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# Varietal Differences on Yield and Yield Contributing Characters of Wheat under Different Levels of Nitrogen and Planting Methods

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**Abstract:** An experiment was conducted at Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi to study the effects of planting method, variety and nitrogen level on the yield and yield contributing characters of wheat. A split-split plot design was adopted with three replications assigning the planting method viz., Bed planting method and Conventional planting method to the main plot, variety viz.,Shotabdi and Prodip to the sub-plots and nitrogen level viz., 0, 60, 100 and 140 kg N $ha^{-1}$ to the sub-sub plots. The result revealed that planting method had significant effect on yield and yield contributing characters.The grain yield (2.93 t $ha^{-1}$) was 21.8% higher in bed planting method than conventional planting method (2.41t $ha^{-1}$) due to improvement in yield components. All the yield components were significantly influenced by different nitrogen levels. Among the N doses, 140 kg N $ha^{-1}$ produced the highest grain yield (3.44 t $ha^{-1}$).The Prodip produced the highest grain yield (3.45 t $ha^{-1}$) with 140 kg N $ha^{-1}$ and Shotabdi produced the lowest (1.57 t $ha^{-1}$) with control. The highest grain yield (3.93 t $ha^{-1}$) was found with the combination of bed planting and 140 kg N $ha^{-1}$ and the lowest (1.53 t $ha^{-1}$) was at control treatment in conventional planting method.

**Keywords:** Wheat, planting method, variety and nitrogen

## INTRODUCTION

Wheat is the most widely grown food crop in the world. It ranks first in world crop production and is the national food staple of 43 countries. At least one-third of the world's population depends on wheat as its main staple. It is the second important cereal crop of Bangladesh and now accounts for about 10% of the total cereal production with coverage of 0.64 million hectares. During the year 2005-2006, about 7.72 lakh metric tons of wheat were produced from about 4.81 lakh hectares of land which is not sufficient to meet up the demand of increasing population [3 ]Wheat has many natural advantages as food. It is nutritious, concentrated, easily stored and transported and processed to give highly refined raw foods. It contains carbohydrate (78.1%), protein (14.7%), fat (2.1%), minerals (2.1%) and considerable proportion of vitamins.

Among different sowing methods used for wheat cultivation bed planting is a new technique in farming system of Bangladesh. It increases crop yield by 10-20% with the proper variety, saves 30-40% irrigation water, reduces seed rate, promotes higher nitrogen use efficiency, reduces production cost over the conventional system[2]. There are indications that yields of wheat on bed can be further increased through nitrogen applications and irrigation because of the reduced loss of lodging on beds. Beds allow farmers to tailor nitrogen applications to suit their production goals and satisfy the crop's nutrient need.

The yield and yield contributing characters of wheat are influenced by variety. Different varieties respond differently for their genotypic characters, input requirement, growth process and the prevailing environment during growing season. Wheat varieties significantly differed in grain yield and most of the measured traits[3]. Bangladesh has a number of modern varieties of wheat namely Sourav, Gourab, Shatabdi, Prodip, Bijoy etc. and these varieties respond differently for their genotypic characters, input requirement and growth process.

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Nitrogen is one of the most important plant nutrient needed to obtain proper plant growth, development and finally to obtain higher yield. It is the structural component of protein molecules, amino acids, nucleotides, enzymes, alkaloids, vitamins, chlorophyll and other constituents. Nitrogen encourages aboveground vegetative growth, increases grain yield and the percentage of protein. Nitrogen fertilizer has significant effect on producing higher grain yield[4]. When nitrogen supply is available leaf enlargement and thickness, tillering, branching, internode elongation, flowering, fruit setting and other such developments are properly. The grain yield of wheat increased with the increasing nitrogen level[5]. So, it is very much important to use the optimum level of nitrogen for obtaining higher wheat yield.

## MATERIALS AND METHODS

The present Research work was carried out at Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi during November, 2006 to April, 2007 to study the effect of planting method, variety and nitrogen level on the yield and yield contributing characters of wheat.

