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EFFECT OF VARIETY AND CULTURE METHOD ON THE YIELD AND YIELD ATTRIBUTES OF WHEAT

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ABSTRACT

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An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to examine the effect of variety and culture method on the yield and yield components of wheat. Four varieties viz. Kanchan, Protiva, Gourab and Sotabdi and two culture methods viz. bed planting and conventional method were included as experimental treatments. From the study it was found that the different varieties significantly influenced the grain yield, straw yield, number of tillers plant^{-1}, number of effective tillers plant^{-1}, number of filled grains spike^{-1} and 1000 grain weight. These characters were also significantly influenced by the culture method. The variety Sotabdi produced the highest grain yield (2.94 t ha^{-1}) and Kanchan produced the lowest grain yield (1.44 t ha^{-1}). Higher grain yield (1.97 t ha^{-1}) was produced by bed planting method than conventional method. The interaction effect of variety and culture method had significant influence on all the crop characters except few. All the variety gave higher yield under bed planting method and the variety Satabdi gave the higher grain yield (2.31 t ha^{-1}). It is concluded that bed planting is better culture method for wheat production.

Key words: *variety, culture method, yield and wheat*

INTRODUCTION

Wheat (*Triticum aestivum*) is one of the major leading cereals in the world, which ranks first in terms of acreage and production. About one third of the world's population lives on wheat grain for their subsistence (Hanson *et al*. 1982). It is the second important cereal crop in Bangladesh after rice. Wheat covered 7.74 million hectare having a total production of 2.19 million tons of grain in 2005-2006 (BBS 2006).

The average yield of wheat in Bangladesh is 1.9 ton ha^{-1}, which is very low in compared to other wheat growing countries like Netherland, UK, France and Norway where average yield is 7.1, 5.9, 5.6 and 4.1 ton ha^{-1} respectively (FAO 1987). The low yield of wheat in Bangladesh may be attributed to number of reasons like cultivation practices, poor knowledge about spacing, lack of improved varieties, improper fertilizer application, seed rate, water management, culture method, time of sowing etc.

Increasing food production of the country in the next 20 years to much population growth is a big challenge in Bangladesh. It is more difficult because, land area devoted to agriculture will stagnate or decline and better quality land and water resources will be divided to the other sector of national economy. In order to grow more food from marginal and good quality lands, the quality of natural resources like seed, water, varieties, fuel must be improved and sustained. On the other hand, establishment of optimum plant density, culture methods are important factors for securing good yield of crop, particularly in wheat. Variety plays an important role in producing high yield of wheat because different varieties responded differently for the genotypic characters, input requirement, growth process and the prevailing environment during growing season.

Raised bed culture in wheat is supposed to be one of the most effective techniques of pre-serving resource base and has manifold advantages. It is the new concept in Bangladesh. Raised bed planting techniques is used in developing countries like India, Nepal and Pakistan. This technique in wheat cultivation helps in saving 50% seed, reduces 30-40% water requirement, increases yield, reduces lodging, avoid temporary water logging, allows better surface, basal and top dress, fertilizer placement and promotes rain water conservation (Gupta *et al*. 2000).

Preliminary research on bed planting in Bangladesh Rice Research Institute (Elahi *et al.* 2001) and Bangladesh Agricultural Research Institute (Hossain *et al.* 2001) showed positive responses. Determination of different aspects of bed planting for wheat cultivation system like appropriate width of beds, optimum number of plant rows per bed, improved varieties and fertilizer rates are essential for development of sustainable resources conservation technologies. The main objectives of the experiment was-

1. The effect of variety and culture method on the yield and yield attributes of wheat under conventional and raised bed method of culture.
2. To assess the performance of bed planting as a resource conservation technology in wheat cultivation.

MATERIALS AND METHODS

The experiment was carried out at Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from November 2004 to March 2005. The experimental field was a medium high land with loamy textural soil having p^H value of 6.8. Status of nitrogen and phosphorus and cation exchange

capacity were medium. The experiment was laid out in two factorial randomized complete block design (RCBD) with three replications. The experiment comprised four varieties viz. Kanchan (V_1), Protiva (V_2), Gourab (V_3) and Sotabdi (V_4) and two culture methods viz. bed planting (T_1) and conventional method (T_2). The experimental field was prepared conventionally and the raised bed with furrows was made by spade. The bed size was 40 cm in width, 15 cm in depth with 30 cm furrows. The land was uniformly fertilized with 220-180-75 kg ha^{-1} N, P_2O_5 and K_2O in the form of urea, triple super phosphate and murate of potash respectively. One third of urea and all other fertilizers were broadcasted and incorporated into the soil at the time of final land preparation. The remaining urea was top dressed in two equal splits. The first split was applied at crown root initiation stage (21 days after sowing) and 2nd at maximum tillering stage followed by irrigation. Seeds were sown continuously by hand on bed and conventional method with two rows and 25 cm row spacing along with all other intercultural operations were conducted to ensure a healthy crop stand in the field. Data on yield and yield attributing characters were recorded at harvest. Recorded data were analyzed following the ANOVA technique and mean differences were adjudged by Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984) with the help of computer package M-STAT.

