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BRRI Dhan63: Exportable Premium Quality Rice Like Soru Balam Suitable for Boro Season in Bangladesh

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Abstract: BRRI dhan63 is a new premium quality Boro rice variety like Soru Balam which is an improvement over existing premium quality rice BRRI dhan50 (Banglamati). BRRI dhan63 has satisfactorily passed in the proposed variety trial conducted in the farmers' field. As a result National Seed Board (NSB) has been released this variety for commercial cultivation in the dry season (Boro) of Bangladesh in 2014. BRRI dhan63 is a modern rice variety having similar plant type with BRRI dhan50. The straw colored long slender grain like Pakistani Basmati rice is the main characteristics of this variety. The important feature is the higher elongation ability of the cooked rice of BRRI dhan63. The growth duration of BRRI dhan63 is 148-150 days which is 4-6 days earlier growth duration than BRRI dhan50. Thousand grain weight of the variety is 22.1 gm. The rice has 25.0% amylose content with 8.2% protein content. The special character of the variety is it has shattering resistance. As it has long flag leaf with deep green leaf color so the whole plot looks very beautiful. BRRI dhan63 can produce 6.5 to 7.0 t/ha yield with proper management. The export quality rice BRRI dhan63 is an excellent variety for cultivating in the Boro season so that farmers can earn more profit by the cultivation of BRRI dhan63.

Keywords: Rice, Premium Quality, BRRI Dhan63, Soru Balam, Boro Season

1. Introduction

Rice (*Oryza sativa* L.) is the staple food of more than half of the world's population [1]. Most of the world's rice is produced and consumed in Asia which constitutes more than half of the global population [2]. Among cereal, rice is grown mainly for direct human consumption with very little making it to other uses. Rice contributes approximately 21% of world per capita caloric intake and 27% of per capita calories in the developing countries [1]. In Bangladesh rice occupies about 70% of the total cropped area of about 13.9 million hectares. Out of this 70%, fine rice is cultivated in roughly 10% land. Grain quality in rice plays an important role in consumer acceptability. Juliano and Duff established that grain quality is second after yield as the major breeding objective for crop improvement [3]. The premium nature of the rice generates higher price than the available other rice like Nizersail, Minikit etc. found in the market. The quality in rice is considered based on milling quality, grain size, shape, appearance, aroma and other cooking characteristics [4]. There is some local premium quality rice like Kalizira, Chinigura, Kataribhog etc. are available in the local market. They are of traditional type like low yielding, lodging and disease susceptible. So in spite of getting higher price the farmers are facing problems in cultivating that rice. Bangladesh Rice Research Institute (BRRI) has developed 7 premium quality rice varieties up to 2016. Among them BR5, BRRI dhan34, BRRI dhan37, BRRI dhan38 and BRRI dhan70 are cultivated in T. Aman season along with BRRI dhan50 and BRRI dhan63 are cultivated in Boro season [5]. BRRI dhan50 is popularly known as Banglamati. It was released in 2008 having long slender and aromatic rice like Pakistani and Indian Basmati. Farmers greatly accepted the first modern long slender rice for their consumption and commercial cultivation. But the farmers got problems at the time of milling of BRRI dhan50. The grain of BRRI dhan50

is slight curvy so its head rice recovery is became low after milling. So we were in need of developing new rice which is high yielding along with higher milling out turn. BRRI dhan63 is an excellent variety having extra-long slender grain like the Basmati. It has higher head rice recovery over BRRI dhan50 as the grains are straight. It is a palatable and tasty rice to eat and higher elongation capacity than BRRI dhan50. BR5 and BRRI dhan37, BRRI dhan37, BRRI dhan38 has somewhat lodging susceptibility. So yield loss is a great problem for these varieties. The farmers face problems in yield loss in cultivating the other premium quality rice varieties including local rice. So the area of cultivation of the premium quality rice is decreasing day by days. BRRI dhan63 is lodging tolerant due to its medium and stout plant structure. So BRRI dhan63 was developed with the aim of improving the productivity of premium quality rice in Bangladesh and to popularize modern rice as table purposes and commercial cultivation. This study describes the breeding procedures, parental lineage, tolerance to lodging, agro-morphological characters and grain quality of BRRI dhan63.

