J. Agrofor. Environ. 2 (2): 9-13, 2008 ISSN 1995-6983

Growth and yield potential of some local and high yielding boro rice cultivars

Bikash C. Sarker, Meshkat Zahan, U. K. Majumder[1], M. Atikul Islam[1] and B. Roy
Department of Agricultural Chemistry, [1]Department of Statistics, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh

Abstract: A field experiment was conducted to study morphological, yield and yield contributing characters of four boro rice varieties of which three were local viz., Bashful, Poshursail and Gosi; while another one was a high yielding variety (HYV) BRRIdhan 28. The BRRIdhan 28 were significantly superior among the cultivars studied. The BRRIdhan 28 was shorter in plant height, having more tillering capacity, higher leaf number which in turn showed superior growth character and yielded more than those of the local cultivars. The HYV BRRIdhan 28 produced higher number of grains panicle^{-1} and bolder grains resulted in higher grain yield over the local cultivars. Further, BRRIdhan 28 had erect leaves and more total dry mass than those of local varieties. The BRRIdhan 28 produced higher grain yield (7.41 t ha^{-1}) and Bashful, Poshurshail and Gosi yielded ha^{-1}, respectively. Among the local rice cultivars, Gosi showed the higher yielding ability than Bashful and Poshursail.
Key words: Growth, yield potential, Local, HYV, boro, rice.

Introduction

Bangladesh is an agro-based country. About 75% of her population depends on agriculture. Rice is extensively grown throughout the year in Aus, Aman and Boro, seasons. Rice is one of the major food crops of the world. Worldwide rice is cultivated in 150 million hectares, which is more than 10% of the earth's arable land. It is also the staple food crops of nearly half of the total population of the world and is the main source of calories of almost 40% of the world population (Hoffman, 1991). It is the most important crop in Asia as a whole comprises to about 92% of the world rice harvest (IRRI, 1995).

Two types of rice cultivars, traditional (local) and modern (high yielding) varieties are cultivated in Bangladesh. Recently, hybrid rice varieties are also grown due to higher yield. Though the soil and climate of our country is quite suitable for the production of rice, still it is facing many problems of which the poor yielding inherent capability of our local varieties is the most important one. Poor plant type, such as tall plants, long and droopy leaves, weak culms, susceptible to lodging etc. are the main causes of the low yield of the local varieties. On the other hand, modem varieties possess short and stout culms with dark green, thick and erect leaves and do not lodge. Recently there is stagnancy in the development of high yielding rice variety compared to the existing modern variety. The reason is the maintainability of superior germpalsm. Several adapted modern rice cultivars have been cultivated from many years by farmers in Bangladesh and had a tremendous impact on rice production. Those cultivar released still could not replace the local cultivar totally. That means local cultivars have some places for their ingenuity in the rice production strategy of Bangladesh. As these cultivars are being producing since long time, there should be a strategy to increase the productive potentials through genetic manipulation. It is, therefore, essential to know the physiological behavior such as their morphological and architectural response to environments and genetic expression of those selected local cultivars. It is also essential to know the morphological and physiological, limitation which actually denotes genetic expression under a certain environmental and micro climatic conditions.

Very little attempts have been made to characterize the local and modern released cultivars concern to their morphological, chemical and physiological expressions and limitation. Dutta *et al.* (1998) a characterized a lot of local rice cultivars both on morphology and their physio-chemical quality and pointed out that some physiological limitation which should be improved for the improvement of those cultivars.

Sharma and Haloi (2001) characterized some local aromatic rice of Assam on the basis of their physiological and assimilate partitioning behavior. They pointed out that the improvement of partitioning efficiency might be one of the best criteria for improvement of aromatic rice. Dutta *et al.* (1997) also pointed out some physiological limitation of modern *Indica-Japonica* types of rice and suggested improvement over IRRI scientist's proposed new model for rice improvement. This information package might be valuable information for the breeders for fixing breeding strategy.

Some of the local rice cultivars arc very popularly adapted in different regions of the country. There are some rice cultivars locally known as 'Bashful' and 'Posursail' and they are cultivated in Hobigonj, Netrokona and Naogaon district during the Boro season. They are much chosen by the people because of the long grain characteristics of cooked rice, softness, non-sticky. It needs study to know the genetic yield potential maintaining modern agronomic packages. Therefore, the objectives was to comparative study of yield potential among the three local and a high yielding varieties using modern agronomic practices.

