Evaluation of growth and yield potentialities of local boro rice varieties in south-west region of Bangladesh

S. K. Roy[1], M. Y. Ali[2], M. A. Hakim[3,4*] , M. M. Hanafi[3], Abdul Shukor Juraimi[5], M. S. Jahan[2], U. K. Saha[2], Md. Amirul Alam[5] and M. A. Kashem[6]

[1]*Assistant Professor in Agriculture, North Khulna Degree College, Khulna, Bangladesh*
[2]*Agrotechnology Discipline, Khulna University, Khulna, Bangladesh*
[3]*Institute of Tropical Agriculture, Universiti Putra Malaysia, Serdang, Selangor, DE 43400, Malaysia*
[4]*Department of Agricultural Chemistry, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh*
[5]*Department of Crop Science, Universiti Putra Malaysia, UPM Serdang, Selangor, DE 43400, Malaysia*
[6]*Bangladesh Institute of Nuclear Agriculture, Mymensingh*
*Corresponding authors email: ahakimupm@gmail.com

Abstract: A field experiment was conducted to evaluate the growth and yield performance of local *boro* rice varieties. Twelve local *boro* rice varieties were included in this study namely Nayon moni, Tere bale, Bere ratna, Ashan boro, Kajol lata, Koijore, Kali boro, Bapoy, Latai balam, Choite boro, GS one and Sylhety boro. Growth parameters *viz.* plant height and number of tillers hill^{-1}(at different days after transplanting); yield contributing characters such as effective tillers hill^{-1}, panicle length, number of grains panicle^{-1}, filled grains panicle^{-1}, thousand grain weight, grain yield, straw yield, biological yield and harvest index were recorded. The result revealed that the plant height and number of tillers hill^{-1} at different days after transplanting varied significantly among the varieties. The plant height for all the varieties and number of tillers hill^{-1} for most of the varieties increased up to harvest. At harvest, the tallest plant (123.80 cm) was recorded in Bapoy and the shortest (81.13 cm) was found in GS one. The maximum number of tillers hill^{-1} (46.00) was observed in Sylhety boro and the minimum (19.80) in Bere ratna. All of the parameters of yield and yield contributing characters differed significantly at 1% level except grain yield, biological yield and harvest index. The maximum number of effective tillers hill^{-1} (43.87) was recorded in the variety Sylhety boro and the minimum (17.73) was found in Bere ratna. The highest (110.57) and the lowest (42.13) number of filled grains panicle^{-1} was observed in the variety Koijore and Sylhety boro, respectively. Thousand grain weight was the highest (26.35g) in Kali boro and the lowest (17.83g) in GS one. Grain yield was not differed significantly among the varieties but numerically the highest grain yield (5.01 t ha^{-1}) was found in the variety Koijore and the lowest in GS one(3.17 t ha^{-1}). Considering all parameters the varieties Koijore (5.01tha^{-1}), Choite boro, Sylhety boro, Ashan boro, Bere ratna performed better for the southwest region of Bangladesh.
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Introduction:

Rice (*Oryza sativa* L.) is life for more than half of the population in the world. Bangladesh is an agro-based country where agriculture is the single largest sector and the main stay of the country's economy. Agriculture in Bangladesh is predominated by intensive rice cultivation. The national average yield of rice in Bangladesh is low (2.77 t ha^{-1}), while yields of the other rice growing countries of Asia such as, China, Taiwan, Indonesia, and Japan are 5.72, 4.60, 4.38, and 5.97 t ha^{-1}, respectively (Quayum *et al.,* 1996). In Bangladesh, the area under rice cultivation was 4706875 hectares in *boro* season in 2009-2010, which produced 18058962 MTs of grains with an average yield of 3.837 MTs (BBS, 2010). With the expansive culture of modern varieties, the number of traditional rice cultivars reduced. The promotion of high yielding variety (HYV) rice mono-culture has led to loss of diversity including 7000 traditional rice varieties (Singh *et al.,* 2000). Now a day, cultivation of modern rice varieties is under threat due to climatic stresses such as salinity, drought, submergence etc. Rice scientists have been giving effort to develop stress tolerant rice varieties. There are thousands of local rice varieties in our country which are well adapted to various stress situations. The local rice varieties are usually said poor yielder but they are superior to modern varieties in terms of stability, resistance to biotic and abiotic factors, quality characters, etc. A number of reports showed that indigenous rice cultivars from Bangladesh possess a wide diversity in ecological, morphological and physiological characteristics (Bhowmik *et al.,* 2000; Islam, 1990; Jahan, 2003). It was reported that a number of local rice varieties have high yield potentiality. Although much research have been done

for understanding modern rice varieties but report on local boro rice cultivar is scanty. This experiment has therefore been undertaken to observe the growth and yield performance as well select the boro rice cultivars and thereby for successful rice production in the southwest region of Bangladesh**.**