2. Materials and Methods

BRRI dhan63 was developed from a single cross between Amol-3, an Iranian rice variety and BRRI developed mega variety BRRI dhan28 in the year 2001 with the aim of improvement of BRRI dhan50 and development of a premium quality rice variety in BRRI Gazipur. The pedigree of BRRI dhan63 is BR7358-30-3-1. The F_1 plants were grown in 2002 in the net house of BRRI along with respective parents. The cross was confirmed and registered as BR7358. The next year disease and insect free, lodging resistant belonging to long slender grain along with strong plants were selected in F_2 population. Pedigree selection method was followed for handling of the segregating generations within and among the rows in F_3-F_4 generations. Some homozygous progeny lines with desirable characteristics were isolated in F_5 generations. During the period of generation advance, progeny rows were selected which were resistant against diseases and insects under field condition. In 2007, several tolerant homozygous lines were tested in Observational Trial (OT) against BRRI dhan50 to observe homogeneity in heading, tolerance to lodging, resistance to diseases and insects as well as overall phenotypic acceptance at field condition. In 2008, the sister lines of the advanced breeding materials were tested for Preliminary Yield Trial (PYT) for primary yield evaluation. Then after proper selection in 2009, eleven promising sister lines were tested in Secondary Yield Trial (SYT) for confirmation of the yield of the materials in the Gazipur farm. Out of 11 lines 2 promising lines were subjected to Regional Yield Trial (RYT) to evaluate specific and general adaptability with standard check BRRI dhan50 in on-station condition of nine regional station of BRRI in randomized complete block (RCB) design with three replications in Boro 2010-11. After proper yield evaluation two materials were subjected to Advanced Lines Adaptive Research Trial (ALART) to evaluate specific and general adaptability with standard check BRRI dhan50 in the farmers' field condition in Boro 2011-12, conducted by Adaptive Research Division (ARD) of BRRI [6-8]. Genotypes of the trial were tested for different physico-chemical properties, cooking qualities, best planting time, disease-insect resistance in artificial inoculated condition, plant height, tillering ability were recorded from the ten random plants excluding border rows and plans surrounded by any missing hills. Growth duration was counted from seedling to 80% grain maturity. Grain yield data was taken from 10 sq-m sample plot in each replication. In Boro 2012-13, BR7358-30-3-1 (BRRI dhan63) was evaluated by the National Seed Board of Bangladesh (NSB) in the nine locations of farmers' field of Bangladesh in Proposed Variety Trial (PVT). Finally after proper evaluation the NSB team found BR7358-30-3-1 as a superior genotype in respect to grain yield, lodging tolerance, earlier than BRRI dhan50 and extra-long slender type grain and has been released as BRRI dhan63 in the year 2014.

The data analysis of the experiments were done with PBTools and Microsoft excel 2013 [9, 10]. A schematic diagram has been illustrated about BRRI dhan63 development (Figure 1).

