

## Identification of Potential Hybrid Rice (*Oryza sativa* L.) Variety in Bangladesh by Evaluating the Yield Potential

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**Abstract:** The field experiment was conducted during the period from January to June. Five varieties of hybrid rice collected from different private seed companies and one hybrid and two checks from Bangladesh Rice Research Institute (BRRRI) were used in this experiment. Varieties were Sonarbangla-1, Jagoron, Hira, Aloron, Richer, BRRRI hybrid-1 and two checks are BRRRI dhan28 and BRRRI dhan29. The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications. In the experiment Maturity was also earlier for Aloron than others. Therefore, Aloron may be considered as earlier variety for cultivation. In correlation analysis a highly significant positive association was found for plant height, days to maturity, days to 50% flowering, panicle length and filled grains per panicle. All the six hybrids were superior to best yielding checks. All the hybrids showed higher grain yield per hectare (6.15 to 7.45 t/ha) than all the checks (4.83 to 5.97 t/ha) on plot harvest basis. In general biological yield per plant had highly significant positive correlation with plant height, days to maturity, filled grain per panicle and total number of grains per panicle. Grain yield per plant had highly significant positive correlation with plant height, panicle length, 1000-grain weight, harvest index, grain yield per plot, grain yield per square meter and with grain yield per hectare. Considering varietal yield performance, the variety Aloron was the best than the respective commercial variety under the study and will be cultivate for higher yield. So, more or less the genotypes Aloron will be recommended for future.

**Key words:** Evaluation • Performances • Productivity • Correlation and Hybrid Rice

### INTRODUCTION

Rice (*Oryza sativa* L.) is the most important crop of tropical world. It is the major sources of food for approximately half of the world population and hence the most important crop on the earth [1]. Rice is cultivated in about 152.04 m ha and contributes 585.59 million tons of grains. Above 90% of total rice is produced and consumed in Asia-Pacific region. Rice provides 20-80% dietary energy and near about 12-17% of dietary protein for Asians [2]. In China, hybrid rice grows well and produce higher yield than modern cultivar and attracts farmer's attention. Outside of China, India is the first country to develop and commercially exploit the hybrid technology and 17 hybrids have been released [3]. It is estimated that the population will gradually

increases to 161 million in 2020 although the population growth rate will be much lower than that in 1991. Population predicted for 2020 will require 27.26 m Mt. During this time, the total rice area will shrink from 10.71 to 10.28 m ha and the hectare rice will be needed to increase from 2.74 tons to 3.74 per capita.

Rice area will gradually shrink to only 0.149 acre in 2020 and the required rice/head per day will be decreased from 528g in 2001 to 463g in 2020 due to the increase of population. This indicates a decreasing trend of daily requirement of rice. Thus for maintaining the adequate level of rice yield required for the estimated population in the years to come rice research should continually develop improved and cost effective technologies [4].

In Bangladesh total rice growing area was 90,83,138.87 ha. Among the total area, hybrid growing area was only 1,88,274.493 ha during the year 2005 [4]. The population of Bangladesh is growing consequently and the country has to produce additional rice for about 2.2 million mouths every year. The country suffers an annual deficit of 2-3 million tons with annual addition of 0.45 million tons. In the year 2020, the country production of milled rice have to be increased 26.797 to 35 million tons [4] and the average yield of milled rice has to be doubled (i.e. 3.39t/ha) from the present level of 1.8 t/ha. To feed the fast increasing global population, the worlds annual rice production must be increase from 520 million tons of 1994 to 760 million tons by the year 2020 [5].

Hybrid rice has about a 30% yield advantages over the conventional pure line varieties (Yuan, 1998). Rice is grown in Bangladesh in three distinct seasons namely Aus, Aman and Boro. Rice is grown in 11.025 million hectares of land with a production of 26.796 million tons [6]. Anonymous [4] reported that the yield of Aus was 1.43 t/ha, Aman 1.82.07 t/ha and Boro was 3.35 t/ha respectively. But the yield of hybrid rice was higher i.e. near doubled (4t/ha) from the average yield 2.15t/ha [7]. The population of Bangladesh is increasing day by day and that is why horizontal expansion of rice area is not possible due to high population pressure on land, to ensure the food security for her increasing population. Therefore, it is an urgent need of the time to increase rice production through increasing yield. Proper practices are the most effective means for increasing yield of rice at farmers level using inbred and hybrid varieties [8].

