



## Evaluation of Growth and Yield of Selected Hybrid and Inbred Rice (*Oryza sativa* L) Varieties Grown in Boro Season

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### Abstract

Pot experiments were conducted in net house during Boro 2002 and 2003 at Bangladesh Rice Research Institute (BRRI) to compare the growth and yield of hybrid and inbred rice varieties under controlled condition. Hybrid variety Sonarbangla-1 and BRRI hybrid dhan1 and inbred modern variety BRRI dhan29 were used in both the years. During Boro 2002, Sonarbangla-1 and BRRI hybrid dhan1 had higher plant height and tillers hill<sup>-1</sup> compared to BRRI dhan29. The largest leaf area of 75cm<sup>2</sup> hill<sup>-1</sup> was recorded in BRRI hybrid dhan1 at 30 DAT but at 60 and 90 DAT, Sonarbangla-1 had the highest leaf area of 723 and 1406 cm<sup>2</sup> hill<sup>-1</sup>, respectively. The highest shoot dry matter production was recorded in BRRI hybrid dhan1 at 30 DAT but in Sonarbangla-1 at 60 and 90 DAT. Rooting depth and root dry weight of Sonarbangla-1 were 15-20% higher than those of BRRI hybrid dhan1 and BRRI dhan29. At harvest, the largest number of panicles hill<sup>-1</sup> was observed in BRRI dhan29 followed by Sonarbangla-1. The number of grains panicle<sup>-1</sup>, 1000-grain weight and grain yield were higher in Sonarbangla-1 followed by BRRI dhan29. During Boro 2003, highest plant height, number of tillers hill<sup>-1</sup>, leaf area and shoot dry matter were recorded in BRRI hybrid dhan1 at all DAT, followed by Sonarbangla-1 in most cases. Rooting depth and root dry weight were the highest in Sonarbangla-1 followed by BRRI hybrid dhan1. At harvest, highest number of panicles hill<sup>-1</sup> were observed in BRRI dhan29 and Sonarbangla-1 but BRRI hybrid dhan1 had the highest number of grains panicle<sup>-1</sup>. Sonarbangla-1 had the highest 1000-grain weight and grain yield.

**Keywords:** Shoot dry matter, root dry matter, leaf area, grain yield, hybrid and inbred rice

### 1. Introduction

Hybrid rice technology is one of the alternative means to meet the challenge of food security for the increasing population in Bangladesh. Chinese rice scientists have developed and used commercial rice hybrid, which increased rice yield by about 20% over the semi-dwarf inbred varieties (Yuan *et al.*, 1994). Many hybrid rice varieties out-yielded the standard check variety by more than 1 t ha<sup>-1</sup> with same growth duration (Julfiquar *et al.*, 1998). Food and Agriculture Organization has considered hybrid rice technology as the key approach for the increase

of global rice production for the next 10 years (Virmani, 1999). It is anticipated that hybrid rice will play an important role in fighting the world's hunger in the near future.

The heterosis for higher yield in hybrid rice comes from vegetative growth. The life cycles of hybrid and inbred rice are very similar, but hybrid rice is more vigorous in the vegetative phase especially at seedling stage. Hybrid rice has higher seedling dry matter content, thicker leaves, larger leaf area and longer root system (BRRI, 2000). Hybrid rice can give 10-15% yield advantage over modern inbred varieties

through vigorous growth, extensive root system, efficient and greater sink size, higher carbohydrate translocation from vegetative parts to spikelets and larger leaf area index during the grain filling stage (Peng, 1998).

For high yield of hybrid rice, sink is not the limiting factor as it is in inbred rice (Yan, 1988). Two-step grain filling is observed in hybrid rice, which means that pollinated spikelets stop development for several days but maintain the ability to fill later (Wen, 1990). During vegetative growth, hybrid rice accumulates more dry matter which results in larger number of spikelets panicle<sup>-1</sup>, whereas inbred rice depends basically on the accumulation of assimilates after heading (Yan, 1988). The main reason for higher yield of hybrid rice is vigorous seedlings with tillers. The tillers that emerge in the seedbed produce more spikelets panicle<sup>-1</sup> than the tillers that emerge after transplanting (Wen, 1990). The common properties of modern inbred and hybrid rice varieties are: high nitrogen response, erect and thick leaves which remain green till maturity, short statured and high harvest index. Dry matter production at different growth stages shows different patterns for hybrid and inbred rice. High grain yield of hybrid rice is attributed to high vegetative biomass production, high leaf area, large panicles and high tillering capacity in some cases (Peng *et al.*, 1998). The present study was undertaken to compare the growth and yield behavior of a few selected hybrid and inbred rice varieties under controlled condition.

