
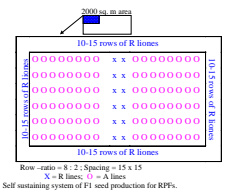


بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ


**Research
& Development of
Hybrid
Rice in Bangladesh**

WELCOME

Bangladesh Agriculture

- Bangladesh- a large deltaic plain formed under the influence of three mighty rivers – Ganges, Brahmaputra and Meghna bounded by India in 3 sides and Bay of Bengal in south.
- It lies in the South Asia sub-continent between 20-26°N latitude and 88-92°E longitude
- Total area of the country is 1,47,570 sq. km. (14.8 M ha)



Bangladesh Agriculture

- Topographically, the land mass lies in about 1-50 m above the sea level.
- Physiographically the soils consists of hills (12%), terrace (8%) and floodplain (80%).

Agriculture in National Economy

Agriculture sector continues to be the mainstay of Bangladesh economy

Contribute to GDP

- Agriculture 21.10%
- Crop 11.72% and
- Rice about 9.38% (~80% of crop)

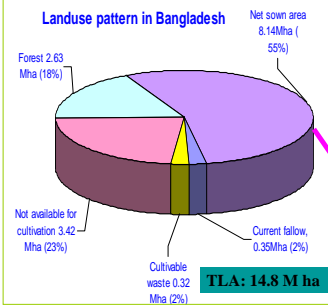
Labour force

Of the total labour forces:

- Agriculture 62.3%
- Rice alone 55%

Land Resources Utilization in Bangladesh

Landuse pattern in Bangladesh



Net sown area 8.14Mha (55%)

Forest 2.63 Mha (18%)

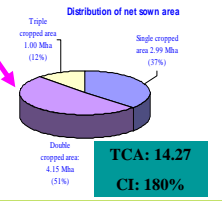
Not available for cultivation 3.42 Mha (23%)

Current fallow, 0.35Mha (2%)

Cultivable waste 0.32 Mha (2%)

TLA: 14.8 M ha

Distribution of net sown area



Triple cropped area 1.00 Mha (12%)

Single cropped area 2.99 Mha (37%)

Double cropped area 4.15 Mha (51%)

TCA: 14.27

CI: 180%

- About 35% of NCA - flood free and rest are flooded from 30cm to as high as 4m.

Climate

Bangladesh enjoys a sub-tropical monsoon climate - short and dry winter from November to February.

- Rainfall: average annual rainfall varies from 1400 to 4500mm, with maximum in the south and north-east part, while minimum in the western and northern parts of the country
- Temperature: in winter, minimum average temp. : 15°C maximum average temp. : 26°C in summer, minimum average temp.: 25°C maximum average temp.: 32°C
- Solar radiation: max. in winter (9 hrs/day) and min. in monsoon (4-5 hrs/day)

Major Problems Faced by Our Crop Agriculture

Abiotic stress	Biotic stress	Socio-economics
<ul style="list-style-type: none"> • Submergence • Salinity • Drought • Temperature <ul style="list-style-type: none"> - Low temp./cold • Soil fertility 	<ul style="list-style-type: none"> • Disease • Insect • Weed 	<ul style="list-style-type: none"> • Marketing • Resource constraints • Knowledge gap

Major Constraints to rice production growth

- ↗ No scope for expansion of area under rice
- ↗ Limited water resource
- ↗ Declining soil health and productivity
- ↗ Plateauing of yields of modern varieties


Technological options for yield breakthrough in rice


- Exploitation of hybrid vigour
- Introducing new plant type
- Use of biotechnology

Research activities of hybrid rice at BIRRI

Present Status of hybrid rice research


BIRRI has released two hybrid rice varieties for Boro season and other two are in pipe line (1 for Boro and 1 for T. Aman)





Seed Production Package and cultivation practices of the released hybrids has been standardized.