## MATERIALS AND METHODS

The field experiment was conducted during the period from January to June 2014. The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications. There were eight treatment combinations. The total no. of unit plots was 24. The size of unit plot is 3m x 2m. The distance between plot to plot and replication were 1m. Thirty days old, seedlings were transplanted in 3m x 2m plot with spacing of 25 cm x 20 cm between rows and plants, respectively with single seedling per hill. At the time of final land preparation total P and K were used as basal dose and total N splitted into three installments. The experimental plot was fertilized with 60:40:40 kg/ha N, P and K respectively. The first one third of N with basal dose, second installment 15 days after first installment and third is 15 days after second installment. Gypsum and Zinc Sulphate were also applied

Table 1: List of the genotypes used in the experiment with their origin

Varieties	Origin	Imported by
Sonarbangla-1	Imported from China	Mollica seed company
Jagoron	Imported from China	BRAC
Aloron	Imported from China	BRAC
Hira	Imported from China	Surreme seed company
Richer	Imported from China	Chens crop science
BRRi hybrid-1	Released by BRRi	
BRRi dhan28	Released by BRRi	
BRRi dhan29	Released by BRRi	

as a source of S and Zn at the rate 60 kg and 10 kg/ha as basal dose. Five hybrid rice varieties from different private seed companies, one hybrid and two check varieties from Bangladesh Rice Research Institute were used for this experiment. Varieties are:  $V_1$ =Sonarbangla-1,  $V_2$ =Jagoron,  $V_3$ = Hira,  $V_4$ = Aloron,  $V_5$ = Richer  $V_6$ = BRRi hybrid-1,  $V_7$ = BRRi dhan-28(Check) and  $V_8$ = BRRi dhan-29(Check) (Table 1).

## RESULTS AND DESICCATION

Yield is the product of yield components i.e. panicle no., grain no. and grain weight in rice. On the other hand, yield of rice is a function of genotype and environment. For increasing yield, a good number of varieties with high yield potential have been developed However, variation of yield may occur due to inability of choosing appropriate variety for an appropriate environment. The discussions on mean performance of yield and yield components of the hybrids and check varieties have been presented in Table 2.

**Grain Yield per Plant (g):** The performance of any hybrid or variety is finally estimated on the basis of the grain yield. Among the hybrids, grain yield/plant ranged from 42.88 g in Richer to 47.87 g in Aloron, with a mean of 45.10. Whereas, the range of the checks varied from 30.45 g (BRRi dhan28) to 36.87g (BRRi dhan29), with a mean of 33.66. The group of high grain yield/plant was constituted by the genotypes of Jagoron (46.22 g), Sonarbangla-1 (46.47 g) and Aloron (47.87g) (Table 2). In the present study, it is summarised that, all the hybrids were superior then their corresponding checks. Sitaramaiah *et al.* [9] observed that high yielding hybrids had higher biomass and harvest index. In the present study, all the hybrids show higher grain yield (40.88 to 48.87 g per plant) than the checks (29.45 to 37.87 g per plant).

Table 2: Mean performances of hybrids and checks for yield related characters

SI No	Variety	Grain yield/plant	Grain yield/plot	Grain yield/ha (t)
1	Sonarbangla-1	46.47	4.35	7.25
2	Jagoron	46.22	3.99	6.66
3	Hira	42.90	3.72	6.20
4	Aloron	47.87	4.47	7.45
5	BRRI hybrid-1	44.30	3.69	6.15
6	Richer	42.88	3.87	6.48
Mean		45.10	4.01	6.70
7	BRRI dhan28 (check)	30.45	2.89	4.83
8	BRRI dhan29 (check)	36.87	3.58	5.97
Mean		33.66	3.23	5.40
Grand mean		42.24	3.82	6.37
SEd		1.38	0.02	0.05
CV%		4.00	0.97	1.03
CD%		2.96	0.05	0.10

**Grain Yield per Plot (Kg):** Among the hybrids, grain yield/plot ranged from 3.69 in BRRI hybrid1 to 4.47 in Aloron, with a mean of 4.01. Whereas, the range of the checks varied from 2.89 in BRRI dhan28 to 3.58 in BRRI dhan29, with a mean of 3.23. Among all the genotypes grain yield/ha ranged from 2.89 BRRI dhan28 to 4.47 Aloron with a grand mean value of 3.82. The genotypes BRRI dhan 28, 2.89 and BRRI dhan29, 3.58 constituted the group with low grain yield/plot (Table 2).