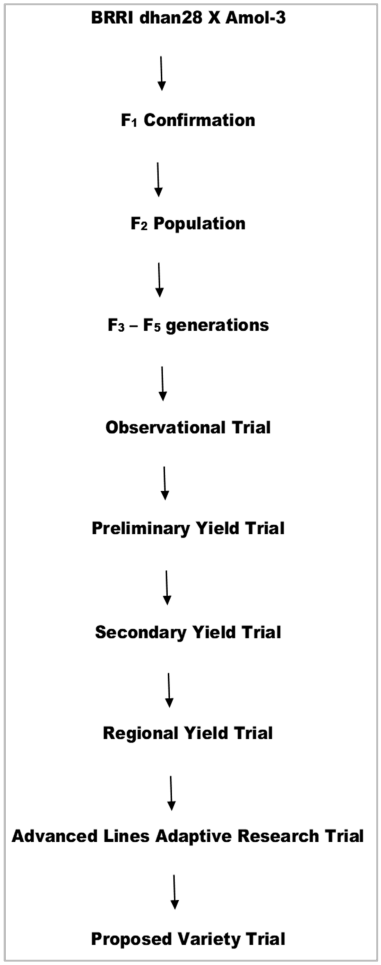

Figure 1. *Schematic diagram for development of BRRI dhan63.*

3. Results and Discussion

The agro-morphological characteristics of BRRI dhan63 is shown in Table 1. It has moderate plant height with BRRI dhan50 which indicates lodging tolerance. BRRI dhan63 has erect flag leaf which facilitates maximum solar light uptake. Its panicle length is also longer than BRRI dhan50. The regional yield trial of two sister lines were conducted in seven BRRI Regional stations of Bangladesh. BR7358-30-3-1 showed the maximum yield (6.4 t/ha), followed by BR7358-5-3-2-1 (Table 1). High yield is the prime objective in developing modern rice varieties. BRRI dhan63 showed higher yield than the all other varieties in Boro 2010. This higher yield of BRRI dhan63 was due to its genetic potentiality of producing higher and longer grains per panicle than BRRI dhan50. Growth duration of BRRI dhan63 was found six days earlier than BRRI dhan50.

In Bar graph, the highest yield was found in Habiganj with 7.4 t/ha followed by 7.3 t/ha in Bhanga and 7.0 t/ha in Barisal. The grain yield of BRRI dhan63 is about 0.9 t/ha higher than BRRI dhan50 (Figure 2).

Table 1. *Morphological and agronomic characteristics of BRRI dhan63, on-station Regional Yield Trial, Boro 2010-11.*

SN	Designation	Plant height (cm)	Growth duration (days)	Panicle length (cm)	Grain Yield (t/ha)
1	BR7358-5-3-2-1	94	153	23.4	6.1
2	BR7358-30-3-1 (BRRI dhan63)	85	157	23.5	6.4
3	BRRI dhan28 (Ck)	97	149	23.0	5.7
4	BRRRI dhan50 (Ck)	86	159	21.5	5.5
SE		2.96	2.22	0.46	0.21
LSD (0.05)		5.80	4.35	0.91	0.40

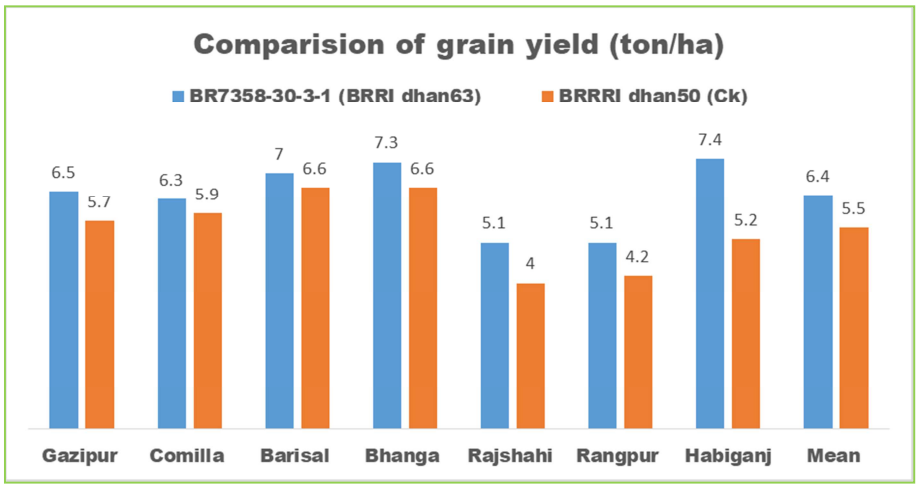

Figure 2. *Location-wise grain yield comparison between BR7358-30-3-1 (BRRI dhan63) and BRRRI dhan50 (Ck).*