The experimental farm is located at the western side of Agronomy & Agricultural Extension Department. The soil of the experimental area is siltyl loam and slightly alkaline in reaction.The experiment consisted three factors viz., Planting Method (Bed planting,Conventional planting method ), Variety (Shotabdi,Prodip) and Nitrogen Levels (0,60,100,140 kg N $ha^{-1}$). The experiment was laid out in a split-split plot design assigning the planting method on the main plot, variety to the sub-plots and nitrogen level to the sub-sub plots. The treatments were replicated three times. The experimental land was opened with tractor drawn disc plough. It was further ploughed two times with country plough followed by laddering for breaking the clods and levelling the soil to obtain desirable tilth. Weeds and stubbles were removed. The land was prepared conventionally and the raised bed with furrows made by spade. Triple super phosphate (TSP), muriate of potash (MP) and gypsum were applied to the plots at the rate of 180, 50, 120 kg $ha^{-1}$2006 during final land preparation. Nitrogenous fertilizer was applied as per treatment in two installments; two-third at the time of final land preparation and one-third at 27 days after sowing.Before sowing collected seeds were treated with Vitavex-200 @ 0.25% to prevent seeds from the attack of soil borne diseases.Seeds were sown on 26 November, 2006 in 20 cm apart rows opened by specially made an iron hand tine. Thinning was done followed by 1st weeding for maintaining 5 cm apart from plant to plant. Two irrigations were applied. First irrigation was applied at 20 DAS and second irrigation at 55 DAS followed by weeding. Ten plants were randomly selected from each plot prior to harvesting for collection of data on plant characters. One $m^2$ area of each plot was harvested and threshed and the grains were cleaned, dried at 12% moisture content and weighed carefully to record the grain yield $m^2$. Finally the grain yield $m^2$ was converted to t $ha^{-1}$. The collected data were statistically analysed and the mean differences were adjudged by Duncan's Multple range Test[6].

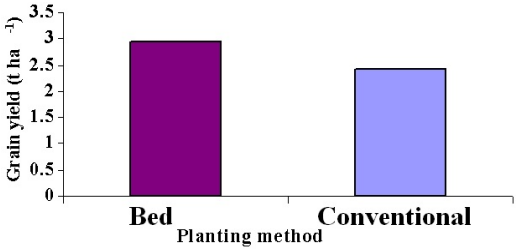


**Fig. 1:** Effect of planting method on grain yield of wheat

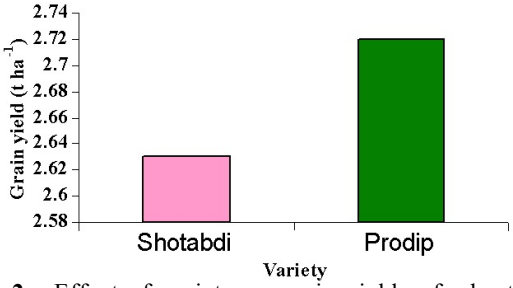


**Fig. 2:** Effect of variety on grain yield of wheat

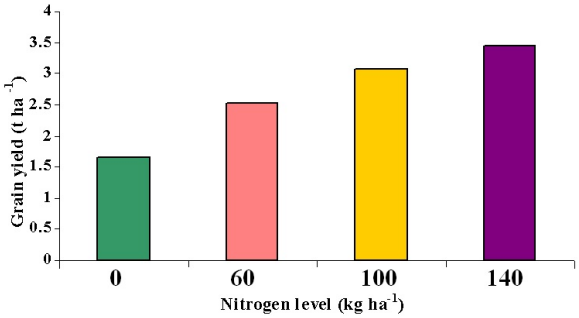


**Fig. 3:** Effect of nitrogen level on grain yield of wheat

## RESULT AND DISCUSSIONS

**Effect of Planting Method:** Planting method had significant positive effect on yield and contributing charactrrs (Table 1).The highest grain yield (2.93 t $ha^{-1}$) was obtained from bed planting method where the lowest (2.41 t $ha^{-1}$) was in conventional method.This

