J. Environ. Sci. & Natural Resources, **5(2): 209 -212, 2012** ISSN 1999-7361

Effect of BARI Wheat Varieties on Seed Germination, Growth and Yield under Patuakhali District

M. A. A. Al-Musa, M. A. Ullah[1], M. Moniruzzaman, M. S. Islam[2] and A. Mukherjee[3]
IFDC Bangladesh
[1]Bangladesh Institute of Nuclear Agriculture, Mymensingh
[2]Dept. of Agronomy, Sher-e-Bangla Agricultural University, Dhaka
[3]Agriculture Development, IRRI, Bangladesh Office

Abstract
A pot experiment was carried at Patuakhali Science and Technology University to study the performance of some BARI wheat varieties under the coastal area of Patuakhali. Four wheat varieties viz. BARI ghom-23, BARI ghom-24, BARI ghom-25 and BARI ghom-26 were planted in the field to evaluate their comparative performance in respect of germination percentage, growth, yield and yield attributing characters. Among the four varieties, BARI ghom-26 showed superior performance irrespective of all parameters studied except total dry matter content (TDM) and yield reduction percentage. Among the BARI varieties, BARI ghom-26 produced greater germination (61.00%) at 13 days judge against to other varieties. The taller plant (47.91 cm), higher LAI (1.84), maximum TDM (17.37 g plant^{-1}) and effective tillers hill^{-1} (18.08) were also obtained with the similar variety. BARI ghom-26 was also most effective to produce the maximum grains spike^{-1} (38.52), higher weight of 1000-grains (49.38 g), higher grain (3.35 t ha^{-1}) and straw (8.50 g plant^{-1}) yield and greater HI (4.03%). So, the variety BARI ghom-26 produced the outstanding superiority among the varieties.

Key words: Germination percentage, Growth and yield, Wheat

Introduction

Wheat (*Triticum astivum* L.) is one of the most important cereal crops of the world ranking first both in acreage and production among the puffed rice crops. In Bangladesh, wheat is the second largest grain cereal crop next to rice. Increasing population together with food shortages and land insufficiency are enforcing the nation to grow food crops on the land that has been unutilized because of soil problems. The area under wheat cultivation during 2007-2008 was about 923 thousand acres producing 31975 thousand M. tons of wheat with an average yield of 976 kg acre^{-1} (BBS, 2010). Its average yield is low compared to that of some other wheat growing countries of the world. It supplies carbohydrate, protein, minerals and vitamin (BARI, 1997) and preferable to rice for its higher seed protein content. Wheat seed contains 12% protein, 1.72% fat, 69.60% carbohydrates and 27.20% mineral matter. The coastal region covers almost 29,000 km^2 or about 20% of the country and 30% of the cultivable lands of the coast. About 53% of the coastal areas are affected by different degree of salinity. More than 1 million hectares of the coastal areas have been seriously affected by salinity (Rahman, 2007), which is considered as one of the major problems of crop production in Bangladesh. Salinity is one of the most important environmental stresses which severely limits plant growth and productivity worldwide (Tester and Davenport, 2003). The problem is ever increasing because of irrational human acts causing secondary salinization and climatic change with consequent rise in sea level (Haque, 2006). However, some research on varietals performance was also obtained in various coastal region of the world with some scientist to find out the most suitable variety. Therefore, considering the above fact, the present study was focused on identifying the most suitable variety regarding to morpho-physiological performance and yield of wheat in coastal areas of Patuakhali district.