**Grain yield/ha (t):** The performance of any hybrid or variety is finally estimated on the basis of the grain yield. Among the hybrids, grain yield/ha ranged from 6.2 in Hira to 7.4 in Aloron with a mean of 6.70. Whereas, the range of the checks varied from 4.8 BRRI dhan28 to 6.0 BRRI dhan29 with a mean of 5.40. The genotypes BRRI dhan28, 4.8 and BRRI dhan29, 5.97 constituted the group with low grain yield/ha (Table 2). In present study, the variety Aloron was superior to all.

**Yield Advantages over Checks (%) at Plot Basis:** Based on LSD test of mean yield per plot, all the hybrids and the checks were given ranking Table 5. The means having a common letters are non significant at 5% level of significance and were ranked into same group. The ranged for grain yield per plot for hybrids from 3.690 kg in BRRI hybrid 1 to 4.470 kg in Aloron with a mean of 4.01kg per plot. Among the checks, BRRI dhan28 showed least yields (2.894 kg) and BRRI dhan29 showed highest yield (3.583 kg) per plot, with a mean yield of 3.23 kg per plot. The high performing groups were Aloron (4.470 kg) and Sonarbangla-1 (4.352 kg), but there were no significant difference between them. The yield per hectare for hybrids ranged from 6050 kg (BRRI hybrid-1) to 7500 kg (Aloron), with a mean of 6681.66 kg. The yield advantage for

hybrids over checks ranged from 2.98% (BRRI hybrid-1) to 24.75% (Aloron) over (BRRI dhan29) and 27.50 (BRRI hybrid-1) to 54.45% (Aloron) over BRRI dhan28 and 2.98% (BRRI hybrid-1) to 27.50 % (BRRI hybrid-1) showed lowest yield advantage and Aloron showed highest yield advantage over both the checks 24.75%, Aloron 27.50to 54.45%. For this trait all the hybrids showed highly significant positive yield advantage over the checks except BRRI hybrid-1 (2.98%) which showed simple significant positive yield advantage incase of check BRRI dhan29. A comparative performance of yield advantage over the checks and grain yield/kg per plot has been graphically presented in Table 3. The present range of yield advantage is fairly higher than the earlier reports. Peng [10] found that hybrids developed from *indica/japonica* derived lines in Sichuan, China yielded 18.8-24% more than the best inbreds with a maximum yield of 11.7 t/ha. Mishra [11] reported 18% to 44.9% yield advantage of 17 released indica hybrids rice over standard checks from on farm evaluation experiment in India.

**Maturity Group Wise per Day Productivity:** Based on days to maturity, collected six hybrids are classified into different maturity group (Table 4.). Of all the hybrids, Three hybrids (Sonarbangla-1, Jagoron and Hira) into medium early, 2 hybrids (Aloron and Richer) into medium and only 1 hybrids (BRRI hybrid-1) into late duration type. The medium early group hybrid had per day productivity of 55.00 kg/ha with a ranged from 49.60 kg/ha to 61.22 kg/ha. In case of medium duration group hybrid per day productivity was 51.59 kg/ha ranging from 48.00 kg to 55.18 kg/ha. The checks BRRI dhan28 and BRRI dhan29 showed per dayproductivity to be 39.28 kg/ha and 40.02 kg/ha, respectively being in medium early maturity group and late in respective order. It is interestingly to

