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List of Personnel

Name and Designation	Working Man Months	Remarks
Dr. Md. Enamul Hoque Chief Scientific Officer	12	-
Dr. Shahanaz Sultana Principal Scientific Officer	12	-
Dr. Jannatul Ferdous Senior Scientific Officer	12	-
Dr. Nilufar Yasmin Shaikh Senior Scientific Officer	-	Deputed to TOC
Dr. S.M. Hisam Al Rabbi Senior Scientific Officer	12	-
Ripon Kumar Roy Senior Scientific Officer	12	-
Md. Arafat Hossain Scientific Officer	12	-
Shampa Das Joya Scientific Officer	11	-
Md. Sentu Rahman Scientific Officer	12	-
Md. Faruq Hossain Asst .Electrical Eng.	-	Deputed to the Building and construction Division
Md. Jahangir Alam Assistant Farm Manager	12	-
Esrat Jahan Computer operator	12	-
Md. Ibrahim Khalil Lab. Attended	12	-
Khuku Moni Lab. Attended	12	-

Summary

A high yielding T Aman rice variety BRR1 dhan103 was approved by National Seed Board of Bangladesh in 2022. The average yield of the variety is 6.2 ton/ha with similar growth duration of BRR1 dhan87. A total 24 experiments were conducted during the year 2022-23. For developing low glycemic index (GI) rice variety five doubled haploid lines derived from a cross between BRR1 dhan29 and Kanaklata were grown as SYT during T Aman 2022 among them three lines were selected. For the development of premium quality rice, doubled haploids plants from BRR1 dhan90/Kataribhog and BRR1 dhan38/Bashful (Acc. No. 3954) were evaluated and 33 fixed lines 08 plants were selected from the cross respectively. Eighty One double haploid lines from cross of BRR1 dhan50/Bashful (Acc. No. 3954) were evaluated in Boro 2022-23. Among them 160 plants were selected. During Boro 2022-23, three, thirteen and fourteen lines for development of antioxidant enriched black rice were selected from RYT, PYT and OT, respectively. For the development of Aus rice variety, two crosses were made (BRR1 dhan48/ BR(Bio) 9786-BC2-124-1-1 and BRR1 dhan98/ BR(Bio)9786-BC2-49-1-2) and total 256 were harvested. Forty four anther culture derived lines were grown in as OT 23 lines were selected for PYT. For developing photosensitive rice variety, 64 plants were selected for further evaluation. Besides, six and 20 lines were selected from two OT for further evaluation. For the development of Boro rice variety five crosses were made and 513 F₁ seeds were harvested. 215 anther culture derived plant were selected from three cross combinations and twenty (20) homozygous lines were selected from the cross combination of BRR1 dhan48/BR(Bio)9786-BC2-49-1-2. Besides twenty and 27 promising advanced lines were selected OT and tow PYT. A total 174 SCV₅ were selected for the development of antioxidant enriched black rice. A total 25 SCV₀ were regenerated from Selasih-SCV14-12-2 and SCV₁ seed were harvested. Three hundred and twenty six somaclonal variants (SCV₃) of Kalijira were harvested from 126 SCV₂ lines. Seed culture was done by using seeds of Kataribhog, Tulshimala, Radhunipagol & Shakkhorkhana to create somaclonal variations. A total 57 plants were regenerated and seeds were harvested from these plants. In a total 29 plants from BRR1 dhan28/*O. glaberrima* (IRGC105190), BRR1 dhan87/*O. glaberrima* (IRGC105190) and BRR1 dhan48/*O. glaberrima* (IRGC105190) were evaluated in Boro 2022-23. Among them 44 plants were selected. Thirty (30) plants from backcross progeny of different wide-cross were evaluated in Boro 2022-23. Among them 11 plants were selected. Five lines derived from wide cross of BRR1 dhan28/*O. nivara* (IRGC103821) were evaluated as PYT in Boro 2022-23 and 3 lines were selected depending on the duration and yield. Besides, A total of 276 plants were selected from five wide cross populations. One hundred and eighty two F₆ progenies were selected based on aroma, growth duration and plant height from the cross between BRR1 dhan87 and Kalijira for the development of high yielding aromatic rice. All tested aromatic lines were confirmed by functional marker of fragrance gene *BADH2* in early generation. A three way cross, two doubled cross and six crosses were done for the development of submergence tolerant aromatic rice and 522 F₁ seed were harvested. For development of both BB and blast resistant lines four crosses were made and F₃ seeds were harvested from 4 populations. Heading dates for short days were scored for each and for long days for association mapping for rice photosensitivity. BRR1 dhan29 was transformed with salt tolerant genes (*GlyI* and *GlyII*) and 17 fixed lines were harvested from T₅ plants. *AeMDHAR* salt tolerant gene (from mangrove plant) containing transgenic plant was crossed with BRR1 dhan28 to introgress *AeMDHAR* gene. Three BC₂F₃ plants of BRR1 dhan28 were harvested for further evaluation. Besides, *AeMDHAR* containing transgenic plant was crossed with BRR1 dhan92 and 81 F₁ seed were harvested. For deactivate the function of *BADH2* gene, guide sequence of *BADH2* was cloned in binary vector pRGEB31 and confirmed by PCR. Total number of 7000 M4 lines Kaoun (*Setaria italica*) have been developed for identification of major regulators for C4 rice. These lines are gradually raised, subjected to CO₂ stress in low concentration (20 ppm) CO₂ chamber for 72 hours and high-throughput screened for loss of C4 functions. So

far, 291 M4 lines have been screened and three among them is seemed to have lost C4 properties. During Aus 2022, 20 fixed lines of EMS treated mutants of BRRI dhan48 were evaluated as OT and seven lines were selected for further evaluation. During T Aman 2022, 200 EMS treated mutant lines of BR11 was evaluated and 200 plants were selected. During Boro 2022-23, 50 fixed mutant lines of BR11 were evaluated as OT and 12 lines were selected for further evaluation. Thirty one lines (M₃) were transplanted in Boro 2022-23 and hundred (100) plants were selected for further evaluation to reduce sterility of BRH-11-9-11-4-5B. One hundred and sixty eight, 6 and 31 M₃ populations were selected from the mutant population of Kilijira, Kataribhog and Tulshimala, respectively. Sixty M₃ plants of BRRI dhan87 were selected to develop high yielding sheath blight resistant rice variety. For kernel elongation study, sixty four selected genotypes were grown in T Aman, 2022 and seed were harvested from single plant to make genetic purity. These pure seeds were grown in net house and purified seed from single hill were harvested for further analysis.

Transferable Technology

BRRI dhan103: A high yielding T Aman rice variety. It was approved by National Seed Board of Bangladesh in December 2022. BRRI dhan103 was derived from the breeding line BR(Bio)8961-AC26-16. The breeding line was developed from a cross between BRRI dhan29 and FL378 followed by anther culture. The growth duration of BRRI dhan103 is 128-133 days. Average height of BRRI dhan103 is 125 cm with a sturdy culm and broad, erect, non-senescent flag leaves. The grains are long slender, 1000 grain weight is 23.7g. The grain amylose content is 24%. The average yield is 6.2 t/ha with the potential to deliver up to 8.0 t/ha with proper management.

Introduction

Biotechnology division has been working for developing modern rice varieties as well as basic information using different biotechnological tools since its inception. Its major thrust includes the development of high yielding rice genotypes having different stress tolerance and nutritional quality. During the reporting period, this division done 24 experiments on rice anther culture, somaclonal variation, wide hybridization, genetic transformation, marker assisted selection (MAS), gene pyramiding, gene cloning, genome editing under eight (8) different projects.

Project I: Development of Doubled Haploid Rice Variety through Anther Culture

General Objective: To develop high yielding rice varieties with desired traits.

Experiment 1.1: Low glycemic index (GI) rice variety development

Activity 1.1.1: Secondary yield trial (SYT) of low glycemic index (GI) rice genotypes

Specific Objective: To evaluate initial yield potential of advanced breeding lines in replicated trials.

Materials and methods: During T Aman 22, five doubled haploid lines derived from a cross between BRRI dhan29 and Kanaklata were grown in a SYT with standards checks. Each entry was grown in a 5.4 m × 8 rows having 25 cm × 15 cm spacing using single seedling/hill with three replications. Fertilizer was applied at 92:12:41:10:1.8 of N, P, K, S and Zn kg/ha, respectively. Standard agronomic practices were followed.

Results and discussion: During T Aman22, five doubled haploid lines derived from a cross between BRRI dhan29 and Kanaklata were grown in a SYT. Among them three lines were selected depending on the growth duration and yield compare with the check variety (Table 1 and Fig. 1).