Materials and Methods:

The study was conducted at the Dr. Purnendu Gain Field Laboratory of Agro technology Discipline, Khulna University, Khulna during the period of November 2011 to May 2012. The experimental field was typical rice growing medium high land of loamy soil and it is situated in the Agro ecological Zones (AEZ) 13, i.e., Gangetic Tidal Floodplain. The geographical situation of the experimental field is at latitude of $22^0 47^/$ N and longitude of $89^0 34^/$ E having subtropical climate characterized by moderately high temperature and heavy rainfall during *kharif* season (March to October) and low rainfall and low temperature during the *robi* season (November to February). The experimental field was typical rice growing medium high land of clay-loam with black colored and p^H was 8. The experiment was organized in a Randomized Complete Block Design (RCBD) with three replications. The selected field was firstly divided into three equal blocks and each block was further divided into twelve unit plots. The size of unit plot was 10 m^2 (4 m x 2.5 m). The total number of plots was thirty six. The distance between block to block was 1.0 m and plot to plot distance was 50 cm. In this research work twelve local *boro* rice varieties were included *viz.* Nayon moni, Tere bale, Bere ratna, Ashan boro, Kajol lata, Koijore, Kali boro, Bapoy, Latai balam, Choite boro , GS one and Sylhety boro. Pre germinated seed were sown in the wet seedbed during *boro* season on 26th November, 2011. Transplanting was done with three seedlings $hill^{-1}$ maintaining 20 cm hill to hill and 25cm line to line spacing on 16th January, 2012. The experimental location was uniformly fertilized with Urea, TSP, MoP, Gypsum and Zinc sulphate @ 110, 60, 45, 30 and 10 kg ha^{-1} respectively. The total TSP, MoP, Gypsum, Zinc sulphate and one third of Urea were applied as basal dose. The rest of the urea was applied at two equal split doses at 30 days after transplanting (DAT) and at 50 DAT. Two hand weeding were done to check weed infestation in the experimental field at 25 DAT and 40 DAT. The experimental field was irrigated regularly up to dough stage depending upon the moisture content of the field and flood irrigation method was practiced. During the experimentation some insect pests like grass hopper, stem borer, rice bug and nematode were infested in the crop. Semcup 50 EC @ 1L ha^{-1} was applied to control grass hopper, stem borer, rice bug and nematode was controlled by application of Furadan 5G @ 10 kg ha^{-1}. Nayonmoni, Ashan boro, Kajol lata, Bapoy, Latai balam and Choite boro were harvested on 23rd April, 2012 and GS one, Bere ratna, Kali boro were harvested on 2nd May 2012 & Koijore, Sylhety boro, Tere bale were also harvested on 5th May 2012. Data were recorded on growth parameters (at 50, 65 and 80 day after transplanting) and yield parameters at final harvest.

Statistical Analysis:

All the collected data were analyzed following the analysis of Variance (ANOVA) technique and mean differences were adjudged by Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984) using a computer operated program named MSTAT-C.

Results and Discussion:

Plant height increased progressively reaching a maximum at harvest. The tallest (123.80 cm) plant was found in the variety Bapoy followed by Choite boro (122.93 cm) and the shortest plant was recorded in the variety G.S one (81.13 cm) proceeded by Tere bale (86.00 cm) and Koijore (91.33 cm) (Table 1). Variation in plant height among the varieties might be due to the differences in their genetic makeup. This result was in consistent to those of Khatun (2001) and Das *et al*. (2012) who observed variable plant height among the rice varieties.