Materials and Methods

A field experiment was conducted in the agricultural farm of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur during the period from February to May 2011. The location of the experimental site was at $25^0 38'$ N latitude and $88^0 41'$ longitude and at the elevation of 34.5 m above the sea level. The experimental site was medium high land and belonging to the Agro-ecological Zone 1 (AEZ-1) named Old Himalayan Piedmont Plain. The soil was sandy loam of experiment plot having low soil p^H (p^H - 6.0).The boro rice cultivars Bashful, Posursail, Gosi and one HYV BRRIdhan 28 was used for the study. The required seeds were collected from Hobiganj, Netrokona and Naogoan district.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The 40 days

old seedlings were transplanted in the experimental plots on February 12, 2011. Healthy seedlings were uprooted carefully from the seed bed and three seedlings in each hill were transplanted in the experimental field following the distance of 20×20 cm. The chemical fertilizers like Urea, TSP, MOP and Gypsum were applied @ 215 kg, 180 kg, 100 kg, and 20 kg per hectare, respectively. At the beginning of land preparation one half of urea, full dose of TSP, MOP and gypsum were applied to the experimental plot. The remaining half of urea was applied in two splits, one at tillering and other at booting stages. After one week, in some plots, gaps of missing seedling were filled with the stock seedlings. Intercultural operations such as weeding by hand picking and applications of pesticides by hand sprayer at the vegetative growth stages were done as and when necessary. As precautionary measures to the crops from the pest attack, Admire-200 SL @ 125 ml per hectare was sprayed 2 times at vegetative and pre-flowering stages during the entire crops season. Data were recorded on plant height, leaf number per hill, leaf length, tiller number per hill, root length per hill, total tiller no, effective tiller, non effective tiller, panicle per plant, grain per panicle, 1000 grain weight, straw weight.

Plant height, leaf number, leaf length and tiller number were recorded at 7 days interval. Plant height was measured form the soil levels to the apex of the leaf. The total number of leaves per plant was counted from selected samples. Measurement was taken from the neck node to the apex of each leaf. The total number of roots per hill was counted from selected sample. The total number of roots per hill was counted from selected plot. The total volume of roots per hill was counted from selected plot. The total number of tillers hills^{-1} was counted from selected samples. Total grains panicle^{-1} was counted from selected plants from each plot. At final harvest, the data of yield and some other yield attributing component ware collected. The height of plant was ascertained by measuring with a master scale placed from ground level to top of the leaves. The leaf number and tiller number of the selected plant was counted carefully. Then the collected plant roots were carefully washed using running tap water to remove soil and blotted with blotting paper to remove the adhering water the roots were weighed carefully for fresh weight followed by oven drying for 72 h at 60^{0}C for constant dry weight. Then roots were weight for dry weight.

The number of filled grains panicle^{-1} plus the number, of unfilled grain panicle^{-1} gave the total number of grain panicle^{-1}. One thousand clean oven dried grains were counted from the seed stock obtained from hill in each plot and weighed for 1000 grain weight. Straw obtained from each plot were oven dried and weighed carefully. Grain obtained from each plot was oven dried and weighed carefully and converted into yield per hectare.

Harvest index is the relationship between economic yield and biological yield (Gardner *et al.,* 1985). It was calculated by using the Following formula:

$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

The data collected on different parameters under the experiment were statistically analyzed using the MSTATC-computer software. If the treatments were significant the mean differences between pairs of means were compared by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Plant height of different varieties varied markedly amongst tested rice cultivars (Fig. 1). Among the four varieties studied, Gosi had the significantly highest plant height (160 cm) which was statistically similar to Bashful (151 cm) and the lowest plant height was recorded in BRRIdhan 28 (105.1 cm) but Bashful and Gosi. Munshi (2005) reported that modern rice plants were shorter than local ones due to shorter internode length, which supported the present result. Different cultivars showed variability in production of leaves (Fig. 2). Among the four varieties, BRRIdhan 28 had the highest leaf number (4.2) which was similar to Gosi (4.0) and the lowest leaf number was recorded in Bashful (3.6). The growth of leaf in respect to length among the varieties was presented in Fig. 3. Gosi possessed the longest leaf (56.50 cm) but the BRRIdhan 28 had the shortest (49.83 cm) at booting stage. The present study inferred that HYV produced shorter leaf than those of local cultivars. This result was supported by the finding of Aktar (2005) who revealed that leaf length was shorter in HYV compared to local. This might be due to the genotypic variation.