Table 1. Agronomic characteristics of anther culture derived materials. SYT-1, T. Aman/2022

Sl. No.	Designation	Plant Height (cm)	Growth Duration (days)	Yield (t/ha)	Remarks
1	BR(Bio)10381-AC11-7-1	128	123	7.08	Amylose content 19-22%
2	BR(Bio)10381-AC11-8-1	116	100	3.65	
3	BR(Bio)13031-AC1-2	108	108	6.04	
4	BR(Bio)10381-AC30-2	112	108	4.07	
5	BR(Bio)10381-AC11-1	116	108	6.15	
6	BRRRI dhan71(ck)	130	115	6.10	-
7	BRRRI dhan87(ck)	123	123	5.56	lodging
	CV (%)			4.58	
	LSD (0.05)			0.44	

Bold = Selected



Figure.1 Field view of BR(Bio)10381-AC11-7-1 during T Aman 2022

Principal Investigator: Jannatul Ferdous,

Co-Investigators: Shahanaz Sultana and Md. Enamul Hoque.

Experiment 1.2: Development of premium quality rice variety through anther culture

Specific Objective: To develop high yielding premium quality rice lines through anther culture.

Materials and methods: DH plants from BRRRI dhan90/Kataribhog cross were evaluated during T. Aman 2022. Four (4) double haploid Plants from BRRRI dhan38/Bashful (Acc. No. 3954) were evaluated in Boro 2022-23. Eighty One (81) double haploid plants from cross of BRRRI dhan50/Bashful (Acc. No. 3954) were evaluated in Boro 2022-23.

Result and Discussion: DH plants from BRRRI dhan90/Kataribhog cross were evaluated during T. Aman 2022. Among them 33 fixed lines were selected. Four (4) double haploid Plants from BRRRI dhan38/Bashful (Acc. No. 3954) were evaluated in Boro 2022-23. Among them 08 plants were selected for generation advancement. Eighty One (81) double haploid plants from cross of BRRRI dhan50/Bashful (Acc. No. 3954) were evaluated in Boro 2022-23. Among them 160 plants were selected for generation advancement.

Principal Investigator: Nilufar Yasmin Shaikh

Co-Investigators: Ripon Kumar Roy, S M Hisam Al Rabbi

Experiment: 1.3 Antioxidant enriched black rice development through anther culture

General Objective: To develop high yielding Antioxidant enriched black rice.

Activity 1.3.1: Regional yield trial (RYT)

Specific Objective: To evaluate advanced rice lines for specific and general adaptability at the regional level.

Material and methods: Five doubled haploid homozygous advanced breeding lines were evaluated in Boro 2022-23 as RYT. Each progeny were grown in a 5.4 m X 12 rows using single seedling/hill in three replications at different regional station of BRRI. RCBD was followed for this experiment. Fertilizer was applied at 137:17.5:62:10:2.25 of N, P, K, S and Zn kg/ha, respectively. Standard agronomic practices were followed.

Results and discussion: During Boro 2022-23 five advanced breeding lines were evaluated at nine regional stations and among them three were selected for ALART (Table 2 and Fig. 2). Physical, chemical and cooking properties of advanced breeding lines are presented in Table 3.

Table 2. Agronomic characteristics and total antioxidant content of anther culture derived advanced lines. RYT, Boro 2022-23

Designation	PH (cm)	GD (da)	Yield (t/ha)										Total Antioxidant		
			Gaz	Cu	Bari	Gop	Son	Sira	Raj	Kus	Satk	Avg.	TPC (mg GAE/100g)	TAC (uM AAE/100g)	FRAP (uM AAE/100g)
BR(Bio)13028-AC24-1-2	113	145	7.01	6.28	5.20	7.23	6.26	6.95	7.54	4.33	5.14	6.22	39.98	542.81	132.25
BR(Bio)13028-AC24-2-3	98	145	6.28	5.67	3.80	6.02	5.93	6.95	5.36	3.39	5.30	5.41	34.23	536.61	154.91
BR(Bio)13028-AC24-2-4	99	141	5.28	6.42	3.80	6.28	4.72	6.09	6.62	3.96	4.84	5.33	59.64	611.05	198.69
BR(Bio)13028-AC24-3-3	104	143	6.01	6.39	4.80	6.71	6.25	5.91	6.3	3.8	5.23	5.71	32.96	541.17	136.47
BR(Bio)13028-AC11-3-1	97	143	5.43	5.26	5.10	6.31	5.77	6.01	6.47	4.77	5.81	5.66	-	-	-
BRRIdhan86	90	141	5.42	6.54	4.20	6.56	5.73	6.91	6.36	5.63	6.91	6.03	18.32	235.61	98.47
BRRIdhan96	89	141	7.01	6.69	4.60	6.85	6.59	7.04	6.66	6	6.94	6.49	20.89	356.07	106.48
CV (%)			14.8	5.7	5.40	8.6	7.9	4.5	10.7	6.3	6.1	14.8			
LSD (0.05)			ns	0.62	0.47	ns	0.83	0.53	ns	ns	ns	ns			

Bold = Selected, TPC= total phenolic compound, TAC= total antioxidant capacity, FRAP= Ferric reducing antioxidant power assay

Table 3. Physical, Chemical and cooking properties of selected anther culture derived advanced lines. RYT, Boro 2022-23

Designation	Milled rice (%)	Head rice (%)	Appearance	Milled rice length (mm)	L/B ratio	Size & Shape	1000 grain wt. (g)	Amylose content (%)	Protein content (%)	ER	I R
BR(Bio)13028-AC24-1-2	70.0	63.0	Fair	6.62	3.4	LS	20.3	21.0	7.8	1.4	4.1
BR(Bio)13028-AC24-2-3	69.0	65.0	Fair	5.98	3.4	MS	17.8	22.0	8.5	1.4	4.3
BR(Bio)13028-AC24-2-4	72.0	66.0	Good	6.23	3.3	LS	19.8	22.0	8.8	1.3	4.7
BR(Bio)13028-AC24-3-3	70.0	63.0	Fair	6.14	3.3	LS	21.2	22.0	8.0	1.3	4.8
BRRIdhan86	72.0	53.0	V.Good	6.31	3.6	LS	21.0	26.0	7.8	1.4	4.8
BRRIdhan96	70.0	31.0	Good	5.06	2.4	MB	18.4	27.0	9.8	1.6	4.8



Figure 2. Field view of BR(Bio)13028-AC24-1-2 during Boro 2022-23

Principal Investigator: Jannatul Ferdous

Co-Investigators: Shahanaz Sultana and Md. Enamul Hoque.

Activity 1.3.2: Preliminary yield trial (PYT) of antioxidant enriched black rice lines

Specific Objective: To evaluate initial yield potential of advanced breeding lines developed through anther culture in replicated trials.

Materials and methods: During T Aman22, twelve doubled haploid lines derived from a cross between BRR1 dhan28 and Padi Kool were grown in a PYT with standard checks. Each entry was grown in a 5.4 m × 8 rows having 25 cm × 15 cm spacing using single seedling/hill with three replications. Fertilizer was applied at 92:12:41:10:1.8 of N, P, K, S and Zn kg/ha, respectively. Standard agronomic practices were followed. During Boro 2022-23, a total of 13 double haploid lines were grown as PYT with standard checks. Each entry was grown in a 5.4m × 8 rows having single seedling/hill at 25 cm × 15 cm spacing. Fertilizer was applied at 137:17.5:62:10:2.25 of N, P, K, S and Zn kg/ha, respectively. Standard agronomic practices were followed.

Results and discussion: During T Aman 22, twelve doubled haploid lines derived from a cross between BRR1 dhan28 and Padi Kool were grown in a PYT. Among them seven lines were selected depending on the growth duration and yield compared with the check variety (Table 4 and Fig.3). During Boro 2022-23, a total of 13 double haploid were evaluated as PYT. Among them six lines were selected depending on the growth duration, yield performance and grain color for further evaluation (Table 5).

Principal Investigator: Jannatul Ferdous

Co-Investigators: Shahanaz Sultana and Md. Enamul Hoque.

Table 4. Agronomic characteristics of anther culture derived advanced lines. PYT-1, T. Aman/2022

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)13028-AC24-5-1-4	132	106	4.35
2	BR(Bio)13028-AC24-5-2-1	120	111	4.38
3	BR(Bio)13028-AC24-5-3-5	120	105	5.37
4	BR(Bio)13028-AC24-5-4-3	120	106	5.63
5	BR(Bio)13028-AC24-5-4-4	113	107	5.02
6	BR(Bio)13028-AC24-5-5-1	144	108	3.11
7	BR(Bio)13028-AC24-5-5-2	103	107	5.31
8	BR(Bio)13028-AC24-7-1-3	98	108	4.49

Cont.