Tiller number in most of the treatments increased almost exponentially up to harvest (Table 2). The maximum number of tillers $hill^{-1}$ (46.13) was recorded in the variety Sylhety boro followed by Nayon moni (33.00). The minimum number of tillers (18.13) was observed in the variety Koijore. Similar result was also reported by Ramasamy *et al*. (1987) who stated that number of tillers $hill^{-1}$ differed due to varietal variation. Variety had significant effect on effective tillers $hill^{-1}$ (Table 3). The highest number of effective tillers $hill^{-1}$ (43.87) was produced by Sylhety boro. The lowest number of effective tiller $hill^{-1}$ (17.73) was observed in Bere ratna which was preceded by Kaijore and Ashan boro. The reason of difference in number of effective tiller $hill^{-1}$ is the variation in the genetic makeup of the variety.

The highest panicle length (21.62 cm) was recorded in the variety Bapoy which was followed by the variety Kajol lata and Bere ratna. The lowest panicle length (15.13 cm) was found with the variety Sylhety boro which was preceded by Nayon moni, GS one, Kali boro and Choite boro. Similar results were also recorded by Idris and Matin (1990) and Anonymous (1993) who reported that panicle length influenced by different varieties.

Table 1. Plant height of local *boro* rice varieties at different days after transplanting

Variety	Plant height (cm) at			
	50 DAT	65 DAT	80 DAT	Harvest
Nayonmoni	62.06bc	75.00d-g	104.73bc	111.40bc
Tere bale	51.13cd	63.00fgh	79.00ef	86.00fg
Bere ratna	67.93ab	78.80cde	95.20cd	97.60de
Ashan boro	62.80bc	73.33e-h	88.20de	92.13ef
Kajol lata	71.26ab	91.13bc	103.86bc	108.67bc
GS one	47.26d	59.20h	70.93f	81.13g
Koijore	49.00d	61.20gh	76.06f	91.33efg
Kali boro	61.93bc	76.86c-f	108.53ab	114.87ab
Bapoy	68.80ab	88.26bcd	116.20a	123.80a
Latai balam	67.93ab	95.33b	110.13ab	117.20ab
Choite boro	77.33a	110.00a	117.73a	122.93a
Sylhety boro	51.53cd	62.06gh	95.46cd	103.47cd
Level of significance	0.01	0.01	0.01	0.01
CV (%)	8.19	7.82	4.73	4.33

In a column figures having similar letter(s) did not differ significantly where as dissimilar letter(s) differed significantly
DAT = Days after transplanting

Table 2. Number of tillers hill^{-1} of local *boro* rice varieties at different days after transplanting

Variety	Number of tillers hill^{-1} at			
	50 DAT	65 DAT	80 DAT	Harvest
Nayon moni	20.36abc	25.66b	29.66 bc	33.00b
Tere bale	12.66c	21.87bc	31.26b	29.80bc
Bere ratna	15.00bc	16.60c	19.13de	19.80e
Ashan boro	17.00abc	19.86bc	20.40cde	22.07de
Kajol lata	19.66abc	23.86bc	24.73b-e	29.60bc
GS One	18.46abc	24.26bc	23.40b-e	24.47cde
Koijore	23.93a	20.53bc	18.13e	20.40e
Kali boro	22.20ab	26.26b	27.26b-e	29.13bc
Bapoy	19.20abc	27.00b	28.20bcd	29.93bc
Latai balam	20.86abc	22.33bc	23.80b-e	25.60cd
Choite boro	25.00a	23.33bc	27.00b-e	27.27bcd
Sylhety boro	25.40a	36.33a	46.13a	46.00a
Level of significance	0.05	0.01	0.01	0.01
CV (%)	22.34	13.33	14.68	9.12

In a column figures having similar letter(s) did not differ significantly whereas dissimilar letter(s) differed significantly
DAT = Days after transplanting

Table 3. Yield and yield contributing characters of different indigenous Boro rice varieties

