ck.)	83.0	151	5.89
LSD at 5% level		1.47	-	0.52

D/S: 12.12.2014 D/T: 26.01.2015

Table 12. Yield and ancillary characters of SYT materials, Boro 2014-15

Sl. #	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	SAGC-04	101.2	152	5.76
2	ZHONG HUA 1	85.5	152	5.99
3	IR 83141-B-18-B	83.7	146	5.87
4	IR 83142-B-21-B	94.2	148	6.15
5	IR 84678-25-5-B	97.7	150	7.02
6	HHZ17-DT6-SAL3-DT1	92.7	150	5.78
7	BRRI dhan28 (Ck.)	76.6	142	6.21
8	BRRI dhan59 (Ck.)	74.9	149	6.35
LSD at 5% level		1.33	-	0.23

D/S: 12.12.2014 D/T: 23.01.2015

Table 13. Yield and ancillary characters of RYT#1 materials, Boro 2014-15

Sl. #	Designation	Plant height (cm)	Growth duration (days)	Yield (t/ha)
1	HHZ15-SAL13-Y1	96.2	153	6.65
2	HHZ23-DT16-DT1-DT1	92.3	153	7.36
3	HHZ15-DT4-DT1-Y1	93.3	149	6.95
4	HHZ11-DT7-SAL1-SAL1	93.5	144	7.64
5	HHZ6-SAL3-Y1-SUB2	96.3	150	6.24
6	BRRI dhan29 (Ck.)	102.7	159	6.62
7	BRRI dhan60 (Ck.)	84.6	150	6.12
LSD at 5% level		1.03	-	0.31

D/S: 12.12.2014 D/T: 23.01.2015

Table 14. Yield and ancillary characters of the Hybrids for T. Aman 2014

Sl. #	Designation	Plant height (cm)	Growth duration (days)	Sterility (%)	Yield (t/ha)
1	H982	115.7	101	31.44	5.69
2	H983	103.9	103	28.88	5.14
3	H984	117.1	117	25.60	5.50
4	H985	123.0	117	23.80	5.72
5	H986	103.1	106	29.20	6.07
6	H987	111.5	107	29.40	5.82
7	H988	111.9	103	31.12	5.08
8	H989	116.5	111	24.72	5.33
9	H990	121.9	109	32.76	6.07
10	H991	114.7	102	27.40	4.31
11	H992	117.6	112	27.20	6.09
12	H993	129.0	117	23.52	6.29
13	H994	133.9	119	27.60	6.10
14	H995	114.7	116	23.88	5.21
15	H996	115.6	99	32.36	4.69
16	H997	116.9	103	26.80	5.18
LSD at 5% level		1.23	-	-	0.87

D/S: 03.07.2014 D/T: 22.07.2014

Table 15. Yield and ancillary characters of the Hybrids for A set, Boro 2014-15

Sl. #	Designation	Plant height (cm)	Growth duration (days)	Sterility (%)	Yield (t/ha)
1	H1038	110.9	162	12.09	7.79
2	H1039	88.7	146	18.99	6.14
3	H1040	115.9	158	19.79	7.87
4	H1041	81.3	148	9.50	7.80
5	H1042	89.6	148	10.34	6.65
6	H1043	92.7	147	8.79	8.14
7	H1044	94.1	145	11.58	8.21
8	H1045	91.2	150	11.59	7.68
9	H1046	100.0	150	8.84	8.89
10	H1047	92.7	145	5.49	7.91
11	H1048	101.0	162	17.07	6.56
12	H1049	87.2	142	5.98	5.33
13	H1050	88.8	150	14.81	7.45
14	H1051	104.1	158	14.84	7.82
15	H1052	104.7	150	13.10	7.43
16	H1053	90.4	145	8.19	8.18
17	H998	92.3	148	5.66	8.42
18	H999	94.7	148	7.14	8.10
19	H1000	95.1	149	8.88	8.07
LSD at 5% level		2.05	-	-	0.52

D/S: 06.12.2014 D/T: 10.01.2015

Table 16. Yield and ancillary characters of the Hybrids for B set, Boro 2014-15

Sl. #	Designation	Plant height (cm)	Growth duration (days)	Sterility (%)	Yield (t/ha)
1	H1001	91.4	145	5.49	8.67
2	H1002	83.9	148	11.80	8.23
3	H1003	108.7	149	10.34	8.21
4	H1004	83.5	147	8.78	7.01
5	H1005	89.1	151	12.94	7.61
6	H1006	95.1	149	15.79	6.73
7	H1007	93.1	155	4.60	9.22
8	H1008	90.9	147	8.39	7.72
9	H1009	90.6	149	11.64	8.37
11	H1011	100.4	162	13.68	6.67
12	H1012	100.5	156	9.94	7.81
13	H1013	98.3	158	13.02	7.96
14	H1014	95.0	147	8.38	8.38
15	H1015	106.6	160	21.43	8.93
16	H1016	101.2	153	11.11	8.15
17	H1017	103.2	162	15.48	7.50
18	H1018	81.5	142	8.19	8.06
19	H1019	95.5	155	6.75	8.42
LSD at 5% level		1.43	-	-	0.59

D/S: 06.12.2014 D/T: 10.01.2015

Table 17. Yield and ancillary characters of the Hybrids for C set, Boro 2014-15

Sl. #	Designation	Plant height (cm)	Growth duration (days)	Sterility (%)	Yield (t/ha)
1	H1020	109.8	161	13.14	9.26

2	H1021	93.9	161	9.94	9.29
3	H1022	95.9	158	8.19	9.24
4	H1023	93.0	146	14.06	5.64
5	H1024	90.5	146	12.21	5.88
6	H1025	90.5	161	12.12	8.33
7	H1026	99.5	156	6.40	9.07
8	H1027	101.0	156	13.45	8.30
9	H1028	98.9	158	9.95	9.27
10	H1029	96.3	149	9.94	8.56
11	H1030	91.9	142	9.22	7.07
12	H1031	98.3	156	10.53	9.12
13	H1032	94.6	156	11.96	9.09
14	H1033	78.7	141	11.97	6.99
15	H1034	95.0	152	9.20	8.90
16	H1035	98.2	156	13.45	8.31
17	H1036	103.3	156	7.78	9.52
18	H1037	97.9	156	9.41	9.08
LSD at 5% level		1.78	-	-	1.78

D/S: 06.12.2014 D/T: 10.01.2015

Table 18. Growth duration and yield of PVT (PQR) materials, T. Aman 2014

Sl. #	Designation	Growth duration (days)	Yield (t/ha)
1	BR7472-16-2-1-2-3	119	3.49
2	BRRI dhan37 (Ck.)	153	1.68
LSD at 5% level		-	0.30

D/S: 07.07.2014 D/T: 23.07.2014

Table 19. Growth duration and yield of PVT (Drought) materials, T. Aman 2014

Sl. #	Designation	Growth duration (days)				Yield (t/ha)			
		Tan	Nac	Pab	Goda	Tan	Nac	Pab	Goda
1	IR83377-B-B-93-3	102	102	104	109	4.49	4.42	5.84	5.06
2	IR82589-B-B-84-3	106	104	105	112	4.57	4.61	5.84	4.78
3	BRRI dhan56	99	99	101	104	4.21	3.48	5.39	4.47
LSD at 5% level		-	-	-	-	0.71	0.80	0.61	0.85

D/S: 07.07.2014 D/T: 23-27.07.2014

Table 20. Yield and ancillary characters of PVT (ADB water saving) materials, Boro 2014-15

Sl. #	Designation	Growth duration (days)			Yield (t/ha)		
		OS	Paba1	Paba2	OS	Paba1	Paba2

1	IR83140-B-36-B-B	168	166	169	4.97	5.44	6.12
2	IR83140-B-71-B-B	163	163	167	5.14	6.73	6.10
3	BRRI dhan28 (Ck.)	161	157	164	4.90	5.50	5.39
4	BRRI dhan29 (Ck.)	183	176	178	7.23	6.47	6.33
LSD at 5% level		1.10	1.29	0.58	1.00	1.32	0.91

D/S: 18.11.2014 D/T: 20.01.2015

Table 21. Yield and ancillary characters of OYT (STRASA) materials, T. Aman 2014

Sl. #	Designation	Growth duration (days)	Plant height (cm)	Grain yield (t/ha)
1	IR 93807-8-1-1-1	105	90	3.18
2	IR 95814-29-1-1-3	110	86	3.51
3	IR 93822-9-2-3-1	109	78	3.08
4	IR 93856-23-1-1-1	105	84	3.82
5	IR 93806-32-2-2-1	107	81	3.01
6	IR 92545-51-1-1-3	106	79	3.01
7	IR 92522-70-3-1-2	108	70	3.24
8	IR 95795-53-1-1-2	106	92	3.06
9	IR 95814-10-2-2-2	109	80	3.57
10	IR 95817-14-1-1-2	109	90	3.22
11	IR 95836-31-2-1-3	112	98	4.44
12	IR 95839-24-1-1-2	113	94	2.97
13	BRRI dhan56 (Ck.)	103	89	0.91
14	MTU 1010 (Ck.)	105	85	2.95
15	IR 64 (Ck.)	108	81	4.35
16	IRRI 123 (Ck.)	113	92	2.83
LSD at 5% level		2.01	1.87	0.11

D/S: 13.08.2014 D/T: 06.09.2014

Table 22. Yield and ancillary characters of AYT (STRASA) materials, T. Aman 2014

Sl.	Designation	Growth duration (days)		Plant Height (cm)		Grain yield (t/ha)	
		Control	Stress	Control	Stress	Control	Stress
1	IR 84852-B-21-5-4	108	104	107	104	2.58	4.06
2	IR 86857-46-1-1-3	111	108	109	110	4.76	3.59
3	IR 87656-21-1-1-4	111	107	113	117	4.88	3.98
4	IR 88965-38-4-2-1	112	110	109	102	4.62	3.05
5	IR 87759-2-2-1-1	113	110	97	113	4.79	3.05
6	IR 88869-2-1-2-2	112	111	104	107	4.86	3.60
7	IR 88839-4-1-1-3	113	110	105	105	4.08	4.12
8	IR 88869-2-1-1-4	113	111	112	111	4.65	3.60
9	IR10L249	114	111	99	115	4.51	2.99
10	PSBRC82	112	110	112	113	4.76	3.24
11	BRRI dhan56 (Ck.)	108	105	117	108	2.55	3.65
12	BINA dhan 7 (Ck.)	112	109	89	93	3.36	3.91
13	MTU1010 (Ck.)	110	108	105	107	3.43	3.60
14	Swarna (Ck.)	127	126	97	93	3.62	2.80
15	Samba Masuri (Ck.)	128	128	96	94	2.85	2.80
LSD at 5% level		0.96	1.95	1.39	2.22	0.83	0.72

D/S: 20.07.2014 D/T: 14.08.2014

Table 23. Yield and ancillary characters of PVS (STRASA) materials, T. Aman 2014

Sl	Designation	Growth duration (days)				Grain yield (kg/ha)			
		Pa-C	Pa-S	Go	Ta	Pa-C	Pa-S	Go	Ta
1	IR 88965-39-1-6-4	110	109	107	106	5.19	3.88	4.56	4.45
2	IR 88867-12-1-1-1	109	108	105	104	4.74	3.82	4.20	3.96
3	IR 88903-8-1-1-3	109	109	106	105	5.35	3.99	4.08	4.76
4	IR 88864-2-1-1-3	109	108	106	105	4.52	4.13	4.40	4.27
5	IR 88966-45-2-1-4	113	112	110	110	5.35	4.35	5.00	4.52
6	IR 88966-39-1-2-3	108	107	106	103	4.17	3.60	4.05	3.89
7	IR 88964-37-1-1-1	111	110	107	106	4.66	3.94	4.74	4.07
8	IR 10L282	108	107	105	103	5.40	4.37	4.59	4.77
9	IR 10L149	110	109	106	104	5.14	3.59	4.19	4.45
10	IR 10L276	109	108	106	104	5.48	4.51	4.78	4.79
11	IR83388-B-B-108-3	114	112	109	109	5.28	3.95	5.08	4.75
12	IR87761-53-1-1-1	112	111	108	107	5.60	4.24	4.57	4.80
13	BRRI dhan56 (Ck.)	107	105	103	102	4.83	3.37	4.15	3.85
14	BINA Dhan 7 (Ck.)	109	108	107	105	4.54	3.44	4.48	3.72
LSD at 5% level		1.25	1.54	0.99	0.73	0.36	0.37	0.35	0.26

D/S: 20.07.2014 D/T: 10.08.2014

Table 24. Production of truthfully level seed at BRRI, Rajshahi during T. Aus 2014, T. Aman 2014 and Boro 2014-15.

Truthfully leveled seed (kg)			Breeders seed (kg)		
Season	Variety	Produced	Season	Variety	Produced
Aus	BR26	105	Aus	-	-
	BRRI dhan48	933			
	BRRI dhan55	514			
Total Aus (kg)		1,552	Total (kg)	-	-
T. Aman	BR10	455	T. Aman	BR11	2,805
	BR11	328		BRRI dhan33	2,836
	BR23	15		BRRI dhan34	2,028
	BRRI dhan33	936		BRRI dhan56	582
	BRRI dhan34	453			
	BRRI dhan39	430			
	BRRI dhan49	1,174			
	BRRI dhan51	378			
	BRRI dhan52	1,031			
	BRRI dhan56	405			
	BRRI dhan57	199			
	BRRI dhan62	65			
Total Aman (kg)		5,869			8,251
Boro	BRRI dhan28	2,996	Boro	BRRI dhan28	5,517
	BRRI dhan29	1,219		BRRI dhan29	5,049
	BRRI dhan36	669		BRRI dhan58	1,134
	BRRI dhan50	1,406			
	BRRI dhan55	228			
	BRRI dhan64	223			
	BRRI dhan69	451			
Total Boro (kg)		7,192	Total Boro (kg)		11,700
Total TLS (kg)		14,613	Total Breeders Seed		19,951

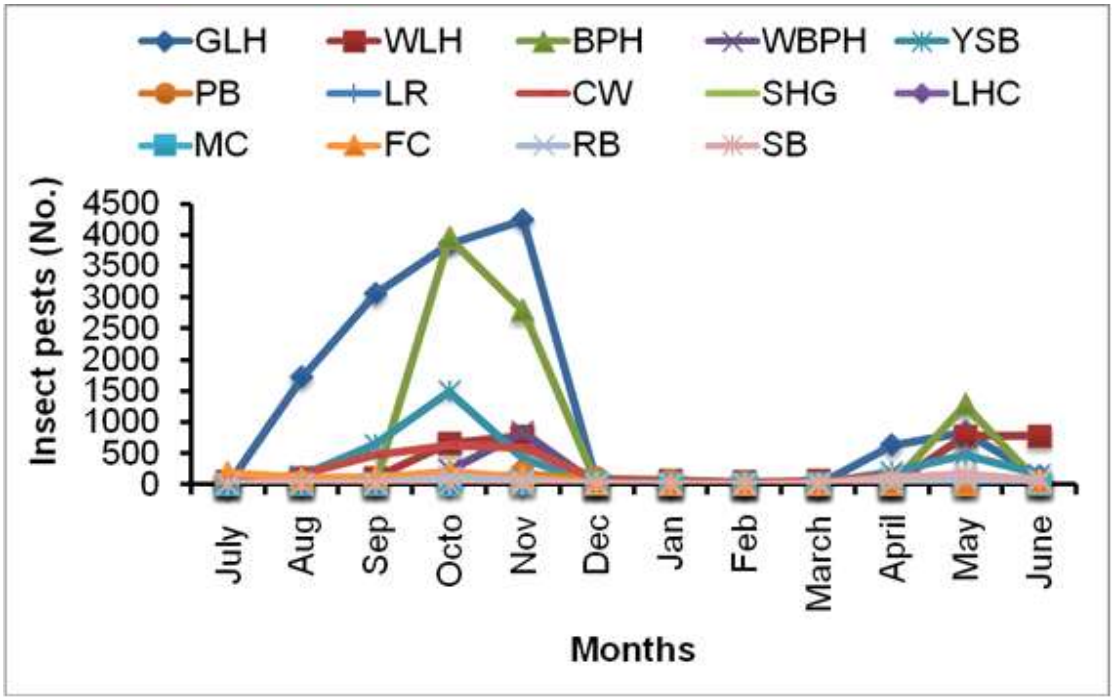

Fig 1: Incidence patterns of major insect pests in light trap, July 2014-June 2015

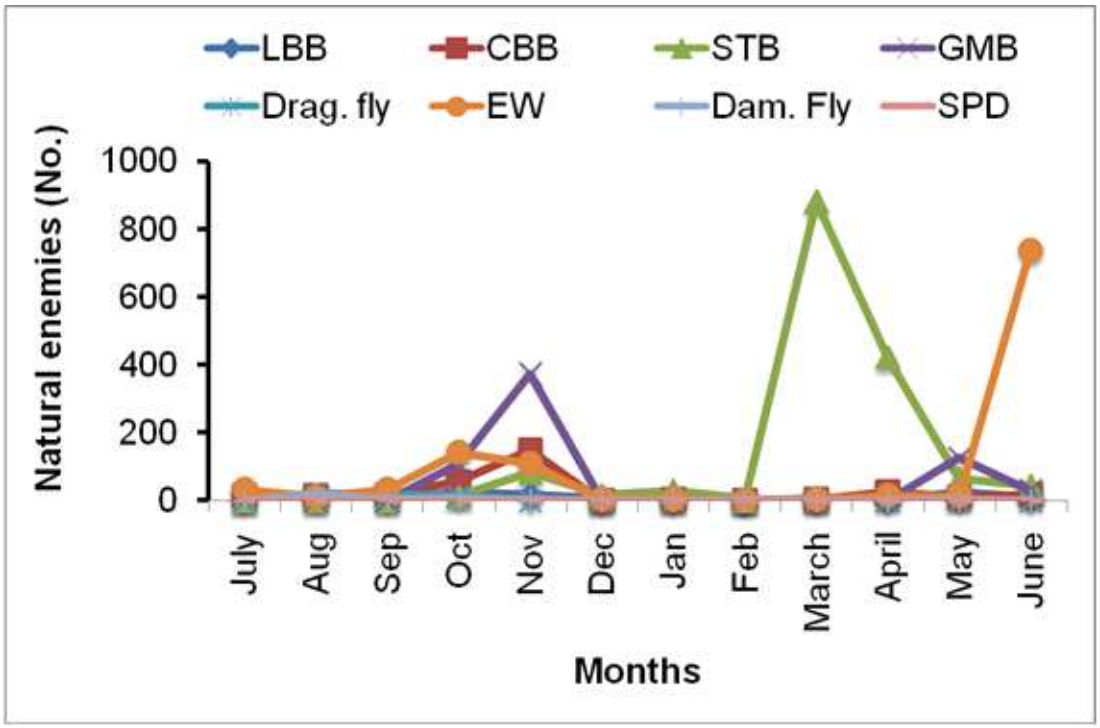

Fig. 2: Incidence pattern of natural enemies of rice insect pests in light trap, July 2014-June 2015

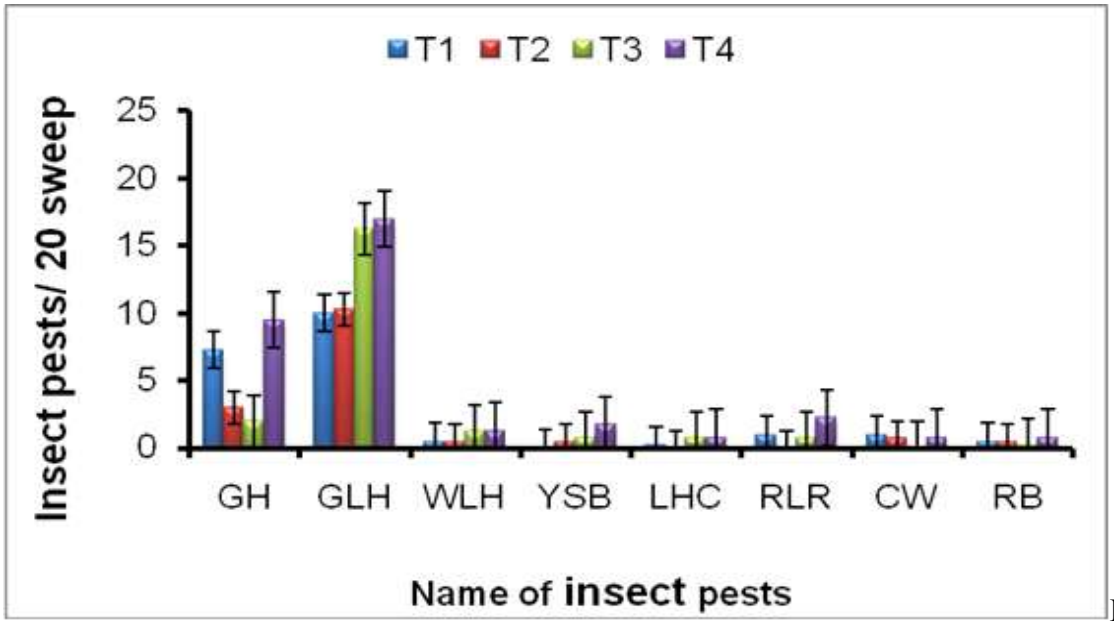

Fig.3. No. insect pest/20 complete sweep in different treatments (T_1 & T_2: 1 & 4 m away from the flowering plants of rice bund; respectively, T_3: Prophylactic insecticide use) and T_4: Control (No insecticide and no flowering plants).

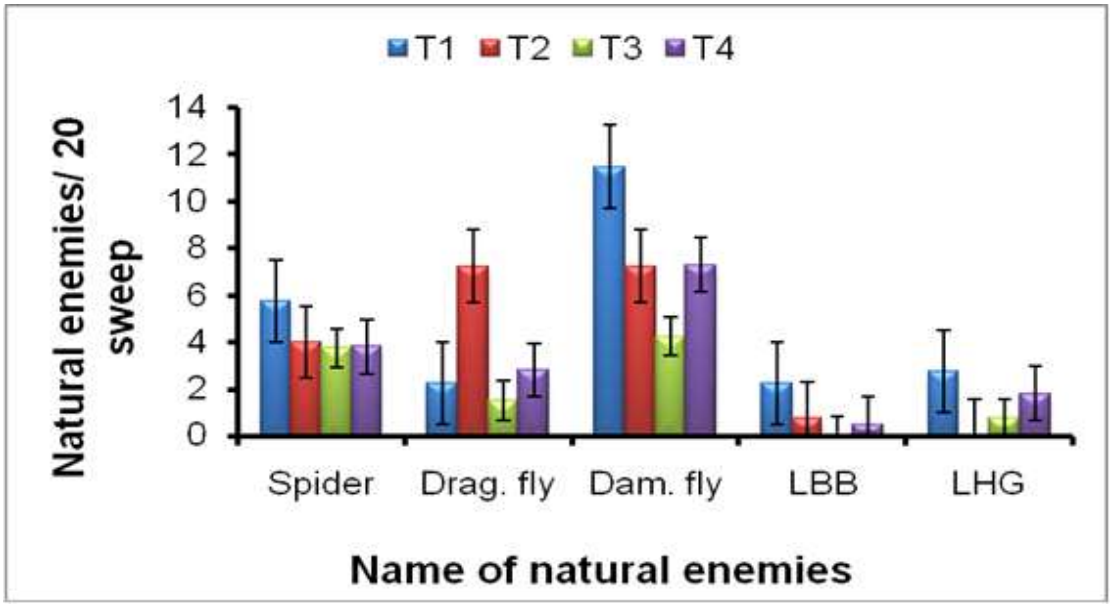

Fig.4. No. natural enemies/20 complete sweep in different treatments (T_1 & T_2: 1 & 4 m away from the flowering plants of rice bund; respectively, T_3: Prophylactic insecticide use) and T_4: Control (No insecticide and no flowering plants).

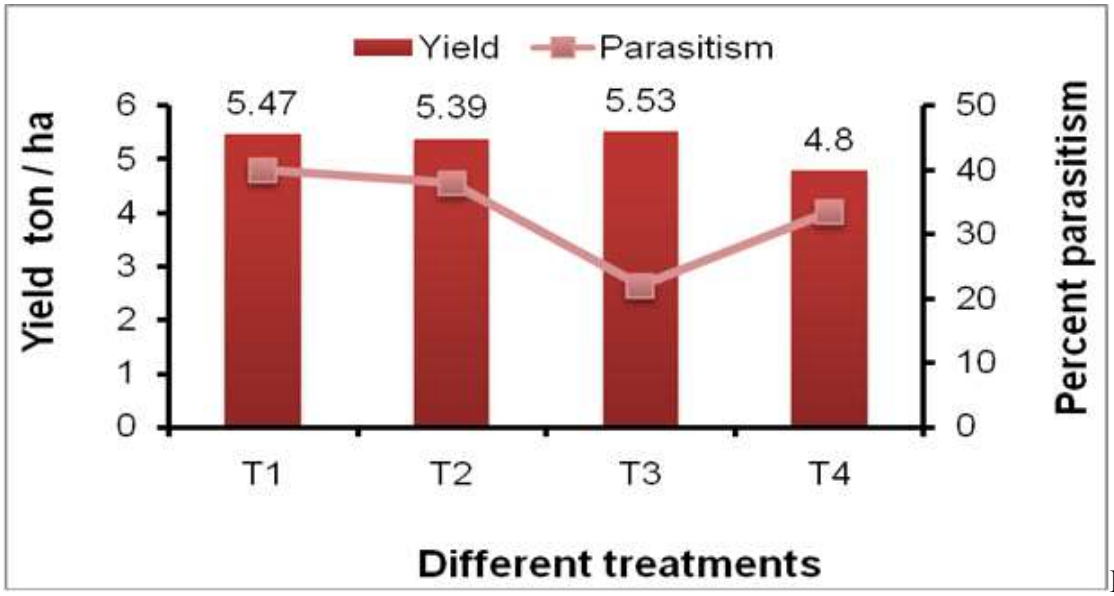

Fig.5. Parasitism (%) by *T. zahiri* and yield in different treatments (T_1 & T_2: 1 & 4 m away from the flowering plants of rice bund; respectively, T_3: Prophylactic insecticide use) and T_4: Control (No insecticide and no flowering plants).