Sl. No.	Designation	Plant Height (cm)	Growth Duration (days)	Yield (t/ha)
9	BR(Bio)13028-AC24-7-3-4	127	113	4.78
10	BR(Bio)13028-AC24-7-6-2	121	117	4.80
11	BR(Bio)13028-AC24-8-2 -3	118	112	5.35
12	BR(Bio)13028-AC15-2-4-1	113	108	5.39
13	BRRi dhan71(ck)	122	113	4.29
14	BRRi dhan87(ck)	129	123	5.88
CV (%)				5.88
LSD(0.05)				0.48

Bold = Selected



Figure. 3 Field view of BR(Bio)13028-AC24-7-1-3 (plant height 98 cm) during T Aman 2022

Table 5. Agronomic characteristics of anther culture derived advanced lines. PYT, Boro 2022-23

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)13029-AC2-2-2	120	142	4.94
2	BR(Bio)13029-AC6-2-6	104	143	5.17
3	BR(Bio)13029-AC6-3-2	146	141	4.75
4	BR(Bio)13028-AC1-2-2	128	140	3.99
5	BR(Bio)13028-AC1-2-3	114	145	4.13
6	BR(Bio)13028-AC1-2-4	108	142	6.51
7	BR(Bio)13028-AC1-2-7	115	148	5.83
8	BR(Bio)13028-AC2-2-2-1	107	152	5.77
9	BR(Bio)13028-AC2-2-2-3	141	142	3.90
10	BR(Bio)13030-AC5-2-1	127	140	5.33
11	BR(Bio)13030-AC13-2-2	102	143	5.21
12	Lansan-2-1	140	139	3.94
13	Lansan-2-2	126	142	5.01
14	BRRi dhan86(CK)	88	144	4.84
15	BRRi dhan96(CK)	89	142	6.11
CV (%)		-	-	10.27
LSD(0.05)		-	-	0.86

Bold = Selected

Activity 1.3.3: Observational yield trial (OT) of antioxidant enriched black rice genotypes

Specific Objective: To evaluate initial yield potential of advanced breeding lines

Materials and methods: During T Aman 22, a total of 16 double haploid lines were grown as OT with standard checks. Each entry was grown in a 5.4m × 4 rows having single seedling/hill at 25 cm × 15 cm spacing. Fertilizer was applied at 92:12:41:10:1.8 of N, P, K, S and Zn kg/ha, respectively. Standard agronomic practices were followed. During Boro 2022-23, a total of 21 double haploid lines were grown as OT with standard checks. Each entry was grown in a 5.4m × 4 rows having single seedling/hill at 25 cm × 15 cm spacing. Fertilizer was applied at 137:17.5:62:10:2.25 of N, P, K, S and Zn kg/ha, respectively. Standard agronomic practices were followed.

Results and discussion: During T Aman22, a total of 16 double haploid lines were evaluated as OT. Among them six lines were selected depending on the growth duration, yield and grain color with checks for further evaluation (Table 6). During Boro 2022-23, a total of 21 double haploid were evaluated as OT. Among them eight lines were selected depending on the duration, yield and grain color for further evaluation (Table 7).

Principal Investigator: Jannatul Ferdous,

Co-Investigators: Shahanaz Sultana and Md. Enamul Hoque.

Table 6. Agronomic characteristics of anther culture derived advanced lines. OT-1, T. Aman/2022

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)13030-AC4-1-1-2	158	105	4.11
2	BR(Bio)13030-AC4-1-1-3	114	106	4.72
3	BR(Bio)13030-AC4-1-1-4	119	108	4.28
4	BR(Bio)13030-AC4-1-1-6	106	108	3.09
5	BR(Bio)13030-AC3-1-2-1	153	112	4.23
6	BR(Bio)13030-AC3-1-3-1	113	109	2.84
7	BR(Bio)13030-AC6-1-1-1	127	105	3.52
8	BR(Bio)13030-AC6-1-1-2	124	108	3.86
9	BR(Bio)13030-AC7-1-1-1	119	109	4.54
10	BR(Bio)13030-AC7-1-1-2	130	105	3.86
11	BR(Bio)13029-AC1-2-1-1	124	104	3.66
12	BR(Bio)13029-AC3-1-1-1	130	112	4.33
13	BR(Bio)13029-AC3-1-2-3	127	106	3.10
14	BR(Bio)13029-AC3-1-2-4	120	110	4.72
15	BR(Bio)13029-AC3-1-3-1-1	119	112	4.82
16	BR(Bio)13029-AC3-1-3-1-2	119	108	4.27
17	BRRRI dhan71(ck)	119	113	5.23
18	BRRRI dhan87 (Ck)	122	125	5.30

Bold = Selected

Table 7. Agronomic characteristics of anther culture derived advanced lines. OT, Boro 2022-23

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)13028-AC24-4-4-2	114	145	5.15
2	BR(Bio)13028-AC24-5-2-2	122	142	5.69
3	BR(Bio)13028-AC11-2-1-1	118	141	5.65
4	BR(Bio)13028-AC11-2-2-3	117	143	7.68
5	BR(Bio)13028-AC15-1-1-1	98	148	4.51
6	BR(Bio)13028-AC15-3-1-2	109	143	5.78
7	BR(Bio)13028-AC24-3 -2-2	127	141	4.87
8	BR(Bio)13028-AC24-3 -2-3	120	145	4.67
9	BR(Bio)13028-AC24-3 -2-4	104	143	5.34
10	BR(Bio)13028-AC24-3-5-1	109	141	6.37
11	BR(Bio)13028-AC24-4-2-2	108	142	6.64
12	BR(Bio)13028-AC24-4-2-3	109	144	3.95
13	BR(Bio)13028-AC24-4-3-3	116	141	7.94
14	BR(Bio)13028-AC24-4-3-4	100	145	4.55
15	BR(Bio)13028-AC24-4-4-2	108	143	5.05
16	BR(Bio)13028-AC24-5-2-4	103	150	6.15
17	BR(Bio)13030-AC 1-2-3	107	143	6.65
18	BR(Bio)13030-AC 2-2-1	110	145	5.31
19	BR(Bio)13030-AC 6-3-1	105	142	5.86
20	BR(Bio)13030-AC 6-4-1	110	141	7.47
21	BR(Bio)13028- AC1-2-3	114	143	4.27
22	BRRRI dhan86	91	143	5.53

Bold = Selected

Experiment 1.4: Development of high yielding Aus rice variety

General Objective: To develop transplanted Aus Rice variety

Activity: 1.4.1 Hybridization

Specific Objective: To generate F₁ seeds for anther culture.

Materials and methods: In the Aus 2022-23 season, two crosses (Table 8) were made using four parents.

Result and discussion: 132 F₁ seeds from the cross BRRRI dhan48/BR(Bio)9786-BC2-124-1-1 and 124 seeds from BRRRI dhan98/ BR(Bio)9786-BC2-49-1-2 were produced.

Table 8. List of cross combinations.

Sl. No.	Cross Combination	No of seeds
1	BRRRI dhan48/BR(Bio)9786-BC2-124-1-1	132
2	BRRRI dhan98/BR(Bio)9786-BC2-49-1-2	124
Total		256

Principal Investigator: Ripon Kumar Roy

Co-Investigators: S.M. Hisam Al Rabbi, Nilufar Yasmin Shaikh, Md. Arafat Hossain, Shampa Das Joya

Activity 1.4.2: Observational yield trial (OT) of the advanced lines

Specific Objective: To evaluate the agronomic performance of the advanced lines.

Materials and methods: In the Aus 2022-23 season, 44 anther culture derived lines were grown in an OT with standard checks. Each entry was grown in 5.4 m × 4 rows with 20 cm ×

20 cm spacing. A single seedling was transplanted for each hill. Standard agronomic management practices followed in the cultivation period.

Results and discussion: Twenty-three doubled haploid lines were selected for the preliminary yield trial based on phenotypic acceptance, growth duration, and yield. (Table 9).