## 2. Materials and Methods

The experiment was conducted at the Bangladesh Rice Research Institute, Gazipur under net-house condition during the Boro seasons, 2002 and 2003 using a completely randomized design with 3 replications, where varieties were considered as treatments. The two hybrid varieties were Sonarbangla-1 and BRRI hybrid dhan1 and the inbred variety was BRRI dhan29.

### 2.1. Number, size and arrangement of pots and condition of net house

A total of 42 earthen pots in both the years [14 pots for each variety, 3 pots for each sampling (3 × 3 pots) and 5 pots for yield data] were taken

with about 10 kg muddy soil in each (Silty clay, O.M%= 2.1, P<sup>H</sup>= 6.0-6.5 and total N= 0.14) and were kept in the net house. The size of the pots was: 12 inches in height, 20 inches diameter at the top and 9 inches at the bottom. The pots were arranged in the net-house in rows (variety wise). The net-house was a ware-net covered and well-protected chamber. Sunlight and rain could enter easily into the net-house.

### 2.2. Fertilization and transplanting in the pots

Considering the weight of top-soil (0-15 cm) of the field ( $6 \times 10^5$  kg ha<sup>-1</sup>), the pots with 10 kg soil were fertilized @ 100-26.4-41.5-10-5 kg N, P, K, S and Zn ha<sup>-1</sup>, respectively. All the fertilizers were applied as basal except urea, which was applied as top dressing in 3 equal splits at 20, 35 and 50 DAT. Single 40 days old seedling was transplanted in the middle of each pot. The pots were irrigated by hand-shower before crack development on the surface soil of the earthen pots.

### 2.3. Measurement of growth parameters

Parameters for seedling quality of different varieties i.e. plant height, tiller seedling<sup>-1</sup>, leaf numbers, leaf area, rooting depth, shoot dry weight, root dry weight, root shoot ratio, weight: height and visual vigor index was measured at 30 DAS from 10 seedlings of each variety. The growth parameters e.g. plant height, tillers Hill<sup>-1</sup>, leaf area, rooting depth, shoot and root dry matter etc. were measured from destructive samples taken from 3 plants for each variety at 30, 60 and 90 DAT.

## 3. Results and Discussion

### 3.1. Seedling quality

In Boro 2002 and 2003, Sonarbangla-1 performed better in respect of all growth parameters of seedling i.e. height, tiller number, leaf area, rooting depth, shoot and root dry weight, root-shoot ratio and vigor index compared to BRRI hybrid dhan1 and BRRI dhan29 (Table1).

### 3.2. Growth parameters

To compare the shoot and root growth performance of Sonarbangla-1, BRRI hybrid

dhan1 and BRR1 dhan29 under controlled condition, plant height, number of tillers hill<sup>-1</sup>, leaf area, shoot dry weight, rooting depth and root dry weight were measured. During Boro 2002, plant height and number of tillers hill<sup>-1</sup> of Sonarbangla-1 and BRR1 hybrid dhan1 were higher than those of BRR1 dhan29 at all DAT. Largest leaf area (75 cm<sup>2</sup>) was observed in BRR1 hybrid dhan1 at 30 DAT, but in Sonarbangla-1 the largest leaf areas were attained at 60 and 90 DAT. The highest shoot dry weight (Stem + leaf) of 0.75 g hill<sup>-1</sup> was recorded in BRR1 hybrid dhan1 at 30 DAT and in Sonarbangla-1 at 60 DAT (6.3 g) and 90 DAT (78.2 g). Rooting depth and root dry weight of Sonarbangla-1 were about 10% higher than those of the other two varieties (Table 2) in Boro 2002.

During Boro 2003, the tallest plants, larger number of tillers hill<sup>-1</sup> and leaf area were observed in BRR1 hybrid dhan1 at all DAT, which was followed by Sonarbangla-1 in most cases (at 90 DAT, number of tillers hill<sup>-1</sup> and leaf area of BRR1 dhan29 were close to those of BRR1 hybrid dhan1). Similarly, BRR1 hybrid dhan1 had the highest shoot dry weight of 1, 17 and 46 g hill<sup>-1</sup> at 30, 60 and 90 DAT, respectively, followed by Sonarbangla-1. Rooting depth and root dry weight were the highest in Sonarbangla-1 at all DAT followed by BRR1 hybrid dhan1 (Table 1) in Boro 2003. It indicates that hybrid varieties showed better root

growth than inbred variety. These results also are in good agreement with those reported by Yang and Sun (1986).