Table 3: Yield performance of selected hybrid and check varieties at plot basis

Sl. No	Name of hybrids	Mean yield/plot (kg) (3m x 2m = 6m <sup>2</sup> )	Yield (kg/ha)	Yield advantage over checks (%)	
				BRR I dhan 29	BRR I dhan 28
1	Aloron	4.470	7450.00	24.75*	54.45*
2	Sonarbangla-1	4.352	7255.00	21.46*	50.38*
3	Jagoron	3.998	6666.60	11.58*	38.14*
4	Richer	3.876	6480.00	8.177*	33.93*
5	Hira	3.720	6200.00	3.82*	28.54*
6	BRR I hybrid-1	3.690	6154.40	2.92*	27.50*
Mean		4.017	6701.01	-	-
Checks					
7	BRR I dhan29	3.583	5973.66	00.00	-19.22*
8	BRR I dhan28	2.894	4832.33	23.80*	00.00
Mean		3.238	5402.99		
Grand mean	6376.00				
Me		0.001	-	-	-
SEd±		0.025	-	-	-
CV (%)		0.974	-	-	-
CD (%)		0.1108	-	-	-

\* Significant at 5% level, Me = Error mean sum of square

Table 4: Classification of hybrids on the basis of days to maturity and their per day productivity

Classification of hybrids on the basis of duration					
Medium early (116 – 130 days)		Medium (135 – 145 days)		Late (more than 145 days)	
Name of hybrids	Per day productivity	Name of hybrids	Per day productivity	Name of hybrids	Per day productivity
Sonarbangla 1	61.22	Aloron	55.18	BRR I hybrid-1	41.30
Jagoron	54.20	Richer	48.00		
Hira	49.60				
Mean	55.00		51.59		
Checks					
BRR I dhan28	39.28			BRR I dhan29	40.02

Table 5: Estimation of simple correlation coefficients for yield and yield components in hybrids and checks

Variables	Plant height	Days to 50% flowering	No. of effective tillers/plant	Days to maturity	Panicle length	Filled grain/panicle	Total grain/panicle	Grain yield/plant	Biological yield	Harvest index	1000 grain weight	Grain yield/plot	Grain yield/ha
Plant height	-												
Days to 50% flowering	.252	-											
No. of effective tillers/plant	.127	-.089	-										
Days to maturity	.370	.344	.180	-									
Panicle length	-.251	.237	.090	.223	-								
Filled grain/panicle	.431(*)	-.038	-.056	.385	-.148	-							
Total grain/panicle	.592(**)	.335	-.009	.694(**)	-.014	.811(**)	-						
Grain yield/plant	-.544(**)	.105	-.148	-.056	.523(**)	-.133	-.058	-					
Biological yield	.462(*)	.265	.139	.825(**)	.273	.504(*)	.674(**)	-.112	-				
Harvest index	-.622(**)	-.139	-.362	-.098	.471(*)	-.101	-.213	.780(**)	-.084	-			
1000 grain weight	-.448(*)	.232	-.087	-.141	.526(**)	-.205	-.143	.894(**)	-.139	.624(**)	-		
Grain yield/plot	-.539(**)	-.048	-.237	-.096	.532(**)	-.118	-.128	.896(**)	-.064	.862(**)	.771(**)	-	
Grain yield/ha	-.539(**)	-.048	-.237	-.096	.532(**)	-.118	-.128	.896(**)	-.064	.862(**)	.771(**)	1.000(**)	-
Grain yield/m <sup>2</sup>	-.539(**)	-.048	-.237	-.096	.532(**)	-.118	-.128	.896(**)	-.064	.862(**)	.771(**)	1.000(**)	1.000(**)

\*Significant at 5% level, \*\*Significant at 1% level

note that medium group and medium early maturing group hybrids have same level of per day productivity. This suggests that the hybrids of medium duration group are likely to be much superior to hybrids of early and medium early maturity group. A comparative study of maturity of hybrids with their per day productivity was shown in Table 6.

**Correlation Analysis:** The relationship between grain yield, biological yield, harvest index, plant height, panicle length, no. of filled and unfilled spikelets etc are varied from variety to variety. As revealed by Table 7. The results of association between pairs of yield components among the hybrids revealed that plant height had highly significant positive correlation with total grain