Principal Investigator: Ripon Kumar Roy

Co-Investigators: S.M. Hisam Al Rabbi, Nilufar Yasmin Shaikh, Md. Arafat Hossain, Shampa Das Joya

Table 9. Agronomic characteristics of selected anther culture-derived lines. OT, T. Aus 2022

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)15085-AC2-3	121	100	5.65
2	BR(Bio)15085-AC2-8	116	108	5.66
3	BR(Bio)15085-AC2-9	122	107	5.79
4	BR(Bio)15085-AC2-10	114	112	5.67
5	BR(Bio)15085-AC6-6	127	112	6.12
6	BR(Bio)15085-AC6-10	120	109	5.69
7	BR(Bio)15085-AC6-12	111	110	5.87
8	BR(Bio)15086-AC11-5	108	110	5.90
9	BR(Bio)15086-AC11-7	108	108	5.64
10	BR(Bio)15086-AC11-9	107	110	5.70
11	BR(Bio)15086-AC15-4	111	110	5.57
12	BR(Bio)15086-AC15-5	115	112	5.77
13	BR(Bio)15086-AC15-6	118	112	5.66
14	BR(Bio)15086-AC16-9	114	110	5.73
15	BR(Bio)15086-AC17-8	110	110	5.86
16	BR(Bio)15086-AC16-10	119	111	5.95
17	BR(Bio)15086-AC18-11	120	109	5.87
18	BR(Bio)15086-AC16-14	115	113	5.95
19	BR(Bio)15086-AC50-6	106	110	5.82
20	BR(Bio)15086-AC51-6	103	110	6.18
21	BR(Bio)15086-AC51-7	107	111	5.72
22	BR(Bio)15086-AC114-8	115	110	5.90
23	BR(Bio)15086-AC118-14	130	110	5.61
24	BRRI dhan48 (CK)	103	106	4.95
25	BRRI dhan98 (CK)	104	113	5.55

Experiment 1.5: Photosensitive rice variety development

General Objective: i. To develop photosensitive rice having the taller seedling capability

ii. To develop photosensitive rice having the standard seedling capability

Activity 1.5.1: Progeny Selection

Specific Objective: To select the best plants having taller seedling capabilities

Materials and methods: Forty-eight (48) advanced lines having taller seedling capabilities were grown in Aman 2022. A single seedling was transplanted for each hill with 20 cm × 20 cm spacing. Standard agronomic management practices followed in cultivation time.

Result and Discussion: Sixty-four plants were selected for further evaluation.

Principal Investigator: Ripon Kumar Roy

Co-Investigators: S.M. Hisam Al Rabbi, Nilufar Yasmin Shaikh, Md. Arafat Hossain, Shampa Das Joya

Activity 1.5.2: Observational yield trial (OT) of the advanced lines

Specific Objective: To evaluate the yield potential of advanced lines having the standard seedling capability.

Materials and methods: Twenty-five (25) advanced lines were grown. A single seedling was transplanted for each hill with 20 cm × 20 cm spacing. Standard agronomic management practices followed in cultivation time.

Result and Discussion: Six (6) lines were selected (Table 10) for further evaluation.

Table 10. Agronomic characteristics of selected anther culture derived lines in OT-2, Aman/2022

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)8033-AC5-1-1-HR1	121	137	5.79
2	BR(Bio)8033-AC5-1-1-HR2	120	136	5.51
3	BR(Bio)8033-AC5-1-2-HR1	122	135	5.60
4	BR(Bio)8033-AC5-1-2-HR2	121	136	5.39
5	BR(Bio)8033-AC7-1-1-HR1	123	137	5.62
6	BR(Bio)8033-AC7-1-1-HR2	122	135	5.43
7	BRRI dhan76 (CK)	140	149	4.48
8	Sada Mota (Local CK)	160	153	4.07

Principal Investigator: Ripon Kumar Roy

Co-Investigators: S.M. Hisam Al Rabbi, Nilufar Yasmin Shaikh, Md. Arafat Hossain, Shampa Das Joya

Activity 1.5.3: Observational yield trial (OT) of the advanced lines

Specific Objective: To evaluate the yield potential of advanced lines having the standard seedling capability.

Materials and methods: Thirty-five (35) advanced lines were grown in an observation yield trial (OT) in Aman 2022. A single seedling was transplanted for each hill with 20 cm × 20 cm spacing. Standard agronomic management practices followed in the cultivation period.

Result and Discussion: Twenty (20) promising advanced lines were selected (Table 11) for further evaluation based on phenotypic acceptance, growth duration, and yield.

Principal Investigator: Ripon Kumar Roy

Co-Investigators: S.M. Hisam Al Rabbi, Nilufar Yasmin Shaikh, Md. Arafat Hossain, Shampa Das Joya

Table 11. Agronomic characteristics of selected advanced lines in OT-1, Aman/2022

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)15086-AC101-4-1	102	115	6.45
2	BR(Bio)15086-AC101-4-2	103	114	6.46
3	BR(Bio)15086-AC101-4-3	109	120	6.70
4	BR(Bio)15086-AC101-4-4	111	119	6.67
5	BR(Bio)15086-AC102-5-1	114	119	6.83
6	BR(Bio)15086-AC102-5-2	111	120	6.88
7	BR(Bio)15086-AC105-6-1	113	123	7.25
8	BR(Bio)15086-AC105-6-2	112	125	7.30
9	BR(Bio)15086-AC112-7-1	116	123	6.60
10	BR(Bio)15086-AC112-7-2	117	122	6.80
11	BR(Bio)15086-AC112-8-1	112	118	7.06
12	BR(Bio)15086-AC112-8-2	114	119	7.15
13	BR(Bio)15086-AC114-8-1	118	122	7.25

Cont.

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
15	BR(Bio)15086-AC116-9-2	114	117	6.47
16	BR(Bio)15086-AC116-10-1	115	114	6.44
17	BR(Bio)15086-AC118-14	119	121	6.98
18	BR(Bio)15086-AC118-15	118	122	7.15
19	BR(Bio)15086-AC119-16	117	120	7.30
20	BR(Bio)15086-AC120-18	119	122	7.18
21	BRRRI dhan87 (CK)	120	128	6.52

Experiment 1.6: Development of high-yielding Boro rice variety

General Objective: Developing high-yielding Boro rice

Activity 1.6.1 Hybridization for the favorable ecosystem of Boro Rice using anther culture techniques

Specific Objective: To generate F₁ seeds for anther culture

Materials and methods: In the Boro 2022-23, six crosses were made using nine parents.

Result and Discussion: A total of season 513 F₁ seeds were produced from the five crosses (Table 12)

Table 12. List of cross combinations.

SL NO.	Cross Combination	No of seeds
1	BR(Bio)9786-BC2-80-1-1/ BR(Bio)9787-BC2-203-1-3	105
2	BR(Bio)9786-BC2-49-1-2/BRRRI dhan50	116
3	BRRRI dhan92/ BR(Bio)9787-BC2-35-4-2	88
4	BRRRI dhan89/Amey dhan (Pahari dhan)	47
5	BRRRI dhan92/Dhul Kamrang (Pahari dhan)	55
6	BRRRI dhan86/BR(Bio)9786-BC2-124-1-1	92
Total		513

Principal Investigator: Ripon Kumar Roy

Co-Investigators: S.M. Hisam Al Rabbi, Nilufar Yasmin Shaikh, Md. Arafat Hossain, Shampa Das Joya

Activity 1.6.2: Progeny selection

Specific objective: To select the desired plants

Materials and methods: 160 Anther cultured derived lines from the cross combination of BRRRI dhan48/BR(Bio)9786-BC2-49-1-2 and 90 lines from BRRRI dhan86/BR(Bio)9786-BC2-49-1-2 were grown. A single seedling was transplanted for each hill with 20 cm × 20 cm spacing. Standard agronomic management practices followed in the cultivation period.

Result and Discussion: 150 plants were selected from the cross combination of BRRRI dhan48/BR(Bio)9786-BC2-49-1-2 {BR(Bio)15086} and 50 from the BRRRI dhan86/BR(Bio)9786-BC2-49-1-2 {BR(Bio)15085}. Twenty (20) homozygous lines from the cross combination of BRRRI dhan48/BR(Bio)9786-BC2-49-1-2 and 15 lines from BRRRI dhan86/BR(Bio)9786-BC2-49-1-2 were selected.

Principal Investigator: Ripon Kumar Roy

Co-Investigators: S.M. Hisam Al Rabbi, Nilufar Yasmin Shaikh, Md. Arafat Hossain, Shampa Das Joya

Activity 1.6.3: Preliminary yield trial (PYT) of the advanced lines

Specific Objective: i. To evaluate the yield potential of short-duration advanced lines.

ii. To evaluate the yield potential of long-duration advanced lines.