Materials and Methods

A pot experiment was conducted at the Research field of Patuakhali Science and Technology University, Patuakhali during the period from Nov. 2010 to April 2011 which was located at 20^{0}20′ N latitude and 90^{0}20′ E longitudes at a height of 1.5 above the sea level and falls under "AEZ-13". The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Four wheat varieties viz. BARI ghom-23 (V_1), BARI ghom-24 (V_2), BARI ghom-25 (V_3) and BARI ghom-26 (V_4) were used as planting materials for this study. Unit pot size was 0.091 m^2. Soils from the PSTU research farm were dried in the sun and grinded well manually. The soil, fertilizer (100, 60, 40 and 7.5 kg ha^{-1} of N, P, K and Zn respectively in the form of Urea, TSP and MoP and $ZnSO_4$) and cowdung were mixed before putting the soil into the pots. Each pot was filled with 18 kg of mixture soil. Four plants were collected from each pot prior to harvesting for sampling and data collection. Germination ability of wheat seeds were tested in Lab condition and germination (%) was recorded at 7, 10 and 13 DAS. Plant height was measured by scale (in cm) from the base of the plant to the spike including awn at 100 DAS. From each pot, 1000 grains were taken randomly and weight was recorded in g 12% moisture. No. of effective tillers hill^{-1} was calculated by counting the number of tillers bearing the ear. The plant parts such as leaves, stems, roots and panicles were detached and were kept separately in oven at 80^O C for 72 hours and then their weight was recorded. Leaf area was also measured at anthesis period using leaf area meter (Model-L-1-3000-LICOR INC. Nebrasca; USA). Grain was harvested from one pot and it was converted to g plant^{-1} and t ha^{-1}. Similarly shoot yield was also recorded g plant^{-1}. Harvest Index (HI) was calculated based on the formula of Gardner *et al*., 1985. Analysis of variance (ANOVA) and mean were done with the help of computer package M-STATC and mean

differences among the varieties were adjusted with Duncan's Multiple Range Test (DMRT) at 5% level of significance (Gomez and Gomez, 1984).

Results and Discussions

Seed germination percentage: Early and maximum germination of seeds is one of the most effective criteria for the establishment of crop plants as well as high yield of any crops. But, in coastal area of Bangladesh viz. Patuakhali, Satkhira, Khulna and another more district soils are affected by different degree of soil salinity and adversely influence the seed germination as well as yield. Seeds were germinated in petridishes containing substratum by blotting paper using distilled water. In the main effect of variety showed significant variation on germination percentage. At Variety BARI ghom-26 significantly reduced the maximum (43.17%; 53.75% and 61.00%) germination at 7, 10 and 13 DAS, respectively and the lowest (28.083, 35.92 and 41.50%) germination was also recorded at 7, 10 and 13DAS, respectively (Fig.1). Similar observation were also obtained by Tajbakhsh *et al*., 2006 who reported that the genotypic effect of barley varieties showed significant difference on germination percentage (Tajbakhsh *et al.*, 2006).

Plant height: Plant height is an important growth index of crop. Varietal effect on plant height showed significant variation at 1% level of probability. Among four BARI genotypes, BARI ghom-26 perform the best and recorded the tallest plant (47.911 cm) whereas the shortest plant height was 42.288 cm in genotypes BARI ghom-25. Another two genotypes, BARI ghom-23 (Bijoy) and BARI ghom-24 (Prodip) showed 46.917 and 45.083 cm height of plant, respectively (Fig.2). These results revealed that the variation in plant height was found due to its genetic variation.

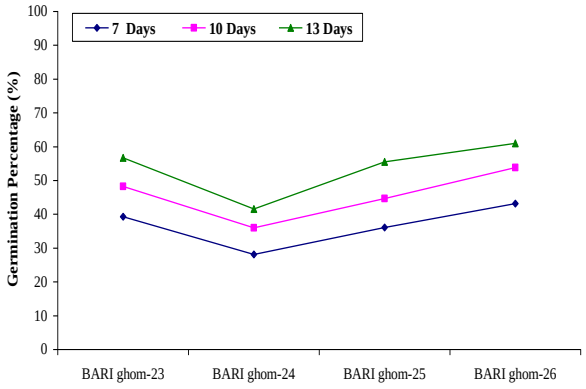

Fig. 1. Effect of varieties on seed germination (%)

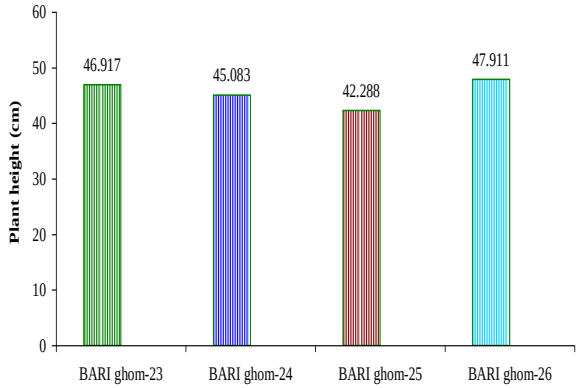

Fig. 2. Effect of varieties on plant height

Shoot dry weight plant^{-1}: The effect of variety under coastal area of Patuakhali showed significant at 1% level of probability regarding to the average results of the shoot dry weight plant^{-1} (g) and was presented in Table 1. The highest (16.13 g) shoot dry weight plant^{-1} was found with BARI ghom-26 followed by the variety BARI ghom-23 (15.13 g) which was statistically different and overall it's ranked in second and the lowest (13.61 g) was found to be the genotype BARI ghom-24 (Prodip). The results indicated that there was difference in shoot dry weight plant^{-1} (g). This might be due to genotypic makeup of the genotypes.