Salient features of BIRRI Hybrid dhan1



Recommended season: Boro
 Plant height: 100-100 cm
 Yield: 7.5-8.5 ton/ha
 Duration: 150-160 days

Salient features of BRR1 Hybrid dhan2



Recommended season: Boro
Plant height: 90-100 cm
Yield: 8-8.5 ton/ha
Duration: 140-145 days

Hybrid rice varieties recommended by government of Bangladesh

Year of Recommendation	No. of hybrids	Source		
		India	China	BRR1
1998	4	3	1	0
2000	1	1	0	0
2001	3	0	2	1
2002	1	0	1	0
2003	6	1	5	0
2006	17	0	17	0
2007	12	0	12	0
2008	13	0	12	1
Total	57	5	50	2

CMS & F1 Seed production by Public, NGO's and Private Seed Companies in Bangladesh

Year	Organization	CMS seed production		F1 Seed Production	
		Area (ha)	Prodn. (tons)	Area (ha)	Prodn. (tons)
2001-2002	Public	1.42	0.64	14.23	7.87
	NGO	0.12	1.15	122.00	140.60
	Private	-	-	1.71	2.37
2002-2003	Public	3.74	1.83	30.16	30.9
	NGO	0.25	0.37	160.22	188.24
	Private	-	-	7.54	10.95
2003-2004	Public	1.62	2.00	37.25	50.00
	Private	-	-	31.27	64.90
2004-2005	NGO	-	-	155.00	193.00
	Private	-	-	117.46	298.29
2005-2006	NGO	-	-	266.78	376.41
	Private	-	-	181.27	304.73

Development of parental lines

- The wild abortive (WA) cyto sterility system from both IRRI-developed CMS lines and China was used to develop locally adaptable CMS lines.
- Several selected local varieties/lines were initially identified as maintainers and were backcrossed to their respective CMS sources. Four stable CMS lines could develop during this period which were comparable with IRRI bred CMS lines & CMS lines introduced from China.
- These were again evaluated for their adaptability in respective season.

Table 1. Features of CMS lines (developed locally & exotic) Found Stable in Bangladesh during T.Aman season.

Designation	Plant height (cm)	50% flowering (days)	Pollen Sterility (%)	PER (%)	SER (%)	OCR (%)	Spikelet sterility (%)
BRR1 1A	97	70	100	78	77	45	100
BRR1 3A	113	88	100	64	66	36	100
BRR1 9A	121	84	100	77	75	42	100
IR 58025A	102	86	98	60	47	33	99
IR 68888A	105	79	100	69	47	39	100
IR 78362A	90	74	100	76	75	35	99
IR 70960A	101	94	100	65	64	38	100
IR 73328A	107	86	100	61	53	32	98
Jin 23A	99	75	100	67	64	41	100
I132A	118	78	100	65	71	40	98
D.ShanA	102	64	100	66	72	39	100

Table 2. Features of CMS lines (developed locally & exotic) Found Stable in Bangladesh during Boro season.

Designation	Plant height (cm)	50% flowering (days)	Pollen Sterility (%)	PER (%)	SER (%)	OCR (%)	Spikelet sterility (%)
BRR1 1A	65	124	100	80	77	49	100
BRR1 3A	73	135	99	63	65	38	100
BRR1 9A	77	134	100	78	76	43	100
BRR1 10A	75	132	100	76	69	41	100
IR 73328 A	76	132	98	63	53	35	100
IR 80156 A	74	132	100	62	66	36	100
IR 58025 A	77	137	97	62	48	34	100
IR 79155A	76	129	100	71	66	36	100
Jin23 A	67	129	100	67	64	41	100
Gan 46 A	67	112	100	70	68	42	100
D. Shan A	65	124	100	66	72	40	99
I132 A	68	134	100	66	72	41	100

Evaluation of experimental hybrids

- ▶ BRR1 developed experimental hybrids are being evaluated under observational nursery.
- ▶ Some promising hybrid combinations have been identified which are being further tested under multilocation trial.
- ▶ Experimental seed production plots of those promising hybrids are being established for fine tuning synchronization and feasibility of F₁ seed production.
- ▶ Two new combinations BRR1 10A/ BRR1 10 R and IR 58025A/ BRR1 10R have been selected suitable for Boro and T.Aman seasons, respectively.
- ▶ These two combinations have already submitted to Seed Certification Agency (SCA) trials.