Materials and methods: Twenty five (25) short-duration advanced lines were grown in a preliminary yield trial (PYT-1) and 16 long-duration advanced lines were grown in a

preliminary yield trial (PYT-2) in Boro 2022-23. A single seedling was transplanted for each hill with 20 cm × 20 cm spacing. Standard agronomic management practices followed in the cultivation period.

Result and Discussion: Twenty (20) lines were selected from PYT-1 (Table 13) and 13 from PYT-2 (Table 14) for further evaluation based on phenotypic acceptance, growth duration, and yield.

Principal Investigator: Ripon Kumar Roy

Co-Investigators: S.M. Hisam Al Rabbi, Nilufar Yasmin Shaikh, Md. Arafat Hossain, Shampa Das Joya, Sentu Rahman, MA Monsur, MN Islam, MM Rana, T Halder, TK Roy

Table 13. Agronomic characteristics of anther culture derived lines in PYT-1, Boro 2022-23

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)15085-AC1-1	119	155	7.82
2	BR(Bio)15085-AC3-3	121	157	7.91
3	BR(Bio)15085-AC9-1	120	157	7.16
4	BR(Bio)15085-AC27-2	109	155	9.26
5	BR(Bio)15085-AC28-2	108	156	8.92
6	BR(Bio)15085-AC29-1	103	155	8.97
7	BR(Bio)15085-AC38-1	103	152	9.33
8	BR(Bio)15085-AC62-1	105	154	9.06
9	BR(Bio)15085-AC63-1	116	157	7.85
10	BR(Bio)15086-AC11-1	109	152	9.12
11	BR(Bio)15086-AC12-1	111	157	8.43
12	BR(Bio)15086-AC13-2	107	154	9.35
13	BR(Bio)15086-AC14-1	108	157	8.09
14	BR(Bio)15086-AC14-6	107	153	9.40
15	BR(Bio)15086-AC15-1	116	157	8.80
16	BR(Bio)15086-AC16-3-1	106	148	8.35
17	BR(Bio)15086-AC16-3-2	108	149	8.42
18	BR(Bio)15086-AC16-3	110	155	9.16
19	BR(Bio)15086-AC16-4	112	154	9.10
20	BR(Bio)15086-AC58-1	105	158	9.30
21	BR(Bio)15086-AC58-2-2	106	150	8.57
22	BR(Bio)15086-AC58-2-3	107	149	8.45
23	BR(Bio)15086-AC58-2-4	106	149	8.40
24	BB(Bio)15086-AC58-3-6	108	150	8.48
25	BR(Bio)15086-AC59-6	110	159	8.67
26	BRRI dhan58 (CK)	103	158	7.37
27	BRRI dhan89 (CK)	107	164	8.25
28	BRRI dhan92 (CK)	108	166	8.33
29	BRRI dhan96 (CK)	90	149	7.17
	CV	1.13	0.69	3.18
	LSD	2.53	2.22	0.56

Note: Bold-marked genotypes are selected for further evaluation in Boro 23-24. Genotypes will be sub-grouped based on the growth duration. We observed increased growth duration, possibly due to a cold shock after transplanting, especially from 26 December 2022 and onward.

Table 14. Agronomic characteristics of anther culture derived lines in PYT-2, Boro 2022-23

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)15085-AC1-4	111	159	9.21
2	BR(Bio)15085-AC3-14	116	164	8.36
3	BR(Bio)15085-AC9-6	119	160	7.26
4	BR(Bio)15085-AC9-7	116	166	8.03
5	BR(Bio)15085-AC19-1	106	154	8.57
6	BR(Bio)15085-AC21-3	109	154	8.88
7	BR(Bio)15085-AC24-2	119	154	8.32
8	BR(Bio)15085-AC27-3	110	153	8.19
9	BR(Bio)15085-AC29-5	106	158	8.89
10	BR(Bio)15085-AC63-8	110	168	9.07
11	BR(Bio)15085-AC63-9	109	166	8.91
12	BR(Bio)15086-AC13-6	102	166	9.41
13	BR(Bio)15086-AC16-1	107	167	8.52
14	BR(Bio)15086-AC58-3	103	163	8.83
15	BR(Bio)15086-AC58-5	111	149	8.42
16	BR(Bio)15086-AC59-8	106	163	8.78
17	BRRI dhan58(CK)	105	158	7.36
18	BRRI dhan89(CK)	108	163	8.25
19	BRRI dhan92(CK)	107	164	8.41
20	BRRI dhan96(CK)	89	148	7.17
	CV	1.16	0.62	2.48
	LDS	2.62	2.08	0.43

Note: Bold-marked genotypes are selected for further evaluation in Boro 23-24. Genotypes will be sub-grouped based on the growth duration. We observed increased growth duration, possibly due to a cold shock after transplanting, especially from 26 December 2022 onward.

PROJECT II: DEVELOPMENT OF RICE VARIETY THROUGH SOMACLONAL VARIATION

Experiment 2.1: Development of antioxidant enriched black rice

Activity 2.1.1 Progeny selection

Specific Objective: To select the best progenies with high yield and desirable traits.

Materials and methods: Forty seven somaclonal (SCV5) variants of antioxidant enriched black rice Selasih were evaluated as pedigree in T aman 2022. Each pedigree line was grown in a 5.4 m single row using single seedling/hill at 20 cm × 15 cm spacing. Standard checks were planted after every 10th row. Fertilizer was applied at 92:12:41:10:1.8 of N, P, K, S, Zn kg/ha, respectively. During Boro 21-22 season 89 somaclonal (SC5) variants of antioxidant enriched black rice Selasih were evaluated as pedigree. Each pedigree line was grown in a 5.4 m single row using single seedling/hill at 20 cm×15 cm spacing. Standard checks were planted after every 10th row. Fertilizer was applied at 137:17.5:62:10:2.25 of N, P, K, S and Zn kg/ha, respectively in Boro season. Standard agronomic practices were followed in both the seasons.

Results and discussion: A total 105 (SC₅) antioxidant enriched black rice plants of Selasih were selected from 47 lines, during T Aman 2022. On the other hand, during Boro 22-23, 69 (SC₅) antioxidant enriched black rice plants of Padi Kool and Selasih were selected from 89 lines.

Principal Investigator: Jannatul Ferdous

Co-Investigator: Shahanaz Sultana, and Md. Enamul Hoque

Activity 2.1.2: Seed culture of black rice variety**Specific Objective: To develop semi dwarf high yielding black rice variety**

Materials and methods: Mature healthy seeds were manually cleaned and dehusked. Dehusked seeds were then surface sterilized with 70% ethanol for 1 minute followed by washing with sterile water. These seeds were further sterilized with 50 ml 2.5% sodium hypochlorite (v/v) containing 1 drop of Tween 20 for 15 min. This step was repeated once without Tween 20 and then washed five times in sterile water to remove the sodium hypochlorite. Then the sterilized seeds were blotted with a sterilized filter paper and dried. These sterilized seeds were inoculated on callus induction medium (CIM) containing MS basal salts, 2.0 mg/L, 2,4-dichlorophenoxyacetic acid (2,4-D) and 30 g/L sucrose. Finally, calli were transferred to regeneration medium (MS with 4 mgL⁻¹ BAP, 1 mgL⁻¹ Kinetin, and 0.5mgL⁻¹ NAA). After 3 weeks green spots were appeared on the callus surface and within 1 month plantlets were regenerated.

Results and discussion: A total 25 (SC₀) antioxidant enriched black rice plants of Selasih-SC14-12-2 were regenerated and SC₁ seeds were harvested.

Principal Investigator: Jannatul Ferdous

Co-Investigator: Shahanaz Sultana, and Md. Enamul Hoque

Experiment 2.2: Development of premium quality (Kalijira type) variety through somaclonal variation

Specific Objective: To create somaclonal variation towards development of high yielding premium quality (Kalijira type) rice varieties

Materials and methods: During T Aman 2022, Fourteen (14) lines somaclonal variants (SCV₁) of Kalijira rice were grown row using single seedling/hill at 20 cm × 15 cm spacing with three replications. Standard checks were planted after every 10th row. Fertilizer was applied at 92:12:41:10:1.8 of N, P, K, S, Zn kg/ha respectively in T. Aman season. Standard agronomic practices were followed.

Results and discussion One hundred and twenty six (126) somaclonal variants (SCV₂) of Kalijira rice were grown in T Aman 2022 and 326 plants were harvested for further evaluation.