BR7358-30-3-1 (BRRI dhan63), one advanced line and check variety BRRI dhan50 were evaluated in 10 locations in the farmers' field of Bangladesh. Results are showed in the Table 2 and Figure 3. There was no significant variation was found for grain yield of the genotypes. Highest grain yield of was found for BR7358-5-3-2-1 (6.6 t/ha) followed by BR7358-30-3-1 (6.5 t/ha) and BRRI dhan50 (6.0 t/ha). Highest grain yield potentiality was found for BR7358-30-3-1 in Rajshahi (7.9 t/ha). Whereas highest grain yield of BR7358-5-3-2-1 was found in Dinajpur (7.8 t/ha) and that of BRRI dhan50 was found in Rajshahi with 6.3 t/ha (Figure 3). The result visualizes the higher yield potentiality of BRRI dhan63 over the check and the other genotype. On an average BRRI dhan63 yielded 0.5 t/ha higher than BRRI dhan50. Although BRRI dhan50 gave the highest (314) panicle/m^2 than BR7358-30-3-1 (298), the 1000 grain weight of BRRI dhan63 showed significant variation with BRRI dhan50 (Table 2). Both the materials were more or less affected by stem borer and rice bug in different locations. Stem borer and rice bug infestation was higher (10-15%) in Dinajpur and minimum in Barisal. All the genotypes were almost disease free in some locations with little diseases were found in some other locations. The medium plant stature (86 cm) of the variety made the line lodging tolerant. Growth duration was found 3 days earlier than the check variety BRRI dhan50. Farmers preferred BR7358-30-3-1 for their better yield, shorter growth duration and importantly lodging tolerance as well as good grain quality, in spite of having some leaf and neck blast in some areas.

Table 2. *Performance of the BR7358-30-3-1 (BRRI dhan63) at different zonal trial in farmers' field, Boro 2011-12.*

Designation	Plant height (cm)	Growth duration (days)	Panicles/ m2	1000 grain weight (g)	Grain Yield (t/ha)
BR7358-5-3-2-1	95	144	271	21.90	6.6
BR7358-30-3-1 (BRRI dhan63)	86	148	298	21.12	6.5
BRRI dhan50 (Ck)	83	151	314	19.67	6.0
LSD (0.05)	0.92	0.15	11.15	0.561	0.19