At harvest during Boro 2002, tallest plants of 100 cm was observed in BRR1 hybrid dhan1, which was followed by Sonarbangla-1, largest number of tillers hill<sup>-1</sup> were observed in BRR1 dhan29 which was followed by Sonarbangla-1. During Boro 2003, the tallest plants of 95 cm were observed in BRR1 hybrid dhan1 followed by Sonarbangla-1, the highest number of tillers (23) was observed in BRR1 dhan29 and Sonarbangla-1.

### 3.3. Yield components and grain yield

The highest numbers of panicles hill<sup>-1</sup> were recorded in BRR1 dhan29 followed by Sonarbangla-1. Number of grains panicle<sup>-1</sup>, 1000-grain weight and grain yield were higher in Sonarbangla-1 followed by BRR1 dhan29. The sterility % was much higher in BRR1 hybrid dhan1, which might have decreased grain yield and HI (Table 3) during Boro 2002. Sonarbangla-1 gave the highest grain yield of 40.5 g hill<sup>-1</sup>, which was followed by BRR1 dhan29 in Boro 2002. During Boro 2003, the largest number of panicles hill<sup>-1</sup> (21) was observed in BRR1 dhan29 and Sonarbangla-1.

**Table 1.** Seedling characters of hybrid and inbred rice varieties in Boro seasons in 2002 and 2003  
2002 (At 40 DAS)

Variety**	Height (cm)	Tiller hill <sup>-1</sup>	Leaf No.	LA (cm <sup>2</sup> )	Root Depth	Shoot dry wt.	Root Dry wt.	Root: Shoot	Weight /Height	Vigor index *
SB-1	17.5	3	8	31	10.0	0.163	0.028	0.17	0.093	9
BH-1	15.1	2	7	26	12.0	0.083	0.020	0.24	0.055	8
BR29	14.0	2	8	23	8.0	0.124	0.016	0.13	0.088	8
2003 (At 40 DAS)										
SB-1	17.7	2	6	30	8.3	0.126	0.076	0.60	0.071	9
BH-1	14.7	2	6	23	13.1	0.076	0.041	0.54	0.068	8
BR29	13.6	1	4	21	9.1	0.065	0.035	0.53	0.045	8

\*Visual Score:1= Very poor growth, 3= Poor growth, 5= Medium growth, 7= Good growth and 9= Excellent

\*\* SB-1= Sonarbangla-1, BH-1= BRR1 hybrid dhan1 and BR29= BRR1 dhan29.

**Table 2.** Plant growth parameters of hybrid and inbred rice varieties at different DAT in Boro seasons of 2002 and 2003