Principal Investigator: Shahanaz Sultana,

Co-Investigator: Jannatul Ferdous and Md. Enamul Hoque

Experiment 2.3: Development of premium quality rice variety through somaclonal variation

Specific Objective: To create somaclonal variation and select rice lines with high yield with desirable traits

Materials and methods: Seeds of Kataribhog, Tulshimala, Radhunipagol & Shakkhorkhana (Local varieties) were used in this experiment. Seed culture was done to create somaclonal variations during T. Aman 2022. Culture Medium consisting of MS basal salts (Murashige and Skoog, 1962) with 2.0 mgL⁻¹ of 2,4-D were used for callus induction and MS media containing 4mg/L BAP + 1.2mg/L NAA + 1.0 mg/L Kinetin were used for plant regeneration.

Results and discussion: In a total 57 plants from Kataribhog (13), Tulshimala (02), Radhunipagol (23) and Shakkhorkhana (19) were regenerated after seed culture. Seeds were harvested from these plants for further evaluation.

Principal Investigator: Nilufar Yasmin Shaikh

Co-Investigator: Ripon Kumar Roy, S M Hisam Al Rabbi

PROJECT III: DEVELOPMENT OF RICE VARIETY THROUGH WIDE HYBRIDIZATION

General Objective: Developing high-yielding Rice

Experiment 3.1: High yielding rice variety through wide hybridization followed by embryo rescue

Activity 3.1.1: Progeny selection

Specific Objective: To select desired plant

Material and methods: In total 29 plants from BRR I dhan28/*O. glaberrima* (IRGC105190), BRR I dhan87/*O. glaberrima* (IRGC105190) and BRR I dhan48/*O. glaberrima* (IRGC105190) were evaluated in Boro 2022-23. Thirty (30) plants from backcross progeny of different wide-cross were evaluated in Boro 2022-23.

Results and discussion: In a total 29 plants from BRR I dhan28/*O. glaberrima* (IRGC105190), BRR I dhan87/*O. glaberrima* (IRGC105190) and BRR I dhan48/*O. glaberrima* (IRGC105190) were evaluated in Boro 2022-23. Among them 44 plants were selected for generation advancement. Thirty (30) plants from backcross progeny of different wide-cross were evaluated in Boro 2022-23. Among them 11 plants were selected for generation advancement.

Principal Investigator: Nilufar Yasmin Shaikh

Co-Investigators: Ripon Kumar Roy, S M Hisam Al Rabbi

Activity 3.1.2: Preliminary Yield Trial (PYT) of lines derived from BRR I dhan28/*O. nivara* (IRGC103821) in Boro 2022-23

Specific Objective: To evaluate initial yield potential of advanced breeding lines in replicated trials

Materials and methods: Five (5) lines derived from wide cross of BRR I dhan28/*O. nivara* (IRGC103821) were evaluated as PYT along with check BRR I dhan96 in Boro 2022-23. Each entry was grown in a 5.4m × 8 rows having 25 cm × 15 cm spacing using single seedling/hill with three replications. Fertilizer was applied at 137:17.5:62:10:2.25 of N, P, K, S and Zn kg/ha, respectively. Standard agronomic practices were followed.

Results and discussion: Five (5) lines derived from wide cross of BRR I dhan28/*O. nivara* (IRGC103821) were evaluated as PYT along with check BRR I dhan96 in Boro 2022-23. Among them 3 lines were selected depending on the duration and yield compare with checks for further evaluation as SYT (Table 15).

Table 15. Agronomic characteristics of lines derived from wide cross of BRR I dhan28/*O. nivara* (IRGC103821) evaluated as PYT in Boro 2022-23

Sl. No.	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR(Bio)13035-ERBC1-6-1 -1	100	145	7.35
2	BR(Bio)13035-ERBC1-6-1 -2	97	146	7.38
3	BR(Bio)13035-ERBC1-6-1 -5	101	145	6.97
4	BR(Bio)13035-ERBC1-6-1 -6	97	147	7.32
5	BR(Bio)13035-ERBC1-6-1 -7	98	146	6.79
6	BRR I dhan96 (Ck)	84	149	7.30
	CV	1.95	0.50	4.27
	LSD	3.19	1.28	0.54

Principal Investigator: Nilufar Yasmin Shaikh

Co-Investigators: Ripon Kumar Roy, S M Hisam Al Rabbi

Activity 3.1.3: Progeny Selection

Specific Objective: To select desired plant

Materials and methods: Five embryos rescued BC₂F₂ populations were grown in T.Aman 2023. A single seedling was transplanted for each hill with 20 cm × 20 cm spacing. Standard agronomic management practices followed in the cultivation period

Result and Discussion: A total of 276 plants (Table 16) were selected from five populations.

Table 16: List of cross combinations

SL	Designation	Generation	No. of plant selection
1	BRRIdhan33*2/O. rufipogon(103404)	ER BC ₂ F ₂	74
2	BRRIdhan11*2/O. rufipogon(103404)	ER BC ₂ F ₂	54
3	BRRIdhan52*2/O. rufipogon(103404)	ER BC ₂ F ₂	32
4	BRRIdhan66*2/O. rufipogon(103404)	ER BC ₂ F ₂	38
5	BRRIdhan39*2/O. rufipogon(103404)	ER BC ₂ F ₂	78
Total			276

Principal Investigator: Ripon Kumar Roy

Co-Investigators: S.M. Hisam Al Rabbi, Nilufar Yasmin Shaikh, Md. Arafat Hossain, Shampa Das Joya

PROJECT IV: MOLECULAR MARKER ASSISTED SELECTION

General Objective: Development of rice variety through molecular marker assisted selection

Experiment 4.1: Marker assisted selection for fragrance in F₅ Population of BRRIdhan87 and Kalijira.

Specific Objective: To develop high yielding aromatic rice

Material and Methods: Seventy two pedigree lines developed from a cross between BRRIdhan87 and Kalijira were grown in the field during T. Aman 2022. Each pedigree line was grown in a 5.4 m single row using single seedling/hill at 20 cm × 15 cm spacing. Standard checks were planted after every 10th row. Fertilizer was applied at 92:12:41:10:1.8 of N, P, K, S, Zn kg/ha, respectively T. Aman season. Standard agronomic practices were followed.

Results and discussion: One hundred and seven (107) pedigree lines developed from a cross between BRRIdhan87 and Kalijira were evaluated as pedigree. Among them 182 plants were selected on the basis of aroma, growth duration and plant height. All tested aromatic lines were confirmed by using functional marker of fragrance gene *BADH2* in early generation. The primers combination of ESP and IFAP amplified the fragrance specific allele at 257 bp. On the other hand, the primers combination of INSP and EAP amplified the expected non-fragrance-specific allele (355 bp).

Principal Investigator: Jannatul Ferdous,

Co-Investigators: S M Hisham Al-Rabbi and Md. Enamul Hoque.

Experiment 4.2: Marker assisted selection for aromatic and submergence tolerance rice genotype

Activity: 4.2.1: Hybridization

Specific Objective: To develop submergence tolerance aromatic genotypes

Materials and methods:

Results and discussion: A three way cross, two doubled crosses and six crosses were done. A total 599 F₁ seeds of different crosses were harvested for further confirmation (Table 17).

Principal Investigator: Jannatul Ferdous

Co-Investigators: Shahanaz Sultana and Md. Enamul Hoque.

Table 17. List of three way cross, doubled crosses and crosses

SL	Three way and doubled crosses	No. of seeds	Remarks
1	BRRi dhan90//BRRi dhan52/kalijira	87	Plants will be Confirmed with functional marker of <i>BADH2</i> gene and <i>SUB1</i> gene
2	BRRi dhan90/Kalijira//BRRi dhan52/Kalijira (SCV26)	39	
3	BRRi dhan90/Kalijira//BRRi dhan52/Kalijira	13	
Crosses			
1	BRRi dhan52/Kalijira	231	Plants will be Confirmed with functional marker of <i>BADH2</i> gene
2	BRRi dhan52/Kataribhog	100	
3	BRRi dhan92/Kalijira	48	
4	BRRi dhan92/BRRi dhan34	1	
5	BRRi dhan89/Kataribhog	30	
6	BRRi dhan89/ Kalijira	50	
	Total	599	

Experiment 4.3: Development of multiple disease resistant (blast and bacterial blight) rice varieties using marker assisted selection

Objective: To introgress bacterial blight (BB) and blast resistant genes in high yielding variety

Activity: 4.3.1: Progeny selection

Specific Objective: To select desired plant with bacterial blight (BB) and blast resistant genes

Materials and methods: Plant from four crosses such as BR(Bio)11447-1-28-14-3/ IR64Pi9 (L), BR(Bio)11447-1-28-14-3/ IR64Pi9 (E), BR(Bio)11447-3-10-7-1/ IR64Pi9 (L), BR(Bio)11447-3-10-7-1/IR64Pi9 (E) were grown to select desired plants.