RESULTS AND DISCUSSION

Almost all the yield and yield attributing characters of wheat were significantly influenced by variety and culture method. Results showed that variety had significant influence on plant height. The variety Sotabdi produced the tallest plant (87.30 cm) and Kanchan produced the shortest plant (83.14 cm) (Table 1). The effect of culture methods on plant height was also statistically significant. Taller plant (88.84 cm) was obtained from bed planting method while shorter plant (82.37 cm) from conventional culture method (Table 2). The interaction effect of variety and culture methods on plant height were statistically significant. The tallest plant (92.00 cm) was obtained from the variety Sotabdi in bed planting method while the shortest one (78.65 cm) from combination of variety Kanchan with conventional method of planting (Table 3).

Number of tillers $plant^{-1}$ influenced significantly due to different varieties. The highest number of tillers $plant^{-1}$ (5.50) was obtained from the variety Sotabdi, while the lowest one (4.58) from variety Protiva (Table 1). Result revealed that the effect of culture methods on the number of tillers $plant^{-1}$ was statistically significant. Higher number of tillers $plant^{-1}$ (5.73) was obtained from bed planting method and lower one (4.66) from conventional method (Table 2). The number of tillers $plant^{-1}$ also varied significantly due to the interaction of variety and culture methods. The highest number of tillers $plant^{-1}$ (6.65) was recorded from the combination of variety Sotabdi with bed planting method, while the lowest one (4.35) from the combination of variety Sotabdi with conventional method (Table 3).

Number of effective tillers $plant^{-1}$ showed a significant response to varieties. The highest number of effective tillers $plant^{-1}$ (5.15) was recorded for variety Gourab, while the variety Protiva showed the lowest number of effective tillers $plant^{-1}$ (4.23) (Table 1). Number of effective tillers $plant^{-1}$ was influenced significantly by culture methods. Higher number of effective tillers $plant^{-1}$ (5.26) was obtained from bed planting method and the lowest one (4.43) from conventional method (Table 2). The interaction effect of variety and culture method on the production of effective tillers $plant^{-1}$ was statistically significant. The highest value (6.10) was obtained from the combination variety Sotabdi with bed planting method, while the lowest value (4.08) from the interaction of variety Protiva with convention cultivation method (Table 3).

Variety had significant influence on the number of non-effective tillers $plant^{-1}$. Results showed that the highest number of non-effective tillers $plant^{-1}$ (0.55) was obtained from variety Kanchan and the lowest one (0.35) from Gourab (Table 1). The effect of culture methods on the number of non-effective tillers $plant^{-1}$ was also statistically significant. The crop under bed planting method produced higher number of non-effective tillers $plant^{-1}$ (0.49), while lower value (0.39) was recorded from conventional method of cultivation (Table 2). The interaction effect of variety and culture methods was found to be significant on the number of non-effective tillers $plant^{-1}$. The highest number of non-effective tillers $plant^{-1}$ (0.75) was obtained from the combination of variety Kanchan with bed planting method, whereas the lowest one (0.20) from the combination of variety Gourab with bed planting method (Table 3).

The number of spikelets $spike^{-1}$ was found to be insignificant due to variety, culture method and interaction of variety and culture method (Table 1, 2 and 3).

The effect of variety was found to be significant on the number of non-effective spikelets $spike^{-1}$. The variety Sotabdi produced the highest number of non-effective spikelets $spike^{-1}$ (1.87), while the variety Kanchan produced the lowest number of non-effective spikelets $spike^{-1}$ (1.40) (Table 1). The number of non-effective spikelets $spike^{-1}$ was found to be insignificant with respect to culture methods (Table 2). The interaction effect of variety and culture methods on the number of non-effective spikelets $spike^{-1}$ was statistically significant. The highest number of non-effective spikelets $spike^{-1}$ (2.08) was produced from the combination of variety Sotabdi with conventional method. On the other hand, the combination of variety Kanchan with conventional method produced the lowest number of non-effective spikelets $spike^{-1}$ (1.00) (Table 3).