Root dry weight plant^{-1}: The effect of different variety showed highly significant variation on root dry weight plant^{-1}. Root dry weight data was collected at 70 days after sowing and its average data was given in table 1. From the table 1, the highest (1.25 g) root dry weight plant^{-1} was found from the variety BARI ghom-26 followed by the second highest (1.24 g) at BARI ghom-23 (Bijoy). Significantly the lowest (1.20 g) root dry weight plant^{-1} was also observed at the genotype BARI ghom-24 (Prodip). The results indicated that there was genotypic difference in root dry weight plant^{-1} production.

Table 1. Effect of different varieties on dry weight characters of wheat

Variety	Shoot dry weight (g plant^{-1})	Root dry weight (g plant^{-1})	TDM (g plant^{-1})
BARI ghom-23 (Bijoy)	15.13 b	1.24 b	16.363 b
BARI ghom-24 (Prodip)	13.61 d	1.20 d	14.808 c
BARI ghom-25	14.27 c	1.22 c	15.491 b
BARI ghom-26	16.13 a	1.25 a	17.374 a
Level of significance	**0.01**	**0.01**	**0.01**
CV (%)	**0.27**	**0.25**	**0.24**

TMD: Total dry matter plant^{-1} showed significant differences due to the effect of different variety. The total dry matter average results are shown in table 1 and the average data was recorded at 70 DAS. From the table 1, the maximum (17.374) total dry matter was found from the variety BARI ghom-26 whereas the second highest (16.363) was recorded at BARI ghom-23 (Bijoy) which was statistically comparable. Significantly the lowest (14.808) total dry matter was also establish at the genotype BARI ghom-24 (Prodip). From the above result it was apparent that the different varieties showed variance result in case of dissimilar salinity stress levels for total dry matter production

Leaf area index: Leaf area index (LAI) showed significant dissimilarity at 5% level of significant under different Patuakhali region at 70 DAS. Among the four BARI wheat genotypes, the highest LAI (1.389) was found from the variety BARI ghom-26 where as the second and third LAI were produced by the variety BARI ghom-23 and BARI ghom-24 (1.291 and 1.204, respectively). On the other hand, the lowest LAI (1.008) was observed in BARI ghom-25 (Table 2).

No. of effective tillers hill^{-1}: No. of effective tillers hill^{-1} varied significantly among the varieties. No. of effective tillers hill^{-1} showed significantly more 4.52 and 4.42 were observed from the genotype BARI ghom-26 and BARI ghom-23 which was statistically more or less similar (Table 2). Number of effective tillers hill $^{-1}$ also showed significantly less 3.979 which was found from the variety BARI 24 (Prodip). From these results it was evident that the different varieties had different degrees of salinity tolerance for number of effective tillers hill $^{-1}$. Similar trends were observed by Jan *et al*., (2003), and Irfan *et al*., (2005), who stated that different varieties respond differently due to difference in their genetic make up.

Length of spike: Length of spike among the varieties was significant at 1% level of provability. The length of spike data range was 14.13 to 16.03 cm, whereas the longest (16.03 cm) spike was obtained from BARI ghom-26 and the shortest (14.13 cm) spike was taken from BARI ghom-24 (Prodip). The intermediate length of spike (15.71 and 14.43 cm) was recorded from the genotypes BARI ghom-23 (Bijoy) and BARI ghom-25, respectively, which was statistically different (Table 2). The results indicated that there was genotypic differences in length of spike might be due to genetic makeup of the genotypes which was reported by Irfan *et al*. (2005).