Results and discussion: To develop multiple disease resistant (blast and bacterial blight) rice varieties F₁ plants of four crosses such as BR(Bio)11447-1-28-14-3/ IR64Pi9 (L), BR(Bio)11447-1-28-14-3/ IR64Pi9 (E), BR(Bio)11447-3-10-7-1/ IR64Pi9 (L), BR(Bio)11447-3-10-7-1/ IR64Pi9 (E) were grown and F₃ seeds were harvested from four lines (Table 18).

Table 18. List of cross combination

SL no	Crosses	No. of selected plant
1	BR(Bio)11447-3-10-7-1/IR64Pi9(L)	3
2	BR(Bio)11447-1-28-14-3/IR64Pi9(L)	2
3	BR(Bio)11447-1-28-14-3/IR64Pi9(E)	3
4	BR(Bio)11447-3-10-7-1/IR64Pi9(E)	2

Principal Investigator: Jannatul Ferdous

Co-Investigators: Shahanaz Sultana and Md. Enamul Hoque, Ashik Ikbal Khan.

Experiment 4.4: Association mapping for rice photosensitivity

Specific Objective: To identify genomic location controlling photosensitivity

Materials and methods: An association mapping panel of 159 was raised in two replications in short-day and long day conditions. Heading dates for short days were scored for each and for long days are under way.

Results and discussion: Heading dates for short days were scored for each and for long days are under way.

Principal Investigator: S.M. Hisam Al Rabbi,

Co-Investigators: Md. Arafat Hossain, Ripon Kumar Roy, Md. Sentu Rahman, and Munnujan Khanam

Project V: RICE GENETIC ENGINEERING

General Objective: Development of stress tolerant transgenic rice variety.

Experiment 5.1: Development of salt tolerant transgenic rice with *GlyI* and *GlyII*

Specific objective: To develop salt tolerant transgenic rice lines.

Material and methods: Rice genotype BRR1 dhan29 was used as plant material and salt tolerant genes *GlyI* (*Glyoxalase I*) and *GlyII* (*GlyoxalaseII*) were used to make the rice variety salt tolerant through *Agrobacterium*-mediated transformation method. BRR1 dhan29 was transformed with salt tolerant genes (*GlyI* and *GlyII*). T₅ progenies were grown in the transgenic green house following standard agronomic management practices in the cultivation period.

Results and discussion: After transformation with *GlyI* and *GlyII* genes, plants were confirmed by *GlyI* and *GlyII* primers and sequencing. T₅ progenies were grown in the transgenic green house and seeds of homozygous line were collected for further molecular study.

Principal Investigator: Shompa Das Joya

Co-Investigator: Ripon Kumar Roy, S.M Hisam Al Rabbi and Md. Arafat Hossain,

Experiment 5.2: Introgression of salt tolerant mangrove gene

Specific Objective: To develop salt tolerant transgenic rice lines

Material and methods: Transgenic plant containing mangrove salt tolerant gene, *AeMDHAR* was crossed with BRR1 dhan28 and BRR1 dhan92 for the introgression of salt tolerant gene *AeMDHAR*

Results and discussion: *AeMDHAR* salt tolerant gene (from mangrove plant) containing transgenic plant was crossed with BRR1 dhan28 to introgress *AeMDHAR* salt tolerant gene. Three BC₂F₃ plants of BRR1 dhan28 were harvested for further evaluation. Besides, *AeMDHAR* salt tolerant gene (from mangrove plant) containing transgenic plant was crossed with BRR1 dhan92 to introgress *AeMDHAR* salt tolerant gene. Eighty one F₁ seed were harvested.

Principal Investigator: Shahanaz Sultana,

Co-Investigator: Shampa Das Joya, Jannatul Ferdous and Md. Enamul Hoque.

Experiment 5.3: Development of high yielding aromatic rice lines through genome editing

Specific Objective: To develop high yielding aromatic rice lines using CRISPR-Cas9 technology.

Materials and methods: For deactivate of function of *BADH2* gene, two primer were designed for construct preparation. Vector pRGEB31 was used in this experiment.

Results and discussion: DNA was extracted from the vector pRGEB31. Both primer and vector DNA were digested with *BsaI* and ligated for construct preparation and confirmed by PCR followed by transformation into *Agrobacterium*.

Principal Investigator: Shahanaz Sultana,

Co-Investigator: Jannatul Ferdous, S.M Hisam Al Rabbi, Shampa Das Joya, Md. Enamul Hoque, Hirendro Nath Barman

PROJECT VI: C4 RICE DEVELOPMENT

General Objective: To develop C4 rice line

Experiment 6.1: Identification of major regulators for C4 rice

Specific Objective: To develop C4 rice line

Materials and methods: This study is a background work for identifying major genes controlling C4 photosynthetic property. *Setaria italica* (Kaoun), being a C4 crop was chosen for this study since this is a C4 crop having comparatively smaller size and short life span. Therefore, we can handle more plants in small areas. Also more generations can be carried out in shorter time. Generation advancement for high-throughput screened for loss of C4 functions.

Results and discussion: Total number of 7000 M4 lines Kaoun (*Setaria italica*) have been developed for further study. These lines are being raised for screening out plants losing C4 properties. For this the plants will be subjected to CO₂ stress in low concentration (20 ppm) CO₂ chamber for 72 hours and high-throughput screened for loss of C4 functions. So far, 291 M4 lines have been screened and three among them is seemed to have lost C4 properties. This line is being maintained very carefully for further study.

Principal Investigator: S. M. Hisam Al Rabbi,

Co-Investigator: Ripon Kumar Roy, Munnujan Khanam, Sazzadur Rahman

PROJECT VII: DEVELOPMENT OF RICE VARIETY THROUGH MUTATION

General Objective: To develop high yielding and premium quality rice

Experiment 7.1: High yielding T Aman, Boro and Aus rice varieties

Activity 7.1.1: Observational yield trial (OT) of mutant BRRI dhan48 in Aus season

Specific Objective: To evaluate initial yield potential of advanced breeding lines

Materials and methods: During Aus 2022, 20 fixed lines of EMS treated variants of BRRI dhan48 were grown as OT with check variety BRRI dhan48. Each entry was grown in a 5.4m × 4 rows having single seedling/hill at 20 cm × 15 cm spacing. Fertilizer was applied at 60:40:40:10:4 of N, P, K, S, Zn kg/ha respectively. Standard agronomic practices were followed.

Results and discussion: During Aus 2022, 20 fixed lines of EMS treated variants of BRRI dhan48 were evaluated as OT with check variety BRRI dhan48 (Table 19). Among them seven lines were selected for further evaluation.

Table 19. Agronomic characteristics of selected mutant of BRRI dhan48. OT, Aus 2022

Sl No	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BRRI dhan48(M)-2-1	97	101	4.75
2	BRRI dhan48(M)-25-3	102	101	5.06
3	BRRI dhan48(M)-1-3	101	101	4.73
4	BRRI dhan48(M)-83-1	101	101	4.54
5	BRRI dhan48(M)-4-2-1	108	101	4.54
6	BRRI dhan48(M)-4-3-1	103	101	4.16
7	BRRI dhan48(M)-9-2-1	109	101	4.87
8	BRRI dhan48 (ck)	100	105	4.24
9	BRRI dhan98 (ck)	102	107	5.00

Principal Investigator: Shahanaz Sultana

Co-Investigators: Jannatul Ferdous, Shampa Das Joya, Md. Arafat Hossain, Md. Enamul Hoque,

Activity 7.1.2: Progeny selection of mutant BR11

Specific Objective: To select the best progenies with high yield and desirable traits.

Materials and methods: During T. Aman 2022 a total of 200 EMS treated mutant line of BR11 was evaluated as pedigree with standard check. Each pedigree line was grown in a 5.4 m single row using single seedling/hill at 20 cm × 15 cm spacing. Standard agronomic practices were followed.

Results and discussion: During T Aman 2022, 200 EMS treated mutant lines of BR11 was evaluated as pedigree. Among them 200 plants were selected for further evaluation.