Fig. 6. Yellow stem borer caught in pheromone trap during T. Aman 2014

Fig. 7. Rice leaf roller caught in pheromone trap during T. Aman 2014

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Contents

SCIENTIFIC PERSONNEL

Md Gous Ali, *PhD**
Principal Scientific Officer and Head
*Md Shahidul Islam, PhD***
Principal Scientific Officer and Head
Md Adil Badshah, *PhD***
Senior Scientific Officer
Md Rokebul Hasan, *MS****
Senior Scientific Officer
Bishnu Pada Ray
Senior Scientific Officer
Md Saju Mia
Scientific Officer
Shah Md Shahriar
Scientific Officer

*Transferred from Rangpur, 2014, ** Joined BRRI RS, Rangpur on April, 2014.
***Deputed to abroad for PhD

SUMMARY

Twenty crosses were made and five crosses were confirmed. A total of 122 plants were selected from four F_2 populations and 568 plants were selected from observational trial during Boro season.

In T. Aman, BR7468-12-1-1-1-1 gave 0.35 t ha^{-1} yield advantage over BRRI dhan49 with six days longer growth duration. But it showed lodging tolerance.

In T. Aman (GSR), IR83140-B-28-B produced 0.52 t ha^{-1} yield advantage with 12 days shorter growth duration over BRRI dhan39.

In Boro (GSR), HHZ5-SAL10-DT1-DT1 produced 0.81 t ha^{-1} yield advantage over check variety BRRI dhan28.

In Boro (Standard), BR7800-63-1-7-3 produced 1.32 t ha^{-1} yield advantage over BRRI dhan28 .

In Boro (MER), BR7830-16-1-5-9-9 & BR7833-11-1-1-3-4 gave 0.73 - 0.82 t ha^{-1} yield advantage over BRRI dhan28.

In Boro (DRR), BR7986-7-4 produced 1.61 t ha^{-1} yield advantage over BRRI dhan28 with 11 days longer growth duration but moderately resistant to BLB and blast disease.

In T. Aman (long term MSW), the genotype IR 09F187 gave the highest yield (3.7 t ha^{-1}) among all tested genotypes and 0.82 t ha^{-1} yield advantage over the check variety (BRRI dhan44).

In Boro, BRRI dhan58 showed better performance in respect of grain yield and it creates farmers interest to cultivate in larger area in this region.

VARIETAL DEVELOPMENT

Modern Boro variety NPT

Hybridization

Sixteen varieties/lines were used in the hybridization block. Single seedling of 40 day old was transplanted under three planting dates with an interval of seven days to synchronize flowering for cross combinations. The unit plot size was 5.4 m and seedling was planted at a spacing of 20 cm × 20 cm. Usual method of emasculation and pollination was done and twenty crosses were made (**Table 1**). Matured F_1 seeds were harvested, sun dried and stored separately in paper bags with proper labeling.

F_1 confirmation

F_1 seeds from eight crosses along with their respective parents were grown in the hybridization block. Single seedling of 40-day-old was transplanted in 3 m single row plots at a spacing of 20 cm × 20 cm. Five crosses were confirmed (**Table 2**) as compared to respective parents and objectives. These confirmed crosses will be used to generate F_2 populations.

F_2 population

Four F_2 populations with approximately 2500-3000 progenies for each cross were grown. Single seedling (45-day-old) was transplanted in 5.4 m single row plots at 20 cm × 20 cm spacing. BRRI dhan28 and BRRI dhan29 were planted as standard check at the end of each cross. A total of 122 plants were selected from four crosses (**Table 3**) based on specific objective of the cross to initiate pedigree nursery and seeds of the selected plants was preserved with proper labelling.

Observational trial (OT)

A total of 400 advanced breeding lines were tested under this experiment. Each entry was grown in 5.4 m x 4 rows plot using single seedling with 25 cm × 15 cm spacing. Forty-five-day-old seedlings were transplanted. BRRI dhan28, BRRI dhan29 and BRRI hybrid dhan3 were planted as standard check at after every 25 entries. A total of 568 plants were selected from 400 advanced promising genotypes based on cold tolerance at seedling and tillering stage, phenotypic acceptance at vegetative and reproductive stages, earliness, seedling and plant height. Most of the lines showed segregation or not homogeneous. So, individual plant was selected.

Growing and screening of pedigree generations under controlled submergence condition

Eleven F_2, 6 F_3, 3 F_4, 9 F_5, 1 F_6, 1 F_7, 4 BC_1F_2, 1 BC_1F_9, 3 BC_2F_8 populations were grown under controlled submergence condition. Thirty-day-old seedlings were transplanted using single seedling per hill with the 25 cm × 15 cm spacing. Ten days after transplanting the crop was submerged for 16 days. A total of 54 PS from F_2 population, 30 PS from BC_1F_2 population, 46 PS from F_3 generation, 17 PS from F_4 generation, 55 from F_5 generation, 5 PS from F_6 generation, 4 PS from F_7 generation, 14 bulks from BC_2F_8 generation, 5 bulks from BC_1F_9 generations were selected and preserved **(Table 4a and b)**.

Mother trial with sub1 and stagnant genotypes under rainfed condition (PVS)

Six submergence and medium stagnant water tolerant high yielding genotypes along with two standard check varieties were evaluated under rainfed condition in BRRI farm. The experiment was laid out in RCB design with three replications. Thirty-day-old seedlings were transplanted using 2-3 seedling per hill with 25×15 cm spacing. All genotypes showed taller plant height and more or

less similar tiller and panicle number. None of the tested entry out yielded over the check varieties. The yield and growth duration of all genotypes ranged from 2.54 t ha^{-1} to 4.81 t ha^{-1} and 128 days to 142 days respectively. The check variety BRRI dhan52 had the highest yield of 4.81 t ha^{-1}. Among the entries, IR 09F130 and IR 09F181 had the highest yield of 4.34 t ha^{-1} and 4.30 t ha^{-1}, respectively **(Table 5)**.

Mother trial with sub1 and stagnant genotypes under controlled submergence condition (PVS)

Six submergence and medium stagnant water tolerant high yielding genotypes along with two standard check varieties were evaluated under controlled submergence condition in BRRI farm. The experiment was laid out in RCB design with three replications. Thirty-day-old seedlings were transplanted using 2-3 seedling per hill with 25×15 cm spacing. Check varieties BRRI dhan51 and BRRI dhan52 showed the highest survival percent (94.4%) followed by BR 7937-28-1(88.2%). All entries showed taller plant height. More or less similar tiller and panicle were observed among the entries. The check varieties BRRI dhan51 and BRRI dhan52 had the highest yield of 4.65 t ha^{-1} and 4.90 t ha^{-1} respectively. Among the tested entries, IR 09F119 and IR 09F130 had the highest yield of 4.05 t ha^{-1} and 4.10 t ha^{-1} respectively **(Table 6)** under controlled submergence condition.

PVS function

PVS function was arranged based on PVS mother trial for preference analysis during T. Aman 2013. A total of 37 farmers (male 27 and female 10) were participated in the voting activities. Each farmer cast two positive and two negative votes for the best and worst entries respectively according to their own choice **(Table 7).**

Preferential analysis

Most preferred. BRRI dhan52 and IR 09F130 were chosen by most of the farmers in PVS function due to taller plant height, long and compact panicle, lodging resistant, early maturing.

Least preferred. IR 09F173 and BRRI dhan51 got the lowest vote due to shorter plant, fewer tillers, shorter and less compact panicle, high sterility, poor yield and long duration.

On-farm mother trial under participatory variety selection (PVS)

There were three on-farm PVS mother trials under Alambiditor, (Gangachara, Rangpur), Sarkerpara, (Nageswari, Kurigram), and Tupamari, (Sadar, Nilphamari) districts. Seeding was done within 22-23 June and 30-day-old seedlings were transplanted from 21 to 25 July. There were flash flood at Gangachara, Rangpur (6 days) and sadar, Nilphamari (10 days) but continued as stagnation up to 16 days. There was almost no flood at Nageswari, Kurigram. IR 09F365 and BR 7937-28-1 exhibited the lowest growth duration (132 days) followed by IR 09F181 (142 days). The highest grain yield was obtained from BRRI dhan52 (4.54 t ha^{-1}) followed by IR 09F130 (3.98 t ha^{-1}) and IR 09F173 (3.94 t ha^{-1}) At sadar, Nilphamari BRRI dhan51 could not perform well (2.12 t ha^{-1}) (**Table 8**).

BRRI dhan52 showed better performance in respect of survival percent and grain **y**ield at every location **(Table 9**).

PVS function: On farm PVS was arranged with the mother trial of Sub1 entries at Alambiditor, Gangachara, Rangpur for preference analysis during T. Aman 2013. A total of 30 farmers (20 male and 10 female) participated in the activities. Each farmer cast two positive and two negative votes for the best and worst entries respectively according to their own choice **(Table 10)**.

Preferential analysis

Most preferred. BRRI dhan52 and IR 09F130 were chosen by most of the farmers in PVS function due to taller plant height, long and compact panicle, lodging resistant, early maturing.

Least preferred. IR 09F119 and BRRI dhan51 got the lowest vote due to shorter plant, fewer tillers, shorter and less compact panicle, high sterility poor yield and long duration.

Participatory variety selection (PVS) baby trial

BRRI dhan51 and BRRI dhan52 were evaluated in farmers' field in submergence-prone areas. Ten farmers were selected and each farmer was supplied with one kilogram seed. At Gangachara and Aditmari seeds were damaged in seedbed due to early flooding. At Sayedpur, early flood was observed and few farmers got crops. In both the locations farmer's got the yield of BRRI dhan51 and BRRI dhan52 rangeed from 4.10 t ha^{-1} to 4.70 t ha^{-1}.

Adaptability of some submergence tolerant genotypes under flash flood prone environment

Four field trails in Rangpur region (Rangpur-1, Nilphamari-1, Lalmonirhat-1. Kurigram-1) were conducted under the management practices of researchers. Four genotypes (IR09F224, IR09F198, BRRI dhan51 and BRRI dhan52) were evaluated in farmers' field. The experiment was laid out in RCB design with three replications. About 30-35-day-old seedlings were transplanted using 2-3 seedlings per hill with the spacing of 20 cm × 20 cm. The unit plot size was 8 m × 5 m. Fertilizers were applied @ 150 kg Urea, 112 kg TSP, 75 kg MoP, 50 kg gypsum and eight kg zinc sulphate ha^{-1}. Total amount of K, P, S and Zn and 1/3 urea were applied at the time of final land preparation. Rest of the urea was applied in two splits. Table 11a presents the flooding situation of different locations. The average yield of IR09F224, IR09F198, BRRI dhan51 and BRRI dhan52 were 4.75 t ha^{-1}, 5.04 t ha^{-1}, 5.18 t ha^{-1} & 6.05 t ha^{-1} respectively (**Table 11b**). Among the varieties BRRI dhan52 was preferred by the farmers for the highest yield and attractive grain type.

Validation and dissemination of modern Boro varieties in Rangpur region.

Four varieties were evaluated in farmers' field (Six locations: - Rangpur-2, Nilphamari-2, Kurigram-1 and Lalmonirhat-1). The experiment was laid out in RCB design with three replications with 5.4 m × 20 rows plot. Tested entries were: PSBRC82, BRRI dhan28, BRRI dhan55 and BRRI dhan58. Forty-day-old seedlings of each genotype were transplanted using 2-3 seedlings/hill with 25 cm × 15 cm spacing. Fertilizer doses of urea, TSP, MoP, gypsum, $ZnSO_4$ were 270, 130, 150, 120, 8 kg ha^{-1}. N fertilizer was applied as top dress with 3 equal splits at 15, 30 and 45 DAT.

The average yield of PSBRC82, BRRI dhan28 BRRI dhan55 and BRRI dhan58 were 6.75 t ha^{-1}, 7.00 t ha^{-1}, 7.05 t ha^{-1} & 7.00 t ha^{-1} respectively. Among the varieties BRRI dhan28 was preferred by the farmers for their shorter growth duration and better yield. The highest average plant height of BRRI dhan28 was 105 cm (**Table 12**).

Preliminary yield trial

Evaluation of medium stagnant flood tolerant entries under controlled stagnant and rainfed conditions

Thirteen genotypes of IRRI along with one check variety were evaluated under controlled medium stagnant water depth and under rainfed conditions. Medium stagnant water stress was applied at 10 DAT. Keeping 20-25 cm standing water at the early vegetative stages with gradual increase of water up to 45 cm at maximum tillering stage and this water level was maintained up to dough stage. Standing water was completely drained out at hard dough stage.

Yield under stagnant condition ranged from 2.45 t ha^{-1} to 3.70 t ha^{-1} and growth duration ranged from 139 days to 175 days and yield under rainfed condition ranged from 3.39 t ha^{-1} to 4.26 t ha^{-1} and growth duration ranged from 127 to 154 days. Advanced line IR09F191 and IR09F187 gave 0.5 to 0.8 t ha^{-1} higher yield with 19-25 days earlier duration than the check. variety BRRI dhan44 (**Table 13**).

Regional yield trial (RYT)

A total of 12 regional yield trials were conducted under T. Aus, T. Aman and Boro seasons to develop rice varieties promising for partially irrigated, rainfed lowland (RLR), low inputs (GSR), disease and insect resistant (DRR), new plant type, premium quality (PQR), micronutrient and infiltrated varieties enriched against standard check varieties.

PVT (Dorshona)

A PVT trial was conducted to release standard Boro variety in Dorshona, Rangpur during 2013-14. Two advanced lines were evaluated with standard check BRRI dhan28.

CROP-SOIL-WATER MANAGEMENT

Rice yield maximization through nutrient management in Rangpur region

The experiment was conducted at BRRI RS farm , Rangpur during T. Aman 2013 and Boro 2013-14 seasons. The treatments were: T_1: Soil test based (STB), T_2: STB + Copper and Manganese ((@ 1.25 and 2.5 kg/ha), T_3: 2.5 t ha^{-1} decomposed poultry litter (PL), T_4: 2.5 t ha^{-1} fresh PL, T_5: USG, T_6: LCC.

Copper and Manganese, which said to reduce percent sterility, were applied at maximum tillering stage of T. Aman rice and at maximum tillering and panicle initiation (PI) stages of Boro rice. Thirty-day-old seedlings of BRRI dhan52 were transplanted on 18 July 2013 during T. Aman season and 45-day-old seedlings of BRRI dhan29 were used in Boro season and were transplanted on 9 January 2014.

T. Aman. Treatment T_2 produced more tillers, panicles and longer panicle than the other treatments during T. Aman. Thousand grain weight was significantly the highest in T_3 treatment, which was followed by T_5 treatment. Significantly the lowest sterility percentage (17.54%) was observed in T_2 treatment and the highest (31.48%) of that was in T_6 treatment, which indicate that application of copper and manganese might reduced the sterility percentage but it didn't reflect on grain yield. Significantly the highest grain yield was observed in T_3 treatment, which was followed by T_1 and the lowest of that was obtained in T_5 treatment.
Tiller production was the highest at 60 DAT and then it decreased with the progress of crop growth. The lowest number of tiller was recorded at maturity. At 60 DAT T_6 produced the highest number of tillers and that trend was maintained up to maturity. Plant dry weight was the highest at 75 DAT and the lowest of that was at 30 DAT. Treatment T_5 produced the highest plant dry matter

Boro. During Boro season, tiller and panicle production, percent sterility and grain yield were significantly influenced by nutrients management. The highest number of tillers was produced in T_2, followed by T_1 while the lowest of that was in T_6. The similar trend was observed regarding panicle production. Percent sterility was the lowest in T_2 and the highest of that was in T_6. Higher percent sterility was also recorded in T_3 and T_5. Application of copper and manganese had an influence to reduce percent sterility but grain yield was not increased. Grain yield was the highest in T_1 followed by T_2 and T_3. The lowest grain yield was obtained in T_6 treatment.

Evaluation of BRRI prilled urea applicator

The experiment was conducted at BRRI RS, farm, Rangpur. Four N management treatments were tested. These were: T_1 = Hand broad casting of prilled urea (recommended rate), T_2 = Prilled urea application by applicator (70% of T_1), T_3 = USG application by applicator (2.7 g/4 hills) and T_4= Control (-N).
The design of the experiment was RCB with three replications. Fertilizers dose was 220 kg Urea, 100 kg TSP, 115 kg MoP, 75 kg Gypsum and 8 kg $ZnSO_4$ ha^{-1}. All fertilizers except urea were applied at final land preparation. Hand broadcasting of prilled urea (T_1) was applied in three equal splits at 15 days after transplanting (DAT), 30 DAT and 45 DAT. Application of prilled urea (T_2) and USG (T_3) were done by applicator at two days after transplanting.
Hand broadcasting of prilled urea (recommended rate) gave the highest tiller per hill (17) followed by T_2 (13). Like tiller number the highest panicles $hill^{-1}$ (16) was found in T_1 followed by T_2 (12). Among the different N management options, 1000 grain-weight was found identical. Hand broadcasting of prilled urea (recommended rate) gave the highest grain yield of 5.89 t/ha followed by prilled urea (5.77 t/ha) application by applicator (70% of total urea). The N control treatment gave the lowest yield of 2.87 t/ha in BRRI farm, Rangpur.

Identification of location specific rice cultivation problem and minimizing rice yield gap through BRRI technologies (MRYG Project)

The experiment was conducted during T. Aman 2013 at three upazilas of Dinajpur district and at parbotipur upazila of Dinajpur district during Boro 2013-14. BRRI dhan49 was grown at Dinajpur sadar and BRRI dhan52 was grown at Fulbari and Parbotipur upazilas within 66 decimal area of each farmer/upazila. During Boro, the tested variety was BRRI dhan58. There were two treatments or practices such as BRRI recommended practice and farmers' practice.
Seeds were sown between 19-22 June during T. Aman 2013.

In T. Aman, BRRI dhan49 yielded 5.82 t/ha at Dinajpur sadar upazila using BRRI recommended practices. Whereas, BRRI dhan49 gave 5.74 t/ha using farmers' practices. BRRI dhan52 yielded 5.76 t ha^{-1} and 4.67 t ha^{-1} using BRRI recommended practices at Fulbari and Parbotipur upazila respectively. On the other hand, BRRI dhan52 obtained 5.62 t ha^{-1} and 4.38 t/ha yield using farmers practices at Fulbari and Parbotipur upazilas. Yield of farmer;s practices was comparatively low because they used old seedlings, imbalanced fertilizer, wider spacing and reluctant to follow recommended pest management techniques at the right time. BRRI recommended practice increased grain yield 3.5% over Farmers' practices.

In Boro, BRRI dhan58 yielded 8.16 t ha^{-1} using BRRI recommended practices, whereas BRRI dhan58 gave 7.71 t ha^{-1} using farmers' practices. Yield of farmers practices was comparatively low because they used imbalanced fertilizer and reluctant to follow recommended pest management techniques timely. BRRI recommended practice increased average grain yield by 5.83% over farmers practices. Farmers were very much interested to grow this variety in next Boro season due to its high yield potential, phenotypic acceptance at flowering and maturity stage, growth duration, disease and insect pest reaction, usually where they cultivated BRRI dhan29.

Technology transfer

Expansion and dissemination of submergence tolerant varieties in submergence prone areas

Seeds of BRRI dhan51 and BRRI dhan52 were distributed in farmers' fields in submergence-prone areas of Rangpur and Lalmonirhat districts through GO and NGO. Each farmer was supplied 1 kg seed of each variety together with a Bangla leaflet on cultivation technique. Farmers got better yield from both the varieties that ranged from 4 to 5 t ha^{-1}.

On-station seed production activity for dissemination of submergence tolerant varieties in submergence prone areas

Seeds of BRRI dhan51 and BRRI dhan52 were transplanted in on-station for distributing farmers field of submergence prone areas through GO and NGO in next season. About 110 kg of BRRI dhan51 and 100 kg of BRRI dhan52 seeds were harvested.

Demonstration of modern T. Aus varieties in Rangpur region 2013

A varietal trial in six farmers' field at six locations of Rangpur region (Rangpur-2, Nilphamari-2, Lalmonirhat-1. Kurigram-1) was conducted in Aus season using four genotypes (BRRI dhan28, BRRI dhan48, BRRI dhan55 and Pariza). The experiment was laid out in RCB design with three replications. Around 20-25-day-old seedlings were transplanted using 2-3 seedlings $hill^{-1}$ with 20 × 15 cm spacing. The unit plot size was 8 m × 5 m. Fertilizers were applied @ 128 kg Urea, 53 kg TSP, 61 kg MoP, 37 kg gypsum and 8 kg zinc sulphate ha^{-1}. Total amount of K, P, S and Zn and 1/3 urea was applied at the time of final land preparation. Rest of the urea was applied in two splits.
Average grain yield of BRRI dhan28, BRRI dhan48, BRRI dhan55 and Pariza were 3.97, 4.21 3.77 and 2.9 t ha^{-1} respectively. Among the varieties BRRI dhan48 was preferred by the farmers due to better yield.

Short duration Aman rice varieties for increasing cropping intensity in Rangpur region

A varietal trial in four farmers' field in Rangpur region (Rangpur-2, Nilphamari-1, Lalmonirhat-1.) was conducted using four genotypes (BRRI dhan62, BRRI dhan56, BRRI dhan33 and IR82475). The experiment was laid out in RCB design with three replications. Fertilizers were applied @ 164 kg urea, 90 kg TSP, 60 kg MoP, 52 kg gypsum and 8 kg zinc sulphate ha^{-1}.
BRRI dhan56 produced the highest number of panicle $plant^{-1}$ (11) and the lowest panicle $plant^{-1}$ (9) was produced by BRRI dhan33 and IR82475. The grains $panicle^{-1}$ of BRRI dhan62, BRRI dhan56, BRRI dhan33 and IR82475 were 99,113.100 and 114 respectively. The highest grain yield (5.40 t

ha^{-1}) was observed by IR82475 followed by BRRI dhan56 (4.65 t ha^{-1}). Almost similar grain yield (3.70 t ha^{-1}) was found in BRRI dhan62 and BRRI dhan33. BRRI dhan62 was early maturing (103 days) than other varieties (112 - 115 days).

Demonstration of DSR techniques using short duration varieties during T. Aman (IAPP)

A total of 10 demonstration trials were conducted in six upazilas of four districts during Aman 2013 with dry DSR using BRRI dhan33 and BRRI dhan56. Sowing was completed from 12-20 July. Forty kg ha^{-1} seed was used. Urea 170-TSP 56- MoP 80-gypsum 60-$ZnSO_4$-7.5 kg ha^{-1} fertilizers were applied. Herbicide glyphosate @ 3.0 L ha^{-1} was applied at 5-7 days before sowing. Pendimethylene @ 1.5 L ha^{-1} was applied at 2-3 days after sowing. Urea was applied as 1/3 basal and the rest 1/3 was top dressed at 20 and 40 DAS.

The highest grain yield was found in BRRI dhan56 followed by BRRI dhan33. With BRRI dhan56, the highest grain yield was found in Nilphamari sadar followed by Aditmari, Lalmonirhat, Mithapukur, Rangpur and, Kurigram sadar. In case of BRRI dhan33, the highest grain yield was found in Mithapukur, Rangpur followed by Aditmarti, Lalmonirhat and Jaldhaka, Nilphamari. The farmer's reaction about BRRI dhan56 was highly positive and they did not like BRRI dhan33 due to high BPH infestation.

Demonstration of submergence tolerant varieties in T. Aman 2013

A total of four demonstration trials were conducted in three upazilas of Kurigram district during Aman 2013 with submergence tolerant varieties (BRRI dhan51 and BRRI dhan52). Urea 195-TSP 52-MoP 82-gypsum 60-ZnSO4 7.5 kg/ha was applied. All fertilizers were applied as basal except urea; 1/3 urea top dress was done at 15-20 DAT, 1/3 at 30-35 DAT and 1/3 at 50 DAT.

There is no flood at Nagessori and Ulipur during crop growth period, but at Fulbari, there was flash flood from 20 September to 24 September. In submergence tolerant variety trials, the highest grain yield was found in BRRI dhan52 followed by BRRI dhan51. In case of BRRI dhan52, the highest grain yield was found in Nageshory Kurigram followed by Ulipur and Foubari Kurigram. In case of BRRI dhan51, the highest grain yield was found in Nageshory, Kurigram followed by Fulbari and Ulipur, Kurigram. Farmers preferred BRRI dhan52 and they did not like BRRI dhan51 due to shorter plant height and poor phenotypic acceptance.

Varietal trials of newly released BRRI varieties in Boro 2013-14

A varietal trial was conducted in farmers' plot during Boro 2013-14 under IAPP project. Two popular (BRRI dhan28 and BRRI dhan29) and two newly released varieties (BRRI dhan58 and BRRI dhan59) were used in this trial. The demonstration trail was conducted in ten farmers' fields of different upazila under Rangpur, Nilfamari, Lalmonirhat and Kurigram districts. Urea 280-TSP 80-MoP 90-gypsum 70-$ZnSO_4$ 7.5 kg ha^{-1} were applied. All fertilizers except urea were applied as basal during final land preparation. Urea was applied in three equal splits as top dress (at 20, 40 and 60 DAT). Each farmer was treated as a replication. Pre-emergence herbicide Pretilachlor was applied @ 1 L ha^{-1} at 5-6 DAT. Carbofuran 5G was applied at 30-35 DAT @ 10 kg ha^{-1}. The short duration variety BRRI dhan59 gave higher grain yield than BRRI dhan28. The long duration variety BRRI dhan29 gave higher grain yield than BRRI dhan58. BRRI dhan28 and BRRI dhan59 gave the highest grain yield in Kurigram district followed by Nilghamari, Lalmonirhat and Rangpur district. BRRI dhan29 and BRRI dhan58 gave the highest grain yield in Nilphamari followed by Kurigram, Lalmonirhat and Rangpur district. The farmer's reaction on BRRI dhan58 and BRRI dhan59 was positive but it was negative on BRRI dhan58 due to neck blast in some areas.