Table 3. Experimental hybrids found promising in observational trials during Boro season 2006-07

Sl no	Designation	DTM (DAS)	PHT (cm)	Pan /m ²	SF (%)	Yield (t ha ⁻¹)	Yield advantage (t ha ⁻¹)
1	IR 68897A / BRR1 10 R	151	90	373	78	8.1	1.0 @ BRR1 dhan28
2	IR 68888A/ BR 736R	155	100	440	83	9.3	1.1 @ BRR1 dhan29 & BRR1 Hybrid Dhan1
3	Jin 23 A / IR 69702-48-2-2R	149	97	340	68	8.1	1.0 @ BRR1 dhan28
4	BRR110A / BR 168R	159	97	307	94	9.9	1.7 @ BRR1 dhan29 & BRR1 Hybrid Dhan1
5	BRR110A / IR72887-38-1-3-2R	161	105	393	72	9.9	1.7 @ BRR1 dhan29 & BRR1 Hybrid Dhan1
6	BRR110A /IR65482-7-216-1-2R	154	101	353	68	10.9	2.7 @ BRR1 dhan29 & BRR1 Hybrid Dhan1
7	BRR110A / BRR 10 R	160	107	340	85	9.5	1.7 @ BRR1 dhan29 & BRR1 Hybrid Dhan1
8	BRR1 dhan 28 (Ck-1)	150	100	405	78	7.1	
9	BRR1 dhan 29 (Ck-2)	163	104	313	78	8.2	
10	BRR1 hybrid dhan-1(Ck-3)	163	106	302	67	8.2	

Table 4. Experimental hybrids found promising in observational trials during Boro season 2007-08

Sl. #	Designation	DTM (DAS)	PHT (cm)	Pan /m ²	SF (%)	Yield (t ha ⁻¹)	Yield advantage over check (t ha ⁻¹)		
							@ BRR1 hybrid dhan1	@BRR1 dhan28	@BRR1 dhan29
1	H 32 A / M.H. 63R	148	100	310	93	8.1	1.04	2.03	0.55
2	Gan 46A / BRR1 10R	145	102	350	81	8.7	1.64	2.63	1.15
3	D. Shan A / BR 7013-62-1-1R	145	120	325	83	8.6	1.54	2.53	1.05
4	BRR1 3A / IR 69702-3-2-3 R	148	108	356	85	8.6	1.54	2.53	1.05
5	IR 80156A /IR 72906-24-1-3-1R	148	87	330	82	8.0	0.94	1.93	0.45
6	BRR1 9A / IR 69702-3-2-3 R	148	113	310	81	8.1	1.04	2.03	0.55
7	BRR1 1A / HP-4	145	91	415	91	8.6	1.54	2.53	1.05
8	BRR1 1A / BRR1 11R	148	100	383	95	8.8	1.74	2.73	1.25
9	BRR1 11A / BRR1 11R	148	100	277	97	8.2	1.14	2.13	0.65
10	BRR1 9A / BRR1 10R	145	100	316	84	9.03	1.97	2.96	1.49
11	BRR1 9A / BRR1 11R	142	103	330	839	9.06	2.00	2.99	1.52
12	H 32A / BRR1 10R	145	105	323	80	8.69	1.62	2.61	1.14
13	H 32A / BR 7013-62-1-1(R)	147	119	376	84	8.08	1.02	2.01	0.54
14	D. Shan A / BR 7013-62-1-1(R)	143	115	349	79	8.89	1.82	2.81	1.34
15	BRR1 1A / BRR1 10R	142	98	356	80	8.23	1.16	2.15	0.68
16	BRR1 1A / BR 6839-41-5-1R	138	100	244	78	8.88	1.82	2.81	1.34
17	BRR1 hybrid dhan 1 (CK-1)	154	111	327	81	7.06			
18	BRR1 dhan 28 (CK-2)	142	107	310	79	6.07			
19	BRR1 dhan 29 (CK-3)	158	104	366	87	7.55			

Table 5. Experimental hybrids found promising in observational trials T.Aman season 2007.