**Table 1:** Effects of planting method, variety and nitrogen level on yield and yield contributing characters of wheat

| Treatment | Plant height (cm) | Total tillers plant$^{-1}$ (no.) | Effective tillers plant $^{-1}$ (no.) | Length of spike (cm) | Spikelets spike$^{-1}$ (no.) | Fertile spikelets spike$^{-1}$ (no.) | Seeds spike$^{-1}$ (no.) | 1000-grain weight (g) | Grain yield (t ha$^{-1}$) | Straw yield(t ha$^{-1}$) | Biological yield (t ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Planting method | | | | | | | | | | | | |
| $M_1$ | 95.06 a | 6.32 a | 4.58 a | 18.49 | 21.56 a | 19.96 a | 44.45 a | 50.85 | 2.93 a | 3.80 a | 6.77 a | 42.25 |
| $M_2$ | 93.15 b | 4.78 b | 3.89 b | 18.40 | 18.78 b | 16.89 b | 36.41 b | 50.28 | 2.41 b | 3.25 b | 5.57 b | 43..58 |
| Level of significance | 0.01 | 0.01 | 0.01 | NS | 0.05 | 0.05 | 0.01 | NS | 0.05 | 0.05 | 0.05 | NS |
| Variety | | | | | | | | | | | | |
| $V_1$ | 95.60 a | 5.18 b | 4.13 b | 18.10 | 18.19 b | 16.53 b | 35.83 b | 46.79 b | 2.63 | 3.40 b | 6.06 | 42.04 |
| $V_2$ | 92.61 b | 5.91 a | 4.34 a | 18.79 | 22.15 a | 20.32 a | 45.03 a | 54.34 a | 2.72 | 3.66 a | 6.28 | 43.79 |
| Level of significance | 0.01 | 0.01 | 0.01 | NS | 0.01 | 0.01 | 0.01 | 0.01 | NS | 0.01 | NS | NS |
| Nitrogen level | | | | | | | | | | | | |
| $N_0$ | 88.49 c | 3.97 c | 2.58 d | 17.73 b | 17.47 c | 14.81 d | 30.88 c | 46.00 c | 1.65 d | 2.36 d | 4.04 d | 40.92 c |
| $N_1$ | 94.64 b | 5.47 b | 4.23 c | 18.44 ab | 19.65 b | 18.02 c | 40.02 b | 50.63 b | 2.52 c | 3.42 c | 5.80 c | 43.33 b |
| $N_2$ | 96.21 ab | 6.31 a | 4.78 b | 19.07 a | 20.62 b | 19.48 b | 44.73 ab | 52.38ab | 3.08 b | 3.81 b | 6.79 b | 44.12 b |
| $N_3$ | 97.07 a | 6.43 a | 5.35 a | 18.53 ab | 22.93 a | 21.40 a | 46.08 a | 53.26 a | 3.44 a | 4.52 a | 8.04 a | 44.50 a |
| Level of significance | 0.01 | 0.01 | 0.01 | 0.05 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |

In a column, figures having similar letter(s) or without letter(s) do not differ significantly as per DMRT
NS = Not significant $M_1$= Bed planting method $M_2$= Conventional method $V_1$= Shotabdi $V_2$= Prodip, $N_0$= 0 kg ha$^{-1}$ $N_1$ = 60 kg ha$^{-1}$ $N_2$= 100 kg ha$^{-1}$ $N_3$= 140 kg ha$^{-1}$