Enhancing Quality Seed Supply Project (EQSSP)

BRRI regional station, Rangpur conducted 10 varietal demonstrations with BRRI dhan58 at 10 upazilas of four districts (Dinajpur-3, Nilphamari-1, Kurigram-2 and Rangpur-4) during the Boro season 2013-14. The variety demonstrations were within 33 decimal area of each farmer's plot. BRRI recommended management practices were followed. In addition, daylong 10 farmers' training and 10 field days were conducted at 10 upazilla.

About 300 farmers (Male-250 and female-50) participated and gathered knowledge on modern rice cultivation techniques from those training programmes. At the time of field day in all locations, Farmers' showed positive response and expressed their interest to grow this variety in upcoming Boro season. Yield of BRRI dhan58 ranged from 6.7 t ha^{-1} to 9.0 t ha^{-1} which was higher than the mega variety BRRI dhan28 (6.0-7.0 t ha^{-1}) but similar to BRRI dhan29 with 7-10 days earlier.

Seed production and dissemination

A total of 5301 kg TLS and 1,600 kg breeder seed was produced during Aman and 6,405 kg TLS and 4,290 kg breeder seed was produced during Boro season. A total of 3,151 kg TLS in Aman and 4,343 kg in Boro was sold among different organizations and farmers in this region.

Table 1. List of crosses to develop standard boro varieties for northern region, 2013-14.

Designation	# F_1 seed	Objective
Mamun/BRRI dhan29	53	Earliness and high yield
BRRI dhan29/Mamun	04	Earliness and high yield
Mamun/BRRI dhan58	57	Earliness and high yield
BRRI dhan58/Mamun	04	Earliness and high yield
BR7166-5B-5/Mamun	11	Earliness, premium quality and high yield
BR7166-5B-5/Masud	15	Earliness and high yield
BR7166-4B-6/Masud	04	Earliness and High yield
BRRI dhan29/Masud	49	Earliness and high yield
BRRI dhan58/Masud	53	Earliness and high yield
BRRI dhan58/Bashmati Rang	140	Earliness, premium quality and high yield
BR8415-10-1-10-Rang1/BRRI dhan28	17	Earliness, premium quality and high yield
BR8415-10-1-10-Rang1/BRRI dhan58	26	Earliness and high yield
BR7166-5B-5/Bashmati Rang	11	Earliness, premium quality and high yield
BRRI dhan29/Bashmati Rang	18	Earliness, premium quality and high yield
BRRI dhan28/Bashmati Rang	22	Earliness, premium quality and high yield
BR7166-5B-5/Moushumi katari	37	Earliness, premium quality and high yield
BRRI dhan29/Mushumi katari	240	Earliness and high yield
BRRI dhan29/HUA565	115	Earliness and high yield
Mamu.n/BR8626-21-2-4-Rang3-4	78	Earliness and high yield
Mamun/BRRI dhan28	10	Earliness and high yield

N.B. Mamun and Masud are the local rice germplasm which were used as parental line

Table 2. List of confirmed crosses for standard Boro for northern region, Boro, 2013-14.

Designation	Objective
BR7166-5B-5/BRRI dhan29	Earliness and High yield
BR7166-5B-5/BR16	Earliness and High yield
BRRI dhan29/Minikit//Subal lata	Earliness, Premium quality and High yield
RRI dhan29/IR82475B-B-75-1	Earliness and High yield
BRRI dhan29/BR7831-63-4-5-2-2	Earliness and High yield

Table 3. List of selected materials, for standard Boro for northern region, Boro, 2013-14.

	BR no.	Parentage	Progeny row
	BR10405	BRRI dhan29/Pariza	30
	BR10406	BRRI dhan29/Minikit	67
	BR10407	BR16/IR83140-B-11-B	07
	BR10408	BR16/BR7823-53-2-1-1-1-4	18
		Total	**122**

Table 4a. Plants selected from F_2 and BC_1F_2 population, T. Aman 2013, Rangpur.

	BR no	Parentage	Character	No. of plant selected (PS)
	F_2 population			
	10192	BR22/BRRI dhan52	Submergence tolerant	5
	10194	BRRI dhan46/BRRI dhan51	do	5
	10195	BRRI dhan46/BRRI dhan52	do	7
	10198	BRRI dhan49/Saita	do	5
	10200	BRRI dhan49/Ciherang-Sub1	do	3
	10201	BRRI dhan39/KaloJoma	do	10
	10202	BRRI dhan49/ KaloJoma	do	6
	10204	BRRI dhan39/DG1-349	do	5
	10205	BRRI dhan49/DG1-349	do	3
	10206	BRRI dhan53/DG1-349	do	2
	10208	BRRI dhan53/IR64-Sub1	do	3
	Total			**54**
	BC_1F_2 population			
	10197	BRRI dhan49/ Mathia	do	8
	10198	BRRI dhan49/Saita	do	8
	10199	BRRI dhan49/Damshi	do	6
	10203	BRRI dhan53/ KaloJoma	do	8
	Total			**30**
	Grand Total			**84**

Table 4b. List of pedigree population selected in T. Aman 2013, BRRI RS, Rangpur

	BR No.	Cross	Character	Progeny selected
	F_3			
	BR9788	BRRI dhan51/BR11-Saltol-HR1	Sub tol.	8
	BR9789	BRRI dhan51/BR11-Saltol-HR2	Sub tol., Sal tol.	6
	BR9790	BRRI dhan52/BR11-Saltol-HR1	Sub tol., Sal tol.	9
	BR9791	BRRI dhan52/BR11-Saltol-HR2	Sub tol., Sal tol.	10
	BR9792	BRRI dhan41/ BRRI dhan52	Sub tol.	7
	BR9793	BRRI dhan32/ BRRI dhan52	Sub tol.	6
	Total			**46**
	F_4			
	BR9214	BR22/IR85260-66-769-Gaz2	Sub tol.	6
	BR9215	IR85260-66-769-Gaz2/BRRI dhan51	Sub tol.	5
	BR9219	BRRI dhan52/ BRRI dhan51	Sub tol.	6
	Total			**17**
	F_5			
	BR9158	BRRI dhan44/BRRI dhan52	Submergence	5
	BR9159	BRRI dhan49/BRRI dhan52	Submergence	6
	BR9157	BRRI dhan33/BRRI dhan52	Submergence	10
	BR9167	BRRI dhan44/Sambha Mahsuri-Sub1	Submergence	6
	BR9169	BR10/ IR85260-391-148	Submergence	6
	BR9170	BR10/Swarna-Sub1	Submergence	5
	BR9173	IR75017-8-LBN-2-1/ IR85260-391-148	Submergence	6
	BR9175	BR23/IR85260-391-148	Submergence	6
	BR9176	IR68544-25-21-3-1-2/IR85260-391-148	Submergence	5

Total				**55**
	F_6			
	BR8746	BR10/IR81213-246-237	Submergence	5
Total				**5**
	F_7			
	BR8448	BRRI dhan44/IR81213-246-237	Submergence	4
Total				**4**
	BC_2F_8			
	BR8146	IR75852-208-8-B-B-HR1*2/IR75852-208-8-B-B-HR1	Submergence	6 bulk
	BR8155	IR67518-B-1-2-B*2/MT6	Submergence	5 bulk
	BR8156	IR67518-B-1-2-B*2/BM9855	Submergence	3 bulk
Total				**14 bulk**
	BC_1F_9			
	RB7932	IR67518-B-1-2-B*2/BR11/	Submergence	5 bulk
Total				5 bulk
Grand Total				127 PS+19 bulk

DS: 18 Jun 2013, DT: 21 Jul 2013, D/sub: 4 Aug 2013, D/de-sub: 20 Aug 2013

Table 5. Performance of sub1 and stagnant flood tolerant genotypes in rainfed condition (PVS mother trial), BRRI RS, Rangpur, T. Aman 2013.

Genotype	Plant height (cm)	Tiller hill^{-1}	Panicle hill^{-1}	Yield (t ha^{-1})	Day to maturity
BR 7937-28-1	133	10.7	9.8	3.85	134
IR 09F130	117	10.3	9.3	4.34	128
IR 09F181	121	10.9	9.9	4.30	129
IR 09F173	124	10.6	9.3	3.85	134
IR 09F365	116	10.7	9.2	3.51	134
IR 09F119	107	9.1	8.5	2.54	134
BRRI dhan51 (ck)	121	11.6	10.3	4.74	142
BRRI dhan52 (ck)	126	11.4	10.0	4.81	140

(DS: 20 Jun 2013, DT: 19 Jul 2013)

Table 6. Performance of Sub1 and stagnant flood tolerant genotypes in submergence condition PVS mother trial, BRRI, Rangpur, T. Aman 2013.

Genotype	Survival percent	Plant height (cm)	Tiller hill^{-1}	Panicle hill^{-1}	Grain yield t ha^{-1}	Day to maturity
BR 7937-28-1	88.2	137.9	10.3	9.9	3.95	161
IR 09F130	92.3	127.9	10.9	10.6	4.10	162
IR 09F181	89.7	120.7	10.3	9.8	3.50	172
IR 09F173	90.3	135.1	10.3	9.8	3.80	161
IR 09F365	93.8	130.0	10.1	9.4	3.90	162
IR 09F119	90.0	125.3	11.3	10.0	4.05	161
BRRI dhan51 (Ck)	94.4	116.8	10.0	9.5	4.65	166
BRRI dhan52 (Ck)	94.4	128.0	8.1	7.6	4.90	164
$LSD_{0.05}$	9.26	13.68	11.78	11.45	0.78	NS

Table 7. Total positive and negative votes in the PVS Function at Alambiditor, Gangachara, mother trial under PVS, BRRI RS Rangpur, T. Aman 2013.

Genotype	Male farmer		Female farmer		Total		Preference index	Yield (t ha^{-1})
	+ ve	-ve	+ ve	-ve	+ ve	-ve		

BR 7937-28-1	12	0	2	2	14	2	0.081	3.95
IR 09F130	15	2	1	0	16	2	**0.095**	4.10
IR 09F181	2	3	2	0	4	3	0.007	3.50
IR 09F173	0	21	0	2	0	23	**-0.155**	3.80
IR 09F365	5	8	0	4	5	12	-0.047	3.90
IR 09F119	0	4	1	7	1	11	-0.068	4.05
BRRI dhan51 (Ck)	0	16	4	5	4	21	**-0.115**	4.65
BRRI dhan52 (Ck)	20	0	10	0	30	0	**0.203**	4.90

Table 8. Performances of Sub1 and stagnant genotypes with on-farm mother trial under PVS, BRRI RS Rangpur, T. Aman 2013.

Genotype		Plant height (cm)			Tiller hill^{-1}			Panicle hill^{-1}		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
1	BR 7937-28-1	155.8	135.6	139.7	11.7	8.6	10.8	11.1	8.3	10.8
2	IR 09F130	126.5	130.3	123.6	10.2	10.7	12.7	9.9	9.8	11.9
3	IR 09F181	129.9	129.7	121.7	7.5	7.3	11.0	7.3	7.4	10.4
4	IR 09F173	130.4	128.5	118.2	8.9	9.2	11.1	8.6	8.6	10.5
5	IR 09F365	119.3	118.1	117.3	10.1	12.0	11.1	9.9	10.9	10.5
6	IR 09F119	137.5	127.5	131.1	11.3	7.7	13.3	10.4	7.3	12.6
7	BRRI dhan51 (ck)	119.5	111.5	102.9	12.6	8.9	14.0	11.9	8.5	13.3
8	BRRI dhan52 (ck)	136.9	131.9	126.3	9.9	7.9	9.1	9.4	7.4	8.5
$LSD_{0.05}$		2.98	2.77	5.60	1.87	1.52	1.85	1.70	1.36	1.75

L1: Alambiditor, Gangachara, Rangpur, L2: Tupamari, Sadar, Nilphamari, L3: Sarkerpara, Nageswari, Kurigr.

Table 9. Performances of sub1 and stagnant genotypes with on-farm mother trial under PVS, BRRI RS Rangpur, T. Aman 2013.

Genotype	Survival percent			Grain yield (t/ha)			Day to maturity		
	L1	L2	*L3	L1	L2	L3	L1	L2	L3
BR 7937-28-1	96.3	90.8	-	3.91	3.53	4.02	140	146	137
IR 09F130	95.7	92.5	-	4.05	3.85	4.04	147	151	133
IR 09F181	95.4	90.8	-	3.32	3.34	4.13	144	151	132
IR 09F173	96.1	92.1	-	3.80	3.81	4.22	146	150	137
IR 09F365	95.1	89.6	-	3.85	2.71	3.48	143	148	133
IR 09F119	96.2	91.4	-	4.00	3.70	3.82	144	148	136
BRRI dhan51 (Ck)	97.8	87.3	-	4.60	2.12	4.46	149	153	141
BRRI dhan52 (Ck)	98.4	94.8	-	4.88	4.22	4.52	146	151	138
$LSD_{0.05}$	NS	0.22	-	0.35	0.31	0.35	1.94	NS	NS

*L1: Alambiditor, Gangachara, Rangpur, L2: Tupamari, sadar, Nilphamari, L3: Sarkerpara, Nageswari, Kurigram, *No flood occurred*

Table 10. Total positive and negative votes in the PVS function at Alambiditor, Gangachara, mother trial under PVS, BRRI RS, Rangpur, T. Aman 2013.

Code no.	Genotype	Male farmer		Female farmer		Total		Preference index	Yield (t ha^{-1})
		+ ve	-ve	+ ve	-ve	+ ve	-ve		
PVS 1	BR 7937-28-1	3	1	0	1	3	2	0.008	3.91
PVS 2	IR 09F130	9	0	8	0	17	0	**0.142**	4.05
PVS 3	IR 09F181	1	5	0	5	1	10	-0.075	3.32
PVS 4	IR 09F173	5	0	2	0	7	0	0.058	3.80
PVS 5	IR 09F365	0	7	3	2	3	9	-0.050	3.85

PVS 6	IR 09F119	2	7	0	8	2	15	**-0.108**	4.00
PVS 7	BRRI dhan51 (Ck)	0	20	0	4	0	24	**-0.200**	4.60
PVS 8	BRRI dhan52 (Ck)	20	0	7	0	27	0	**0.225**	4.88
Total		**40**	**40**	**20**	**20**	**60**	**60**	**-**	**-**

Table 11a. Flooding situation at crop growing period of different locations of Rangpur.

Location	Flooding status			Water height
	First flood	2nd flood	3 rd flood	
Gangachara	12-19 August (8 days)	-	-	58 cm
Nilphamari	No flood	-	-	-
Lalmonirhat	No flood	-	-	-
Kurigram	1-4 August (4 days)	-	-	60 cm

Table 11b. Average performance (Four trials) of the entries under validation trials in Rangpur region, T. Aman 2013.

Entry	Plant ht. (cm)	TGD (day)	Grain yield (t ha^{-1})				
			Rang	Kuri	Nil	Lal	Ave.
IR09F224	123	133	5.18	5.05	3.84	4.94	**4.75**
IR09F198	128	142	4.85	5.12	4.41	5.80	**5.04**
BRRI dhan51	101	148	5.20	5.55	3.77	6.21	**5.18**
BRRI dhan52	123	144	6.67	6.49	4.10	6.94	**6.05**

Table 12. Performance of four entries in validation trials, (Six locations) in Rangpur region, Boro 2014.

Genotype	Duration (day)	Average plant height (cm)	Grain yield (t ha^{-1})
PSBRC82	147	93	6.75
BRRI dhan28	145	105	7.00
BRRI dhan55	150	96	7.05
BRRI dhan58	155	99	7.00

Table 13. Performance of Stagnant flood tolerant genotypes in rainfed and controlled stagnant conditions, BRRI RS, Rangpur, T. Aman 2013.

Genotype	Plant ht. (cm)		Tiller hill^{-1}		Panicle hill^{-1}		Yield (t ha^{-1})		TGD (day)	
	*Rnfd	**Ctrl	*Rnfd	**Ctrl	*Rnfd	**Ctrl	*Rnfd	**Ctrl	*Rnfd	**Ctrl
IR 09F130	126.8	118.1	9.9	8.9	9.3	8.7	4.07	2.45	128	152
IR 09F165	111.7	110.6	8.6	9.6	8.2	9.1	4.14	2.59	128	149
IR 09F175	130.3	120.1	10.4	6.9	9.8	6.6	3.39	3.00	154	171
IR 09F177	123.8	119.9	9.3	11.2	8.9	11.0	4.09	3.00	154	175
IR 09F181	128.5	122.9	7.8	8.8	7.4	8.8	4.15	3.43	129	149
IR 09F186	113.2	111.8	11.3	10.7	10.7	10.3	4.26	2.64	129	144
IR 09F187	121.3	119.6	10.6	11.5	9.2	11.2	*3.49	3.70	127	143
IR 09F188	122.3	132.0	9.6	11.0	8.6	10.7	4.02	2.46	128	151
IR 09F202	120.0	133.2	9.3	8.3	8.6	8.1	3.58	2.61	128	149
IR 09F203	123.1	126.1	9.9	10.5	8.8	10.3	3.53	2.88	134	152
IR 09F220	119.4	119.3	9.8	8.2	8.9	8.0	3.90	3.06	136	148
IR 09F222	116.9	110.8	9.4	9.5	9.1	9.2	3.87	2.86	130	139
IR 09F224	125.3	124.6	7.7	7.2	7.5	6.8	3.93	3.16	127	148
BRRI dhan44 (ck)	136.8	134.9	8.4	7.9	8.1	7.8	5.02	2.88	144	168

LSD $_{0.05}$	9.45	16.41	2.07	2.76	1.88	2.58	0.73	1.09	3.33	0.88

*20 percent were Rat damaged, **DS: 21 Jun 2013, DT: 20 Jul 2013**

BRRI ANNUAL RESEARCH REVIEW WORKSHOP 2014-15




XXI: REGIONAL STATION, KUSHTIA

BANGLADESH RICE RESEARCH INSTITUTE
GAZIPUR 1701

Bangladesh Rice Research Institute
Regional Station, Kushtia
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PERSONNEL

Name	Designation	Working days
1. Md. Mosaddeque Hossain, MS	Principal Scientific Officer & Head	365
2. Mahmuda khatun, Ph D	Senior Scientific Officer	166
3. Md. Mahbubur Rahman Dewan, MS	Senior Scientific Officer	115
4. Md. Habibur Rahman Mukul, MS	Scientific Officer	166
5. Mrst. Afroze Zahan	Scientific Officer	18
6. Md. Hannan Ali, MS	Scientific Officer	135
7. Md. Belal Hossain, MS	Scientific Officer	233
8. Md. Mohobbat Hossain	Accountant	365
9. Md. Ruhul Amin	Scientific Assistant	297
10. Md. Selim	LDA cum Computer Operator	94

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INTRODUCTION

Bangladesh Rice Research Institute (BRRI), Regional Station, Kushtia represents Agro-ecological Zone (AEZ) 11a, which is the low rainfall area of the country. The soil of Kushtia is light and sandy loam to loam in high and medium lands and silty loam to clay loam in medium low to low lands. Rice based double and triple cropped lands dominate the area. The station does not have its own farm area yet. The experiments are conducted in farmers' fields and at the experimental farm of the Irrigation Extension Training Centre (IETC) of Bangladesh Water Development Board (BWDB), Kushtia widely known as Baradi farm. During the reporting year several experiments were conducted under Varietal Development, Crop Soil Water Management, Pest Management, Socio-Economic and Technology Transfer Programme areas. Research findings of these studies are presented under different programme areas.

SCIENTIFIC INFORMATION

1. VARIETAL DEVELOPMENT PROGRAMME AREA

1.1 Regional Yield Trial (RYT), Upland Rice (Aus), 2014

Objective: To observe the performance of some BRRI developed lines under Upland Rice ecosystem

Methodology

Seven lines namely, BR7698-2B-1-9-1, BR7698-2B-1-9-2, BR7699-2B-3-13-3, BR7992-2B-5-2, BR7992-2B-5-4, BR7383-2B-23 and BR7587-2B-3 were tested at Boria, Kushtia as Upland Rice (Aus) in 2014. BRRI dhan43 was used as the standard checks. The unit plot size was 5 m X 10 m with spacing of 25 cm between the rows. Dry direct seeding was done in rows. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Results

The yield of the tested lines ranged from 1.6 t to 2.5 t/ha. The lines BR7698-2B-1-9-1, BR7698-2B-1-9-2 and BR7383-2B-23 gave highest yield (2.5t/ha) followed by BR7992-2B-5-4, BR7587-2B-3. One line namely, BR7699-2B-3-13-3 gave the lowest yield (1.6 t/ha) among the tested lines. Growth duration of the lines was more or less similar to the standard check BRRI dhan43 (Table 1). Plant height of the tested lines was 1.20-34.0 cm shorter than the check (114.8 cm).

Table 1. Performance of some RYT lines, Upland Rice (Aus), 2014

Designation	Plant height (cm)	Growth duration (days)*	1000 grain wt (gm)	Yield (t/ha)
BR7698-2B-1-9-1	84.8	110	25.3	2.5
BR7698-2B-1-9-2	81.8	108	24.1	2.5
BR7699-2B-3-13-3	104.3	112	20.5	1.6
BR7992-2B-5-2	113.6	108	29.9	2.1
BR7992-2B-5-4	99.6	114	25.3	2.3
BR7383-2B-23	91.2	108	23.7	2.5
BR7587-2B-3	112.3	110	21.9	2.3
BRRI dhan43 (Ck)	114.8	108	21.2	2.1
LSD (0.5)				

D/S: 20.04.2014

1.2 Regional Yield Trial (RYT), T. Aus, 2014

Objective: To observe the performance of some BRRI developed lines under T. Aus ecosystem

Methodology

Seven materials were tested at Boria, Kushtia in T. Aus season, 2014. The materials were BR8113-21-3-1, BR7922-45-2-2-1, IR71866-3R-3-1, BR7708-62-1-1, BR7718-56-3-1, BR7716-49-1-3 and BR7718-55-1-3. BR26 and BRRI dhan48 were used as standard checks. Thirty days old seedlings were planted in 5.4 m x 1.6 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 2. Performance of some BRRI developed RYT lines, T. Aus, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	1000 grain wt (gm)	Yield (t/ha)
1	BR8113-21-3-1	118	92.6	22.0	4.2
2	BR7922-45-2-2-1	110	103.1	23.3	4.5
3	IR71866-3R-3-1	101	93.0	23.5	4.3
4	BR7708-62-1-1	112	95.5	22.1	5.4
5	BR7718-56-3-1	109	90.2	24.1	4.8
6	BR7716-49-1-3	105	93.0	20.8	5.4
7	BR BR7716-49-1-37718-55-1-3	110	93.1	21.4	5.2
8	BR26 (Ck)	112	96.6	24.2	4.5
9	BRRI dhan48 (Ck) LSD (0.5)	108	88.9	22.3	4.3

D/S: 28.04.14 D/ T: 28.05.14

Results

The yield of the tested lines ranged from 4.2 to 5.4 t/ha. Highest yield 5.4 t/ha was observed in the lines BR7708-62-1-1 and BR7716-49-1-3 which was 1.10 t/ha higher than the check and lowest yield 4.2 t/ha was found from the line BR8113-21-3-1. The range of the growth duration was 105-118 days where the growth duration of the check varieties was 112 days (BR26) and 108 days (BRRI dhan48) (Table 2).

1.3 Regional Yield Trial (RYT), T. Aus, 2014

Objective: To observe the performance of some BRRI developed lines under T. Aus ecosystem

Methodology

Seven materials were tested at Boria, Kushtia in T. Aus season, 2014. The materials were BRRI dhan29-SC3-28-16-10-8-HR1, BRRI dhan29-SC3-28-16-10-6-HR3, BRRI dhan29-SC3-28-16-10-4-HR5, BRRI dhan29-SC3-28-16-10-6-HR6, Parija, WK1 and Nerica10. BRRI dhan48 was used as standard check. Thirty one days old seedlings were planted in 5.4 m x 1.6 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 3. Performance of some BRRI developed RYT lines, T. Aus, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	1000 grain wt (gm)	Yield (t/ha)
1	BRRI dhan29-SC3-28-16-10-8-HR1	107	88.2	20.0	4.47
2	BRRI dhan29-SC3-28-16-10-6-HR3	104	106.4	19.8	4.90
3	BRRI dhan29-SC3-28-16-10-4-HR5	103	106.4	19.5	5.10
4	BRRI dhan29-SC3-28-16-10-6-HR6	104	105.0	19.2	4.60
5	Parija	109	96.0	23.4	5.30
6	WK1	98	81.9	19.7	4.10
7	Nerica10				V. Late
8	BRRI dhan48 (Ck)	110	98.3	23.7	4.80
	LSD (0.5)				

D/S: 28.04.14 D/ T: 29.05.14

Results

The yield of the tested lines ranged from 4 .10 to 5.30 t/ha. Highest (5.30 t/ha) and lowest (4.10 t/ha) yield was observed in the line Parija and WK1 respectively. The range of the growth duration was 98-109 days where the growth duration of the check varieties was 110 days (BRRI dhan48) (Table 3).

1.4 Proposed Variety Trial (PVT), Drought, T. Aman, 2014

Objective: To observe the yield and agronomic performance of some lines under proposed variety trial in drought condition

Methodology

The proposed variety trial was performed with IR83377-B-B-93-3, IR82589-B-B-84-3 and BRRI dhan56 (Std. check) at Boria, Kushtia in T. Aman season, 2014. Thirty days old rice seedlings were planted in 6 m x 5.0 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 4. Performance of some Proposed Variety Trial (PVT) lines, Drought, T. Aman, 2014

Sl. no	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)

1	IR83377-B-B-93-3	120	104.6	256		6.29
2	IR82589-B-B-84-3	120	120.6	232		5.97
3	BRRI dhan56(Ck)	119	110.3	222		4.69

D/S: 09.07.14 D/T: 08.08.14

Results

Yield of the line IR83377-B-B-93-3 (6.29 t/ha) and IR82589-B-B-84-3 (5.97 t/ha) were higher than the check variety BRRI dhan56 (4.69 t/ha). Growth duration of the both lines was similar to the check variety BRRI dhan56 (Table 4). Therefore, the material (IR83377-B-B-93-3 and IR82589-B-B-84-3) can be proposed as a variety in drought prone situation.