Sl.#	Designation	DTM (DAS)	PHT (cm)	Pan/ m ²	SF (%)	Yield (t ha ⁻¹)	Yield advantage over check (t ha ⁻¹)		
							@BRR1 dhan30	@BRR1 dhan33	@BRR1 dhan39
1	D. Shan A / Gui 99 R	108	102	251	78	6.42	1.91	2.78	2.88
2	BRR1 9A/ M.H1 63R	106	95	297	79	6.13	1.62	2.49	2.59
3	BRR1 9A/ IR 73004-7-3-3-3R	118	122	198	72	6.65	2.14	3.01	3.11
4	BRR1 9A/ IR 73013-95-1-3-2R	120	112	178	75	6.45	1.94	2.81	2.92
5	BRR1 9A/ IR21567R	122	110	185	70	6.84	2.33	3.20	3.30
6	IR 78355 A /M.H.77 R	108	102	257	77	6.71	2.20	3.07	3.17
7	IR 80154A / BR 827R	113	104	205	86	6.85	2.34	3.21	3.31
8	Gan 46A / BRR1 10 R	118	102	297	75	6.98	2.47	3.34	3.44
9	BRR1 9A / BRR1 10 R	108	94	223	78	6.52	2.01	2.88	2.98
10	BRR1 9A / Gui 99 R	112	109	178	75	6.01	1.50	2.37	2.47
11	IR58025A / BRR1 10R	110	108	185	86	6.29	1.78	2.66	2.76
12	BRR1 dhan 30(Check -1)	132	117	207	80	4.51			
13	BRR1 dhan 33 (Check-2)	112	110	200	70	3.64			
14	BRR1 dhan 39 (Check-3)	115	108	206	78	3.54			

Multilocation trials (MLT)

- Two promising hybrids were evaluated during T.Aman at headquarter, Gazipur with BRR1 dhan30, BRR1 dhan33 and BRR1 dhan39 as check to find out the adaptability and yield potentiality of the identified hybrids.
- BRR1 1A / BR 827R and BRR1 1A / BR 168 R combinations were out yielded by 1.30 t/ ha and 1.23 t/ ha, respectively compared to BRR1 dhan33 with similar growth duration.
- During Boro season 2007-08, three promising hybrids were evaluated at five locations with BRR1 hybrid dhan 1, BRR1 dhan28 and BRR1 dhan29 as checks.
- The hybrid combinations, BRR1 1A/BR 168R and BRR1 10A/ BRR1 10R out yielded by about 1.82, 2.33 t/ha, respectively over BRR1 dhan28 and IR 58025A/ BRR1 10R produced 1.41 t/ ha more yield than BRR1 dhan29.

Table 6a. Performance of Multi location trial at Gazipur during T. Aman 2007

Sl. #	Designation	Days to maturity (days)	Plant height (cm)	Panicle / m ²	Spikelet fertility (%)	Yield (t ha ⁻¹)	Yield advantage (t ha ⁻¹)
1	BRR11A/ BR827R	118	114	286	75	3.74	1.30 @ BRR1 dhan33
2	BRR11A/BR168R	119	109	251	76	3.67	1.23 @ BRR1 dhan33
3	BG 407	126	120	209	63	3.02	
4	BRR1 dhan-30	133	128	229	81	3.17	
5	BRR1 dhan-33	118	113	204	76	2.44	
6	BRR1 dhan-39	122	114	211	74	2.71	

Table 6b. Average performance of multi location trial of promising hybrids at five locations during Boro season 2007-08

Sl. #	Designation	Days to maturity (days)	Plant height (cm)	Panicle /m ²	Spikelet fertility (%)	Yield (t ha ⁻¹)	Yield advantage (t ha ⁻¹)
1	BRR11A/BR168R	142	87	331	82	7.45	1.82 @ BRR1 dhan28
2	BRR10A/BRR1 10R	147	101	304	77	7.96	2.33 @ BRR1 dhan28
3	IR58025A/ BRR1 10R	151	101	326	75	8.34	1.41 @ BRR1 dhan29
4	RP-703	150	97	303	70	6.13	
5	RP-704	144	104	209	71	6.24	
6	BRR1 hybrid dhan1	154	106	343	73	6.97	
7	BRR1 dhan28	140	104	326	81	5.63	
8	BRR1 dhan29	157	106	330	78	6.93	

Table 7. CMS multiplication of some promising A lines during T Aman-2007 & Boro 2007-08.