**Table 2:** Interaction effects of planting method and variety on yield and yield contributing characters of wheat

| Interaction (Planting method×Variety) | Plant height (cm) | Total tillers plant$^{-1}$ (no.) | Effective tillers plant$^{-1}$ (no.) | Length of spike (cm) | Spikelets spike$^{-1}$ (no.) | Fertile spikelets spike$^{-1}$ (no.) | Seeds spike$^{-1}$ (no.) | 1000-grain weight(g) | Grain yield (t ha$^{-1}$) | Straw yield (t ha$^{-1}$) | Biological yield(t ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $M_1 \times V_1$ | 97.15 a | 6.06 | 4.46 b | 18.36 | 19.75 | 18.18 | 42.38 c | 47.30 | 2.90 | 3.65 | 6.62 | 43.58 |
| $M_1 \times V_2$ | 92.97 c | 6.57 | 4.70 a | 18.61 | 23.37 | 21.75 | 46.52 a | 54.41 | 2.97 | 3.95 | 6.92 | 42.92 |
| $M_2 \times V_1$ | 94.05 b | 4.31 | 4.25 c | 17.84 | 16.62 | 14.88 | 29.28 d | 46.28 | 2.35 | 3.14 | 5.50 | 42.50 |
| $M_2 \times V_2$ | 92.24 c | 5.25 | 4.16 d | 18.96 | 20.93 | 18.89 | 43.54 b | 54.28 | 2.47 | 3.37 | 5.64 | 42.67 |
| Levelof significance | 0.05 | NS | 0.01 | NS | NS | NS | 0.01 | NS | NS | NS | NS | NS |

In a column, figures having similar letter(s) or without letter(s) do not differ significantly as per DMRT
NS = Not significant $V_1$=Shotabdi $V_2$= Prodip

**Table-3:** Interaction effects of planting method and nitrogen level on yield and yield contributing Characters of Wheat

| Interaction ofPlanting Method & N Level | Plant Height (cm) | Total Tillers Plant$^{-1}$ (no.) | Effective Tillers Plant$^{-1}$ (no.) | Length of Spike (cm) | Spikelets Spike$^{-1}$ (no.) | Fertile Spikelets Spike$^{-1}$ (no.) | Seeds Spike$^{-1}$ (no.) | 1000-grain Weight(g) | Grain Yield (t ha$^{-1}$) | Straw Yield(t ha$^{-1}$) | Biologi-cal Yield (t ha$^{-1}$) | Harvest Index (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $M_1 \times N_0$ | 90.84 | 4.65 | 2.97 f | 17.74 | 18.51 d | 15.65 e | 36.20 c | 44.89 | 1.77 e | 2.58 e | 4.36 f | 40.33 c |
| $M_1 \times N_1$ | 95.25 | 6.70 | 4.64 d | 18.35 | 20.50 bc | 19.20 c | 46.31 ab | 50.98 | 2.67 c | 3.48 cd | 6.14 d | 41.67 bc |
| $M_1 \times N_2$ | 96.70 | 6.92 | 5.16 b | 19.23 | 21.73 b | 21.00 b | 47.11 a | 53.25 | 3.37 b | 3.93 b | 7.26 b | 44.50 a |
| $M_1 \times N_3$ | 97.37 | 7.00 | 5.56 a | 18.64 | 25.50 a | 24.00 a | 48.16 a | 54.30 | 3.93 a | 5.21 a | 9.31 a | 45.50 a |
| $M_2 \times N_0$ | 86.14 | 3.29 | 2.19 g | 17.73 | 16.43 e | 13.97 f | 25.55 e | 47.10 | 1..53 e | 2.14 f | 3.73 g | 41.50 bc |
| $M_2 \times N_1$ | 94.03 | 4.25 | 3.63 e | 18.53 | 18.80 d | 16.83 de | 33.73 d | 50.28 | 2..37 d | 3.36 d | 5.47 e | 43.00 b |
| $M_2 \times N_2$ | 95.64 | 5.71 | 4.40 c | 18.92 | 19.50 cd | 17.95 cd | 42.35 b | 51.50 | 2.79 c | 3.69 bc | 6.32 d | 43.33 b |
| $M_2 \times N_3$ | 96.78 | 5.86 | 5.14 b | 18.42 | 20.37 bc | 18.80 c | 44.00 b | 52.22 | 2.95 c | 3.83 b | 6.77 c | 42.50 bc |
| Levelof significance | NS | NS | 0.01 | NS | 0.01 | 0.01 | 0.01 | NS | 0.01 | 0.01 | 0.01 | 0.05 |
| CV(%) | 2.88 | 12.45 | 3.04 | 5.44 | 6.15 | 6.26 | 4.11 | 5.22 | 8.47 | 7.10 | 5.29 | 4.02 |