1.5 Proposed Variety Trial (PVT), RLR, T. Aman, 2014

Objective: To observe the yield and agronomic performance of some lines under proposed variety trial in rainfed low land ecosystem

Methodology

The proposed variety trial was performed with BR7472-16-2-1-2-3, BR7622-5-1-1-1and BRRI dhan39, BRRI dhan49 (Std. check) at Boria, Kushtia in T. Aman season, 2014. Thirty one days old rice seedlings were planted in 6 m x 5.0 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 5. Performance of some Proposed Variety Trial (PVT) lines, RLR, T. Aman, 2014

Sl. No.	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7472-16-2-1-2-3	129	117.7	213		6.03
2	BR7622-5-1-1-1	127	116.9	212		5.42
3	BRRI dhan39(Ck)	122	104.3	231		5.69
4	BRRI dhan49(Ck)	130	90.7	262		5.23

D/S: 09.07.14 D/T: 09.08.14

Results

Yield (6.03 t/ha) of the proposed line BR7472-16-2-1-2-3 was higher than the both check variety BRRI dhan39 and BRRI dhan49 (5.23 &5.69 t/ha). Growth duration of the proposed line BR7472-16-2-1-2-3 was similar to that of the check variety BRRI dhan49 but 8 days longer than check variety BRRI dhan39. On the other hand, grain yield (5.42 t/ha) of another proposed line BR7622-5-1-1-1 was higher than the check variety BRRI dhan49 (5.23 t/ha) but lower than the check BRRI dhan39 (5.69 t/ha). Growth duration of the proposed line BR7622-5-1-1-1 was 3 days shorter than the check variety BRRI dhan49 but 5 days longer than check variety BRRI dhan39 (Table 5). Therefore, the material (BR7472-16-2-1-2-3) can be proposed as a variety.

1.6 Proposed Variety Trial (PVT), Premium Quality Rice (PQR), T. Aman, 2014

Objective: To observe the yield and agronomic performance of some green super rice lines under proposed variety trial

Methodology

The line BR7357-11-2-4-1-1 with BRRI dhan37 as check was tested to observe the yield and some agronomic performance at Boria, Kushtia in T. Aman season, 2014. Thirty one days old rice seedlings were planted in 6 m x 5.0 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 6. Performance of some Proposed Variety Trial (PVT) lines, PQR, T. Aman, 2014

Sl. No.	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7357-11-2-4-1-1	129	121.1	254		4.99
2	BRRI dhan37(Ck)	147	126.0	234		3.26

D/S: 09.07.14 D/T: 09.08.14

Results

The proposed material BR7357-11-2-4-1-1 gave 1.63 t/ha higher grain yield with 18 days shorter growth duration than the check variety BRRI dhan37 (Table 6). Number of panicles/m^2 (254) of the proposed material was higher than the check variety BRRI dhan37 (234) and this character might be contributed to the yield. Considering the above yield and yield contributing characters the material (BR7357-11-2-4-1-1) can be proposed as a variety.

1.7 Proposed Variety Trial (PVT), Micro Nutrient (MN), T. Aman, 2014

Objective: To observe the yield and agronomic performance of some green super rice lines under proposed variety trial

Methodology

The line BR7528-2R-19-HR10 with BRRI dhan39 as check was tested to observe the yield and some agronomic performance at Boria, Kushtia in T. Aman season, 2014. Thirty one days old rice seedlings were planted in 5 m x 5.0 m unit plots with 20 cm x 20 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 7. Performance of some Proposed Variety Trial (PVT) lines, MN, T. Aman, 2014

Sl. No.	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7528-2R-19-HR10	130	105.7	222		5.13
2	BRRI dhan39 (Ck)	125	95.4	230		5.27

D/S: 09.07.14 D/T: 09.08.14

Results

Yield (5.13 t/ha) and growth duration (130 days) of the proposed material BR7528-2R-19-HR10 was poorer to the check variety BRRI dhan39 (Table 7). Number of panicles/m^2 (222) of the

proposed material was lower than the check variety BRRI dhan39 (230) and this character might be contributed to the yield. Considering the above yield and yield contributing characters the proposed line might be considered for further evaluation.

1.8 Regional Yield Trial (RYT), RLR-1, T. Aman, 2014

Objective: To observed the performance of some rainfed low land rice lines under T. Aman ecosystem

Methodology

Three entries were tested at Boria, Kushtia in T. Aman, 2014. The materials were IR70213-10-CPA 4-2-2-2, B 10533 F-KN-12-2 and BR8033-2-2-1-2. BRRI dhan32 and BRRI dhan49 was used as standard checks. Thirty four days old rice seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 8. Performance of some Rainfed Low Land Rice (RLR) lines, T. Aman, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	IR70213-10-CPA 4-2-2-2	125	107.2	265	29.5	5.78
2	B 10533 F-KN-12-2	126	114.6	285	23.03	5.26
3	BR8033-2-2-1-2	133	97.2	319	18.47	5.43
4	BRRI dhan32 (Ck)	130	116.9	271	20.47	6.28
5	BRRI dhan49 (Ck)	135	99.5	323	19.37	5.56

D/S: 14.07.14 D/T: 17.08.14

Results

The yield of the tested lines ranged from 5.26 to 5.78 t/ha. IR70213-10-CPA 4-2-2-2, B 10533 F-KN-12-2 and BR8033-2-2-1-2 gave similar yield with the check varieties BRRI dhan49 (5.56 t/ha) but lower than the check BRRI dhan32 (6.28 t/ha). Among the tested line IR70213-10-CPA 4-2-2-2 gave the higher grain yield with shorter growth duration. Growth duration (125 days) of the line IR70213-10-CPA 4-2-2-2 was 5-10 days earlier than the standard check BRRI dhan32 and BRRI dhan49 (130 & 135 days, respectively) and 1000 grain wt (29.5 gm) was so high to the both check variety BRRI dhan49 and BRRI dhan49 (20.47 & 19.37 gm) (Table 8).

1.9 Regional Yield Trial (RYT), RLR-2, T. Aman, 2014

Objective: To observed the performance of some rainfed low land rice lines under T. Aman ecosystem

Methodology

Six entries were tested at Boria, Kushtia in T. Aman, 2014. The materials were WAS122-IDSA 14-WAS B-FKR 1(NERICA-L-8), WAS122-IDSA 1-WAS -2-B-1-TGR 132 (NERICA-L-16), WAS 161-B-6-B-1(NERICA-L-36) , WSA 161-B-4-B-1-TGR 51 (NERICA-L-32), WAS 191-4-10 (NERICA-L-54) and NERICA Mutant. BRRI dhan56 and BRRI dhan49 was used as standard checks. Twenty five days old rice seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm

x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 9. Performance of some Rainfed Low Land Rice (RLR) lines, T. Aman, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	WAS122-IDSA 14-WAS B-FKR 1. (NERICA-L-8)	122	102.7	341	26.37	5.68
2	WAS122-IDSA 1-WAS -2-B-1-TGR 132 (NERICA-L-16)	125	107.8	279	27.20	5.62
3	WAS 161-B-6-B-1(NERICA-L-36)	124	102.1	352	25.43	6.59
4	WSA 161-B-4-B-1-TGR 51 (NERICA-L-32)	123	101.1	323	26.40	5.33
5	WAS 191-4-10 (NERICA-L-54)	123	95.2	291	24.40	4.71
6	NERICA Mutant	114	104.7	244	24.70	4.44
7	BRRI dhan56 (Ck)	115	115.3	265	23.27	5.43
8	BRRI dhan49 (Ck)	132	94.3	262	25.60	5.49

D/S: 14.07.14 D/T: 09.08.14

Results

The yield of the tested lines ranged from 4.44 to 6.59 t/ha. WAS122-IDSA 14-WAS B-FKR 1. (NERICA-L-8), WAS122-IDSA 1-WAS -2-B-1-TGR 132 (NERICA-L-16) and WSA 161-B-4-B-1-TGR 51 (NERICA-L-32) gave similar yield to both check varieties BRRI dhan56 (5.43 t/ha) and BRRI dhan49 (5.49 t/ha) but more than 1.0 t/ha higher yield found from line WAS 161-B-6-B-1(NERICA-L-36). Growth duration of the lines WAS 161-B-6-B-1(NERICA-L-36) was 7 days earlier than the standard check BRRI dhan49 (132 days) but 9 days longer than the check BRRI dhan56 (115 days). Plant height of these two lines was intermittent than the both standard checks and lodging tendency was not occurred. 1000 grain wt was similar to the both check variety BRRI dhan56 and BRRI dhan49 (23.27 & 25.60 gm) (Table 9).

1.10 Regional Yield Trial (RYT), PQR, T. Aman, 2014

Objective: To observe the performance of some BRRI developed premium quality materials under T. Aman ecosystem

Methodology

Eight materials were tested at Baradi, Kushtia in T. Aman season, 2014. The materials were BR8226-8-5-2-2, BR8226-11-4-4-3, BR8226-11-4-6-2, BR8294-1-3-2-2, BR8226-13-1-2, BR8226-17-1-2, BR8227-11-6-2-1 and BR8515-23-6-3. BRRI dhan34 and BRRI dhan37 were used as standard checks. Twenty six days old seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 10. Performance of some Premium Quality Rice (PQR) T. Aman, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR8226-8-5-2-2	138	101.4	353	36.63	5.17
2	BR8226-11-4-4-3	143	88.7	329	18.63	4.63
3	BR8226-11-4-6-2	139	94.2	305	16.37	4.31
4	BR8294-1-3-2-2	119	111.1	220	18.33	4.33
5	BR8226-13-1-2	132	109.1	306	16.37	4.84
6	BR8226-17-1-2	135	105.1	289	19.50	4.74
7	BR8227-11-6-2-1	136	110.8	236	22.23	5.62
8	BR8515-23-6-3	131	110.1	264	16.33	2.76
9	BRRI dhan34(Ck)	132	133.8	251	10.30	3.77
10	BRRI dhan37(Ck)	137	134.4	263	14.13	3.61

D/S: 17.07.14 D/T: 13.08.14

Results

The yield of the tested lines ranged from 2.76 to 5.62 t/ha. Most of the lines gave higher grain yield than the both check varieties (BRRI dhan34 and BRRI dhan37) except line BR8515-23-6-3. Highest yield was observed in the line BR8227-11-6-2-1 (5.62 t/h) and it was about 1.85-2.01 t/ha higher yield than the standard check BRRI dhan34 (3.77 t/ha) and BRRI dhan37 (3.61 t/ha) fallowed by line BR8226-8-5-2-2 (5.17 t/ha) and BR8226-13-1-2 (4.84 t/ha). Growth duration of the lines BR8227-11-6-2-1 & BR8226-8-5-2-2 were similar with the check variety BRRI dhan37 but longer than the check BRRI dhan34 and line BR8226-13-1-2 similar with the check BRRI dhan34 but shorter than the check BRRI dhan37. All of the entries showed shorter plant height than the check varieties BRRI dhan34 and BRRI dhan37 (Table 10).

1.11 Regional Yield Trial (RYT), Micronutrient Enrich Rice (MER), T. Aman, 2014

Objective: To observe the performance of some micronutrient rice lines under T. Aman ecosystem

Methodology

Seven materials were tested at Baradi, Kushtia in T. Aman, 2014. The materials were BR7840-54-3-2-2, BR7879-17-2-4-HR3-P1, BR7671-37-2-2-3-7-3, BR8143-15-2-1, BR8418-1-3, IR85850-75-

2-2-3-2(IR10M 300) and PSBRC 82(IRRI 123). BRRI dhan32 and BRRI dhan39 were used as standard checks. Thirty days old seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 11. Performance of some RYT (MER) T. Aman, 2014

Sl. No.	Designation	Growth Duration (day)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7840-54-3-2-2	122	116.9	169	24.88	5.21
2	BR7879-17-2-4-HR3-P1	132	127.3	192	24.42	5.02
3	BR7671-37-2-2-3-7-3	126	100.9	247	25.95	5.15
4	BR8143-15-2-1	112	112.9	191	25.77	5.62
5	BR8418-1-3	121	94.5	274	21.26	4.93
6	IR85850-75-2-2-3-2(IR10M 300)	128	100.3	291	24.50	5.49
7	PSBRC 82(IRRI 123)	128	100.3	291	24.50	5.49
8	BRRI dhan32 (Ck)	129	118.3	230	22.17	5.56
9	BRRI dhan39 (Ck)	125	100.1	219	23.30	4.86

D/S: 14.07.14 D/T: 15.08.14

Results

The yield of the tested lines ranged from 4.93 to 5.62 t/ha. Most of the lines gave more or less similar grain yield to the check variety BRRI dhan32 except lines BR8418-1-3 & BR7879-17-2-4-HR3-P1. Highest yield was observed in the line BR8143-15-2-1 (5.62 t/h) and it was about 0.06 t/ha and 0.76 t/ha higher yield than the standard check BRRI dhan32 (5.56 t/ha) and BRRI dhan39 (4.86 t/ha), respectively fallowed by line IR85850-75-2-2-3-2(IR10M 300) & PSBRC 82(IRRI 123 (5.49 t/ha). Growth duration of the line BR8143-15-2-1 was 18 days and 13 days shorter than the checks BRRI dhan32 (129 days) and BRRI dhan39 (125 days), respectively (Table 11). Therefore, the line BR8143-15-2-1 might be considered for further evaluation.

1.12 Regional Yield Trial, Green Super Rice (GSR), T. Aman, 2014

Objective: To observe the performance of some green super rice material under T. Aman ecosystem

Methodology

Four materials were tested at Boria, Kushtia in T. Aman season, 2013. The materials were IR83140-B-28-B, IR83142-B-19-B, IR83142-B-60-B and HHZ5-SAL10-DT1-DT1. BRRI dhan39 and BRRI dhan56 were used as standard check. Twenty-six-days old rice seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with two

replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 12: Performance of some GSR lines, T. Aman, 2014

Sl. No.	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	IR8340-B-28-B	121	103.4	219	27.30	4.95
2	IR83142-B-19-B	116	102.5	294	25.90	4.92
3	IR83142-B-60-B	116	106.6	228	28.83	4.43
4	HHZ5-SAL10-DT1-DT1	121	103.7	193	26.75	3.97
5	BRRI dhan39 (Ck)	121	102.5	225	22.10	5.14
6	BRRI dhan56 (Ck)	116	115.6	251	23.57	5.19

D/S: 14.07.2014 D/T: 10.08.2014

Results

The yield of the tested lines ranged from 3.97 to 4.95 t/ha. None of the tested lines gave higher grain yield than the both checks BRRI dhan39 (5.14 t/ha) and BRRI dhan56 (5.19 t/ha). Growth duration of the test entries was similar with the both checks. All of the entries showed similar plant height to the check varieties (Table 12).

1.13 Proposed Variety Trial (PVT), ARL, Boro, 2014-'15

Objective: To observe the yield and agronomic performance of some favorable Boro lines to propose variety

Methodology

Two lines namely, IR83140-B-36-B-B, IR83142-B-71-B-B with BRRI dhan28 and BRRI dhan29 as check were tested under alternate wetting and drying (AWD) to observe the yield and some agronomic performances at Kushtia in Boro, 2014-'15. Twenty days old rice seedlings were planted in 5.4 m x 20 rows unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 13. Performance of Proposed Variety Trial (PVT), ARL, Boro, 2014-'15

Sl.no	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/ m^2	1000 grain wt (gm)	Yield (t/ha)
1	IR83140-B-36-B-B	150	93.8	367	25.21	7.87
2	IR83142-B-71-B-B	147	101.2	343	26.87	8.30
3	BRRI dhan28(ck)	144	117.7	308	22.38	6.74
4	BRRI dhan29(ck)	160	111.9	384	21.45	8.67

D/S: 02.12.14 D/T: 22.12.14

Results

The proposed line, IR83142-B-71-B-B gave 1.56 t/ha higher yield than the check variety BRRI dhan28 (6.74 t/ha) with similar growth duration but 0.37 t/ha lower yield than the check variety BRRI dhan29 with 13 days shorter growth duration. On the other hand line IR83140-B-36-B-B gave 1.13 t/ha yield advantage over check variety BRRI dhan28 with 5 days longer growth duration but 0.80 t/ha lower yield than the check variety BRRI dhan29 with 10 days shorter growth duration. Therefore, these two lines can be proposed for future variety.

1.14 Proposed Variety Trial (PVT), Zinc, Boro, 2014-'15

Objective: To observe the yield and agronomic performance of some favorable Boro lines to propose variety

Methodology

Two lines namely, BR7671-37-2-2-3-7, BR7833-11-1-1-2-1-285 with BRRI dhan28 and BRRI dhan64 as check were tested to observe the yield and some agronomic performances at Kushtia in Boro, 2014-'15. Forty five days old rice seedlings were planted in 6.0 m x 5.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 14. Performance of Proposed Variety Trial (PVT), Boro, 2014-'15

Sl. no	Designation	Growth duration (days)	Plant height (cm)	No of Panicles /m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7671-37-2-2-3-7	149	95.0	265	0.00	5.83
2	BR7833-11-1-1-2-1-285	142	101.7	291	0.00	5.48
3	BRRI dhan(64)	152	104.3	253	0.00	5.06
4	BRRI dhan(28)	144	109.8	291	0.00	6.06

D/S: 07.12.14 D/T: 22.01.15

Results

The proposed line, BR7833-11-1-1-2-1-285 gave 0.42 t/ha higher yield over check variety BRRI dhan64 with 10 days early growth duration but 0.58 t/ha lower yield than check variety BRRI dhan28 with similar growth duration. While line, BR7671-37-2-2-3-7 gave 0.77 t/ha higher yield over check variety BRRI dhan64 with 3 days early growth duration but 0.23 t/ha lower yield than check variety BRRI dhan28 with 5 days longer growth duration. Therefore, these two lines might be selected for further evaluation.

1.15 Regional Yield Trial-1, Premium Quality Rice (PQR), Boro, 2014-'15

Objective: To observe the performance of some Green super Rice lines during Boro season

Methodology

Five materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were IRR77734-93-2-3-2, BR8079-52-2-2-2, BR8096-55-1-9-1, BR8076-1-2-2-3 and BR8096-48-2-2-4. BRRI dhan50 and BRRI dhan63 were used as standard check. Forty eight days old seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 15. Performance of some Premium Quality Rice (PQR) lines, Boro, 2014-'15

Sl. No.	Designation	Growth Duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	IRR77734-93-2-3-2	148	97.30	396.00	25.22	7.24
2	BR8079-52-2-2-2	151	90.90	414.00	19.93	7.52
3	BR8096-55-1-9-1	147	93.00	415.50	18.21	6.90
4	BR8076-1-2-2-3	147	100.60	366.50	22.18	7.26
5	BR8096-48-2-2-4	150	88.70	391.00	19.13	6.86
6	BRRI dhan50 (ck)	150	88.70	391.00	19.13	6.86
7	BRRI dhan63 (ck)	145	89.70	324.50	21.01	6.85

D/S: 09.12.14 D/T: 27.01.15

Results

The yield of the tested entries ranged from 6.86 to 7.52 t/ha. Most of the tested entries gave higher yield over both the check varieties BRRI dhan50 and BRRI dhan63. Highest yield was observed in the line BR8079-52-2-2-2 (7.52 t/h) and this was followed by BR8076-1-2-2-3 (6.1 t/h) and IRR77734-93-2-3-2 (7.24 t/ha). These materials had higher plant height with similar 1000 grain wt except line IRR77734-93-2-3-2 to the check variety and higher number of panicles/m^2. Growth duration of the tested entries was more or less similar to the both check varieties BRRI dhan50 (150 days) and BRRI dhan63 (145 days). Therefore, these entries might be selected for further evaluation.

1.16 Regional Yield Trial (RYT-2), PQR, Boro, 2014-'15

Objective: To observe the performance of some BRRI developed premium quality rice lines during Boro season.

Methodology

Five materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were BR7372-35-3-3-HR9, BR73580-5-3-2-1-HR, BR7372-18-2-1-HR1-HR6, BR7372-18-3-3-HR3 and BR7372-35-3-3-HR5. BRRI dhan28, BRRI dhan50, BRRI dhan60 and BRRI dhan63 were used as standard checks. Forty seven days old rice seedlings were planted in 5.4 m x 2.5 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic

practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 16. Performance of some Premium Quality Rice (PQR) lines, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR7372-35-3-3-HR9	148	103.30	269	26.92	5.78
2	BR73580-5-3-2-1-HR	144	90.40	331	22.76	5.91
3	BR7372-18-2-1-HR1-HR6	146	99.70	276	27.94	6.88
4	BR7372-18-3-3-HR3	146	105.10	296	27.90	7.10
5	BR7372-35-3-3-HR5	147	102.30	277	27.6	6.52
6	BRRI dhan28(ck)	146	105.40	384	22.42	7.36
7	BRRI dhan50(ck)	147	91.20	343	19.22	6.77
8	BRRI dhan60(ck)	145	96.80	332	25.38	7.28
9	BRRI dhan63(ck)	145	94.00	338	22.03	6.97

D/S: 13.12.14 D/T: 30.01.15

Results

The yield of the tested lines ranged from 5.78 to 7.10 t/ha. None of the line gave better yield than the checks but line BR7372-18-3-3-HR3 gave similar yield (7.10 t/ha) with the standard checks, BRRI dhan28, BRRI dhan60 and BRRI dhan63 respectively. Growth duration of tested lines were similar to the checks (145-147 days) (Table 16). Therefore, these materials can be selected for further evaluation.

1.17 Regional Yield Trial (RYT), Short Duration (SD), Boro, 2014-'15

Objective: To observe the performance of some BRRI developed disease resistant rice lines during Boro season.

Methodology

One material was tested at Baradi farm, Kushtia in Boro, 2014-'15. The material was NERICA Mutant with BRRI dhan28 and BRRI dhan29 were used as standard checks. Fifty days old rice seedlings were planted in 5.4 m x 2.5 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 17. Performance of some Disease Resistant Rice, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	NERICA Mutant	149	97.40	306.00	24.51	5.97
5	BRRI dhan28(ck)	144	91.40	365.50	22.02	6.34
6	BRRI dhan45(ck)	144	92.20	323.00	26.22	7.17

D/S: 09.12.14 D/T: 28.01.15

Results

The yield of the tested line was 5.97 t/ha. Tested entry NERICA Mutant gave lower yield than the both checks BRRI dhan28 (6.34 t/ha) and BRRI dhan45 (7.17 t/ha) with 5 days higher growth duration (Table 17). Therefore, the material NERICA Mutant might be further evaluation.

1.18 Regional Yield Trial (RYT), Favorable Boro (FB), 2014-'15

Objective: To observe the performance of some BRRI developed favorable Boro lines during Boro season.

Methodology

Ten materials were tested at Baradi farm, Kushtia in Boro, 2013-'14. The materials were BR7683-30-3-3-4, BR7671-37-2-2-3-7, BR7988-4-5-3-4, BR7783-AC12-3, BR7783-AC13-5, BR7783-AC14-5, BR7783-AC6-3-2-2-1, BRRI dhan29-SC3-28-16-10-8-HR1(com), BR7988-10-4-1 and BR7800-63-1-7-3. BRRI dhan28, BRRI dhan29 and BRRI dhan60 were used as standard checks. Fifty-two-days old rice seedlings were planted in 5.4 m x 2.5 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 18. Performance of some Favorable Boro Rice (FB) lines, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR7683-30-3-3-4	145	89.10	337	25.51	4.89
2	BR7671-37-2-2-3-7	146	88.50	277	26.04	6.16
3	BR7988-4-5-3-4	148	77.10	268	21.20	5.96
4	BR7783-AC12-3	160	95.60	304	21.16	6.56
5	BR7783-AC13-5	162	102.30	312	20.71	6.75
6	BR7783-AC14-5	162	103.00	318	21.07	6.22
7	BR7783-AC6-3-2-2-1	162	98.20	279	21.10	6.35
8	BRRI dhan29-SC3-28-16-10-8-HR1(com)	144	81.60	322	19.96	5.23
9	BR7988-10-4-1	143	82.30	333	20.06	5.59

10	BR7800-63-1-7-3	146	96.60	243	26.38	5.51
11	BRRI dhan28(ck)	146	93.20	298	21.37	5.56
12	BRRI dhan29(ck)	160	108.00	317	22.77	7.49
13	BRRI dhan60(ck)	144	83.80	360	24.62	5.29

D/S: 09.12.14 D/T: 30.01.15

Results

The yield of the tested lines ranged from 5.23-6.75 t/ha. The yield of the line BR7783-AC13-5 was 6.75 t/ha which was 0.74 t/ha lower yield than the check BRRI dhan29 with similar growth duration (162 days). The line BR7671-37-2-2-3-7 gave 6.16 t/ha yield which was 0.60 t/ha yield advantage than the check variety BRRI dhan28 (5.56 t/ha) with similar growth duration (146 days) (Table 18). Other tested lines did not give positive yield with growth duration than the check varieties. Therefore, these two lines might be selected for further evaluation.

1.19 Regional Yield Trial, Micronutrient Rice (MN), Boro, 2014-'15

Objective: To observe the performance of micronutrient rice genotypes during Boro season

Methodology

Nine materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were BR7840-54-3-2-1, BR7840-54-3-4-1, BR7840-54-3-4-4, BR8257-37-1-2-2, BR7833-19-2-3-5, BR8261-19-1-1-3, BR7820-18-1-6-3-P4, BR7881-62-2-3-7-P3 and BR7879-17-2-4-HR3-P1. BRRI dhan28 and BRRI dhan29 were used as standard checks. Forty-nine-days old rice seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 19. Performance of some Micro Nutrient Rice (MN) lines, Boro, 2014-'15

Sl. No.	Designation	Plant height (cm)	Growth duration	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR7840-54-3-2-1	147	92.20	278.5	26.39	4.97
2	BR7840-54-3-4-1	142	92.00	213.00	25.72	4.45
3	BR7840-54-3-4-4	143	87.70	229.5	27.93	4.27
4	BR8257-37-1-2-2	142	80.00	263	26.44	4.00
5	BR7833-19-2-3-5	147	100.20	219.00	20.37	4.01
6	BR8261-19-1-1-3	144	98.70	227.5	20.33	5.17
7	BR7820-18-1-6-3-P4	157	94.00	300.00	21.84	5.64
8	BR7881-62-2-3-7-P3	-	100.90	279.50	23.28	5.37
9	BR7879-17-2-4-HR3-P1	156	127.70	218.50	26.11	5.28
10	BRRI dhan28(ck)	142	100.90	319.00	22.05	5.49

11	BRRI dhan29(ck)	156	96.50	288.5	21.80	6.30

D/S: 13.12.14 D/T: 31.01.15

Results

The yield of the tested lines ranged from 4.00-5.64 t/ha. None of the evaluated entries gave positive yield with growth duration than the both checks BRRI dhan28 and BRRI dhan29. So, these lines might be further evaluation.