Comb.	Plant height (cm)		Days to 50% flowering		PER (%)	OCR (%)	Yield (t/ha)	Comb.	Plant height (cm)		Days to 50% flowering		PER (%)	OCR (%)	Yield (t/ha)
	A line	B line	A line	B line					A line	B line	A line	B line			
IR58025A/B	88	90	91	93	72	30	1.16	IR58025A/B	74	76	137	135	72	33	1.65
BRR1 1 A/B	78	96	73	76	72	35	2.20	BRR1 1 A/B	66	68	124	121	73	42	2.38
BRR1 3 A/B	105	107	85	88	64	32	1.28	BRR1 3 A/B	75	79	135	132	66	36	1.48
BRR1 9 A/B	115	118	81	84	77	37	1.35	BRR1 9 A/B	78	80	134	132	78	37	1.75
H 32A/B	116	118	76	78	78	33	1.30	BRR1 10A/B	75	78	132	130	78	45	2.35
IR 6888A/B	105	107	76	79	69	30	1.23	H 32A/B	68	70	135	133	78	40	2.06
IR 7332A/B	107	110	84	86	61	31	1.20	Gui-46A/B	65	68	112	110	75	45	2.16
IR 9835A/B	98	101	73	75	67	31	1.15	IR 6888A/B	80	82	135	132	69	33	1.23
								D-Shan A/B	64	66	124	122	72	41	1.85
								IR 7332A/B	75	77	135	133	62	32	1.48
								Ini23A/B	68	70	129	126	67	35	1.58
								IR 9835A/B	75	77	132	130	69	33	1.48

◊During T. Aman CMS seed production ranges from 1.15 to 2.20 t/ha and the highest seed yield was obtained from BRR1 1A/B.

◊During Boro season CMS seed production ranges from 1.23 to 2.35 t/ha and the highest seed yield was obtained from BRR1 10A/B.

Table 9. Determination of suitable row ratio and spacing for increasing seed yield in hybrid rice seed production (BRR1 1A/ BR 168R) during Boro 2006-07.

Row ratio	Spacing	50% F(A)	50% F(R)	PH (cm)	Tiller /hill	Pan /m ²	PER (%)	OCR (%)	Yield (t ha ⁻¹)
R0(2:8)	S1(15x15)	106	132	78	9	313	80.84	49.29	1.89
R0(2:8)	S2(20x15)	106	131	81	10	278	77.06	58.24	2.26
R0(2:8)	S3(20x20)	107	132	81	11	243	79.39	48.55	2.17
R1(2:10)	S1(15x15)	107	132	79	8	337	77.15	46.74	2.43
R1(2:10)	S2(20x15)	108	133	81	10	276	80.48	49.30	2.71
R1(2:10)	S3(20x20)	107	132	81	11	226	80.53	43.34	2.17
R2(2:12)	S1(15x15)	108	132	81	9	332	79.12	43.16	2.40
R2(2:12)	S2(20x15)	107	132	81	10	287	79.90	42.10	2.34
R2(2:12)	S3(20x20)	105	131	79	12	245	79.57	47.70	2.86
R3(2:14)	S1(15x15)	107	131	78	8	338	77.41	39.58	2.23
R3(2:14)	S2(20x15)	107	132	78	10	286	77.93	43.21	2.86
R3(2:14)	S3(20x20)	107	131	78	10	217	81.58	43.45	2.22

◊During Boro season 2006-07, experiments were conducted to find out the optimum row ratio and spacing for hybrid rice seed production.

◊Planting spacing of 20x15cm with 2:10 row ratio gave the highest seed yield (2.71 t/ ha). Highest out crossing rate was found in 2:8 ratios with 20x15 cm spacing followed by 2:10 ratio with 20x15 cm spacing

Table 10. Determination of suitable row ratio and spacing for increasing seed yield in hybrid rice seed production (IR58025A/ BRR1 10R) during Boro 2007-08.