per panicle (0.592), grain yield per plant (0.544), harvest index (0.622), grain yield per plot (0.539), grain yield per square meter (0.539), grain yield per hectare (0.539) and significant positive correlation with unfilled grain per panicle (0.487), filled grain per panicle (0.431), biological yield per plant (0.462). On the other hand a significant negative correlation with 1000-grain weight (-0.448). Days to 50% flowering was found to have highly significant and positive correlation with unfilled grain per panicle (0.614). Days to maturity showed highly significant and possible correlation with unfilled grain per panicle (0.715), total grain per panicle (0.694) and with biological yield per plant (0.825). In case of panicle length, highly positive correlation was observed with grain yield per plant (0.523), 1000-grain weight (0.526) and grain yield per plot (0.532), grain yield per square meter (0.532) and grain yield per hectare (0.532). Grain yield per plant had highly significant positive correlation with plant height (0.544), panicle length (0.523), 1000-grain weight (0.894), harvest index (0.780), grain yield per plot (0.896) and grain yield per square meter (0.896) and with grain yield per hectare (0.896). Similarly, grain yield per plot had highly significant positive correlation with plant height (0.539), panicle length (0.532), grain yield per plant (0.896), harvest index (0.862), 1000-grain weight (0.771) and with grain yield per square meter (1.000). Also grain yield per hectare had highly significant positive correlation with plant height (0.539), panicle length 0.532, grain yield per plant (0.896), harvest index (0.862). For filled grains per panicle a highly significant positive correlation with total grains per panicle (0.811), no. of filled spikelets per panicle (0.523) and had a positive correlation with biological yield per plant (0.504). On the other hand for unfilled grain per panicle, a highly positive significant correlation with plant height (0.487), days to 50% flowering (0.614), days to maturity (0.715), total grains per panicle (0.716), no. of filled spikelets per panicle (0.515) and biological yield per plant (0.536). Total grains per panicle had a highly significant positive correlation with plant height (0.592), days to maturity (0.694), unfilled grains per panicle (0.716), no. of filled grains per panicle (0.811) and no. of filled spikelets per panicle (0.682) and with biological yield per plant (0.674). Biological yield per plant had highly significant positive correlation with plant height (0.462), days to maturity (0.825), unfilled grain per panicle (0.536), filled grain per panicle (0.504) and total grain per panicle (0.674) and with no. of filled spikelets per panicle (0.480). Harvest index had highly significant positive correlation with plant height (0.622) and with panicle length (0.471). 1000-grain weight had highly significant positive

correlation with panicle length (0.526), grain yield per plant (0.894), harvest index (0.624), grain yield per plot (0.771) and grain yield per square meter (0.771) and with grain yield per hectare (0.771) showed. A significant negative correlation with plant height (-0.448). In the present study a significant correlation between effective tiller no. and grain yield and highly significant negative correlation between HI and effective tiller no. is observed Table 5. Ganesan, K. N [12] reported that plant height, days to flowering, number of tillers/plant and productive tillers/plant had both positive and negative indirect effects on yield. Iftekharuddaula, K.M. *et al.*, [13] reported that days to maturity, days to flowering, plant height and spikelets/panicle had positive and higher indirect effect on grain yield through grains/panicle. Laza, M.R.C *et al.* [14] measured yield-related traits, panicle size had the most consistent and closest positive correlation with grain yield. Yuan, J.C *et al.* [15] the variation in fertile grain percentage/panicle in indica was greater than that in japonica. Chaudhary and Motiramani, [16] said that filled grain per panicle showed significant positive correlation with effective tillers per plant, spikelets density and biological yield per plant. Sarkar *et al.* [17] studied the number of grains/panicle was negatively associated with number of panicle. According Peng *et al.* [18] concluded that the increasing trend in yield of cultivars mainly due to the improvement in harvest index (HI). Kadoo [19] also observed similar weak correlation among these traits. Thus the following traits viz. biological yield, panicle length, days to 50% flowering, days to maturity and plant height seem to be directly correlated with grain yield of hybrids. Where as many traits namely total tiller no., effective tiller no., no. of filled spikelets, total no. of spikelets, 1000 grain weight and harvest index show indirect correlation being associated with traits directly correlated with yield.

## CONCLUSION

The experiment Maturity was also earlier for Aloron than others. Therefore, Aloron may be considered as earlier variety for cultivation. Existing of significant level of variation present in the materials indicate the possibility of improving the yield potential. Considering varietal characters and yield performance, the variety Aloron was the best than the respective commercial variety under the study and will be cultivate for higher yield. So, more or less the genotypes Aloron will be recommended for future.

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