1.20 Regional Yield Trial-1, Green Super Rice (GSR), Boro, 2014-'15

Objective: To observe the performance of some Green super Rice lines during Boro season

Methodology

Five materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were HHZ15-SAL13-Y1, HHZ23-DT16-DT1-DT1, HHZ15-DT4-DT1-Y1, HHZ11-DT17-SAL1-SAL1 and HHZ6-SAL3-Y1-SUB2. BRRI dhan29 and BRRI dhan60 were used as standard check. Fifty-one-days old seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 20. Performance of some Green Super Rice (GSR) lines, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	HHZ15-SAL13-Y1	154	90.50	248.00	21.34	6.14
2	HHZ23-DT16-DT1-DT1	160	93.60	326.00	21.51	6.81
3	HHZ15-DT4-DT1-Y1	154	85.10	343.00	22.89	6.41
4	HHZ11-DT17-SAL1-SAL1	152	79.80	326.50	23.10	5.76
5	HHZ6-SAL3-Y1-SUB2	155	91.20	301.50	23.40	6.85
6	BRRI dhan29 (ck)	163	101.70	354.50	22.07	7.61
7	BRRI dhan60 (ck)	155	85.90	388.00	25.76	5.10

D/S: 11.12.14 D/T: 31.01.15

Results

The yield of the tested entries ranged from 5.76 to 6.85 t/ha. Most of the tested lines gave higher yield than the check variety BRRI dhan60 (5.10 t/ha) but lower than the check variety BRRI dhan29 (7.61 t/ha). Growth duration of the tested entries was 0-3 days shorter than the check variety BRRI dhan60 (155 days) and 8-11 days than the check variety BRRI dhan29 (days) Table 20 except line HHZ23-DT16-DT1-DT1. Therefore, these materials might be selected for further evaluation.

1.21 Regional Yield Trial-1, (Bio-tech. SD), Boro, 2014-'15

Objective: To observe the performance of some Green super Rice lines during Boro season

Methodology

Five materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were BR8072-AC5-4-2-1-2-1, BR8072-AC7-4-1-2-2-1, BR8072-AC8-1-1-3-1-1, BR8072-AC11-2-3-2-1-1 and BR4909-R1-R2. BRRI dhan28 was used as standard check. Fourty-six-days old seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 21. Performance of some SD lines, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR8072-AC5-4-2-1-2-1	139	92.67	292.33	23.68	5.80
2	BR8072-AC7-4-1-2-2-1	137	89.93	275.00	23.22	5.81
3	BR8072-AC8-1-1-3-1-1	138	91.53	284.33	23.85	6.57
4	BR8072-AC11-2-3-2-1-1	138	90.07	287.33	24.25	5.95
5	BR4909-R1-R2	144	112.50	260.50	21.89	5.96
6	BRRI dhan28(ck)	141	93.20	302.67	21.94	5.69

D/S: 17.12.14 D/T: 02.02.15

Results

The yield of the tested entries ranged from 5.80 to 6.57 t/ha. Most of the tested lines gave higher yield than the check variety BRRI dhan28 (5.69 t/ha). Highest yield was observed in the line BR8072-AC8-1-1-3-1-1 (6.57 t/h). Growth duration of the tested entries was shorter than the check variety BRRI dhan28 (141 days) except line BR4909-R1-R2 (144 days) Table 21. Therefore, these entries might be selected for further evaluation.

1.22 Regional Yield Trial-2, (Bio-tech. FB), Boro, 2014-'15

Objective: To observe the performance of some Green super Rice lines during Boro season

Methodology

One material was tested at Baradi farm, Kushtia in Boro, 2014-'15. The material was BR6158RWBC2-2-1-1. BRRI dhan58 and BRRI dhan29 were used as standard check. Fourty-six-days old seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 22. Performance of some FB lines, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR6158RWBC2-2-1-1	154.00	116.00	359.33	24.26	7.90
2	BRRI dhan58(ck)	149.00	103.00	333.33	22.00	7.24
3	BRRI dhan29(ck)	154.00	103.13	371.67	21.21	7.88

D/S: 17.12.14 D/T: 02.02.15

Results

The yield of the tested entry BR6158RWBC2-2-1-1 was 7.90 t/ha that was similar to the check variety BRRI dhan29 with similar growth duration but higher yield than the check variety BRRI dhan58 with 5 days early (Table. 22). Therefore, The line BR6158RWBC2-2-1-1 can be selected for further evaluation.

2. CROP SOIL WATER MANAGEMENTPROGRAMME AREA

2.1 Terminal Drought Mitigation Adopting Transplanting Dates in T. Aman, 2014

Introduction:

Drought is a common event in the T.Aman season in Bangladesh. Around 2 million hectares of land in Bangladesh are affected by different level of drought. Now a day both early and terminal drought is experienced in Bangladesh. Common measures applied for drought mitigation are supplemental irrigation, change in cultivation time and use of drought tolerant varieties. This experiment was conducted with a view to find a transplanting period of low risk drought. It means that if any rice variety is transplanted in this transplanting period than the vaiety gets less drought or escape drought during its critical stages (reproductive and ripening stages). To make the success of this study the following objectives were taken;

Objectives:

- To determine effect of drought for different transplanting dates
- To determine drought severity and its probability at different growth stages of T. Aman.

Methodology

A long duration variety (BR11) and a short duration variety (BRRI dhan33) were tested during T. Aman season. There were six treatments with three replications in the experiment and the treatments were transplanting at 10 July (T_1), transplanting at 17 July (T_2), transplanting at 24 July (T_3), transplanting at 31 July (T_4), transplanting at 7 August (T_5) and transplanting at 14 August (T_6).

Thirty-day old rice seedlings were transplanted with 20 cm x 20 cm spacing. Individual plot size was 8 m x 6 m with 60 cm buffer zones. Fertilizer was applied as per BRRI recommendation. The whole amount of P, K, Zn and S fertilizer were applied as basal dose during the final land preparation. Urea was top-dressed in three equal splits. Weeding and spraying were done twice to control weeds and insect pests in each season. Rice yield was assessed taking samples from 10 square meter area of each plot. Harvested paddy was threshed, cleaned and weighed to determine yield. Finally, the yield was adjusted to 14% moisture content to determine yield per hectare. A USWB Class A evaporation pan and a rain gauge were installed near the experimental field to determine rainfall and evaporation during the growing season of rice. Data were recorded at 09:00h

daily to determine seepage &percolation, rainfall and evaporation from the experimental field. The historical rainfall data were collected from the Department of Agricultural Extension, Kushtia. Drought amount (deficit water in soil) was calculated using drought model (developed by Dr. Towfiqul Islam).

Table 23. Drought amount at different growth stages of rice, T. Aman, 2014

Treatment	Vegetative phase (mm)	Reproductive phase (mm)	Ripening phase (mm)	Total (mm)
BRRI dhan33				
10 July (T_1)	7.1	0	18.8	25.9
17 July (T_2)	7.1	0	26.8	33.9
24 July (T_3)	7.1	7.6	35.1	49.9
31 July (T_4)	7.1	7.6	44.1	58.8
07 August (T_5)	0	11.8	44.9	56.7
14 August (T_6)	0	40.8	40.9	81.7
BR11				
10 July (T_1)	7.1	40.8	39.9	87.8
17 July (T_2)	7.1	42.8	49.9	99.8
24 July (T_3)	10.3	39.6	54.9	104.8
31 July (T_4)	14.7	40.1	58.0	112.8
07 August (T_5)	7.6	59.1	57.0	123.7
14 August (T_6)	7.6	64.1	58.0	129.7

Table 24. Yield and yield components for different transplanting dates, T. Aman 2014

Treatment	Growth duration	Plant height (cm)	Panicle/m^2	Filled grains/panicle	1000 grain weight (gm)	Yield (t/ha)
BRRI dhan33						
10 July (T_1)	124	114.67	261	139	25.36	5.27
17 July (T_2)	120	115.67	285	127.33	25.42	5.60
24 July (T_3)	120	111.67	248.3	130.33	23.39	5.40
31 July (T_4)	121	101.67	224	135.33	24.47	4.87
07 Aug (T_5)	119	102.63	262.3	121	23.02	4.51
14 Aug (T_6)	118	102.67	301.6	102.67	24.02	4.07
$LSD_{0.05}$	-	4.73	17.48	18.01	1.2	0.36
CV (%)	-	2.4	3.6	7.9	2.7	4.0
BR11						
10 July (T_1)	154	120.2	265.33	107.2	24.55	4.75
17 July (T_2)	147	116.0	333.3	106.3	24.47	5.96
24 July (T_3)	145	109.7	275.0	102.2	24.13	5.66
31 July (T_4)	143	107.3	304.3	143.5	24.79	5.41
07 Aug (T_5)	142	108.4	302.3	140.4	23.53	4.95
14 Aug (T_6)	139	104.3	296.7	127.4	23.85	4.64
$LSD_{0.05}$	-	5.97	34.7	17.7	0.91	0.32
CV (%)	-	3	6.4	8	2.1	3.4

Results

The annual rainfall amount from 2002 to 2014 was analyzed and is shown in Fig. 1. A downward trend of rainfall indicates rainfall amount is decreasing year after year. More terminal drought may cause due to climate change. In 2014, total annual rainfall was 1432 mm which was slightly higher than average annual rainfall (1388 mm) in this region. Figure 2 represents the monthly rainfall over the years up to 2014. In 2014, rainfall exceeds the average amount only in the month of February, June and August.

Drought amount at different growth stages of rice for different dates of transplanting is shown in Table 1. BRRI dhan33 suffered comparatively less drought than BR11 due to its shorter growth duration. From the drought pattern of the previous year in case of BRRI dhan33 drought in reproductive and ripening phases increased with delay transplanting (fig.3). In 2014, drought in reproductive and ripening phase increased (fig.4) for transplanting after 24 July. When short duration variety transplanted before 24 July it can escape terminal drought.

For long duration variety, drought amount increased with late transplanting. Fig.5 represents terminal drought over transplanting dates for different growth phases in the previous years (2009-13) and Fig.6 drought in 2014. Drought in vegetative phase shows decreasing trends over transplanting dates (Fig. 5), reproductive and ripening phases have rising trends after transplanting on 24 July and ripening phase has almost similar trend. In 2014, vegetative phase shows decreasing trend on delay transplanting. But in reproductive and ripening phases severe drought occurred in case of transplanting after 24 July.

Yield and yield contributing character was shown in table 24. BRRI dhan33 yielded highest (5.6 t/ha) when it was transplanted on July 17 and lowest yield was found 4.07 t/ha in case of transplanting on 14 August. For BR11, the highest yield was found for July 17 transplanting (5.96 t/ha) and lowest yield was observed in case of 14 August (4.64 t/ha). Yield decreased for both short and long duration variety after transplanting on 24 July.

Drought is an unpredictable phenomenon and it reappears after 5-10 years. But we can't forecast the year of occurrence. Short duration variety faced fewer droughts due to its shorter growth duration. But both short and long duration variety faced fewer droughts when they transplanted before 24 July. So transplanting before 24 July would be low risk period of drought and after that it would be high risk period.

Figure 1. Annual Rainfall (2002-2014)

Figure 2. Monthly rainfall pattern

Fig.3: Average drought pattern(2009-13) for BRRI dhan33

Fig. 4: drought pattern in 2014 fo

Fig.5: Average drought pattern(2009-13) for BR11

Fig. 6: drought pattern in 2014 for BR11

2.2. Determination of suitable time for application of supplemental irrigation in T. Aman2014

Objective: Since drought is not a visible phenomenon, so it's beginning of occurrence in the soil (micro level drought) is not visible. But effect of drought is observed after some days of its beginning. Meanwhile crop is hampered and yield is reduced consequently. To determine the beginning of the drought in the soil the status of the perch water table can play an important role. Farmer does not know when drought begins and when supplemental irrigation should be applied. To find out the mean to determine the beginning of drought the following objective was taken

- To determine the relationship between perched water tables depletion during critical stages of rice and grain yield.

Methodology

The experiment was conducted in Takimara, Kushtia Sadar, Kushtia. BRRI dhan49 was used in this experiment during T.Aman 2014 season. There were three treatments with three replications in the experiment and the treatments were:

T_1 = Supplemental irrigation applied when water level reaches at 15 cm below ground surface

T_2= Supplemental irrigation applied when water level reaches at 20 cm below ground surface

T_3= Supplemental irrigation applied when water level reaches at 25 cm below ground surface

BRRI recommended cultural and fertilizer management practices were followed in growing the crop. Thirty-day-old rice seedlings were transplanted after proper land preparation with 20 cm x 20 cm spacing. Individual plot size was 8 m x 7 m, separated by 60 cm buffer zone. Supplemental irrigation was applied according to different treatment (T_1, T_2 and T_3). A USWB Class A evaporation pan and a rain gauge were installed near the experimental field for determining rainfall and evaporation amounts during the growing season of rice. Data were recorded at 08:30h daily to determine seepage & percolation, rainfall and evaporation from the experimental field.

Table. 25. Yield and yield components for different supplemental irrigation depth, T. Aman 2014

Treatment	No. of irrigation applied	Days to irrigate after disappearing standing water	Plant height (cm)	No of Panicle/m^2	Filled grain per panicle	1000 grain wt (gm)	Yield (t/ha)
T_1	8	3	107.1	295	155.1	21.56	5.65
T_2	7	4	108	297	164.4	21.51	5.63
T_3	6	5	109.3	300	156.1	21.76	5.63
$LSD_{(0.05)}$			2.03	9.18	14.65	0.52	0.51
CV (5%)			0.8	1.4	4.1	1.1	3.5

T_1 = Supplemental irrigation applied when water level reaches at 15 cm below ground surface

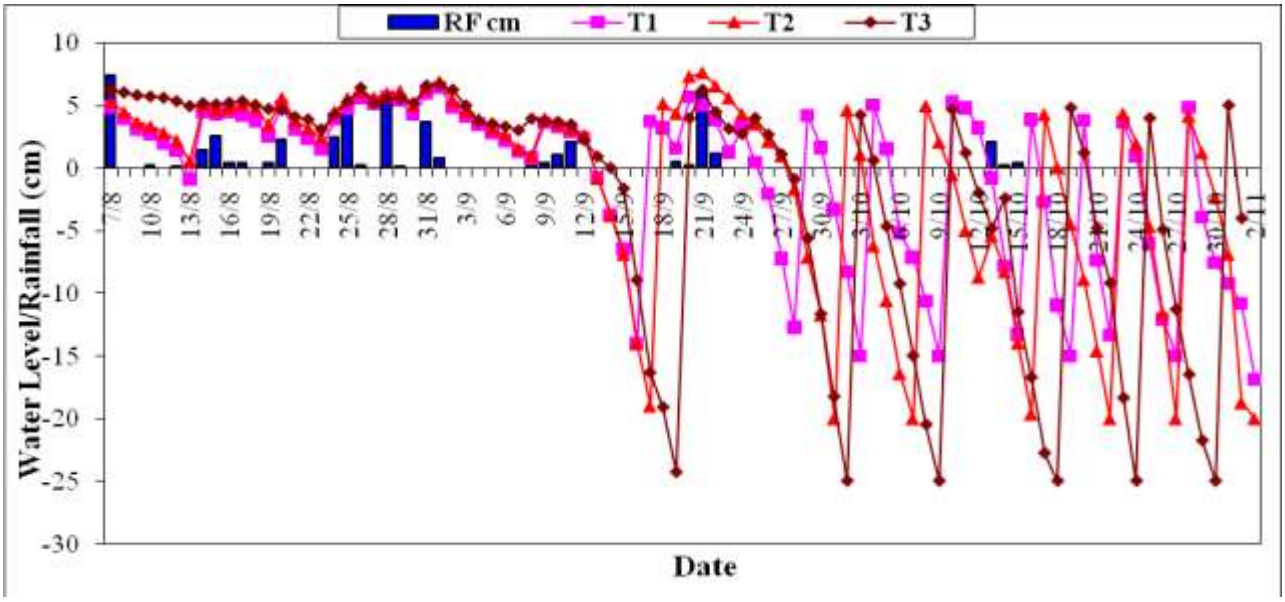
T_2= Supplemental irrigation applied when water level reaches at 20 cm below ground surface

T_3= Supplemental irrigation applied when water level reaches at 25 cm below ground surface

Results

Fig. 7 represents water level fluctuation and rainfall occurrence during the rice growth stages. Water stress and supplemental irrigation was applied according to different treatments. Yield is seriously hampered if crop suffered from water stresses during these periods. In 2014, the rainfall was mostly occurred in the vegetative part of the crop, but it was not uniformly distributed. So, supplemental irrigation was applied in all stages of crop. The number of supplemental irrigation application was eight, seven and six for the treatments T_1, T_2 and T_3. The depth of irrigation water was 5 cm above the ground surface in all irrigation applications. There were no considerable yield differences among the treatments (Table 25). The highest yield was found in T_1 (5.65 t/ha) and the lowest in T_2 (5.63 t/ha).

In terms of yield performances, T_1 performed slightly better than the other two treatments. But yield was insignificantly decreased following irrigation application when water level goes 25 (suitable water depth below ground surface). This is one year experiment and further trial is needed to draw a conclusion



D/S: 29/06/2014 D/T: 27/07/2014

Fig. 7: Rainfall and groundwater level fluctuation over the growing period

2.3 Adoption and Demonstration of Water Saving Technologies at farmer's fields in Boro 2014-15

Objectives:

1. To save irrigation water
2. To reduce irrigation cost, and
3. To increase water productivity

Methodology:

The experiment was conducted at two different locations at Khordo Ailchara, Sadar, Kushtia in farmer's field in Boro, 2014-15. Each experimental field was divided into two plots to perform two different treatments. The treatments were

T_1 = AWD Practices and T_2 = Farmers Management (continuous standing water)

Forty five days' old seedlings of BRRI dhan28 was transplanted with 20 cm × 15 cm spacing. BRRI recommended fertilizer doses were applied. The whole amount of P, K, S and Zn fertilizer were applied as basal dose during land preparation. Urea was top-dressed in three equal splits. Herbicide was applied after 5 days of transplanting. Furthermore weeding and spraying were done to control weed and insect pests.

For the treatment T_1, alternate wetting and drying (AWD) method was performed and for T_2 irrigation was applied as farmers practice i.e. continuous standing water. A 10 cm diameter and 25 cm long PVC perforated pipe was installed at the corner of both the field having 10 cm above the ground surface and perforated 15 cm part was below the ground surface. Continuous water level was monitored in the PVC pipe. In AWD practice irrigation was applied when the water level goes down 15 cm below the ground surface monitored at the pipe. From one week before to one after flowering AWD practice was stopped and 2-3 cm standing water was maintained. Discharge and time required to irrigate each plot was recorded every time. Discharge was measured using a V-notch and verified the same using volumetric method. Rice yield was assessed taking samples from

10 square meter area of each plot. Yield contributing parameters were collected. Finally the yield was adjusted to 14% moisture content to determined yield per hectare.

Table 26: Yield and yield parameters of AWD practice over farmers practices

Treatment	Irrigation nos.	Plot size (m^2)	time of irrigation (min)	water use (m)	% Water saved over FP	% Time saved	No of panicles/m^2	Filled Grains/ panicle	1000 grain wt (gm)	Yield (t/ha)	% yield increase
Field 1											
T_1	17	650	1105	1.06	23.19	23	305	58	22.0	3.2*	6.25
T_2	21	680	1510	1.38			287	55	22.1	3.0*	
Field 2											
T_1	15	610	1015	1.03	20.15	19.3	313	68	22	3.53*	3.6
T_2	20	715	1475	1.29			290	65	22.1	3.4*	

T_1= AWD practice T_2= Farmer's Management Practice

* Yield was found lower than average yield due to a heavy hailstorm on 06.04.2015 over the area

Result:

In both field, AWD practice saved irrigation water and time of irrigation application. T_1 saved 23.19% and 20.15% irrigation water over T_2 in research field 1 and 2 respectively. From table 26, it is noticeable that field 1 and field 2 saved 4 and 5 numbers of irrigation over farmers practice. AWD practice also saved total time of irrigation application as well as fuel or electricity consumption of pump.

Both the field gave similar yield in two methods. But a heavy hailstorm was occurred 06 April, 2015 when the crop was in maturity stages. It seriously damaged the production of rice in the affected area. Highest yield was found for BRRI dhan28 was 3.53 t/ha but its average yield is about 6 t/ha. There were also yield advantages of research management practices over farmer's management practices. In field 1, T_1 gave yield of 3.2 t/ha with 6.25% yield advantages over T_2 (3.0 t/ha). In field 2, yield of T_1 and T_2 were 3.53 t/ha and 3.4 t/ha respectively with yield advantages 3.6%.

3. SOCIO ECONOMICS AND POLICY PROGRAMME AREA

3.1 Stability Analysis of BRRI varieties

Objective: To maintain season, year and location-wise data base on the yield performance of BRRI varieties.

Methodology

An experiment on the yield performance of BRRI varieties was conducted at the Baradi farm of BWDB, Kushtia both in the T. Aman 2013 and in Boro 2014-15 seasons. Twenty-nine BRRI developed rice varieties were taken into consideration in T.Aman, 2014 and 32 BRRI varieties in

Boro, 2014-15. The experiment was designed in RCB with three replications. Twenty-seven-day-old rice seedlings were transplanted at 20 cm x 20 cm spacing in unit plots measuring 5.0 m x 2.0 m in the T. Aman season. In the Boro season unit plot size was 5.4 m x 2.0 m. recommended agronomic practices were followed for crop production and proper crop protection measures were taken depending on the necessity. For estimation of yield, samples from 10 m^2 area of each plot were harvested and grain yield was adjusted to 14% moisture content and were converted to t/ha.

Table 27. Yield and growth durations of some BRRI varieties, T. Aman, 2014

Variety	Growth duration (days)	Standard Growth duration (days)	Yield (t/ha)	Standard Yield (t/ha)	Ranks
BR3	133	145	4.60	4.0	18
BR4	144	145	4.91	5.0	14
BR5	151	150	4.08	3.0	23
BR10	145	150	4.75	5.5	17
BR11	141	145	5.81	5.5	4
BR22	160	150	6.17	5.0	1
BR23	159	150	5.19	5.5	11
BR25	140	135	5.19	4.5	11
BRRI dhan30	145	145	5.14	5.0	13
BRRI dhan31	145	140	5.51	5.0	7
BRRI dhan32	135	130	5.25	5.0	10
BRRI dhan33	115	118	5.34	4.5	9
BRRI dhan34	144	135	4.41	3.5	20

BRRI dhan37	152	140	4.29	3.5	21
BRRI dhan38	149	140	3.81	3.5	25
BRRI dhan39	119	122	4.79	4.5	16
BRRI dhan40	144	145	5.17	4.5	12
BRRI dhan41	153	148	5.17	4.5	12
BRRI dhan44	142	145	5.49	5.5	8
BRRI dhan46	153	150	6.14	4.7	2
BRRI dhan49	140	135	5.51	5.5	7
BRRI dhan51	145	142	5.68	4.5	5
BRRI dhan52	141	145	4.84	5.0	15
BRRI dhan53	134	125	5.57	4.5	6
BRRI dhan54	141	135	6.05	4.5	3
BRRI dhan56	122	110	4.45	4.5	19
BRRI dhan57	116	105	4.01	4.5	24
BRRI dhan62	112	100	2.57	4.5	26
BRRI hybrid dhan4	119	118	4.09	6.5	22

D/S: 30/06/2014 D/T: 06/08/14

In BRRI dhan62 Plot, Rat damaged about 40% at early flowering.

Table 28. Yield and growth durations of some BRRI varieties, Boro, 2014-15

Variety	Growth duration (days)	Standard Growth duration (days)	Yield (t/ha)	Standard Yield (t/ha)	Ranks
BR1	148	150	5.62	5.5	24
BR2	151	160	6.17	5.0	18
BR3	165	170	7.25	6.5	5
BR6	142	140	7.06	4.5	6
BR7	154	155	6.31	4.5	15
BR8	155	160	7.90	6.0	1
BR9	152	155	7.71	6.0	2
BR12	163	170	5.43	5.5	25

BR14	152	160	5.88	6.0	22
BR15	158	165	6.69	5.5	9
BR16	156	165	6.48	6.0	12
BR17	150	155	4.90	6.0	26
BR18	158	170	6.23	6.0	17
BR19	160	170	6.37	6.0	14
BR26	148	140	6.51	3.5	11
BRRIdhan27	150	122	5.86	4.5	23
BRRIdhan28	143	140	6.31	6.0	15
BRRIdhan29	157	160	7.34	7.5	3
BRRIdhan35	156	155	6.39	5.0	13
BRRIdhan36	144	140	6.12	5.0	19
BRRIdhan45	141	145	6.37	6.5	14
BRRIdhan47	150	152	6.03	6.0	20
BRRIdhan50	150	155	6.30	6.0	16
BRRIdhan55	142	145	7.27	7.0	4
BRRIdhan58	149	155	6.80	7.0	8
BRRIdhan59	145	153	6.68	7.1	10
BRRIdhan60	141	151	5.92	7.3	21
BRRIdhan61	-	150	0.00	6.3	-
BRRIdhan64	150	152	6.03	6.5	20
BRRI Hybrid dhan1	-	155	0.00	8.5	-
BRRI Hybrid dhan2	141	145	7.27	8.0	4
BRRI Hybrid dhan3	144	145	6.96	9.0	7

D/S: 17/12/2014 D/T: 03/02/2015

Results

Yields and growth duration of the test-varieties of the T. Aman season have been presented in the Table 27. Among the varieties highest yield was obtained with the BR22 (6.17 t/ha) and the lowest with the BRRI dhan62 (2.57 t/ha) because of rat damaged. Of the 29 varieties, 20 were found to give higher yields than the standard yield determined for them. The other varieties yielded similar

or lower than the standard yield. Highest increase in yield was obtained with BRRIdhan54 (increase by 1.55 t/ha), where as the highest reduction was found in case of BRRRI Hybrid dhan4 (2.35 t/ha reduction). Growth duration of some of the test varieties decreased (up to 12 days as in the case of BR3), whereas in some verities it increased (up to 12 days as in the case of BRRI dhan37,56 & 62). Lodging at different magnitudes (25%-50%) was observed in case of five test varieties viz., BR5, BR25, BRRI dhan32, BRRI dhan34, BRRI dhan37 and BRRI dhan38.