Number of grain spike^{-1}: No. of grain spike^{-1} was significantly influenced by the varieties. No. of grain spike^{-1} 37.667, 35.083, 36.646 and 38.521 were observed with the genotypes BARI ghom-23 (Bijoy), BARI ghom-24 (Prodip), BARI ghom-25 and BARI ghom-26, respectively. Whereas significantly the more was 38.521 at BARI ghom-26 and less was 35.083 at BARI ghom-24 were observed (Table 2). This variation was found due to genetically variation. Similar results were reported by Akmal *et al.* (2000) and Nadeem (2001), who also observed significant differences among the cultivars for no. of grain spike^{-1}.

Thousand-grain weight: Thousand-grain weight (g) showed significant variation due to the effect of varieties where significantly the highest weight of 1000-grains of 45.470, 44.015, 44.844 and 49.380 g were observed from the genotypes BARI ghom-23, BARI ghom-24 , BARI ghom-25 and BARI ghom-26, respectively. The significantly more was 49.380 g at BARI ghom-26 and less was 44.015 g at BARI ghom-24 (Prodip) were observed (Table 2). From this result, it was clear that the different variety produced the variation result on seed production under salinity level in case of seed size. 1000-grain weight, a very important yield component in wheat, varied from 37g for Bakhtawar-92 to 43g each for cultivar Dirk and Nowshera-96 (Table 2). As reported by Ali *et al*., (2008), this larger variation in grain weight may be due to diverse genetic make-up of wheat cultivars and their differential response to prevalent environment during grain filling stage.

Table 2. Effect of different varieties on growth and yield contributing characters of wheat

Variety	Leaf area index	No. of effective tillers hill^{-1}	Length of spike (cm)	No. of grain spike^{-1}	1000-grain weight (g)
BARI ghom-23 (Bijoy)	1.291 b	4.42 b	15.71 b	37.667 b	45.470 b
BARI ghom-24 (Prodip)	1.204 c	3.98 d	14.13 d	35.083 d	44.015 d
BARI ghom-25	1.008 d	4.15 c	14.43 c	36.646 c	44.844 c
BARI ghom-26	1.389 a	4.52 a	16.03 a	38.521 a	49.380 a
Level of significance	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
CV (%)	**1.02**	**1.38**	**0.09**	**0.47**	**0.55**

Grain yield plant^{-1} and yield ha^{-1}: In the main effect of variety on grain yield plant^{-1} showed the significant variation (P <0.01) at 1% level of provability (Table 3). Among the four BARI wheat genotypes, BARI ghom-26 produced the significantly highest (7.628 g plant^{-1} or 3.03 t ha^{-1}). The variety BARI ghom-24 (Prodip) showed the lowest (6.202 g plant^{-1} or 2.73 t ha^{-1}) (Table 3). The result agrees with the findings of Ehsan *et al.* (1994) who conducted a pot experiment to study the effect of salinity stress on growth and

yield of wheat and found that salinity stress through the growing period significantly decreased grain yield of wheat. From the results it was evident that the different varieties had different stress tolerance of salinity for yield per hectare. It was concluded that the statement that grain yield was significantly affected by different varieties.

Shoot yield plant^{-1} and yield ha^{-1}: In the main effect of variety on shoot yield plant^{-1} showed the significant variation (P <0.01) (Table 3). Among the wheat genotypes, BARI ghom-26 produced significantly the highest (8.498 g) shoot yield and the variety BARI ghom-24 showed the lowest (7.403 g) grain yield (Table 3). From the above result it was obvious that the different varieties had different stress tolerance of salinity for grain yield.

Harvest index: A significant variation was found to be the effect of variety at 1% level of provability (Table 3). The average result of the harvest index was presented in Table 9. The highest (44.031%) harvest index was found with BARI ghom-26 followed by the variety BARI ghom-25 (42.753%) which was statistically dissimilar and overall it's ranked in second. The lowest (41.950%) harvest index was also found to be the genotype BARI ghom-24.

Table 3. Effect of different varieties on yield characters of wheat

Variety	Grain yield (g plant^{-1})	Grain yield (t ha^{-1})	Shoot yield (g plant^{-1})	Harvest index (%)
BARI ghom-23 (Bijoy)	6.890 b	3.029	8.237 b	42.109 c
BARI ghom-24 (Prodip)	6.202 d	2.726	7.403 d	41.950 d
BARI ghom-25	6.595 c	2.899	7.679 c	42.753 b
BARI ghom-26	7.628 a	3.353	8.498 a	44.031 a
Level of significance	**0.01**	**0.01**	**0.01**	
CV (%)	**0.22**		**0.51**	**0.32**

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