Variety*	Plant ht. (cm)	Tillers hill <sup>-1</sup>	LA (cm <sup>2</sup> )	Rooting depth (cm)	Shoot dry weight (g hill <sup>-1</sup> )			Root DW (g hill <sup>-1</sup> )
					Stem	Leaf	Total	
					2002			
30 DAT								
SB-1	33.5±0.2	6.0±0.3	71±1.8	22.4±0.6	0.51±0.02	0.22±0.0	0.73±0.03	0.23±0.01
BH-1	33.3±0.3	6.7±0.2	75±1.7	18.0±0.8	0.52±0.01	0.23±0.0	0.75±0.02	0.18±0.01
BR29	27.3±0.2	5.0±0.3	63±2.7	15.4±0.3	0.40±0.02	0.01±0.0	0.57±0.03	0.15±0.01
60 DAT								
SB-1	65.1±0.8	14.0±0.3	723±22	31.0±0.58	3.60±0.24	2.74±0.3	6.34±0.50	2.22±0.06
BH-1	63.3±0.9	15.0±0.3	459±10	26.3±0.51	2.06±0.03	1.83±0.0	3.89±0.04	1.59±0.02
BR29	56.4±0.4	13.7±0.2	547±4	26.3±0.84	2.42±0.07	2.15±0.0	4.57±0.11	2.17±0.07
90 DAT								
SB-1	90.8±0.5	24.7±1.0	1406±26	39.4±0.7	63.79±3.49	14.45±0.8	78.23±4.2	15.28±0.25
BH-1	92.6±1.1	24.7±1.0	1194±16	34.9±1.1	43.07±1.04	11.99±0.6	55.06±1.6	12.77±0.62
BR29	86.0±0.7	20.7±0.8	1067±24	31.7±0.6	30.43±0.71	10.48±0.3	40.91±1.0	9.83±0.22
2003								
30 DAT								
SB-1	41.0±0.6	3.3±0.19	62±2.19	12.7±0.3	0.65±0.02	0.31±0.0	0.97±0.03	0.23±0.0
BH-1	54.2±0.9	5.0±0.33	73±5.09	12.0±0.2	0.72±0.01	0.31±0.0	1.04±0.02	0.21±0.0
BR29	28.7±0.8	2.3±0.19	41±1.07	10.8±0.3	0.56±0.02	0.24±0.0	0.80±0.03	0.19±0.0
60 DAT								
SB-1	71.8±0.7	18.7±0.7	1614±45	22.7±1.3	7.46±0.27	4.66±0.3	12.12±0.6	3.36±0.2
BH-1	73.0±0.9	27.3±1.6	1940±64	21.8±1.0	10.42±0.26	6.73±0.3	17.15±0.5	2.43±0.1
BR29	61.1±0.9	23.3±1.4	1178±54	17.2±0.4	4.16±0.08	3.20±0.1	7.36±0.2	1.70±0.0
90 DAT								
SB-1	89.2±1.1	20.0±0.7	1890±57	29.6±0.6	19.47±0.79	12.84±0.9	32.30±1.64	16.77±0.5
BH-1	90.2±0.7	29.3±2.0	3244±179	27.2±1.2	29.24±2.72	17.21±1.0	46.45±3.68	16.63±1.7
BR29	79.1±0.7	26.0±1.8	2666±235	26.0±0.5	19.75±1.34	9.23±0.5	28.99±1.84	12.67±0.2

\*SB-1= Sonarbangla-1, BH-1= BRRI hybrid dhan1 and BR29= BRRI dhan29.

**Table 3.** Plant growth parameters at harvest, yield components and grain yield of hybrid and inbred rice varieties grown in Boro seasons of 2002 and 2003

Variety*	Plant ht (cm)	Tillers hill <sup>-1</sup>	Panicles hill <sup>-1</sup>	Grains panicle <sup>-1</sup>	1000 GW (g)	Yield (g hill <sup>-1</sup> )	Sterility (%)	HI
SB-1	95.2±1.0	22.7±0.7	20.7±1.7	81.3±1.7	25.9±0.15	40.5±0.62	18±0.88	0.50±0.0
BH-1	99.8±0.8	17.0±0.3	16.3±0.19	72.7±1.6	23.2±0.10	26.6±0.77	32±0.69	0.47±0.0
BR 29	88.2±0.9	23.7±1.1	21.0±1.45	80.3±1.0	23.5±0.1	37.4±1.44	17±0.84	0.49±0.0
2003								
SB-1	90.3±0.7	23.0±0.9	21.0±0.67	75±1.0	25.4±0.07	40.8±0.30	13±0.33	0.48±0.0
BH-1	95.3±0.8	22.3±1.1	20.3±0.84	78±0.69	23.2±0.03	36.2±0.63	13±0.19	0.47±0.0
BR 29	88.0±0.9	23.3±1.4	21.0±0.67	71±1.76	23.5±0.03	35.6±0.93	24±5.78	0.46±0.0

\*SB-1= Sonarbangla-1, BH-1= BRRI hybrid dhan1 and BR29= BRRI dhan29.

BRRRI hybrid dhan1 had the highest number of grains panicle<sup>-1</sup> (78), but Sonarbangla-1 had the highest 1000-grain weight of 25.4 g and grain yield of 40.8 g hill<sup>-1</sup>. BRRRI dhan29 had the maximum sterility (24%) with decreased HI (Table 3) in Boro 2003. Sonarbangla-1 and BRRRI dhan29 gave similar grain yield in both Boro 2002 and 2003, but BRRRI hybrid dhan1 gave 28% higher grain yield in Boro 2003 compared to Boro 2002. Considering all the growth and yield related parameters, hybrid Sonarbangla-1 and BRRRI hybrid dhan1 performed better compared to inbred BRRRI dhan29.

#### 4. Conclusions

Hybrid Sonarbangla-1 had the highest vigor index at seedling stage. Compared to inbred BRRRI dhan29, the hybrids Sonarbangla-1 and BRRRI hybrid dhan1 showed better root growth. Both the hybrids showed better growth and yield performance during 2003 due to prevailing low temperature compared to 2002.

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