Results showed that the effect of variety on the number of grains spike^{-1} was non-significant (Table 1) while the effect of culture methods on the number of grains spike^{-1} was statistically significant. Higher number of grains spike^{-1} (39.58) were produced in bed planting method and the lower one (36.36) from conventional method (Table 2). The interaction effect of variety and culture methods on the number of grains spike^{-1} was also statistically significant. The interaction of variety Protiva with bed planting method produced the highest number of grains spike^{-1} (41.51), whereas the interaction of variety Protiva with conventional method of planting produced the lowest number of grains spike^{-1} (34.47) (Table 3).

Varieties differed significantly with respect to 1000-grain weight of wheat. Sotabdi gave the highest 1000-grain weight (51.82 g), whereas the lowest one (45.27 g) was recorded for variety Gourab (Table 1). The effect of culture methods on 1000-grain weight was statistically significant. Higher 1000-grain weight (49.21 g) was obtained from bed planting method and the lower 1000-grain weight (45.80 g) was recorded in conventional method (Table 2). The interaction effect of variety and culture methods on 1000-grain weight of wheat had significant influence. The highest value (54.91 g) was noticed for the combination of variety Sotabdi with bed planting method and the lowest value (43.76 g) for the combination of variety Gourab with conventional method of planting (Table 3).

Grain yield was significantly influenced by variety. The highest grain yield (2.94 t ha^{-1}) was obtained from variety Sotabdi and the lowest grain yield (1.44 t ha^{-1}) was obtained from variety Kanchan (Table 1). The highest grain yield in Sotabdi might be due to its highest number of fertile tillers hill^{-1}, 1000-grain weight, number of filled grains spike^{-1} and number of spikelets spike^{-1}. Differences in grain yield among the varieties might be due to its inherent quality of varieties. Singh *et al.* (1980) reported that varietal differences were exhibited in terms of grain yield. On the other hand the effect of culture methods on grain yield was statistically significant. The highest grain yield (1.97 t ha^{-1}) was obtained from bed planting method and the lowest grain yield (1.34 t ha^{-1}) was recorded in conventional method (Table 2). Hossain *et al.* (2001) reported that bed planting gave higher grain yield of wheat than conventional planting method. The interaction effect of variety and culture methods on grain yield was statistically significant. The highest grain yield (2.31 t ha^{-1}) was obtained from the combination of variety Sotabdi with bed planting method and the lowest grain yield yield (0.96 t ha^{-1}) from the combination of variety Kanchan with conventional method (Table 3). These results are in agreement with that of Dhillon (2002).

The influence of variety, culture methods and the interaction of variety and culture methods on straw yield was statistically significant. Among the varieties, Sotabdi gave the highest straw yield (2.43 t ha^{-1}), while Kanchan gave the lowest straw yield (1.60 t ha^{-1}) (Table 1). On the other hand, higher straw yield (2.52 t ha^{-1}) was recorded in bed planting method and lower straw yield (1.80 t ha^{-1}) was recorded from conventional method of planting (Table 2). Among the interactions, the interaction of variety Sotabdi and bed planting method produced the highest straw yield (2.83 t ha^{-1}), while the interaction of variety Kanchan and conventional method produced the lowest straw yield (1.22 t ha^{-1}) (Table 3).

Variety, culture methods and the interaction of variety and culture methods had significant influence on biological yield. Among the varieties, Sotabdi gave the highest biological yield (5.37 t ha^{-1}), while Kanchan gave the lowest biological yield (3.04 t ha^{-1}) (Table 1). In case of culture methods, higher biological yield (4.49 t ha^{-1}) was recorded in bed planting method and lower biological yield (3.15 t ha^{-1}) was recorded from conventional method of planting (Table 2). Among the interactions, the interaction of variety Sotabdi and bed culture methods produced the highest biological yield (5.16 t ha^{-1}), while the interaction of variety Kanchan and conventional method produced the lowest biological yield (2.19 t ha^{-1}) (Table 3).

Results revealed that variety had significant influence on harvest index. The highest (54.73%) and lowest (41.47%) value of harvest index were recorded for variety Sotabdi and Protiva respectively (Table 1). The influence of culture methods on harvest index was statistically significant (Table 2). Higher value of harvest index was recorded from bed planting method and lower harvest index was recorded from conventional planting method. On the other hand, the interaction effect of variety and culture methods on harvest index was statistically significant. The highest value of harvest index (49.17%) was recorded for the combination of variety Kanchan with bed planting method, while the lowest value (39.56%) from the combination of variety Gourab with conventional method of planting (Table 3).