In a column, figures having similar letter(s) or without letter(s) do not differ significantly as per DMRT
NS = Not significant CV = Co-efficient of Variation $M_1$= Bed Planting Method, $M_2$= Conventional Method
$N_0$= 0 kg ha$^{-1}$, $N_1$ = 60 kg ha$^{-1}$, $N_2$= 100 kg ha$^{-1}$, $N_3$= 140 kg ha$^{-1}$,

**Table 4:** Interaction effects of variety and nitrogen level on yield and yield contributing characters of wheat

| Interaction (Variety × Niyrogen level) | Plant height (cm) | Total tillers plant$^{-1}$ (no.) | Effective tillers plant$^{-1}$ (no.) | Length of spike (cm) | Spikelets spike$^{-1}$ (no.) | Fertile spikelets spike$^{-1}$ (no.) | Seeds spike$^{-1}$ (no.) | 1000-grain weight(g) | Grain yield (t ha$^{-1}$) | Straw yield(t ha$^{-1}$) | Biological yield(t ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $V_1 \times N_0$ | 89.55 | 3.71 | 2.50 | 17.40 | 15.94 | 13.55 | 20.85 f | 42.05 | 1.57 | 2.21 | 3.79 f | 41.50 cd |
| $V_1 \times N_1$ | 96.63 | 5.13 | 4.07 | 18.19 | 17.35 | 15.52 | 34.75 e | 46.85 | 2.50 | 3.36 | 5.86 d | 42.67 bc |
| $V_1 \times N_2$ | 97.69 | 5.77 | 4.77 | 18.61 | 18.60 | 17.35 | 42.85 c | 48.75 | 3.00 | 3.74 | 6.79 c | 44.00 ab |
| $V_1 \times N_3$ | 98.53 | 6.14 | 5.19 | 18.20 | 20.85 | 19.70 | 44.85 b | 49.50 | 3.43 | 4.29 | 7.79 b | 44.00 ab |
| $V_2 \times N_0$ | 87.44 | 4.23 | 2.66 | 18.07 | 19.00 | 16.07 | 40.90 d | 49.94 | 1.73 | 2.51 | 4.30 e | 40.33 d |
| $V_2 \times N_1$ | 92.65 | 5.82 | 4.39 | 18.69 | 21.95 | 20.52 | 45.29 b | 54.41 | 2.54 | 3.49 | 5.75 d | 44.00 ab |
| $V_2 \times N_2$ | 94.73 | 6.86 | 4.78 | 19.53 | 22.63 | 21.60 | 46.61 ab | 56.00 | 3.16 | 3.89 | 6.79 c | 44.83 a |
| $V_2 \times N_3$ | 95.61 | 6.73 | 5.51 | 18.86 | 25.02 | 23.10 | 47.31 a | 57.02 | 3.45 | 4.74 | 8.29 a | 45.00 a |
| Level of significance | NS | NS | NS | NS | NS | NS | 0.01 | NS | NS | NS | 0.05 | 0.01 |

In a column, figures having similar letter(s) or without letter(s) do not differ significantly as per DMRT
NS = Not significant $V_1$=Shotabdi $V_2$= Prodip $N_0$=0 kg ha$^{-1}$ $N_1$= 60 kg ha$^{-1}$ $N_2$=100 kg ha$^{-1}$ $N_3$=140 kg ha$^{-1}$

result is supported by Talukder *et al.,* [7]. Similarly straw yield (3.80 t $ha^{-1}$), biologilogical yield (6.77 t $ha^{-1}$), effective tillers $plant^{-1}$(4.58), spikelets $spike^{-1}$(21.56), fertile spikelets $spike^{-1}$,(19.96), seeds $spike^{-1}$(44.45) were highest in the bed planting method. Tripathi *et al.* [8] reported that bed planting showed significantly higher grain $spike^{-1}$ than conventional method.