Yields and growth duration of the test-varieties of the Boro season have been presented in the Table 28. Among the varieties highest yield was obtained with the BR8 (7.9 t/ha) and the lowest with the BR17 (4.9 t/ha). Of the 32 varieties, nineteen were found to give higher yields than the standard yield determined for them. The other varieties yielded lower than the standard yield. Highest increase in yield was obtained with BR26 (increase by 3.01 t/ha), where as the highest reduction was found in case of BRRI Hybrid dhan3 (2.04 t/ha reduction). Growth duration of some of the test varieties decreased (up to 12 days as in the case of BR18), where as in some varieties it increased (up to 28 days as in the case of BRRI dhan27). Lodging tendency was not found in the BRRI varieties during Boro season.

4. TECHNOLOGY TRANSFER PROGRAMME AREA

4.1 Farmers' training

One-day Farmers' training on 'Modern rice production technology' was conducted to train farmers on modern rice cultivation and to encourage them to adopt modern rice varieties and relevant technologies.

In total, 22 (20 training was funded by Enhancing Quality Seed Supply Project (EQSSP) and rest 2 was funded by Harvest Plus Project) farmers' training was conducted with the cooperation of the Department of Agricultural Extension (DAE) at different upazillas of Kushtia, Magura, Jhenaidah, Meherpur and Rajbari district. About 650 farmers were participated in the training program. Modern rice varieties and relevant technologies were disseminated to the farmers.

4.2 Field day and Agricultural fair

Field day is a very useful tool for generating awareness and interests among the farmers and concerned extension personnel about the modern rice production technologies. These provide wide publicity and familiarity of BRRI, its technologies and its contribution in national economy. Twenty two field day was conducted at different upazillas of Kushtia, Jhenaidah and Meherpur districts which was funded by Enhancing Quality Seed Supply Project (EQSSP) and Harvest Plus Project in Aman and Boro season on BRRI developed varieties in which a total of about 1500 farmers were participated.

We participated in an 'Agricultural Fair' arranged by DAE, Kushtia district in which BRRI developed technologies were demonstrated. This program generated much enthusiasm about modern rice production technologies among the visitors.

BRRI REGIONAL STATION

SONAGAZI, FENI

SUMMARY

During the reporting period, 81 breeding lines were evaluated in replicated trials of which 21 entries appeared promising for further evaluation. In proposed variety trial BR7528-2R-19-HR10 and BR78761-B-SATB1-28-3-24 yielded higher against their respective checks and have been released as T. Aman varieties named BRRI dhan72 and BRRI dhan73. For Boro rice, N is the most limiting element and STB based fertilizer dose along with 25% higher NPK was most profitable fertilizer package in saline charland ecosystem. Cultivation of *khesari* as a relay crop in T. Aman season suppressed the soil salinity than fallow land in Sonagazi areas. In Sonagazi regions, BR11 and BRRI dhan29 performed better in T. Aman and Boro seasons respectively. During the reporting period, the station produced 43 ton seed of recently developed BRRI varieties and also arranged 20 farmers' training and several farmers' field days.

PERSONNEL

Name and designation
Jatish Chandra Biswas, PhD Chief Scientific Officer (Current Charge) and Head
Md. Rafiqul Islam, PhD Chief Scientific Officer (Current Charge) and Head
Md. Anwarul Haque, PhD Principal Scientific Officer
Md Mamunur Rashid Scientific Officer
Md Monsur Habib, Dip-in-Ag, Farm Manager

Regional yield trial (RYT) during Aus 2014-15

Seventeen breeding lines were evaluated in two different RYTs at BRRI RS farm, Sonagazi against standard checks of BR26 and BRRI dhan48. Advanced line IR71866-3R-3-1 performed better for RYT in partially irrigated Aus against check of BR26 and BRRI dhan48 while entries BRRI dhan29-SC3-28-16-10-8-HR1, parija and Wk1 yielded higher for RYT somaclone Aus than their respective check of BRRI dhan48 and were selected for further trial.

RYT during T. Aman 2014-15

Eighteen breeding lines were evaluated in three different RYTs at BRRI RS farm, Sonagazi against standard checks of BRRI dhan32, BRRI dhan39, BRRI dhan49 and BRRI dhan56. Among these, three breeding lines gave higher yield for RYT-GSR, two entries gave higher yield for RYT-RLR and four entries showed higher yield for RYT-drought than their respective checks and were selected for further evaluation.

RYT during Boro 2014-15

For Plant Breeding Division, 41 breeding lines were evaluated in five different RYTs at BRRI RS farm, Sonagazi along with standard checks BRRI dhan28, BRRI dhan29, BRRI dhan45, BRRI dhan50, BRRI dhan60 and BRRI dhan63. Among them, one entry gave higher yield for RYT-PQR, three entries gave higher yield for RYT-GSR and also four entries yielded higher for RYT-FB than their respective checks and were selected for further evaluation. In case of Biotechnology Division, five breeding lines were evaluated in two different RYTs at BRRI RS farm Sonagazi along with standard checks of BRRI dhan28, BRRI dhan29 and BRRI dhan58. Of them, none of the breeding lines performed better over the checks.

PVT (Salt tolerance)

For propsed variety trial (PVT) two salt tolerant genotypes as new variety were evaluated in two farmer's field of Cox's Bazar sadar against standard check of BRRI dhan53. Both the salt tolerant lines of BR78761-B-SATB1-28-3-24 and BR78761-B-SATB1-28-3-26 gave higher yield than the standard check with similar growth duration and were selected for release as salt tolerant T. Aman varieties.

PVT (high zinc)

One high zinc genotype for new variety was evaluated in farmer's field of Sonagazi, Feni along with check of BRRI dhan39. High zinc line of BR7528-2R-19-HR10 gave the higher yield than the standard check with six days higher growth duration and was selected for release as a high zinc T. Aman variety.

PVT (high zinc)

Two proposed genotypes for new variety were evaluated in farmer's field of Sonagazi, Feni along with check of BRRI dhan28 and BRRI dhan64. Proposed line of BR7833-11-1-1-2-1-2B5 gave the higher yield than the standard check with three days shorter growth duration and was selected for release as favourable Boro varieties.

Long-term missing elements trial

The experiment was initiated on a permanent layout at the BRRI farm, Sonagazi during Boro 2014-15 season viewing missing element approach using seven treatments in RCB design with three replications. NPKSZn @ 140-20-30-15-4 was used in this experiment. Complete fertilizer treatment (NPKSZn) gave significantly higher grain yield than the all missing along with N missing plot (Table 1). However, P, K, S and Zn missing plot gave the statistically similar grain yield with NPKSZn treatment. It is concluded that, in Boro rice N is the most limiting nutrient element for saline charland ecosystem.

Table 1. Effect of long-term missing on the grain yield of Boro rice (BRRI dhan61) at the BRRI RS farm, Sonagazi in 2014-15.

Treatment	Grain yield (t/ha)
All missing	1.40
NPKSZn	5.97
- N	1.80
- P	5.40
- K	5.47
- S	5.53
- Zn	5.36
$LSD_{0.05}$ CV (%)	0.62 7.30

Evaluation of soil management packages for rice production in char land ecosystem

The experiment was initiated at the BRRI RS farm, Sonagazi during Boro 2014-15 season viewing to identify the proper soil management packages through organic and inorganic amendments in char land ecosystem. A total of six different fertilizer combinations were imposed in this experiment. Soil test based fertilizer (NPKSZn @ 140-20-30-15-4) was used in this experiment. The STB based fertilizer dose along with 25% higher NPK (T_3) gave statistically higher grain yield than that of control treatment along with local farmers' practice (Table 2). However, T_2, T_4 and T_5 treatments obtained the statistically similar yield with T_3 treatment.

Table 1. Effect of different fertilizer combinations on the grain yield of Boro rice (BRRI dhan61) at the BRRI RS farm, Sonagazi in 2014-15.

Treatments	Grain yield (t/ha)
T_1 = Control	1.76
T_2 = Soil test based fertilizer (NPKSZn @ 140-20-30-15-4 kg/ha)	4.70
T_3= T_1 + 25% over NPK	4.74
T_4 = T_1 + 25% over NPKSZn	4.71
T_5 = T_1 + Rice straw @ 3.0 t/ha (oven dry basis)	4.56
T_6 = Local farmers practice (NPK @ 120-10-30 kg/ha)	3.49
$LSD_{0.05}$ CV (%)	0.49 6.90

Soil salinity scenario of BRRI RS, Sonagazi farm soil

During the dry period, outside the coast embankment of the Bangladesh Water Development Board (BWDB), most of the char land remains fallow due to soil salinity stress and drought. But some farmers grow *kheshari* in their fallow land after harvesting Aman rice. From a study at Sonagazi farm soil, it was found that the salinity level (1:5 soil water ratios) of khesari covered land was

lower than fallow land. Soil salinity of fallow land remains high up to March after first shower in April it declined sharply. It may be due to increase of soil moisture content.

Evaluation of different T. Aman varieties at direct wet seeded condition

BRRI RS, Sonagazi cultivated about 50 acres of land under direct wet seeded condition during T. Aman 2014 season to observe the yield performance of rice under wet seeded conditions. BRRI dhan32, BRRI dhan40, BRRI dhan41, BRRI dhan44, BRRI dhan46, BRRI dhan49 and BR23 were used as test varieties. Sprouted seeds of respective verities were broadcast uniformly on well-prepared puddle field on 1st week of July to last week of August. Seed rate was 50 kg/ha. In wet seeded condition, BRRI dhan46 produced the highest yield of 3.70 t/ha followed by BRRI dhan49 (3.3 t/ha) while BRRI dhan32 gave the lowest yield of 2.20 t/ha (Fig. 1). The yield difference among the varieties was 0.24 t/ha.

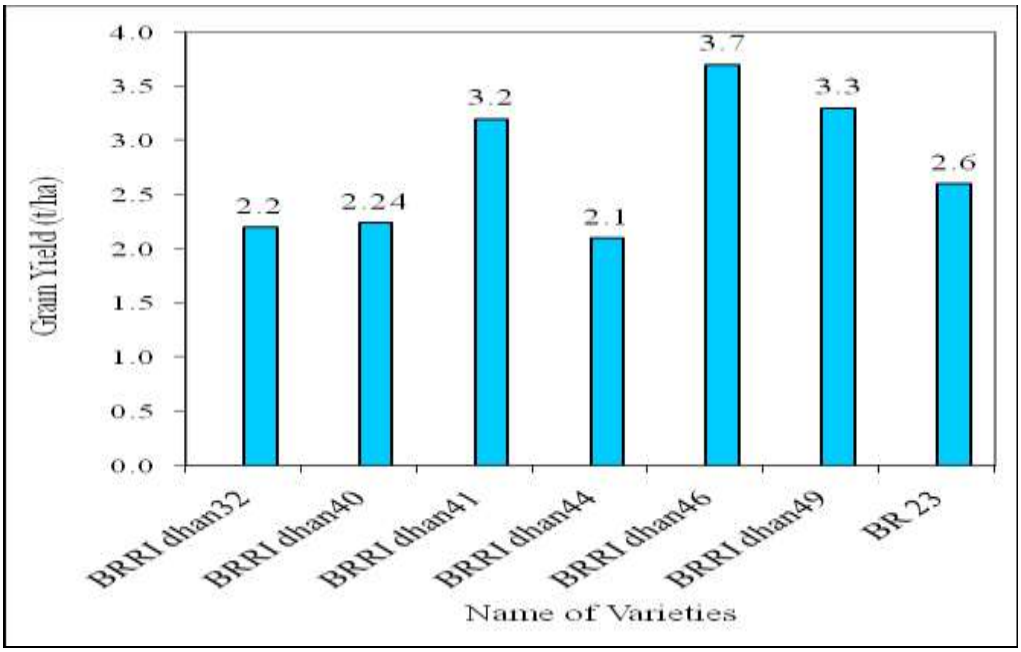


Fig. 1. Grain yield (t/ha) of different varieties at direct wet seeded condition during T. Aman season.

Stability Analysis of BRRI Released Variety

Different BRRI released varieties were grown in T. Aman and Boro seasons at BRRI Sonagazi farm to find out the suitable rice cultivars in this region. Three replications with RCB design were followed. Crop management practices were adopted as per BRRI recommendation. In T. Aman season, BR11 gave the higher while in Boro season BRRI dhan29 gave the highest yield in Sonagazi Station.

Demonstration of BRRI released Boro varieties

Field demonstrations were carried out at different locations of Sonagazi region during Boro 2014-15 season. BRRI dhan28, BRRI dhan58 and BRRI dhan64 were demonstrated in 35 locations of

Sonagazi region. The farmers of Sonagazi area are very much interested about these Boro varieties. The DAE personnel can take initiative for rapid dissemination of the varieties.

Farmers' Training

Farmers' training is an important tool to train up farmers on updated information for rice cultivation. Sonagazi Regional Station arranged twenty training programs at different Upazillas of Feni district in collaboration with DAE and BADC of which 600 farmers were trained. Most of the farmers were very much impressed by taking this rice production training.

Breeder and TLS Seed Production

Nucleus seed stock was collected from GRS Division of BRRI. Single seedling was transplanted per hill. For breeder seed production, all official formalities with SCA and BRRI authority were performed through proper channel. Breeder seed was produced in T. Aman and Boro seasons but TLS seed was produced in Aus and T. Aman and Boro seasons. Considering three seasons (Aus, T. Aman and Boro), breeder and TLS seed were produced 11.99 and 31.06 tons, respectively.

BRRI ANNUAL RESEARCH REVIEW WORKSHOP 2014-15




XXI: REGIONAL STATION, KUSHTIA

BANGLADESH RICE RESEARCH INSTITUTE
GAZIPUR 1701

Bangladesh Rice Research Institute
Regional Station, Kushtia
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1. Md. Mosaddeque Hossain, MS	Principal Scientific Officer & Head	365
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3. Md. Mahbubur Rahman Dewan, MS	Senior Scientific Officer	115
4. Md. Habibur Rahman Mukul, MS	Scientific Officer	166
5. Mrst. Afroze Zahan	Scientific Officer	18
6. Md. Hannan Ali, MS	Scientific Officer	135
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INTRODUCTION

Bangladesh Rice Research Institute (BRRI), Regional Station, Kushtia represents Agro-ecological Zone (AEZ) 11a, which is the low rainfall area of the country. The soil of Kushtia is light and sandy loam to loam in high and medium lands and silty loam to clay loam in medium low to low lands. Rice based double and triple cropped lands dominate the area. The station does not have its own farm area yet. The experiments are conducted in farmers' fields and at the experimental farm of the Irrigation Extension Training Centre (IETC) of Bangladesh Water Development Board (BWDB), Kushtia widely known as Baradi farm. During the reporting year several experiments were conducted under Varietal Development, Crop Soil Water Management, Pest Management, Socio-Economic and Technology Transfer Programme areas. Research findings of these studies are presented under different programme areas.

SCIENTIFIC INFORMATION

1. VARIETAL DEVELOPMENT PROGRAMME AREA

1.1 Regional Yield Trial (RYT), Upland Rice (Aus), 2014

Objective: To observe the performance of some BRRI developed lines under Upland Rice ecosystem

Methodology

Seven lines namely, BR7698-2B-1-9-1, BR7698-2B-1-9-2, BR7699-2B-3-13-3, BR7992-2B-5-2, BR7992-2B-5-4, BR7383-2B-23 and BR7587-2B-3 were tested at Boria, Kushtia as Upland Rice (Aus) in 2014. BRRI dhan43 was used as the standard checks. The unit plot size was 5 m X 10 m with spacing of 25 cm between the rows. Dry direct seeding was done in rows. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Results

The yield of the tested lines ranged from 1.6 t to 2.5 t/ha. The lines BR7698-2B-1-9-1, BR7698-2B-1-9-2 and BR7383-2B-23 gave highest yield (2.5t/ha) followed by BR7992-2B-5-4, BR7587-2B-3. One line namely, BR7699-2B-3-13-3 gave the lowest yield (1.6 t/ha) among the tested lines. Growth duration of the lines was more or less similar to the standard check BRRI dhan43 (Table 1). Plant height of the tested lines was 1.20-34.0 cm shorter than the check (114.8 cm).

Table 1. Performance of some RYT lines, Upland Rice (Aus), 2014

Designation	Plant height (cm)	Growth duration (days)*	1000 grain wt (gm)	Yield (t/ha)
BR7698-2B-1-9-1	84.8	110	25.3	2.5
BR7698-2B-1-9-2	81.8	108	24.1	2.5
BR7699-2B-3-13-3	104.3	112	20.5	1.6
BR7992-2B-5-2	113.6	108	29.9	2.1
BR7992-2B-5-4	99.6	114	25.3	2.3
BR7383-2B-23	91.2	108	23.7	2.5
BR7587-2B-3	112.3	110	21.9	2.3
BRRI dhan43 (Ck)	114.8	108	21.2	2.1
LSD (0.5)				

D/S: 20.04.2014

1.2 Regional Yield Trial (RYT), T. Aus, 2014

Objective: To observe the performance of some BRRI developed lines under T. Aus ecosystem

Methodology

Seven materials were tested at Boria, Kushtia in T. Aus season, 2014. The materials were BR8113-21-3-1, BR7922-45-2-2-1, IR71866-3R-3-1, BR7708-62-1-1, BR7718-56-3-1, BR7716-49-1-3 and BR7718-55-1-3. BR26 and BRRI dhan48 were used as standard checks. Thirty days old seedlings were planted in 5.4 m x 1.6 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 2. Performance of some BRRI developed RYT lines, T. Aus, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	1000 grain wt (gm)	Yield (t/ha)
1	BR8113-21-3-1	118	92.6	22.0	4.2
2	BR7922-45-2-2-1	110	103.1	23.3	4.5
3	IR71866-3R-3-1	101	93.0	23.5	4.3
4	BR7708-62-1-1	112	95.5	22.1	5.4
5	BR7718-56-3-1	109	90.2	24.1	4.8
6	BR7716-49-1-3	105	93.0	20.8	5.4
7	BR BR7716-49-1-37718-55-1-3	110	93.1	21.4	5.2
8	BR26 (Ck)	112	96.6	24.2	4.5
9	BRRI dhan48 (Ck) LSD (0.5)	108	88.9	22.3	4.3

D/S: 28.04.14 D/ T: 28.05.14

Results

The yield of the tested lines ranged from 4.2 to 5.4 t/ha. Highest yield 5.4 t/ha was observed in the lines BR7708-62-1-1 and BR7716-49-1-3 which was 1.10 t/ha higher than the check and lowest yield 4.2 t/ha was found from the line BR8113-21-3-1. The range of the growth duration was 105-118 days where the growth duration of the check varieties was 112 days (BR26) and 108 days (BRRI dhan48) (Table 2).

1.3 Regional Yield Trial (RYT), T. Aus, 2014

Objective: To observe the performance of some BRRI developed lines under T. Aus ecosystem

Methodology

Seven materials were tested at Boria, Kushtia in T. Aus season, 2014. The materials were BRRI dhan29-SC3-28-16-10-8-HR1, BRRI dhan29-SC3-28-16-10-6-HR3, BRRI dhan29-SC3-28-16-10-4-HR5, BRRI dhan29-SC3-28-16-10-6-HR6, Parija, WK1 and Nerica10. BRRI dhan48 was used as standard check. Thirty one days old seedlings were planted in 5.4 m x 1.6 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 3. Performance of some BRRI developed RYT lines, T. Aus, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	1000 grain wt (gm)	Yield (t/ha)
1	BRRI dhan29-SC3-28-16-10-8-HR1	107	88.2	20.0	4.47
2	BRRI dhan29-SC3-28-16-10-6-HR3	104	106.4	19.8	4.90
3	BRRI dhan29-SC3-28-16-10-4-HR5	103	106.4	19.5	5.10
4	BRRI dhan29-SC3-28-16-10-6-HR6	104	105.0	19.2	4.60
5	Parija	109	96.0	23.4	5.30
6	WK1	98	81.9	19.7	4.10
7	Nerica10				V. Late
8	BRRI dhan48 (Ck)	110	98.3	23.7	4.80
	LSD (0.5)				

D/S: 28.04.14 D/ T: 29.05.14

Results

The yield of the tested lines ranged from 4 .10 to 5.30 t/ha. Highest (5.30 t/ha) and lowest (4.10 t/ha) yield was observed in the line Parija and WK1 respectively. The range of the growth duration was 98-109 days where the growth duration of the check varieties was 110 days (BRRI dhan48) (Table 3).

1.4 Proposed Variety Trial (PVT), Drought, T. Aman, 2014

Objective: To observe the yield and agronomic performance of some lines under proposed variety trial in drought condition

Methodology

The proposed variety trial was performed with IR83377-B-B-93-3, IR82589-B-B-84-3 and BRRI dhan56 (Std. check) at Boria, Kushtia in T. Aman season, 2014. Thirty days old rice seedlings were planted in 6 m x 5.0 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 4. Performance of some Proposed Variety Trial (PVT) lines, Drought, T. Aman, 2014

Sl. no	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)

1	IR83377-B-B-93-3	120	104.6	256		6.29
2	IR82589-B-B-84-3	120	120.6	232		5.97
3	BRRI dhan56(Ck)	119	110.3	222		4.69

D/S: 09.07.14 D/T: 08.08.14

Results

Yield of the line IR83377-B-B-93-3 (6.29 t/ha) and IR82589-B-B-84-3 (5.97 t/ha) were higher than the check variety BRRI dhan56 (4.69 t/ha). Growth duration of the both lines was similar to the check variety BRRI dhan56 (Table 4). Therefore, the material (IR83377-B-B-93-3 and IR82589-B-B-84-3) can be proposed as a variety in drought prone situation.

1.5 Proposed Variety Trial (PVT), RLR, T. Aman, 2014

Objective: To observe the yield and agronomic performance of some lines under proposed variety trial in rainfed low land ecosystem

Methodology

The proposed variety trial was performed with BR7472-16-2-1-2-3, BR7622-5-1-1-1and BRRI dhan39, BRRI dhan49 (Std. check) at Boria, Kushtia in T. Aman season, 2014. Thirty one days old rice seedlings were planted in 6 m x 5.0 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 5. Performance of some Proposed Variety Trial (PVT) lines, RLR, T. Aman, 2014

Sl. No.	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7472-16-2-1-2-3	129	117.7	213		6.03
2	BR7622-5-1-1-1	127	116.9	212		5.42
3	BRRI dhan39(Ck)	122	104.3	231		5.69
4	BRRI dhan49(Ck)	130	90.7	262		5.23

D/S: 09.07.14 D/T: 09.08.14

Results

Yield (6.03 t/ha) of the proposed line BR7472-16-2-1-2-3 was higher than the both check variety BRRI dhan39 and BRRI dhan49 (5.23 &5.69 t/ha). Growth duration of the proposed line BR7472-16-2-1-2-3 was similar to that of the check variety BRRI dhan49 but 8 days longer than check variety BRRI dhan39. On the other hand, grain yield (5.42 t/ha) of another proposed line BR7622-5-1-1-1 was higher than the check variety BRRI dhan49 (5.23 t/ha) but lower than the check BRRI dhan39 (5.69 t/ha). Growth duration of the proposed line BR7622-5-1-1-1 was 3 days shorter than the check variety BRRI dhan49 but 5 days longer than check variety BRRI dhan39 (Table 5). Therefore, the material (BR7472-16-2-1-2-3) can be proposed as a variety.

1.6 Proposed Variety Trial (PVT), Premium Quality Rice (PQR), T. Aman, 2014

Objective: To observe the yield and agronomic performance of some green super rice lines under proposed variety trial

Methodology

The line BR7357-11-2-4-1-1 with BRRI dhan37 as check was tested to observe the yield and some agronomic performance at Boria, Kushtia in T. Aman season, 2014. Thirty one days old rice seedlings were planted in 6 m x 5.0 m unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 6. Performance of some Proposed Variety Trial (PVT) lines, PQR, T. Aman, 2014

Sl. No.	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7357-11-2-4-1-1	129	121.1	254		4.99
2	BRRI dhan37(Ck)	147	126.0	234		3.26

D/S: 09.07.14 D/T: 09.08.14

Results

The proposed material BR7357-11-2-4-1-1 gave 1.63 t/ha higher grain yield with 18 days shorter growth duration than the check variety BRRI dhan37 (Table 6). Number of panicles/m^2 (254) of the proposed material was higher than the check variety BRRI dhan37 (234) and this character might be contributed to the yield. Considering the above yield and yield contributing characters the material (BR7357-11-2-4-1-1) can be proposed as a variety.

1.7 Proposed Variety Trial (PVT), Micro Nutrient (MN), T. Aman, 2014

Objective: To observe the yield and agronomic performance of some green super rice lines under proposed variety trial

Methodology

The line BR7528-2R-19-HR10 with BRRI dhan39 as check was tested to observe the yield and some agronomic performance at Boria, Kushtia in T. Aman season, 2014. Thirty one days old rice seedlings were planted in 5 m x 5.0 m unit plots with 20 cm x 20 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 7. Performance of some Proposed Variety Trial (PVT) lines, MN, T. Aman, 2014

Sl. No.	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7528-2R-19-HR10	130	105.7	222		5.13
2	BRRI dhan39 (Ck)	125	95.4	230		5.27

D/S: 09.07.14 D/T: 09.08.14

Results

Yield (5.13 t/ha) and growth duration (130 days) of the proposed material BR7528-2R-19-HR10 was poorer to the check variety BRRI dhan39 (Table 7). Number of panicles/m^2 (222) of the

proposed material was lower than the check variety BRRI dhan39 (230) and this character might be contributed to the yield. Considering the above yield and yield contributing characters the proposed line might be considered for further evaluation.