Variety	No. of effective tiller hil^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	No. of filled grains panicle^{-1}	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
Nayonmoni	30.73b	17.71c	53.77e	46.51de	26.28a	3.72	3.68bc	7.42	50.08
Tere bale	27.13bc	19.11bc	74.01cde	61.36cde	20.92cd	3.36	3.21bc	6.57	51.26
Bere ratna	17.73f	20.22ab	113.17ab	97.42ab	22.02bc	4.24	3.31bc	7.55	55.68
Ashan boro	20.00def	18.82bc	96.57bc	83.29bc	21.86bc	4.34	3.15bc	7.49	57.52
Kajol lata	26.13bcd	21.54a	88.17bcd	74.96bc	24.80ab	3.68	2.77c	6.45	56.74
GS one	22.00c-f	18.32c	108.95ab	83.36bc	17.83e	3.17	3.37bc	6.77	51.48
Koijore	18.00ef	18.58bc	132.80a	110.57a	18.88de	5.01	4.46ab	9.47	53.01
Kali boro	27.13bc	17.66c	45.32e	40.52e	26.35a	3.72	3.66bc	7.39	49.85
Bapoy	27.06bc	21.62a	86.75bcd	66.69cd	24.34ab	3.67	3.76bc	7.43	49.38
Latai balam	23.60c-f	18.26c	55.81e	49.17de	25.74a	3.94	3.10bc	7.04	56.13
Choite boro	24.53b-e	18.34c	62.81de	48.64de	24.34ab	4.78	3.99abc	8.77	54.52
Sylhety boro	43.87a	15.13d	47.69e	42.13e	24.19ab	4.67	5.44a	10.11	46.07
CV (%)	10.61	3.98	14.59	14.44	5.50	22.65	17.76	18.28	8.36
Level of significance	0.01	0.01	0.01	0.01	0.01	NS	0.01	NS	NS

In a column figures having similar letter(s) did not differ significantly whereas dissimilar letter(s) differed significantly, NS = Not significant.

The number of grains panicle^{-1} was the highest (132.80) with the variety Koijore which was statistically identical with Bere ratna and GS one. The lowest number of grains panicle^{-1} (45.32) was recorded with the variety Kali boro which was statistically identical with Nayon moni and Latai balam. The results revealed that number of filled grains panicle^{-1} was the highest (110.57) with the variety Koijore which was statistically identical with Bere ratna. The lowest number of filled grains panicle^{-1} (40.52) was recorded with the variety Kali boro which was statistically similar to Sylhety boro. The results were also supported by Singh and Gangwer (1989) who stated that varietal differences regarding the number of filled grains panicle^{-1} might be due to their differences in genetic constituents.

Among the tested varieties the highest 1000-grain weight (26.35 g) was produced by Kali boro which might be due to its larger grain size and that was statistically similar to Nayon moni and Latai balam. The lowest 1000-grain weight (17.83 g) was found in GS one for its smaller grain size which was statistically similar to Koijore. Similar results were reported by Gupta and Sharma (1991). Results showed that the grain yield did not vary significantly among the varieties but was varied numerically (Table 3). The highest grain yield (5.01 t ha^{-1}) was recorded in Koijore which might be due to its highest number of filed grains panicle^{-1} and the lowest grain yield (3.17 t ha^{-1}) was found in GS one.

Varieties differed significantly in their straw yield (Table 3). The highest straw yield (5.44 t ha^{-1}) was obtained from the variety Sylhety boro which might be due to its highest number of tillers hill^{-1}. The lowest straw yield (2.77 t ha^{-1}) was observed in the Kajol lata. The result are in accordance with the findings of Hossain (2002).

Biological yield did not vary significantly among the varieties (Table 3). However, numerically the highest biological yield (10.11 t ha^{-1}) was obtained from the variety Sylhety boro. The lowest biological yield (6.45 t ha^{-1}) was found in the Kajol lata. These results are in agreement with the findings of Sohel *et al.* (2009). Varieties did not follow any regular trend in case of harvest index and was not varied significantly (Table 3). However, numerically the highest harvest index (57.52%) was recorded from the variety Ashan boro and that of the lowest (46.07%) was recorded in Sylhety boro. The result was supported by Sohel *et al.* (2009).

Conclusion:

From the results of this study it may be concluded that the varieties Koijore (5.01tha^{-1}), Choite boro, Sylhety boro, Ashan boro, Bere ratna (> 4.0tha^{-1}) gave the high yield potentiality in compared to modern varieties. Other varieties have moderate yield potentiality (> 3.0tha^{-1}). Moreover these varieties are well adapted to the agro-ecology in southwest region of the country. So, farmers can cultivate these local varieties instead of modern varieties without significant yield loss.

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