Table 1. Effect of variety on yield and yield attributes of wheat

Varieties of wheat	Plant height (cm)	Tillers plant^{-1} (no.)	Effective tillers plant^{-1} (no.)	Non-effective tillers plant^{-1} (no.)	Spikelets spike^{-1} (no.)	Non-effective spikelets spike^{-1} (no.)	Grains spike^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1	83.14b	5.43a	5.03a	0.55a	17.82	1.40c	37.55a	47.63b	1.44c	1.60c	3.04c	46.57b
V_2	84.92ab	4.58b	4.23b	0.43b	17.27	1.47bc	37.99a	45.30c	1.71b	2.46b	4.16b	41.47c
V_3	87.06a	5.28a	5.15a	0.35c	17.24	1.61b	37.14a	45.27c	1.56c	2.16b	3.72c	41.69c
V_4	87.30a	5.50a	5.08a	0.43b	18.03	1.87a	37.20a	51.82a	2.94a	2.43a	5.37a	54.73a
LS	0.05	0.05	0.01	0.01	NS	0.01	0.01	0.01	0.01	0.01	0.01	0.05
CV (%)	2.80	11.07	8.04	11.08	8.48	11.09	3.85	3.98	7.98	5.99	5.99	6.52

In a column, means followed by the same letter(s) or without letter(s) do not differ significantly as per DMRT, LS = Level of Significance, NS = Non Significant

Table 2. Effect of culture methods on yield and yield attributes of wheat

Cultivation methods	Plant height (cm)	Total tillers plant^{-1} (no.)	Effective tillers plant^{-1} (no.)	Non-effective tillers plant^{-1} (no.)	Spikelets spike^{-1} (no.)	Non-effective spikelets spike^{-1} (no.)	Grains spike^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
T_1	88.84a	5.73a	5.26a	0.49a	18.35a	1.59	39.58a	49.21a	1.97a	2.52a	4.49a	44.06a
T_2	82.37b	4.66b	4.43b	0.39b	16.83b	1.58	36.36b	45.81b	1.35b	1.80b	3.15b	42.91b
LS	0.01	0.01	0.01	0.01	0.05	NS	0.05	0.01	0.01	0.01	0.01	0.05
CV (%)	2.80	11.07	8.04	11.08	8.48	11.09	3.85	3.98	7.98	5.99	5.99	6.52

In a column, means followed by the same letter(s) or without letter(s) do not differ significantly as per DMRT, LS = Level of Significance, NS = Non Significant

Table 3. Interaction effect of variety and culture methods on yield and yield attributes of wheat

Interactions	Plant height (cm)	Tillers plant^{-1} (no.)	Effective tillers plant^{-1} (no.)	Non-effective tillers plant^{-1} (no.)	Spikelets spike^{-1} (no.)	Non-effective spikelets spike^{-1} (no.)	Grains spike^{-1} (no.)	1000-Grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
$V_1 \times T_1$	87.63bc	5.80ab	5.30bc	0.75a	18.77	1.79b	40.14ab	49.32b	1.91b	1.98c	3.89b	49.17a
$V_1 \times T_2$	78.65f	5.05bc	4.75cd	0.35e	16.87	1.00d	34.96c	45.93cd	0.96e	1.22d	2.19c	43.97bc
$V_2 \times T_1$	86.70b-d	4.55c	4.00f	0.40de	18.42	1.30c	41.51a	45.86cd	1.83b	2.20a	4.03a	45.40b
$V_2 \times T_3$	83.13de	4.50c	4.25d-f	0.45cd	16.11	1.63b	34.47c	44.74d	1.58c	1.97c	3.55cd	44.51b
$V_3 \times T_1$	89.03ab	5.90ab	5.65ab	0.20f	17.71	1.61b	38.26b	46.77b-d	1.83b	2.34bc	4.18b	43.83bc
$V_3 \times T_2$	85.08c-e	4.65c	4.65de	0.50c	16.77	1.62b	36.02c	43.76d	1.28d	1.96c	3.24d	39.56cd
$V_4 \times T_1$	92.00a	6.65a	6.10a	0.60b	18.50	1.66b	38.41b	54.91a	2.31a	2.83a	5.16a	44.83b
$V_4 \times T_2$	82.60e	4.35c	4.05ef	0.25f	17.56	2.08a	35.99c	48.73be	1.56c	2.03c	3.59cd	43.54bc
LS	0.05	0.05	0.01	0.01	NS	0.01	0.05	0.05	0.01	0.05	0.05	0.05
CV (%)	2.80	11.07	8.04	11.08	8.48	11.09	3.85	3.98	7.98	10.23	5.99	6.52

In a column, means followed by the same letter(s) or without letter(s) do not differ significantly as per DMRT, LS = Level of Significance, NS = Non Significant

CONCLUSION

From above discussion it is concluded that among used 4 varieties of wheat Sotabdi gave highest yield attributing characters like number of tillers plant^{-1}, number of effective tillers plant^{-1}, number of filled grains spike^{-1} and 1000 grain weight as well as it produced highest grain yield . The bed planting method showed better performance than conventional method. So farmers may adopt Sotabdi variety in bed planting method.

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