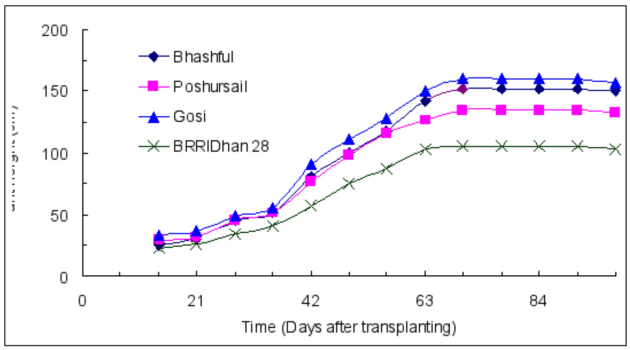

Fig. 1. Plant height of different rice varieties in boro season

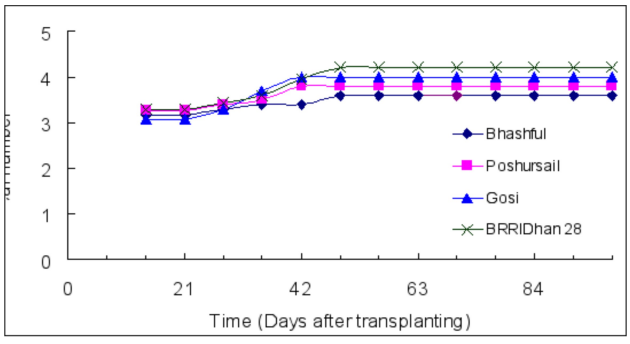

Fig. 2. Leaf number of different rice varieties in boro season

Number of effective tiller hill^{-1} had shown differently amongst the studied cultivars presented in Table 1.The cultivars effect on tiller production at all growth stages was markedly variable. The highest effective tiller hill^{-1}

was observed in BRRI dhan28 (12.25) which was statistically similar to Gosi while the lowest effective tiller hill^{-1} was found in Poshurshail (7.75) and That is statistically identical with Bashful. The variability in effective tillers hill^{-1} were in full agreement with several workers (Yong *et al.* 2001; Dutta *et al*. 2002; Shrirame and Muley, 2003; Munshi, 2005). The differential response of tillering in the genotype could be attributed to its genetic potentiality.

Number of non-effective tillers hill^{-1} amongst the studied cultivars were genotypes was statistically significant (Table 1). Result revealed that non-effective tillers hill^{-1} was greater in local cultivars than in HYV (BRRIdhan 28). Interestingly, some local cultivars also showed higher yield performance indicating negatively correlated with non-effective tillers hill^{-1}. In the study, the highest number of non-effective tillers hill^{-1} was recorded in Posursail (5.5) followed by Bashful (3.0). Interestingly the lowest non-effective tillers hill was observed both in Gosi (2.5) and BRRIdhan 28 (2.5). This result was supported by Aktar (2005) and Hoque (2004) in several rice cultivars. The cultivars effect on tiller production at all growth stages was significant (Table 1). It revealed that tiller number increased till 77 DAT followed by a decline to harvest due to death of some undeveloped tillers. BRRIdhan 28 and Gosi produced the higher number of the tillers compared to others. In contrast, Bashful and Poshursail produced the lowest number of tillers hill^{-1} at all growth stages. The number of filled grains panicle^{-1} is the most important attribute which was markedly different among the cultivars (Table 1). The highest grain number panicle^{-1} was recorded in BRRIdhan28 (147.5) and the lowest grain number panicle^{-1} was in Bashful (86.25) which was statistically similar with Poshursail.

There was significant difference in grain weight among the boro rice varieties in the study (Table 1). The highest grain weight was recorded in BRRIdhan 28 (7.41 t ha^{-1}) and the lowest grain weight was recorded in Bashful (4.75 t ha^{-1}). The higher yield in BRRIdhan 28 might be due to the production of higher number of effective tillers hill^{-1} and higher number of filled grain panicle^{-1}. Pruneddu and Spanu (2001) reported that the genotypes; which produced higher number of effective tillers hill^{-1} and higher number of grains panicle^{-1} in influenced higher grain yield. Similar results were also reported by Dutta *et al*. (2002) and Mondal *et al*. (2005) in rice crops.

Table 1. Yield and yield contributing characters of four rice cultivars grown

Varieties	Panicle hill^{-1}	Effective tiller hill^{-1}	Non effective tiller hill^{-1}	Total tiller hill^{-1}	Grain panicle^{-1}	1000 grain wt (g)	Total dry matter (t ha^{-1})	Harvest index (%)	Grain Yield (t ha^{-1})
Bashful	8.95b	8.75b	3.0b	11.50b	86.25c	24.33b	17.81	26.74b	4.75b
Poshursail	7.95b	7.75b	5.5a	13.56ab	95c	32.76a	16.30	33.40ab	5.46b
Gosi	12.00a	12.0a	2.5b	14.38a	105b	25.58b	17.71	31.90b	5.63b
BRRIdhan 28	12.32a	12.25a	2.5b	14.94a	147.5a	31.75a	17.66	41.39a	7.41a
	2.248	1.639	1.639	2.106	16.97	1.994	NS	8.625	1.51