**Effect of Variety:** Variety had significant effects on the all yield and yield contributing characters except length of spike, grain yield, biological yield and harvest index (Table 1). The highest value for all the growth and yield parameters was obtained from the variety Prodip. This result is supported by BARI[2]. The reasons for differences in producing growth and yield characters might be due to genetic make up of the varieties primarily influenced by heredity.

**Effect of Nitrogen Level:** The application of different levels of nitrogen produced significantly positive impact on yield and yield contributing characters of wheat (Table 1). All the growth parameters showed positive increase with the increased level of nitrogen applications. Application of 140 Kg N $ha^{-1}$ exhibited the highest performance among the treatment moreover, statistically significant over the control. Grain yield was noted highest (3.44 t $ha^{-1}$) with the highest level of nitrogen application (140 Kg N $ha^{-1}$) which was significantly over rest of the levels of nitrogen application. The obtained results are in good agreement with those of Tripathi *et al.*[8], Halepyati[9] and Yadav *et al.*[10]. The grain $spike^{-1}$ was also found to increase linearly with increased nitrogen levels. The highest number of grains $spike^{-1}$ ((46.08 ) was recorded with 140 Kg N $ha^{-1}$ and the lowest (30.88) was in control. This result was supported by Hossain *et al.*[11].

**Interaction Effect of Planting Method and Variety:** Interaction between planting method and variety were not found to have significant effect on yield and yield contributing characters except seeds spike, biological yield and harvest index (Table 2). All the yield components except plant height and spike length produced higher values under bed planting method with Prodip variety. The highest grain yield (2.97 t $ha^{-1}$) was observed in Prodip in bed planting method.This is confirmed to that of Talukder [12] who have stated that wheat genotypes produced significantly higher yield under bed planting system.

**Interaction Effect of Planting Method and Nitrogen Level:** Interaction effect of planting method and nitrogen level had significant effect on all most all the parameters (Table 3). The highest grain yield (3.93 t $ha^{-1}$) was found in bed planting method at 140 kg N $ha^{-1}$ which was was mainly due to the highest response crops to N and its use efficiency; proper water use by the plants, resulting significantly the maximum tillers $plant^{-1}$ (7.00), bold grains, higher number of grains $spike^{-1}$ (46.16). Similar results werw also found by Talukder *et al.*[13]. The lowest grain yield (1.53 t $ha^{-1}$) was found with the combination of conventional method and control treatment.

**Interaction Effect of Variety and Nitrogen Level:** Variety and nitrogen level interacted non-significantly for all growth and yield parameters except seeds $spike^{-1}$, biological yield and harvest index (Table 4). The Prodip showed better performance on the growth and yield at the higher level of nitrogen (140 kg $ha^{-1}$) application.On the other hand the Shotabdi showed lowest performance. Probably, this was due to the variation of genetic potentiality of the variety. Dhuka *et al.,*[14], Patel *et al.,*[15], Upadhyay and tiwari [16] and Sing *et al.,*[17] also found similar response in respect spikelets $spike^{-1}$, fertile spikelets, grain yield and straw yield respecttively.

**Conclusion:** It may, therefore, be cocluded that, bed planting is better than the conventional planting. Prodip produced the highest grain yield at 140 kg N $ha^{-1}$ in bed planting system. So, we can use Prodip variety in bed planting system with 140 kg N $ha^{-1}$ to obtain better performance of yield.

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