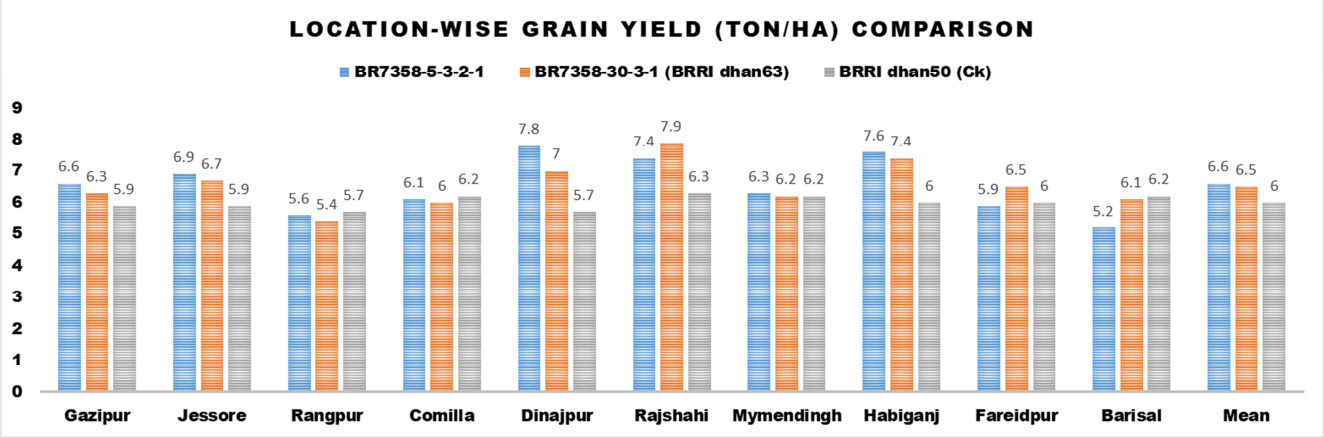

Figure 3. *Yield performances of proposed lines in ten locations of Bangladesh.*

Table 3. *Performance of the BR7358-30-3-1 (BRRI dhan63) at Proposed Variety Trial in farmers' field, Boro, 2012-13.*

Location	Proposed Variety/ Check			
	BR7358-30-3-1 (BRRI dhan63)		BRRI dhan50 (Ck)	
	Grain yield (t/ha)	Growth duration (days)	Grain yield (t/ha)	Growth duration (days)
Mymensingh	8.37	143	7.77	150
Comilla	6.8	142	6.3	144
Rajshahi	7.44	155	6.79	161
Rangpur	8.59	157	8.02	166
Habiganj	8.04	148	6.42	157
Kushtia	6.70	151	5.9	154
Sathkhira	6.47	143	5.60	150
Bhanga	7.72	154	6.53	160
Sonagazi	6.00	147	5.49	149
Mean	7.35	149	6.54	155
SE	0.30	1.88	0.29	2.33
LSD (0.05)	0.590	3.7	0.577	4.6

Performance of the BR7358-30-3-1 (BRRI dhan63) at on farm trial, Boro, 2012-13 is shown in Table 3. Evaluation of the BR7358-30-3-1 (BRRI dhan63) at on farm trial was performed by the National Seed Board (NSB) of Bangladesh in Boro 2012-13 seasons. The highest yield of the genotype was found with 8.59 t/ha in Rangpur followed by Mymensingh with 8.37 t/ha, 8.04 t/ha in Habiganj. The grain yield indicated that the variety could be produce more with proper crop management. The grain yield range of BRRI dhan50 was found from 5.6 -7.77 t/ha. On an average BRRI dhan63 produced 7.35 t/ha yield where as BRRI dhan50 produced 6.54 t/ha yield, that is 0.81 t/ha higher for the variety (Table 3). Growth duration of BRRI dhan63 was ranged from 142 days in Comilla to 157 days in Rangpur depending on the agro climatic situation in the T. Aman season. Mean growth duration of the variety was found 149 days which is six days earlier than the check variety BRRI dhan50.

Additive Main effects and Multiplicative Interaction (AMMI) model shows only environmental interaction for predicted potentiality of breeding line. According to AMMI Biplot, the BRRI dhan63 is the best performer in Rajshahi (E3) followed by in Mymensingh (E1). It will perform constantly in Rangpur (E4), Habiganj (E5), Bhanga (E8) and Sonagazi (E9). BRRI dhan63 will comparatively less perform in Kushtia (E6) (Figure 4).