Row ratio	Spacing	50% F(A)	50% F(R)	PH (cm)	Tiller /hill	Pan /m ²	PER (%)	OCR (%)	Yield (t ha ⁻¹)
R0(2:8)	S1(15x15)	129	128	80	8	287	80	56	2.50
R0(2:8)	S2(15x20)	129	128	83	10	274	80	52	2.35
R0(2:8)	S3(20x20)	128	127	85	11	218	83	54	2.30
R1(2:10)	S1(15x15)	128	128	81	8	296	79	52	2.80
R1(2:10)	S2(15x20)	129	128	83	10	268	80	51	2.47
R1(2:10)	S3(20x20)	128	127	84	11	215	84	50	2.37
R2(2:12)	S1(15x15)	129	128	81	8	296	78	49	2.38
R2(2:12)	S2(15x20)	128	128	84	10	249	80	47	2.45
R2(2:12)	S3(20x20)	129	128	85	11	225	84	45	2.42
R3(2:14)	S1(15x15)	128	128	81	9	323	79	43	2.16
R3(2:14)	S2(15x20)	129	129	82	10	253	80	40	2.06
R3(2:14)	S3(20x20)	129	129	84	11	212	83	42	2.00

◊During Boro season 2007-08, experiments were conducted to find out the optimum row ratio and spacing for hybrid rice seed production.

◊Highest seed yield (2.80 t/ha) was found from 2:10 row ratio with 15cmx15cm planting spacing. Row ratio 2:8 showed highest out crossing rate with 15x15cm spacing followed by 2:8 ratios with 20x20cm spacing.

Table 11: F1 seed production of promising hybrids during Boro season 2006-07

Combination	Plant height (cm)		Days to 50% flowering		PER (%)		OCR (%)	Area (m ²)	Yield (kg/ ha)
	A line	R line	A line	R line	A line	A line			
IR58025A/BR827R	73.8	112	126	138	82	33	500	1020	
BRR1 1A/BR168R	71	96	96	122	79	54	300	1800	
BRR1 1A/BR827R	70.5	111	108	135	78	36	500	1200	
BRR1 10A/ BRR1 10R	76	110	130	135	76	43	300	2333	



Seed production of promising hybrid BRR1 10A/ BRR1 10R

Table 12: Results of the effect of different doses of GA3 and its time of application on hybrid seed production using BRR1 1A/BR168R promising hybrid combination

Sl	Treatment Combination	PH (cm)		DTF (50%)		PER (%)	OCR (%)	Yield (t/ha)
		A line	R line	A line	R line			
1	C ₀ S ₀ S ₀	78	106	104	128	74	35	1.50
2	C ₁ S ₁ S ₁	81	106	104	128	76	38	1.70
3	C ₂ S ₂ S ₂	83	106	104	128	78	60	2.60
4	C ₃ S ₃ S ₃	83	106	104	128	76	56	2.40
5	C ₀ S ₀ S ₁	77	106	104	128	72	25	1.60
6	C ₁ S ₁ S ₁	81	106	104	128	78	39	1.90
7	C ₂ S ₂ S ₁	83	106	104	128	80	55	2.50
8	C ₃ S ₃ S ₁	84	106	104	128	79	58	2.45
9	C ₀ S ₀ S ₂	79	106	104	128	76	40	1.40
10	C ₁ S ₁ S ₂	79	106	104	128	74	37	1.60
11	C ₂ S ₂ S ₂	84	106	104	128	76	65	2.40
12	C ₃ S ₃ S ₂	82	106	104	128	73	54	2.35



GA3 application @ 60 gm/ha at 5% and 15-20% flowering gave the highest seed yield.

C₀=control, C₁=40gm, C₂=60gm, C₃=80gm, S₁=5% flowering, S₂=15-20% flowering and S₃=35-40% flowering. Unit plot size: 20 m²

Achievements of BRR in hybrid rice research & Development



Training on SP & cultivation



Field day of SP in farmers field



Training on seed production



HR publication in Bangla

Technological cooperation needed for enhancing hybrid rice technology in Bangladesh

1. Exchange of parental lines for three-line and two-line hybrids.
2. Conducting training course in three-line and two-line hybrid rice breeding & seed production and standard agronomic and nutrient management of hybrid rice.
3. Technological cooperation for attaining high F1 seed yield under Bangladesh condition.
4. Joint venture with Hunan Hybrid Rice Research & Development Center (HHRDC) will be useful for development of hybrid rice technology.
5. Exchange of advance knowledge and ideas through visit and study tour of researchers, administrators and policy makers in the field of hybrid rice seed production.
6. Super rice hybrid varieties can be tested under Bangladesh condition for their adaptability. The best adaptable variety(s) could be introduced for cultivation in Bangladesh.