There was a significant difference in 1000-grain weight among the studied boro rice varieties (Table 1). The highest 1000-grain weight was recorded in Poshurshail (32.76 g) which is statistically similar with BRRIdhan 28. The lowest grain weight was in Bashful (24.33 g) and was statistically identical with Gosi. Mondal *et al*. (2005) studied 3 local and 1 modern variety of transplant boro rice and reported that 1000-grain weight differed significantly among the cultivars studied which supported the present the experimental result.

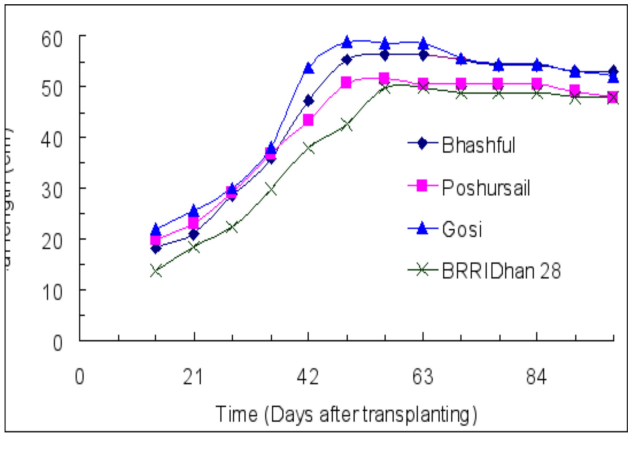

Fig. 3. Leaf length of different rice varieties in the study area.

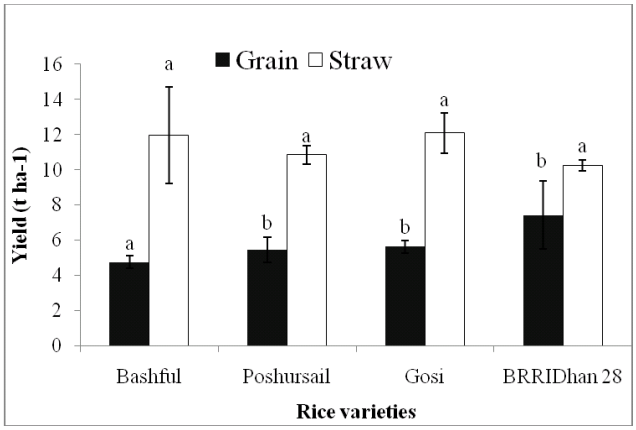

Fig. 4. Grain and straw yield of different rice varieties in the study area.

Figure 4 shows the grain and straw yield of four rice varieties. A statistically significant difference was observed in the grain yield among the varieties studied. The highest grain yield was in BRRIdhan 28. The grain yield was statistically similar among Bashful, Posurshail and Gosi variety. The HYV showed the highest yield (7.41 t ha^{-1}) (Table 1). This study indicated that some local varieties tested here also produced a remarkable amount of grain using modern agronomic practices (Judicious

application of fertilizers, pesticides, irrigations and cultural practices).

There was no significant difference in straw yield among the rice cultivars (Fig. 4). The highest straw yield was recorded in Gosi (12.08 t ha^{-1}). Pashursail and Bashful 28 had intermediate straw yield (10.83 and 10.25 t ha^{-1}). In contrast, the lowest straw yield was recorded in BRRIdhan 28 (10.25 t ha^{-1}). Chowdhury *et al.* (1995) reported that grain yield was positively correlated with biological yield in rice. Similar result was also reported by Munshi (2005) in rice. In the present investigation, the studied cultivars also showed higher straw yield than the grain. A marked difference was found in total dry matter among the boro rice varieties (Table 1). The Bashful produced the highest total dry matter (17.81 t ha^{-1}) and the lowest total dry matter was in Poshurshail (16.30 t ha^{-1}). The above results of differences in total dry matter were in full agreement with Haque (2004). The differential response of dry matter in the genotype could be attributed to its genetic potentiality.

The harvest index (HI) is the measure of the efficiency of conversion of photosynthetic into economic yield of a crop plant (Dutta and Mondal, 1986). Harvest index (HI) differed significantly among the varieties. In the study, the highest harvest index was recorded for BRRIdhan 28 (41.39%) which was significantly higher from local varieties studied. The lowest harvest index was recorded in Bashful (26.74%) (Table 1). The other test varieties showed intermediate values. There was no significant difference Bashful, Poshursail and Gosi. It infers that dry matter partitioning to economic yield was inferior in Bashful, Pashursail and Gosi but BRRIdhan 28.