1.8 Regional Yield Trial (RYT), RLR-1, T. Aman, 2014

Objective: To observed the performance of some rainfed low land rice lines under T. Aman ecosystem

Methodology

Three entries were tested at Boria, Kushtia in T. Aman, 2014. The materials were IR70213-10-CPA 4-2-2-2, B 10533 F-KN-12-2 and BR8033-2-2-1-2. BRRI dhan32 and BRRI dhan49 was used as standard checks. Thirty four days old rice seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 8. Performance of some Rainfed Low Land Rice (RLR) lines, T. Aman, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	IR70213-10-CPA 4-2-2-2	125	107.2	265	29.5	5.78
2	B 10533 F-KN-12-2	126	114.6	285	23.03	5.26
3	BR8033-2-2-1-2	133	97.2	319	18.47	5.43
4	BRRI dhan32 (Ck)	130	116.9	271	20.47	6.28
5	BRRI dhan49 (Ck)	135	99.5	323	19.37	5.56

D/S: 14.07.14 D/T: 17.08.14

Results

The yield of the tested lines ranged from 5.26 to 5.78 t/ha. IR70213-10-CPA 4-2-2-2, B 10533 F-KN-12-2 and BR8033-2-2-1-2 gave similar yield with the check varieties BRRI dhan49 (5.56 t/ha) but lower than the check BRRI dhan32 (6.28 t/ha). Among the tested line IR70213-10-CPA 4-2-2-2 gave the higher grain yield with shorter growth duration. Growth duration (125 days) of the line IR70213-10-CPA 4-2-2-2 was 5-10 days earlier than the standard check BRRI dhan32 and BRRI dhan49 (130 & 135 days, respectively) and 1000 grain wt (29.5 gm) was so high to the both check variety BRRI dhan49 and BRRI dhan49 (20.47 & 19.37 gm) (Table 8).

1.9 Regional Yield Trial (RYT), RLR-2, T. Aman, 2014

Objective: To observed the performance of some rainfed low land rice lines under T. Aman ecosystem

Methodology

Six entries were tested at Boria, Kushtia in T. Aman, 2014. The materials were WAS122-IDSA 14-WAS B-FKR 1(NERICA-L-8), WAS122-IDSA 1-WAS -2-B-1-TGR 132 (NERICA-L-16), WAS 161-B-6-B-1(NERICA-L-36) , WSA 161-B-4-B-1-TGR 51 (NERICA-L-32), WAS 191-4-10 (NERICA-L-54) and NERICA Mutant. BRRI dhan56 and BRRI dhan49 was used as standard checks. Twenty five days old rice seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm

x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 9. Performance of some Rainfed Low Land Rice (RLR) lines, T. Aman, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	WAS122-IDSA 14-WAS B-FKR 1. (NERICA-L-8)	122	102.7	341	26.37	5.68
2	WAS122-IDSA 1-WAS -2-B-1-TGR 132 (NERICA-L-16)	125	107.8	279	27.20	5.62
3	WAS 161-B-6-B-1(NERICA-L-36)	124	102.1	352	25.43	6.59
4	WSA 161-B-4-B-1-TGR 51 (NERICA-L-32)	123	101.1	323	26.40	5.33
5	WAS 191-4-10 (NERICA-L-54)	123	95.2	291	24.40	4.71
6	NERICA Mutant	114	104.7	244	24.70	4.44
7	BRRI dhan56 (Ck)	115	115.3	265	23.27	5.43
8	BRRI dhan49 (Ck)	132	94.3	262	25.60	5.49

D/S: 14.07.14 D/T: 09.08.14

Results

The yield of the tested lines ranged from 4.44 to 6.59 t/ha. WAS122-IDSA 14-WAS B-FKR 1. (NERICA-L-8), WAS122-IDSA 1-WAS -2-B-1-TGR 132 (NERICA-L-16) and WSA 161-B-4-B-1-TGR 51 (NERICA-L-32) gave similar yield to both check varieties BRRI dhan56 (5.43 t/ha) and BRRI dhan49 (5.49 t/ha) but more than 1.0 t/ha higher yield found from line WAS 161-B-6-B-1(NERICA-L-36). Growth duration of the lines WAS 161-B-6-B-1(NERICA-L-36) was 7 days earlier than the standard check BRRI dhan49 (132 days) but 9 days longer than the check BRRI dhan56 (115 days). Plant height of these two lines was intermittent than the both standard checks and lodging tendency was not occurred. 1000 grain wt was similar to the both check variety BRRI dhan56 and BRRI dhan49 (23.27 & 25.60 gm) (Table 9).

1.10 Regional Yield Trial (RYT), PQR, T. Aman, 2014

Objective: To observe the performance of some BRRI developed premium quality materials under T. Aman ecosystem

Methodology

Eight materials were tested at Baradi, Kushtia in T. Aman season, 2014. The materials were BR8226-8-5-2-2, BR8226-11-4-4-3, BR8226-11-4-6-2, BR8294-1-3-2-2, BR8226-13-1-2, BR8226-17-1-2, BR8227-11-6-2-1 and BR8515-23-6-3. BRRI dhan34 and BRRI dhan37 were used as standard checks. Twenty six days old seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 10. Performance of some Premium Quality Rice (PQR) T. Aman, 2014

Sl. No.	Designation	Growth duration (day)	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR8226-8-5-2-2	138	101.4	353	36.63	5.17
2	BR8226-11-4-4-3	143	88.7	329	18.63	4.63
3	BR8226-11-4-6-2	139	94.2	305	16.37	4.31
4	BR8294-1-3-2-2	119	111.1	220	18.33	4.33
5	BR8226-13-1-2	132	109.1	306	16.37	4.84
6	BR8226-17-1-2	135	105.1	289	19.50	4.74
7	BR8227-11-6-2-1	136	110.8	236	22.23	5.62
8	BR8515-23-6-3	131	110.1	264	16.33	2.76
9	BRRI dhan34(Ck)	132	133.8	251	10.30	3.77
10	BRRI dhan37(Ck)	137	134.4	263	14.13	3.61

D/S: 17.07.14 D/T: 13.08.14

Results

The yield of the tested lines ranged from 2.76 to 5.62 t/ha. Most of the lines gave higher grain yield than the both check varieties (BRRI dhan34 and BRRI dhan37) except line BR8515-23-6-3. Highest yield was observed in the line BR8227-11-6-2-1 (5.62 t/h) and it was about 1.85-2.01 t/ha higher yield than the standard check BRRI dhan34 (3.77 t/ha) and BRRI dhan37 (3.61 t/ha) fallowed by line BR8226-8-5-2-2 (5.17 t/ha) and BR8226-13-1-2 (4.84 t/ha). Growth duration of the lines BR8227-11-6-2-1 & BR8226-8-5-2-2 were similar with the check variety BRRI dhan37 but longer than the check BRRI dhan34 and line BR8226-13-1-2 similar with the check BRRI dhan34 but shorter than the check BRRI dhan37. All of the entries showed shorter plant height than the check varieties BRRI dhan34 and BRRI dhan37 (Table 10).

1.11 Regional Yield Trial (RYT), Micronutrient Enrich Rice (MER), T. Aman, 2014

Objective: To observe the performance of some micronutrient rice lines under T. Aman ecosystem

Methodology

Seven materials were tested at Baradi, Kushtia in T. Aman, 2014. The materials were BR7840-54-3-2-2, BR7879-17-2-4-HR3-P1, BR7671-37-2-2-3-7-3, BR8143-15-2-1, BR8418-1-3, IR85850-75-

2-2-3-2(IR10M 300) and PSBRC 82(IRRI 123). BRRI dhan32 and BRRI dhan39 were used as standard checks. Thirty days old seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 11. Performance of some RYT (MER) T. Aman, 2014

Sl. No.	Designation	Growth Duration (day)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7840-54-3-2-2	122	116.9	169	24.88	5.21
2	BR7879-17-2-4-HR3-P1	132	127.3	192	24.42	5.02
3	BR7671-37-2-2-3-7-3	126	100.9	247	25.95	5.15
4	BR8143-15-2-1	112	112.9	191	25.77	5.62
5	BR8418-1-3	121	94.5	274	21.26	4.93
6	IR85850-75-2-2-3-2(IR10M 300)	128	100.3	291	24.50	5.49
7	PSBRC 82(IRRI 123)	128	100.3	291	24.50	5.49
8	BRRI dhan32 (Ck)	129	118.3	230	22.17	5.56
9	BRRI dhan39 (Ck)	125	100.1	219	23.30	4.86

D/S: 14.07.14 D/T: 15.08.14

Results

The yield of the tested lines ranged from 4.93 to 5.62 t/ha. Most of the lines gave more or less similar grain yield to the check variety BRRI dhan32 except lines BR8418-1-3 & BR7879-17-2-4-HR3-P1. Highest yield was observed in the line BR8143-15-2-1 (5.62 t/h) and it was about 0.06 t/ha and 0.76 t/ha higher yield than the standard check BRRI dhan32 (5.56 t/ha) and BRRI dhan39 (4.86 t/ha), respectively fallowed by line IR85850-75-2-2-3-2(IR10M 300) & PSBRC 82(IRRI 123 (5.49 t/ha). Growth duration of the line BR8143-15-2-1 was 18 days and 13 days shorter than the checks BRRI dhan32 (129 days) and BRRI dhan39 (125 days), respectively (Table 11). Therefore, the line BR8143-15-2-1 might be considered for further evaluation.

1.12 Regional Yield Trial, Green Super Rice (GSR), T. Aman, 2014

Objective: To observe the performance of some green super rice material under T. Aman ecosystem

Methodology

Four materials were tested at Boria, Kushtia in T. Aman season, 2013. The materials were IR83140-B-28-B, IR83142-B-19-B, IR83142-B-60-B and HHZ5-SAL10-DT1-DT1. BRRI dhan39 and BRRI dhan56 were used as standard check. Twenty-six-days old rice seedlings were planted in 5.4 m x 12 rows unit plots with 20 cm x 15 cm spacing. The trial was designed in RCB with two

replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 12: Performance of some GSR lines, T. Aman, 2014

Sl. No.	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	IR8340-B-28-B	121	103.4	219	27.30	4.95
2	IR83142-B-19-B	116	102.5	294	25.90	4.92
3	IR83142-B-60-B	116	106.6	228	28.83	4.43
4	HHZ5-SAL10-DT1-DT1	121	103.7	193	26.75	3.97
5	BRRI dhan39 (Ck)	121	102.5	225	22.10	5.14
6	BRRI dhan56 (Ck)	116	115.6	251	23.57	5.19

D/S: 14.07.2014 D/T: 10.08.2014

Results

The yield of the tested lines ranged from 3.97 to 4.95 t/ha. None of the tested lines gave higher grain yield than the both checks BRRI dhan39 (5.14 t/ha) and BRRI dhan56 (5.19 t/ha). Growth duration of the test entries was similar with the both checks. All of the entries showed similar plant height to the check varieties (Table 12).

1.13 Proposed Variety Trial (PVT), ARL, Boro, 2014-'15

Objective: To observe the yield and agronomic performance of some favorable Boro lines to propose variety

Methodology

Two lines namely, IR83140-B-36-B-B, IR83142-B-71-B-B with BRRI dhan28 and BRRI dhan29 as check were tested under alternate wetting and drying (AWD) to observe the yield and some agronomic performances at Kushtia in Boro, 2014-'15. Twenty days old rice seedlings were planted in 5.4 m x 20 rows unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 13. Performance of Proposed Variety Trial (PVT), ARL, Boro, 2014-'15

Sl.no	Designation	Growth duration (days)	Plant height (cm)	No of Panicles/ m^2	1000 grain wt (gm)	Yield (t/ha)
1	IR83140-B-36-B-B	150	93.8	367	25.21	7.87
2	IR83142-B-71-B-B	147	101.2	343	26.87	8.30
3	BRRI dhan28(ck)	144	117.7	308	22.38	6.74
4	BRRI dhan29(ck)	160	111.9	384	21.45	8.67

D/S: 02.12.14 D/T: 22.12.14

Results

The proposed line, IR83142-B-71-B-B gave 1.56 t/ha higher yield than the check variety BRRI dhan28 (6.74 t/ha) with similar growth duration but 0.37 t/ha lower yield than the check variety BRRI dhan29 with 13 days shorter growth duration. On the other hand line IR83140-B-36-B-B gave 1.13 t/ha yield advantage over check variety BRRI dhan28 with 5 days longer growth duration but 0.80 t/ha lower yield than the check variety BRRI dhan29 with 10 days shorter growth duration. Therefore, these two lines can be proposed for future variety.

1.14 Proposed Variety Trial (PVT), Zinc, Boro, 2014-'15

Objective: To observe the yield and agronomic performance of some favorable Boro lines to propose variety

Methodology

Two lines namely, BR7671-37-2-2-3-7, BR7833-11-1-1-2-1-285 with BRRI dhan28 and BRRI dhan64 as check were tested to observe the yield and some agronomic performances at Kushtia in Boro, 2014-'15. Forty five days old rice seedlings were planted in 6.0 m x 5.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/variety. Data were taken on the yield and some agronomic characteristics.

Table 14. Performance of Proposed Variety Trial (PVT), Boro, 2014-'15

Sl. no	Designation	Growth duration (days)	Plant height (cm)	No of Panicles /m^2	1000 grain wt (gm)	Yield (t/ha)
1	BR7671-37-2-2-3-7	149	95.0	265	0.00	5.83
2	BR7833-11-1-1-2-1-285	142	101.7	291	0.00	5.48
3	BRRI dhan(64)	152	104.3	253	0.00	5.06
4	BRRI dhan(28)	144	109.8	291	0.00	6.06

D/S: 07.12.14 D/T: 22.01.15

Results

The proposed line, BR7833-11-1-1-2-1-285 gave 0.42 t/ha higher yield over check variety BRRI dhan64 with 10 days early growth duration but 0.58 t/ha lower yield than check variety BRRI dhan28 with similar growth duration. While line, BR7671-37-2-2-3-7 gave 0.77 t/ha higher yield over check variety BRRI dhan64 with 3 days early growth duration but 0.23 t/ha lower yield than check variety BRRI dhan28 with 5 days longer growth duration. Therefore, these two lines might be selected for further evaluation.

1.15 Regional Yield Trial-1, Premium Quality Rice (PQR), Boro, 2014-'15

Objective: To observe the performance of some Green super Rice lines during Boro season

Methodology

Five materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were IRR77734-93-2-3-2, BR8079-52-2-2-2, BR8096-55-1-9-1, BR8076-1-2-2-3 and BR8096-48-2-2-4. BRRI dhan50 and BRRI dhan63 were used as standard check. Forty eight days old seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 15. Performance of some Premium Quality Rice (PQR) lines, Boro, 2014-'15

Sl. No.	Designation	Growth Duration (days)	Plant height (cm)	No of Panicles/m^2	1000 grain wt (gm)	Yield (t/ha)
1	IRR77734-93-2-3-2	148	97.30	396.00	25.22	7.24
2	BR8079-52-2-2-2	151	90.90	414.00	19.93	7.52
3	BR8096-55-1-9-1	147	93.00	415.50	18.21	6.90
4	BR8076-1-2-2-3	147	100.60	366.50	22.18	7.26
5	BR8096-48-2-2-4	150	88.70	391.00	19.13	6.86
6	BRRI dhan50 (ck)	150	88.70	391.00	19.13	6.86
7	BRRI dhan63 (ck)	145	89.70	324.50	21.01	6.85

D/S: 09.12.14 D/T: 27.01.15

Results

The yield of the tested entries ranged from 6.86 to 7.52 t/ha. Most of the tested entries gave higher yield over both the check varieties BRRI dhan50 and BRRI dhan63. Highest yield was observed in the line BR8079-52-2-2-2 (7.52 t/h) and this was followed by BR8076-1-2-2-3 (6.1 t/h) and IRR77734-93-2-3-2 (7.24 t/ha). These materials had higher plant height with similar 1000 grain wt except line IRR77734-93-2-3-2 to the check variety and higher number of panicles/m^2. Growth duration of the tested entries was more or less similar to the both check varieties BRRI dhan50 (150 days) and BRRI dhan63 (145 days). Therefore, these entries might be selected for further evaluation.

1.16 Regional Yield Trial (RYT-2), PQR, Boro, 2014-'15

Objective: To observe the performance of some BRRI developed premium quality rice lines during Boro season.

Methodology

Five materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were BR7372-35-3-3-HR9, BR73580-5-3-2-1-HR, BR7372-18-2-1-HR1-HR6, BR7372-18-3-3-HR3 and BR7372-35-3-3-HR5. BRRI dhan28, BRRI dhan50, BRRI dhan60 and BRRI dhan63 were used as standard checks. Forty seven days old rice seedlings were planted in 5.4 m x 2.5 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic

practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 16. Performance of some Premium Quality Rice (PQR) lines, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR7372-35-3-3-HR9	148	103.30	269	26.92	5.78
2	BR73580-5-3-2-1-HR	144	90.40	331	22.76	5.91
3	BR7372-18-2-1-HR1-HR6	146	99.70	276	27.94	6.88
4	BR7372-18-3-3-HR3	146	105.10	296	27.90	7.10
5	BR7372-35-3-3-HR5	147	102.30	277	27.6	6.52
6	BRRI dhan28(ck)	146	105.40	384	22.42	7.36
7	BRRI dhan50(ck)	147	91.20	343	19.22	6.77
8	BRRI dhan60(ck)	145	96.80	332	25.38	7.28
9	BRRI dhan63(ck)	145	94.00	338	22.03	6.97

D/S: 13.12.14 D/T: 30.01.15

Results

The yield of the tested lines ranged from 5.78 to 7.10 t/ha. None of the line gave better yield than the checks but line BR7372-18-3-3-HR3 gave similar yield (7.10 t/ha) with the standard checks, BRRI dhan28, BRRI dhan60 and BRRI dhan63 respectively. Growth duration of tested lines were similar to the checks (145-147 days) (Table 16). Therefore, these materials can be selected for further evaluation.

1.17 Regional Yield Trial (RYT), Short Duration (SD), Boro, 2014-'15

Objective: To observe the performance of some BRRI developed disease resistant rice lines during Boro season.

Methodology

One material was tested at Baradi farm, Kushtia in Boro, 2014-'15. The material was NERICA Mutant with BRRI dhan28 and BRRI dhan29 were used as standard checks. Fifty days old rice seedlings were planted in 5.4 m x 2.5 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 17. Performance of some Disease Resistant Rice, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	NERICA Mutant	149	97.40	306.00	24.51	5.97
5	BRRI dhan28(ck)	144	91.40	365.50	22.02	6.34
6	BRRI dhan45(ck)	144	92.20	323.00	26.22	7.17

D/S: 09.12.14 D/T: 28.01.15

Results

The yield of the tested line was 5.97 t/ha. Tested entry NERICA Mutant gave lower yield than the both checks BRRI dhan28 (6.34 t/ha) and BRRI dhan45 (7.17 t/ha) with 5 days higher growth duration (Table 17). Therefore, the material NERICA Mutant might be further evaluation.

1.18 Regional Yield Trial (RYT), Favorable Boro (FB), 2014-'15

Objective: To observe the performance of some BRRI developed favorable Boro lines during Boro season.

Methodology

Ten materials were tested at Baradi farm, Kushtia in Boro, 2013-'14. The materials were BR7683-30-3-3-4, BR7671-37-2-2-3-7, BR7988-4-5-3-4, BR7783-AC12-3, BR7783-AC13-5, BR7783-AC14-5, BR7783-AC6-3-2-2-1, BRRI dhan29-SC3-28-16-10-8-HR1(com), BR7988-10-4-1 and BR7800-63-1-7-3. BRRI dhan28, BRRI dhan29 and BRRI dhan60 were used as standard checks. Fifty-two-days old rice seedlings were planted in 5.4 m x 2.5 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with three replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 18. Performance of some Favorable Boro Rice (FB) lines, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR7683-30-3-3-4	145	89.10	337	25.51	4.89
2	BR7671-37-2-2-3-7	146	88.50	277	26.04	6.16
3	BR7988-4-5-3-4	148	77.10	268	21.20	5.96
4	BR7783-AC12-3	160	95.60	304	21.16	6.56
5	BR7783-AC13-5	162	102.30	312	20.71	6.75
6	BR7783-AC14-5	162	103.00	318	21.07	6.22
7	BR7783-AC6-3-2-2-1	162	98.20	279	21.10	6.35
8	BRRI dhan29-SC3-28-16-10-8-HR1(com)	144	81.60	322	19.96	5.23
9	BR7988-10-4-1	143	82.30	333	20.06	5.59

10	BR7800-63-1-7-3	146	96.60	243	26.38	5.51
11	BRRI dhan28(ck)	146	93.20	298	21.37	5.56
12	BRRI dhan29(ck)	160	108.00	317	22.77	7.49
13	BRRI dhan60(ck)	144	83.80	360	24.62	5.29

D/S: 09.12.14 D/T: 30.01.15

Results

The yield of the tested lines ranged from 5.23-6.75 t/ha. The yield of the line BR7783-AC13-5 was 6.75 t/ha which was 0.74 t/ha lower yield than the check BRRI dhan29 with similar growth duration (162 days). The line BR7671-37-2-2-3-7 gave 6.16 t/ha yield which was 0.60 t/ha yield advantage than the check variety BRRI dhan28 (5.56 t/ha) with similar growth duration (146 days) (Table 18). Other tested lines did not give positive yield with growth duration than the check varieties. Therefore, these two lines might be selected for further evaluation.

1.19 Regional Yield Trial, Micronutrient Rice (MN), Boro, 2014-'15

Objective: To observe the performance of micronutrient rice genotypes during Boro season

Methodology

Nine materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were BR7840-54-3-2-1, BR7840-54-3-4-1, BR7840-54-3-4-4, BR8257-37-1-2-2, BR7833-19-2-3-5, BR8261-19-1-1-3, BR7820-18-1-6-3-P4, BR7881-62-2-3-7-P3 and BR7879-17-2-4-HR3-P1. BRRI dhan28 and BRRI dhan29 were used as standard checks. Forty-nine-days old rice seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 19. Performance of some Micro Nutrient Rice (MN) lines, Boro, 2014-'15

Sl. No.	Designation	Plant height (cm)	Growth duration	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR7840-54-3-2-1	147	92.20	278.5	26.39	4.97
2	BR7840-54-3-4-1	142	92.00	213.00	25.72	4.45
3	BR7840-54-3-4-4	143	87.70	229.5	27.93	4.27
4	BR8257-37-1-2-2	142	80.00	263	26.44	4.00
5	BR7833-19-2-3-5	147	100.20	219.00	20.37	4.01
6	BR8261-19-1-1-3	144	98.70	227.5	20.33	5.17
7	BR7820-18-1-6-3-P4	157	94.00	300.00	21.84	5.64
8	BR7881-62-2-3-7-P3	-	100.90	279.50	23.28	5.37
9	BR7879-17-2-4-HR3-P1	156	127.70	218.50	26.11	5.28
10	BRRI dhan28(ck)	142	100.90	319.00	22.05	5.49

11	BRRI dhan29(ck)	156	96.50	288.5	21.80	6.30

D/S: 13.12.14 D/T: 31.01.15

Results

The yield of the tested lines ranged from 4.00-5.64 t/ha. None of the evaluated entries gave positive yield with growth duration than the both checks BRRI dhan28 and BRRI dhan29. So, these lines might be further evaluation.

1.20 Regional Yield Trial-1, Green Super Rice (GSR), Boro, 2014-'15

Objective: To observe the performance of some Green super Rice lines during Boro season

Methodology

Five materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were HHZ15-SAL13-Y1, HHZ23-DT16-DT1-DT1, HHZ15-DT4-DT1-Y1, HHZ11-DT17-SAL1-SAL1 and HHZ6-SAL3-Y1-SUB2. BRRI dhan29 and BRRI dhan60 were used as standard check. Fifty-one-days old seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 20. Performance of some Green Super Rice (GSR) lines, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	HHZ15-SAL13-Y1	154	90.50	248.00	21.34	6.14
2	HHZ23-DT16-DT1-DT1	160	93.60	326.00	21.51	6.81
3	HHZ15-DT4-DT1-Y1	154	85.10	343.00	22.89	6.41
4	HHZ11-DT17-SAL1-SAL1	152	79.80	326.50	23.10	5.76
5	HHZ6-SAL3-Y1-SUB2	155	91.20	301.50	23.40	6.85
6	BRRI dhan29 (ck)	163	101.70	354.50	22.07	7.61
7	BRRI dhan60 (ck)	155	85.90	388.00	25.76	5.10

D/S: 11.12.14 D/T: 31.01.15

Results

The yield of the tested entries ranged from 5.76 to 6.85 t/ha. Most of the tested lines gave higher yield than the check variety BRRI dhan60 (5.10 t/ha) but lower than the check variety BRRI dhan29 (7.61 t/ha). Growth duration of the tested entries was 0-3 days shorter than the check variety BRRI dhan60 (155 days) and 8-11 days than the check variety BRRI dhan29 (days) Table 20 except line HHZ23-DT16-DT1-DT1. Therefore, these materials might be selected for further evaluation.

1.21 Regional Yield Trial-1, (Bio-tech. SD), Boro, 2014-'15

Objective: To observe the performance of some Green super Rice lines during Boro season

Methodology

Five materials were tested at Baradi farm, Kushtia in Boro, 2014-'15. The materials were BR8072-AC5-4-2-1-2-1, BR8072-AC7-4-1-2-2-1, BR8072-AC8-1-1-3-1-1, BR8072-AC11-2-3-2-1-1 and BR4909-R1-R2. BRRI dhan28 was used as standard check. Fourty-six-days old seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 21. Performance of some SD lines, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR8072-AC5-4-2-1-2-1	139	92.67	292.33	23.68	5.80
2	BR8072-AC7-4-1-2-2-1	137	89.93	275.00	23.22	5.81
3	BR8072-AC8-1-1-3-1-1	138	91.53	284.33	23.85	6.57
4	BR8072-AC11-2-3-2-1-1	138	90.07	287.33	24.25	5.95
5	BR4909-R1-R2	144	112.50	260.50	21.89	5.96
6	BRRI dhan28(ck)	141	93.20	302.67	21.94	5.69

D/S: 17.12.14 D/T: 02.02.15

Results

The yield of the tested entries ranged from 5.80 to 6.57 t/ha. Most of the tested lines gave higher yield than the check variety BRRI dhan28 (5.69 t/ha). Highest yield was observed in the line BR8072-AC8-1-1-3-1-1 (6.57 t/h). Growth duration of the tested entries was shorter than the check variety BRRI dhan28 (141 days) except line BR4909-R1-R2 (144 days) Table 21. Therefore, these entries might be selected for further evaluation.