Principal Investigator: Shahanaz Sultana

Co-Investigators: Jannatul Ferdous, Shampa Das Joya, Md. Arafat Hossain, Md. Enamul Hoque,

Activity 7.1.3: Observational yield trial (OT) of mutant BR11 in Boro season**Specific Objective:** To evaluate initial yield potential of advanced breeding lines**Materials and methods:** During Boro 2022-23, 50 fixed mutant of BR11 were evaluated as OT with check variety BRR1 dhan74, BRR1 dhan89, BRR1 dhan92 and BRR1 dhan96. Each entry was grown in a 5.4m × 4 rows having single seedling/hill at 20 cm × 20 cm spacing. Fertilizer was applied at 137:17.5:62:10:2.25 of N, P, K, S and Zn kg/ha, respectively. Standard agronomic practices were followed.**Results and discussion:** During Boro 2022-23, 50 fixed mutant lines of BR11 lines were evaluated as OT with standard check and twelve (12) lines were selected for further evaluation (Table 20).**Table 20. Agronomic characteristics of selected mutant line of BR11. OT, Boro 2022-23**

Sl No	Designation	Plant Height (cm)	Growth Duration (day)	Yield (t/ha)
1	BR11(M)-4-1-1	120	157	9.54
2	BR11(M)-5-1-2	120	159	8.65
3	BR11(M)-5-1-3	124	161	9.62
4	BR11(M)--7-1-1	124	159	9.86
5	BR11(M)-17-1-3	105	150	7.42
6	BR11(M)-26-1-2	126	157	8.01
7	BR11(M)-53-1-1	121	148	9.33
8	BR11(M)-53-1-2	120	146	9.06
9	BR11(M)-83-1-1	120	161	8.05
10	BR11(M)-100-1-2	111	156	8.59
11	BR11(M)-104-23-8-3	114	154	8.01
12	BR11(M)-104-23-8-4	110	150	7.84
13	BRR1 dhan74	101	146	7.18
14	BRR1 dhan89	109	159	7.98
15	BRR1 dhan92	110	162	8.14
16	BRR1 dhan96	88	146	6.56

Principal Investigator: Shahanaz Sultana**Co-Investigators:** Jannatul Ferdous, Shampa Das Joya, Md. Arafat Hossain, Md. Enamul Hoque**Experiment 7.2: Development of variants using NMU of BRH-11-9-11-4-5B having reduced sterility****Specific Objectives:** To reduce sterility of BRH-11-9-11-4-5B**Materials and methods:** 1000 BRH-11-9-11-4-5B seeds were treated with 20 mM NMU solution to get M₁ plants. Two time point 3 hr and 4 hr were used to create variation. Thirty one lines (M₃) along with check variety were transplanted in Boro 2022-23. Standard agronomic practices were followed.**Results and discussion:** Thirty one lines (M₃) along with check were transplanted in Boro 2022-23 and hundred (100) plants were selected for further evaluation**Principal Investigator:** Shahanaz Sultana,**Co-Investigator:** Jannatul Ferdous, S.M Hisham Al Rabbi, Shampa Das Joya and Md. Enamul Hoque.**Experiment 7.3: Development of Kilijira type rice variety through mutation****Specific Objectives:** To develop high yielding short stature aromatic Kilizira type rice varieties**Materials and methods:** Seed from 91 M₃ Kilizira lines were transplanted in T Aman 2022 with optimum management.

Results and discussion: Ninety One (91) M₂ Kilijira lines were transplanted in T Aman 2022 along with check and 168 plants were selected based on aroma and plant height for further evaluation

Principal Investigator: Shahanaz Sultana,

Co-Investigator: Jannatul Ferdous, S.M Hisham Al Rabbi, Shampa Das Joya and Md. Enamul Hoque.

Experiment 7.4: Development of Premium Quality Rice through Mutation by EMS

Specific Objectives: To develop high yielding, short duration, short stature plant type aromatic rice lines

Materials and Methods: EMS treated seeds of two local varieties (Kataribhog & Tulshimala) were used in this experiment. Thirty six (36) Kataribhog plants (M₂) and Twenty nine (29) Tulshimala plants (M₂) were evaluated during T. Aman 2022. Data of plant height, flowering days, tiller number, panicle length, maturity days, grain per panicle and grain per plant were collected. Pedigree selections were done with desirable traits.

Results and Discussion: Thirty six (36) Kataribhog plants (M₂) and Twenty nine (29) Tulshimala plants (M₂) were evaluated during T. Aman 2022. Among them six (06) Kataribhog (M₃) plants and thirty one (31) Tulshimala (M₃) plants were selected for generation advancement.

Principal Investigator: Nilufar Yasmin Shaikh

Co- Investigator: Ripon Kumar Roy, S M Hisam Al Rabbi and Md Arafat Hossain

Experiment 7.5: Development of High Yielding Sheath Blight Resistant Rice Variety

Specific Objectives: Sheath Blight resistant lines through mutation by NMU

Materials and methods: During T. Aman 2022, 22 mutant population of BRRI dhan87 were grown for evaluation.

Results and discussion: In T. Aman 2022, 60 plants from M3 generation were selected for further evaluation.

Principal Investigator: Md. Arafat Hossain,

Co-Investigator: S.M Hisham Al Rabbi, Md. Enamul Hoque and Shamima Akter

Experiment 7.6: Development of premium quality rice variety

Specific Objectives: To develop high yielding short stature premium quality rice varieties

Materials and methods: 350 and 450 Gy gamma radiations were imposed on 200 seeds of 11 rice genotypes from Bangladesh Atomic Energy Commission, Savar.

Results and discussion: Decreasing trend of seedling height was observed with increasing of radiation dose (Fig 4). The highest seedling height reduction was found in Biroi and the lowest was in Ranisalut.

Principal Investigator: Shahanaz Sultana,

Co-Investigator: Jannatul Ferdous, Md Sentu Rahman

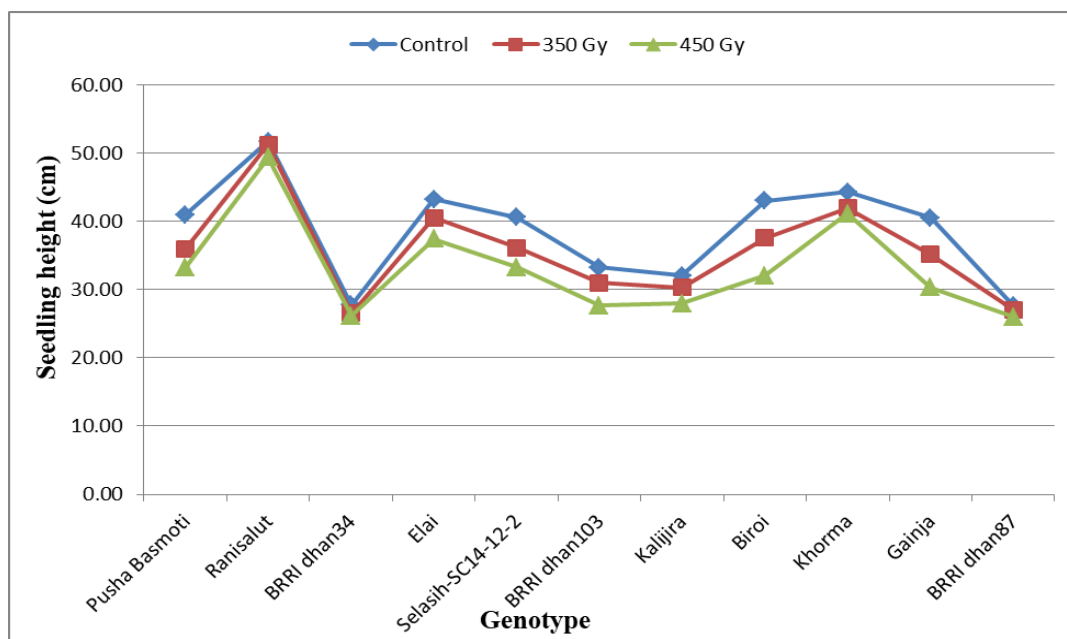


Fig 4. Effect of radiation dose Gray (Gy) on seedling height

PROJECT VIII: BASIC RESEARCH

Experiment 8.1: Study on Kernel Elongation of Rice

Specific Objective: to develop long slender rice variety with high kernel elongation (>1.7)

Materials and methods: Sixty four selected genotypes were grown in T Aman, 22 to make genetic purity.

Results and discussion: Sixty four selected genotypes were grown in T Aman, 2022 and seed were harvested from single plant to make genetic purity. These pure seeds were grown in net house and purified seed from single hill were harvested for further analysis.

Principal Investigator: Shahanaz Sultana,

Co-Investigator: Jannatul Ferdous, Shampa Das Joya, Md. Enamul Hoque, Habibul Bari Sojib