The result indicated that plant height differed markedly between local and HYV rice cultivars at different growth stages viz. tillering, flowering and maturity. The highest plant height was found in Gosi and the lowest was found in BRRIdhan 28. The BRRIdhan 28 and Gosi produced greater effective number of tillers $hill^{-1}$ compared to other cultivars. In case of effective and non effective tillers, BRRIdhan 28 produced highest effective tillers and Poshursail produced lowest effective tillers. Among all the varieties BRRIdhan 28 produced the highest yield due to its highest panicle $hill^{-1}$. Among the local rice cultivars, Gosi had the best yielding ability than others. Therefore it can be suggested that BRRIdhan 28 might be superior among the four studied varieties. But the selected three local varieties namely, Poshurshail, Bashful and Gosi also showed remarkable yield under advanced agronomic practices.Still BRRIdhan 28 showed the highest yield potential than those of local cultivars. This study also infers that Bashful, Gosi and Poshurshail might be selected for screening as alternative cultivars due to its high genetic yield potential along with BRRIdhan 28 in Northwest Bangladesh.

References

Aktar, M.B. 2005. Morphophysiological evaluation and characterization in four aman rice genotypes. M.S. Thesis, Dept. Crop Bot., Bangladesh Agricultural University, Mymensingh.

Chowdhury, S.A., Majid ,M.A., Hoque, K.S., Islam, M. and Rahman, M.M. 1995. Effect of variety on yield and nutritive value of rice straw. Asian J. Animal Sci. 8(4): 329-335.

Dutta, R.K., Mia, M.A.B. and Khanum, S. 2002. Plant architecture and growth characteristics of fine grain and aromatic rice and their relations with yield. Int. Rice Comm. Newsl., 51: 51-55.

Dutta, R.K, Lahiri, B.P. and Mia, M.A.B. 1998. Characterization of aromatic and fine rice cultivars in relation to their physio-chemical qual grains. Indian J. Plant Physiol. 3: 61-64.

Dutta, R.K. and Mondal, M.M.A. 1986. Evaluation of lentil genotypes in relation to growth characteristics, assimilate distribution and yield Potential. LENS Newsl. 25:51-55.

Dutta, R.K., Mia, M.A.B., Lahri, B.P. and Salam, M.A. 1997. Assessment of grain yield and quality improvements in rice by modern breeding techniques in Bangladesh and projections of future rice improvements. Int. Rice Comm. Newsl. 46:63-70.

Gardner, F.P., Pearce, R.B. and Mistecell, R.I. 1985. Physiology of Crop Plants. Iowa State University. Press, Iowa. 66.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for Agriculture Research. (2nd lids.) John Wiley and Sons., New York p 640.

Hoque, M.N. 2004. Morpho-physiological studies in aromatic and modern cultivars. M. S. Thesis, Dept. Crop Botany, Bangladesh Agricultural University. Mymensingh.

Hoffman ,M.S. 1991. The world Alamanae Bookof Facts. An important of Pharos books. A Scrips Howard company. 200 sue, New York, NY-10116 (in Bengali).

IRRI (International Rice Research Institute). 1995. Annual report for 1994. Int. Rice Res. Inst., Los Banos Laguna, Philipines. pp. 179-181.

Mondal, M.M.A, Islam, A.F.M.S. and Siddique, M.A. 2005. Performance of 11 modern transplant aman cultivar in the northern region of Bangladesh. Bangladesh J. Crop Sci. 16: 23-29.

Munshi, R.U. 2005. A comparative morphophysiological study between two and two modern rice cultivars. M. S. Thesis, Department of crop Botany, Bangladesh Agriculture University, Mymensingh.

Pruneddu, G. and Spanu, T.A. 2001. Varietal comparison of rice in Sardinia. Dipartimentodi Science Agronomiche Genetica vegetable Agaria, Universita degli, Italy Informatore-Agrario. 57(5): 47-49.

Shrirame, M.D. and Muley, D.M. 2003. Variability and correlation studies in rice. J Soil Crops, 13: 165-167.

Sharma, S.K. and Haloi, B. 2001. Characterization of crop growth variables in some selected rice cultivars of Assam. Indian J. Plant Physiol., 6(2): 166-171.

Yong ,F., Wang, X.L., Ma, J.Y. and Ling, F.L. 2001. A comparative analysis of yield component factors of the two rice varieties of JNI and JND 13. J. Jilin Agril. Univ., 23 (4): 21-24.