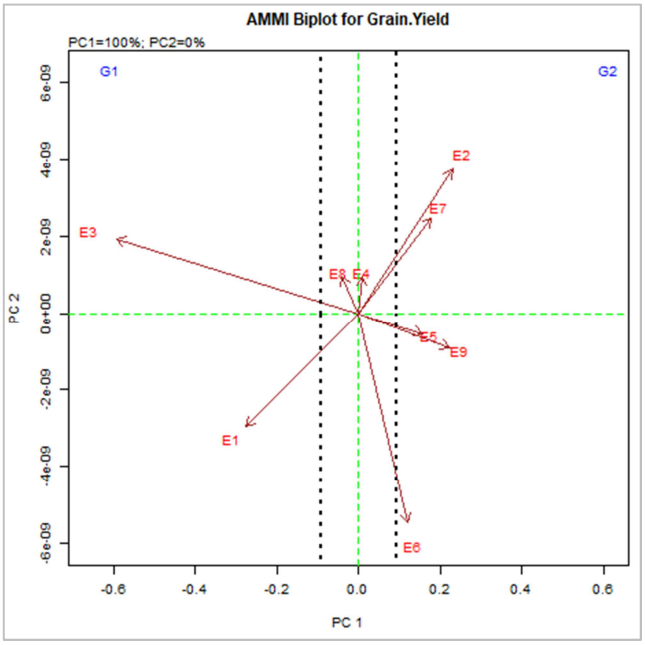

Figure 4. *AMMI Biplot analysis showing the environmental interaction to genotypes.*

The What-won-where Biplot analysis indicates BRRI dhan63 (G1) was higher yielder than BRRI dhan50 (G1)

among nine trial locations (Figure 5).

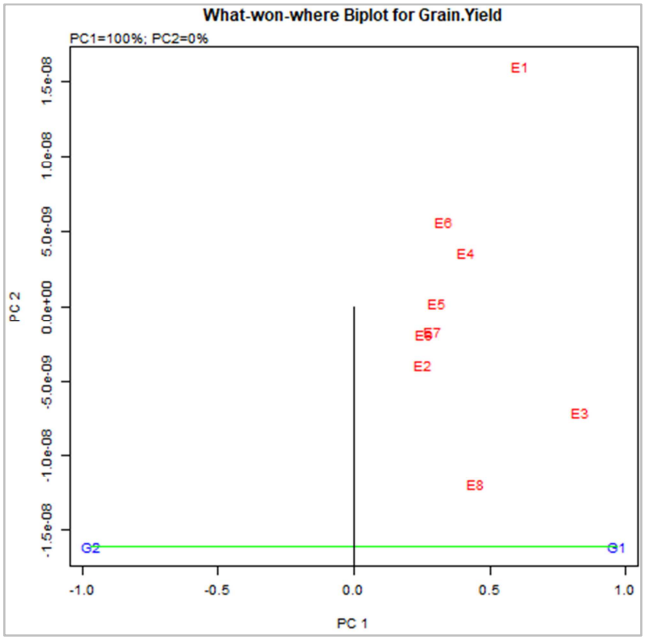

Figure 5. *What-won-where Biplot analysis shows the better performance of BRRI dhan63 in each trial location.*

An Adaptation Map was constructed using data from nine farmer's field trial, the analysis predicts that BRRI dhan63 is likely to be more adapted variety than the BRRI dhan50 in anywhere of trial locations (Figure 6).