1.22 Regional Yield Trial-2, (Bio-tech. FB), Boro, 2014-'15

Objective: To observe the performance of some Green super Rice lines during Boro season

Methodology

One material was tested at Baradi farm, Kushtia in Boro, 2014-'15. The material was BR6158RWBC2-2-1-1. BRRI dhan58 and BRRI dhan29 were used as standard check. Fourty-six-days old seedlings were planted in 5.4 m x 3.0 m unit plots with 25 cm x 15 cm spacing. The trial was designed in RCB with two replications. Standard agronomic practices were followed to grow the lines/varieties. Data were taken on the yield and some agronomic characteristics.

Table 22. Performance of some FB lines, Boro, 2014-'15

Sl. No.	Designation	Growth duration	Plant height (cm)	No of Panicles/m^2	1000 grain wt	Yield (t/ha)
1	BR6158RWBC2-2-1-1	154.00	116.00	359.33	24.26	7.90
2	BRRI dhan58(ck)	149.00	103.00	333.33	22.00	7.24
3	BRRI dhan29(ck)	154.00	103.13	371.67	21.21	7.88

D/S: 17.12.14 D/T: 02.02.15

Results

The yield of the tested entry BR6158RWBC2-2-1-1 was 7.90 t/ha that was similar to the check variety BRRI dhan29 with similar growth duration but higher yield than the check variety BRRI dhan58 with 5 days early (Table. 22). Therefore, The line BR6158RWBC2-2-1-1 can be selected for further evaluation.

2. CROP SOIL WATER MANAGEMENTPROGRAMME AREA

2.1 Terminal Drought Mitigation Adopting Transplanting Dates in T. Aman, 2014

Introduction:

Drought is a common event in the T.Aman season in Bangladesh. Around 2 million hectares of land in Bangladesh are affected by different level of drought. Now a day both early and terminal drought is experienced in Bangladesh. Common measures applied for drought mitigation are supplemental irrigation, change in cultivation time and use of drought tolerant varieties. This experiment was conducted with a view to find a transplanting period of low risk drought. It means that if any rice variety is transplanted in this transplanting period than the vaiety gets less drought or escape drought during its critical stages (reproductive and ripening stages). To make the success of this study the following objectives were taken;

Objectives:

- To determine effect of drought for different transplanting dates
- To determine drought severity and its probability at different growth stages of T. Aman.

Methodology

A long duration variety (BR11) and a short duration variety (BRRI dhan33) were tested during T. Aman season. There were six treatments with three replications in the experiment and the treatments were transplanting at 10 July (T_1), transplanting at 17 July (T_2), transplanting at 24 July (T_3), transplanting at 31 July (T_4), transplanting at 7 August (T_5) and transplanting at 14 August (T_6).

Thirty-day old rice seedlings were transplanted with 20 cm x 20 cm spacing. Individual plot size was 8 m x 6 m with 60 cm buffer zones. Fertilizer was applied as per BRRI recommendation. The whole amount of P, K, Zn and S fertilizer were applied as basal dose during the final land preparation. Urea was top-dressed in three equal splits. Weeding and spraying were done twice to control weeds and insect pests in each season. Rice yield was assessed taking samples from 10 square meter area of each plot. Harvested paddy was threshed, cleaned and weighed to determine yield. Finally, the yield was adjusted to 14% moisture content to determine yield per hectare. A USWB Class A evaporation pan and a rain gauge were installed near the experimental field to determine rainfall and evaporation during the growing season of rice. Data were recorded at 09:00h

daily to determine seepage &percolation, rainfall and evaporation from the experimental field. The historical rainfall data were collected from the Department of Agricultural Extension, Kushtia. Drought amount (deficit water in soil) was calculated using drought model (developed by Dr. Towfiqul Islam).

Table 23. Drought amount at different growth stages of rice, T. Aman, 2014

Treatment	Vegetative phase (mm)	Reproductive phase (mm)	Ripening phase (mm)	Total (mm)
BRRI dhan33				
10 July (T_1)	7.1	0	18.8	25.9
17 July (T_2)	7.1	0	26.8	33.9
24 July (T_3)	7.1	7.6	35.1	49.9
31 July (T_4)	7.1	7.6	44.1	58.8
07 August (T_5)	0	11.8	44.9	56.7
14 August (T_6)	0	40.8	40.9	81.7
BR11				
10 July (T_1)	7.1	40.8	39.9	87.8
17 July (T_2)	7.1	42.8	49.9	99.8
24 July (T_3)	10.3	39.6	54.9	104.8
31 July (T_4)	14.7	40.1	58.0	112.8
07 August (T_5)	7.6	59.1	57.0	123.7
14 August (T_6)	7.6	64.1	58.0	129.7

Table 24. Yield and yield components for different transplanting dates, T. Aman 2014

Treatment	Growth duration	Plant height (cm)	Panicle/m^2	Filled grains/panicle	1000 grain weight (gm)	Yield (t/ha)
BRRI dhan33						
10 July (T_1)	124	114.67	261	139	25.36	5.27
17 July (T_2)	120	115.67	285	127.33	25.42	5.60
24 July (T_3)	120	111.67	248.3	130.33	23.39	5.40
31 July (T_4)	121	101.67	224	135.33	24.47	4.87
07 Aug (T_5)	119	102.63	262.3	121	23.02	4.51
14 Aug (T_6)	118	102.67	301.6	102.67	24.02	4.07
$LSD_{0.05}$	-	4.73	17.48	18.01	1.2	0.36
CV (%)	-	2.4	3.6	7.9	2.7	4.0
BR11						
10 July (T_1)	154	120.2	265.33	107.2	24.55	4.75
17 July (T_2)	147	116.0	333.3	106.3	24.47	5.96
24 July (T_3)	145	109.7	275.0	102.2	24.13	5.66
31 July (T_4)	143	107.3	304.3	143.5	24.79	5.41
07 Aug (T_5)	142	108.4	302.3	140.4	23.53	4.95
14 Aug (T_6)	139	104.3	296.7	127.4	23.85	4.64
$LSD_{0.05}$	-	5.97	34.7	17.7	0.91	0.32
CV (%)	-	3	6.4	8	2.1	3.4

Results

The annual rainfall amount from 2002 to 2014 was analyzed and is shown in Fig. 1. A downward trend of rainfall indicates rainfall amount is decreasing year after year. More terminal drought may cause due to climate change. In 2014, total annual rainfall was 1432 mm which was slightly higher than average annual rainfall (1388 mm) in this region. Figure 2 represents the monthly rainfall over the years up to 2014. In 2014, rainfall exceeds the average amount only in the month of February, June and August.

Drought amount at different growth stages of rice for different dates of transplanting is shown in Table 1. BRRI dhan33 suffered comparatively less drought than BR11 due to its shorter growth duration. From the drought pattern of the previous year in case of BRRI dhan33 drought in reproductive and ripening phases increased with delay transplanting (fig.3). In 2014, drought in reproductive and ripening phase increased (fig.4) for transplanting after 24 July. When short duration variety transplanted before 24 July it can escape terminal drought.

For long duration variety, drought amount increased with late transplanting. Fig.5 represents terminal drought over transplanting dates for different growth phases in the previous years (2009-13) and Fig.6 drought in 2014. Drought in vegetative phase shows decreasing trends over transplanting dates (Fig. 5), reproductive and ripening phases have rising trends after transplanting on 24 July and ripening phase has almost similar trend. In 2014, vegetative phase shows decreasing trend on delay transplanting. But in reproductive and ripening phases severe drought occurred in case of transplanting after 24 July.

Yield and yield contributing character was shown in table 24. BRRI dhan33 yielded highest (5.6 t/ha) when it was transplanted on July 17 and lowest yield was found 4.07 t/ha in case of transplanting on 14 August. For BR11, the highest yield was found for July 17 transplanting (5.96 t/ha) and lowest yield was observed in case of 14 August (4.64 t/ha). Yield decreased for both short and long duration variety after transplanting on 24 July.

Drought is an unpredictable phenomenon and it reappears after 5-10 years. But we can't forecast the year of occurrence. Short duration variety faced fewer droughts due to its shorter growth duration. But both short and long duration variety faced fewer droughts when they transplanted before 24 July. So transplanting before 24 July would be low risk period of drought and after that it would be high risk period.

Figure 1. Annual Rainfall (2002-2014)

Figure 2. Monthly rainfall pattern

Fig.3: Average drought pattern(2009-13) for BRRI dhan33

Fig. 4: drought pattern in 2014 fo

Fig.5: Average drought pattern(2009-13) for BR11

Fig. 6: drought pattern in 2014 for BR11

2.2. Determination of suitable time for application of supplemental irrigation in T. Aman2014

Objective: Since drought is not a visible phenomenon, so it's beginning of occurrence in the soil (micro level drought) is not visible. But effect of drought is observed after some days of its beginning. Meanwhile crop is hampered and yield is reduced consequently. To determine the beginning of the drought in the soil the status of the perch water table can play an important role. Farmer does not know when drought begins and when supplemental irrigation should be applied. To find out the mean to determine the beginning of drought the following objective was taken

- To determine the relationship between perched water tables depletion during critical stages of rice and grain yield.

Methodology

The experiment was conducted in Takimara, Kushtia Sadar, Kushtia. BRRI dhan49 was used in this experiment during T.Aman 2014 season. There were three treatments with three replications in the experiment and the treatments were:

T_1 = Supplemental irrigation applied when water level reaches at 15 cm below ground surface

T_2= Supplemental irrigation applied when water level reaches at 20 cm below ground surface

T_3= Supplemental irrigation applied when water level reaches at 25 cm below ground surface

BRRI recommended cultural and fertilizer management practices were followed in growing the crop. Thirty-day-old rice seedlings were transplanted after proper land preparation with 20 cm x 20 cm spacing. Individual plot size was 8 m x 7 m, separated by 60 cm buffer zone. Supplemental irrigation was applied according to different treatment (T_1, T_2 and T_3). A USWB Class A evaporation pan and a rain gauge were installed near the experimental field for determining rainfall and evaporation amounts during the growing season of rice. Data were recorded at 08:30h daily to determine seepage & percolation, rainfall and evaporation from the experimental field.

Table. 25. Yield and yield components for different supplemental irrigation depth, T. Aman 2014

Treatment	No. of irrigation applied	Days to irrigate after disappearing standing water	Plant height (cm)	No of Panicle/m^2	Filled grain per panicle	1000 grain wt (gm)	Yield (t/ha)
T_1	8	3	107.1	295	155.1	21.56	5.65
T_2	7	4	108	297	164.4	21.51	5.63
T_3	6	5	109.3	300	156.1	21.76	5.63
$LSD_{(0.05)}$			2.03	9.18	14.65	0.52	0.51
CV (5%)			0.8	1.4	4.1	1.1	3.5

T_1 = Supplemental irrigation applied when water level reaches at 15 cm below ground surface

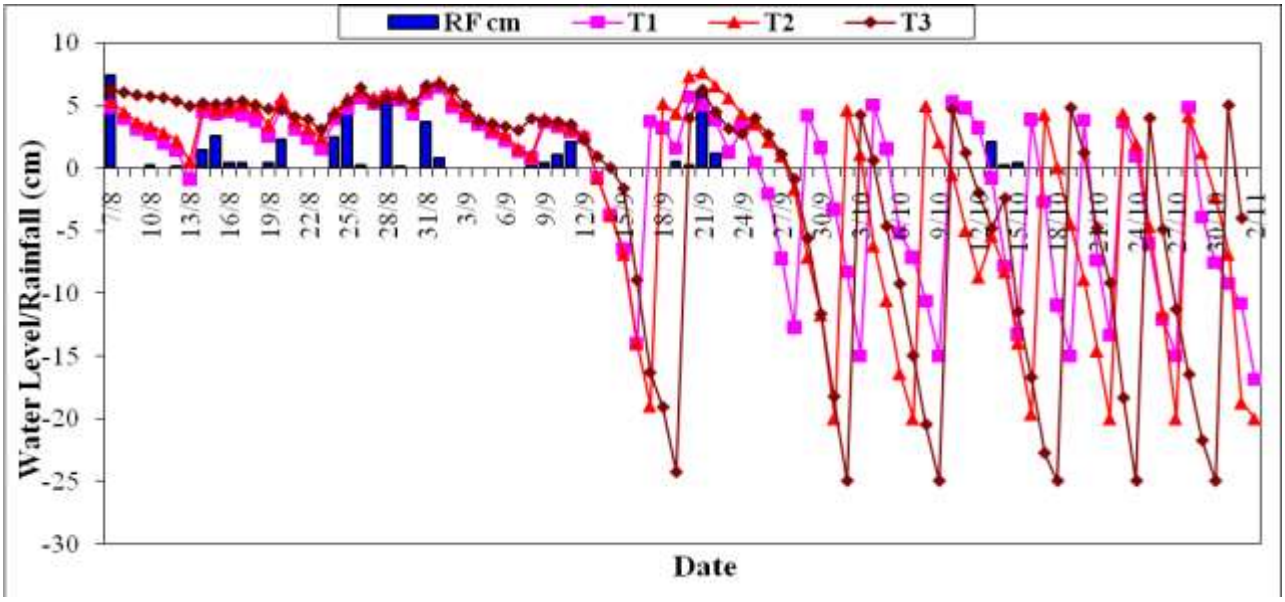
T_2= Supplemental irrigation applied when water level reaches at 20 cm below ground surface

T_3= Supplemental irrigation applied when water level reaches at 25 cm below ground surface

Results

Fig. 7 represents water level fluctuation and rainfall occurrence during the rice growth stages. Water stress and supplemental irrigation was applied according to different treatments. Yield is seriously hampered if crop suffered from water stresses during these periods. In 2014, the rainfall was mostly occurred in the vegetative part of the crop, but it was not uniformly distributed. So, supplemental irrigation was applied in all stages of crop. The number of supplemental irrigation application was eight, seven and six for the treatments T_1, T_2 and T_3. The depth of irrigation water was 5 cm above the ground surface in all irrigation applications. There were no considerable yield differences among the treatments (Table 25). The highest yield was found in T_1 (5.65 t/ha) and the lowest in T_2 (5.63 t/ha).

In terms of yield performances, T_1 performed slightly better than the other two treatments. But yield was insignificantly decreased following irrigation application when water level goes 25 (suitable water depth below ground surface). This is one year experiment and further trial is needed to draw a conclusion



D/S: 29/06/2014 D/T: 27/07/2014

Fig. 7: Rainfall and groundwater level fluctuation over the growing period

2.3 Adoption and Demonstration of Water Saving Technologies at farmer's fields in Boro 2014-15

Objectives:

1. To save irrigation water
2. To reduce irrigation cost, and
3. To increase water productivity

Methodology:

The experiment was conducted at two different locations at Khordo Ailchara, Sadar, Kushtia in farmer's field in Boro, 2014-15. Each experimental field was divided into two plots to perform two different treatments. The treatments were

T_1 = AWD Practices and T_2 = Farmers Management (continuous standing water)

Forty five days' old seedlings of BRRI dhan28 was transplanted with 20 cm × 15 cm spacing. BRRI recommended fertilizer doses were applied. The whole amount of P, K, S and Zn fertilizer were applied as basal dose during land preparation. Urea was top-dressed in three equal splits. Herbicide was applied after 5 days of transplanting. Furthermore weeding and spraying were done to control weed and insect pests.

For the treatment T_1, alternate wetting and drying (AWD) method was performed and for T_2 irrigation was applied as farmers practice i.e. continuous standing water. A 10 cm diameter and 25 cm long PVC perforated pipe was installed at the corner of both the field having 10 cm above the ground surface and perforated 15 cm part was below the ground surface. Continuous water level was monitored in the PVC pipe. In AWD practice irrigation was applied when the water level goes down 15 cm below the ground surface monitored at the pipe. From one week before to one after flowering AWD practice was stopped and 2-3 cm standing water was maintained. Discharge and time required to irrigate each plot was recorded every time. Discharge was measured using a V-notch and verified the same using volumetric method. Rice yield was assessed taking samples from

10 square meter area of each plot. Yield contributing parameters were collected. Finally the yield was adjusted to 14% moisture content to determined yield per hectare.

Table 26: Yield and yield parameters of AWD practice over farmers practices

Treatment	Irrigation nos.	Plot size (m^2)	time of irrigation (min)	water use (m)	% Water saved over FP	% Time saved	No of panicles/m^2	Filled Grains/ panicle	1000 grain wt (gm)	Yield (t/ha)	% yield increase
Field 1											
T_1	17	650	1105	1.06	23.19	23	305	58	22.0	3.2*	6.25
T_2	21	680	1510	1.38			287	55	22.1	3.0*	
Field 2											
T_1	15	610	1015	1.03	20.15	19.3	313	68	22	3.53*	3.6
T_2	20	715	1475	1.29			290	65	22.1	3.4*	

T_1= AWD practice T_2= Farmer's Management Practice

* Yield was found lower than average yield due to a heavy hailstorm on 06.04.2015 over the area

Result:

In both field, AWD practice saved irrigation water and time of irrigation application. T_1 saved 23.19% and 20.15% irrigation water over T_2 in research field 1 and 2 respectively. From table 26, it is noticeable that field 1 and field 2 saved 4 and 5 numbers of irrigation over farmers practice. AWD practice also saved total time of irrigation application as well as fuel or electricity consumption of pump.

Both the field gave similar yield in two methods. But a heavy hailstorm was occurred 06 April, 2015 when the crop was in maturity stages. It seriously damaged the production of rice in the affected area. Highest yield was found for BRRI dhan28 was 3.53 t/ha but its average yield is about 6 t/ha. There were also yield advantages of research management practices over farmer's management practices. In field 1, T_1 gave yield of 3.2 t/ha with 6.25% yield advantages over T_2 (3.0 t/ha). In field 2, yield of T_1 and T_2 were 3.53 t/ha and 3.4 t/ha respectively with yield advantages 3.6%.

3. SOCIO ECONOMICS AND POLICY PROGRAMME AREA

3.1 Stability Analysis of BRRI varieties

Objective: To maintain season, year and location-wise data base on the yield performance of BRRI varieties.

Methodology

An experiment on the yield performance of BRRI varieties was conducted at the Baradi farm of BWDB, Kushtia both in the T. Aman 2013 and in Boro 2014-15 seasons. Twenty-nine BRRI developed rice varieties were taken into consideration in T.Aman, 2014 and 32 BRRI varieties in

Boro, 2014-15. The experiment was designed in RCB with three replications. Twenty-seven-day-old rice seedlings were transplanted at 20 cm x 20 cm spacing in unit plots measuring 5.0 m x 2.0 m in the T. Aman season. In the Boro season unit plot size was 5.4 m x 2.0 m. recommended agronomic practices were followed for crop production and proper crop protection measures were taken depending on the necessity. For estimation of yield, samples from 10 m^2 area of each plot were harvested and grain yield was adjusted to 14% moisture content and were converted to t/ha.

Table 27. Yield and growth durations of some BRRI varieties, T. Aman, 2014

Variety	Growth duration (days)	Standard Growth duration (days)	Yield (t/ha)	Standard Yield (t/ha)	Ranks
BR3	133	145	4.60	4.0	18
BR4	144	145	4.91	5.0	14
BR5	151	150	4.08	3.0	23
BR10	145	150	4.75	5.5	17
BR11	141	145	5.81	5.5	4
BR22	160	150	6.17	5.0	1
BR23	159	150	5.19	5.5	11
BR25	140	135	5.19	4.5	11
BRRI dhan30	145	145	5.14	5.0	13
BRRI dhan31	145	140	5.51	5.0	7
BRRI dhan32	135	130	5.25	5.0	10
BRRI dhan33	115	118	5.34	4.5	9
BRRI dhan34	144	135	4.41	3.5	20

BRRI dhan37	152	140	4.29	3.5	21
BRRI dhan38	149	140	3.81	3.5	25
BRRI dhan39	119	122	4.79	4.5	16
BRRI dhan40	144	145	5.17	4.5	12
BRRI dhan41	153	148	5.17	4.5	12
BRRI dhan44	142	145	5.49	5.5	8
BRRI dhan46	153	150	6.14	4.7	2
BRRI dhan49	140	135	5.51	5.5	7
BRRI dhan51	145	142	5.68	4.5	5
BRRI dhan52	141	145	4.84	5.0	15
BRRI dhan53	134	125	5.57	4.5	6
BRRI dhan54	141	135	6.05	4.5	3
BRRI dhan56	122	110	4.45	4.5	19
BRRI dhan57	116	105	4.01	4.5	24
BRRI dhan62	112	100	2.57	4.5	26
BRRI hybrid dhan4	119	118	4.09	6.5	22

D/S: 30/06/2014 D/T: 06/08/14

In BRRI dhan62 Plot, Rat damaged about 40% at early flowering.

Table 28. Yield and growth durations of some BRRI varieties, Boro, 2014-15

Variety	Growth duration (days)	Standard Growth duration (days)	Yield (t/ha)	Standard Yield (t/ha)	Ranks
BR1	148	150	5.62	5.5	24
BR2	151	160	6.17	5.0	18
BR3	165	170	7.25	6.5	5
BR6	142	140	7.06	4.5	6
BR7	154	155	6.31	4.5	15
BR8	155	160	7.90	6.0	1
BR9	152	155	7.71	6.0	2
BR12	163	170	5.43	5.5	25

BR14	152	160	5.88	6.0	22
BR15	158	165	6.69	5.5	9
BR16	156	165	6.48	6.0	12
BR17	150	155	4.90	6.0	26
BR18	158	170	6.23	6.0	17
BR19	160	170	6.37	6.0	14
BR26	148	140	6.51	3.5	11
BRRIdhan27	150	122	5.86	4.5	23
BRRIdhan28	143	140	6.31	6.0	15
BRRIdhan29	157	160	7.34	7.5	3
BRRIdhan35	156	155	6.39	5.0	13
BRRIdhan36	144	140	6.12	5.0	19
BRRIdhan45	141	145	6.37	6.5	14
BRRIdhan47	150	152	6.03	6.0	20
BRRIdhan50	150	155	6.30	6.0	16
BRRIdhan55	142	145	7.27	7.0	4
BRRIdhan58	149	155	6.80	7.0	8
BRRIdhan59	145	153	6.68	7.1	10
BRRIdhan60	141	151	5.92	7.3	21
BRRIdhan61	-	150	0.00	6.3	-
BRRIdhan64	150	152	6.03	6.5	20
BRRI Hybrid dhan1	-	155	0.00	8.5	-
BRRI Hybrid dhan2	141	145	7.27	8.0	4
BRRI Hybrid dhan3	144	145	6.96	9.0	7

D/S: 17/12/2014 D/T: 03/02/2015

Results

Yields and growth duration of the test-varieties of the T. Aman season have been presented in the Table 27. Among the varieties highest yield was obtained with the BR22 (6.17 t/ha) and the lowest with the BRRI dhan62 (2.57 t/ha) because of rat damaged. Of the 29 varieties, 20 were found to give higher yields than the standard yield determined for them. The other varieties yielded similar

or lower than the standard yield. Highest increase in yield was obtained with BRRIdhan54 (increase by 1.55 t/ha), where as the highest reduction was found in case of BRRRI Hybrid dhan4 (2.35 t/ha reduction). Growth duration of some of the test varieties decreased (up to 12 days as in the case of BR3), whereas in some verities it increased (up to 12 days as in the case of BRRI dhan37,56 & 62). Lodging at different magnitudes (25%-50%) was observed in case of five test varieties viz., BR5, BR25, BRRI dhan32, BRRI dhan34, BRRI dhan37 and BRRI dhan38.

Yields and growth duration of the test-varieties of the Boro season have been presented in the Table 28. Among the varieties highest yield was obtained with the BR8 (7.9 t/ha) and the lowest with the BR17 (4.9 t/ha). Of the 32 varieties, nineteen were found to give higher yields than the standard yield determined for them. The other varieties yielded lower than the standard yield. Highest increase in yield was obtained with BR26 (increase by 3.01 t/ha), where as the highest reduction was found in case of BRRI Hybrid dhan3 (2.04 t/ha reduction). Growth duration of some of the test varieties decreased (up to 12 days as in the case of BR18), where as in some varieties it increased (up to 28 days as in the case of BRRI dhan27). Lodging tendency was not found in the BRRI varieties during Boro season.

4. TECHNOLOGY TRANSFER PROGRAMME AREA

4.1 Farmers' training

One-day Farmers' training on 'Modern rice production technology' was conducted to train farmers on modern rice cultivation and to encourage them to adopt modern rice varieties and relevant technologies.

In total, 22 (20 training was funded by Enhancing Quality Seed Supply Project (EQSSP) and rest 2 was funded by Harvest Plus Project) farmers' training was conducted with the cooperation of the Department of Agricultural Extension (DAE) at different upazillas of Kushtia, Magura, Jhenaidah, Meherpur and Rajbari district. About 650 farmers were participated in the training program. Modern rice varieties and relevant technologies were disseminated to the farmers.

4.2 Field day and Agricultural fair

Field day is a very useful tool for generating awareness and interests among the farmers and concerned extension personnel about the modern rice production technologies. These provide wide publicity and familiarity of BRRI, its technologies and its contribution in national economy. Twenty two field day was conducted at different upazillas of Kushtia, Jhenaidah and Meherpur districts which was funded by Enhancing Quality Seed Supply Project (EQSSP) and Harvest Plus Project in Aman and Boro season on BRRI developed varieties in which a total of about 1500 farmers were participated.

We participated in an 'Agricultural Fair' arranged by DAE, Kushtia district in which BRRI developed technologies were demonstrated. This program generated much enthusiasm about modern rice production technologies among the visitors.