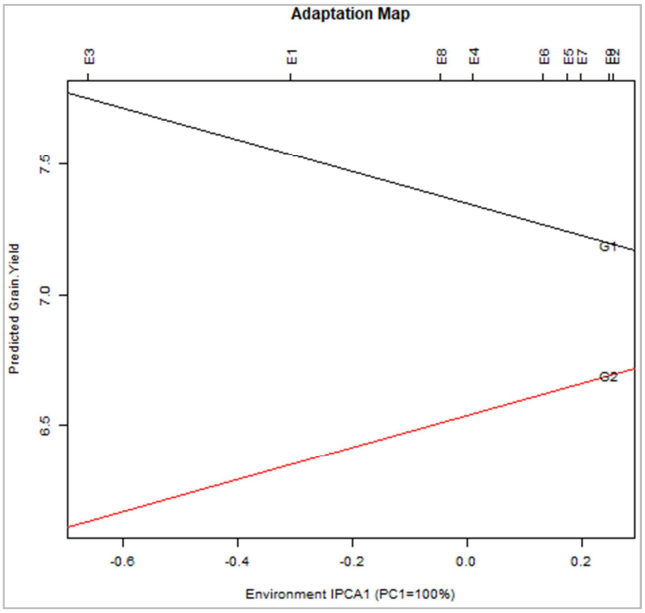

Figure 6. *Adaptation map of BRRI dhan63.*

BRRI dhan63 showed tolerance to major diseases and insects under the natural field condition in the field of plant breeding division. The variety showed a bacterial score 3, meaning it is more or less tolerant to bacterial blight. The variety is found resistant to sheath blight disease (Table 4). For the insects the variety is also tolerant to brown plant hopper for the dead heart and white head symptoms. BRRI dhan50 also showed similar symptoms.

Table 4. *Reaction of the BRRI dhan63 against major diseases and insects under natural field condition, T. Aman 2011-12.*

Designation	BB	ShB	DH	WH
BR7358-30-3-1 (BRRI dhan63)	3	1	1	1
BRRI dhan50 (Ck)	3	1	1	1

BB = Bacterial Blight, ShB = Sheath Blight, DH = Dead Heart, WH = White Head
Disease/Insect severity scale (0 – 9)

BRRI dhan63 looks like the local rice Balam so it is popularly known as Soru Balam. It is an extra-long slender grain having length-breadth ratio 3.7 which is higher than that of BRRI dhan50. The milling outturn of the variety is 72% with the head rice recovery 76% which is far better than the other varieties (Table 5). BRRI dhan50 has a problem lower head rice recovery as it is slight curved rice. But BRRI dhan63 is straight and it could be milled in any kind of milling machine. This result revealed that BRRI dhan63 will get high market price because of extra-long slender premium quality brand polish rice. The protein and amylose percentage of BRRI dhan63 is also higher than BRRI dhan50 and other varieties (Table 5). The important feature is the higher elongation ability of the cooked rice of BRRI dhan63 than BRRI dhan50. The physicochemical property of BRRI dhan63 is presented in Table 5 represents the fine quality rice nature of BRRI dhan63. So Bangladesh could earn foreign currency by exporting the rice of BRRI dhan63.

Table 5. *Physicochemical properties of BRRI dhan63.*

Designation	Milling Yield (%)	Head rice yield (%)	Decorticated grain				ER*	Protein (%)	Amylose (%)
			Length (mm)	Breadth (mm)	L-B Ratio	Size and shape			
BR7358-5-3-2-1	72	68	6.6	1.9	3.5	Long slender	1.6	10.3	25.0
BR7358-30-3-1 (BRRI dhan63)	70	76	7.1	1.9	3.7	Extra Long Slender	1.4	8.2	24.0
BRRI dhan28 (Ck)	70	78	6.5	2.1	3.1	Long slender	1.4	7.7	22.3
BRRRI dhan50 (Ck)	68	67	6.2	1.8	3.4	Long Slender	1.2	8.0	23.8

* ER= Elongation Ratio

After proper evaluation by the National Seed Board of Bangladesh (NSB) in the nine locations of farmers' field of Bangladesh BR7358-30-3-1 has been released as BRRI dhan63 in the year 2014. The pictorial view of BRRI dhan63 in the field condition with its grain, rice and cooked rice is shown in figure 7 and 8.

Figure 7. *pictorial view of BRRI dhan63 in the field condition.*

Figure 8. *pictorial view of Rough Rice, Unparboiled Rice and cooked rice of BRRI dhan63.*

4. Conclusion

In conclusion, BRRI dhan63 was released as a high yielding and premium quality rice variety. Adaptability tests of this variety under multi-location trials in the farmers' field showed satisfactory performance with respect to grain yield, slenderness and some yield contributing parameters. It is anticipated that this exportable rice variety will contribute to the national Gross Domestic Product (GDP) and also alleviate poverty from Bangladesh by earning foreign currency. This variety also can be used as parent material for development of new aromatic, biotic and abiotic stress tolerant and long slender premium quality rice variety.

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