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Effects of nitrogen and boron on the yield and yield attributes of wheat

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Abstract

The experiment was carried out at the Agronomy Field Laboratory of Bangladesh Agricultural University (BAU), Mymensingh during the period from November 2006 to March 2007 with a view to finding out the suitable dose of nitrogen (N) and boron (B) for achieving higher yield of wheat (cv. Shatabdi). There were four levels of N viz., 0, 60, 120, 180 kg ha^{-1} and four levels of B viz., 0, 1, 2 and 3 kg ha^{-1}, applied as urea and boric acid respectively. The results showed significant differences in yield due to the application of N and B though some of the yield attributes were not found significant. Interaction effect of N and B for yield and most of the yield attributes were found significant. The highest grain yield (4.08 t ha^{-1}) was obtained from the application of N at 120 kg ha^{-1} coupled with 2 kg B ha^{-1}. The grain yield was found to be significantly and positively correlated with spike length, number of grains $spike^{-1}$ and straw yield .

Keywords: Boron, Nitrogen, Wheat

Introduction

Wheat (*Triticum aestivum* L.) next to rice, is the second most important staple food crop in Bangladesh. Wheat has higher food value over rice is that it contains 12.1% protein, 1.72% fat, 69.6% carbohydrate and 27.2% minerals (BARI, 1997).Recently the BARI scientists have developed some varieties with high yield potential and shatabdi is one of them. Unfortunately the average yield of wheat in this country is low (2.16 t ha^{-1}) compared to many wheat growing countries of the world (BBS, 2004). This low yield can be attributed to the traditional cultural practices and improper fertilizer management.

Nitrogen is the key element for the production of crops and it is highly difficult in Bangladesh soils. Optimum supply of N raises the protein content, nutritive value of grain and also improves baking qualities. Grain unfilling is a main cause of low wheat yield in this country and this is induced by boron deficiency. Boron supply has more influence on reproductive development than on wheat (Ahmed, *et al.*, 2007). Therefore, the present research work was undertaken to find out the dose of N and B for higher yield of wheat (cv. Shatabdi).

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University (BAU), Mymensingh. The experimental field was a high land belonging to the old Brahmaputra Floodplain agro-ecological zone (AEZ 9) (UNDP and FAO, 1988). The soil of the experimental field was sandy loam having pH 6.4, 0.058% total N, 0.463% organic matter, 23.0 ppm available P, 5.0 ppm available S and 0.13 ppm exchangeable K. Four N levels viz., 0, 60, 120, 180 kg ha^{-1} and four B levels viz., 0, 1, 2, and 3 kg ha^{-1} constituted the experimental treatments. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The unit plot size was 4 m × 2.5 m. The land was fertilized with 150 kg TSP ha^{-1}, 100 kg MOP ha^{-1} and 110 kg Gypsum ha^{-1}. Nitrogen and Boron were applied as per treatments through urea and boric acid, respectively. One-third of the urea and full amount of the other fertilizers were applied at the time of final land preparation and the remaining two-thirds of urea were top-dressed in two equal splits on 20 and 55 days after sowing (DAS) of the seed. Seeds were sown on 27 November 2006 continuously at 25 cm apart rows. Weeding was done at 18 and 50 days after sowing (DAS). Irrigation was given twice after first weeding and then at 55 DAS. Plant protection measures was not required, as the crop was free from insect and disease attack. The crop was harvested at full maturity on 25 March 2007. Grain and straw were then dried in the sun for four days. For collecting data on several plant characters, 10 randomly selected plants were uprooted from each plot before harvesting. The harvested crops were threshed plot-wise and grain and straw yields were recorded plot-wise on 14% moisture basis and converted to t ha^{-1}. Data analysis was done using Analysis of Variance (ANOVA) techniques and mean differences were adjudged by Duncan's. Multiple Range Test (Gomez and Gomez, 1984) using a computer based Statistical Program M-STAT.

Results and Discussion

Spike length was affected significantly by N application (Table 1). The longest spike (9.35 cm) was obtained from 180 kg N ha^{-1} which was statistically identical with 60 and 120 kg N ha^{-1} and the shortest (7.88 cm) was noticed at no nitrogen treatment.

Table 1. Effect of Nitrogen on the yield and yield contributing characters of wheat (cv. Shatabdi)

Treatment N levels (kg ha^{-1})	Spike length (cm)	No. of grains $spike^{-1}$	1000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
N_0	7.85 b	14.0 d	44.7 b	1.91 d	3.27 d
N_{60}	9.21 a	20.9 c	45.7 a	3.39 c	4.19 c
N_{120}	9.21 a	24.5 b	45.6 a	3.93 a	4.74 a
N_{180}	9.35 a	26.0 a	45.8 a	3.68 b	4.52 b
$S\bar{x}$	0.12	0.28	0.23	0.04	0.05
CV (%)	4.73	4.56	4.73	4.83	4.65

In a column, figures with same letter do not differ significantly as per DMRT.

The number of grains $spike^{-1}$ and 1000-grain weight showed significant variation due to N application (Table 1). The number of grains $spike^{-1}$ was highest (26.0) at 180 kg N ha^{-1} and the lowest (14.0) at control. The highest 1000-grain weight (45.8 g) was found from 180 kg N ha^{-1} and which was statistically identical with 60 and 120 kg N ha^{-1} and lowest (44.7 g) was obtained from control.

The grain and straw yields also showed significant variation for different N levels (Table 1). Among the treatments, the 120 kg N ha^{-1} produced the highest grain yield (3.93 t ha^{-1}) and the control did the lowest (1.91 t ha^{-1}). Iqtidar *et al.*(2006) reported that grain yield increased significantly with increasing N levels. The highest straw yield (4.74 t ha^{-1}) in 120 kg N ha^{-1} might be due to the fact that the N primarily encouraged vegetative growth. The lowest straw yield (3.27 t ha^{-1}) was obtained from control treatment.

Variation in spike length were found to be significant due to B fertilization (Table 2). The highest spike length (9.21 cm) was produced by 2 kg B ha^{-1}, which was statistically identical with 1 and 3 kg B ha^{-1}. The shortest spike length (8.52 cm) was obtained from control treatment.

Table 2 Effect of boron on the yield and yield contributing characters of wheat (cv. Shatabdi)

Treatment B levels (kg ha^{-1})	Spike length (cm)	No. of grains $spike^{-1}$	1000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
B_0	8.52 b	17.5 d	45.2	2.93 c	3.33 c
B_1	8.92 a	20.3 c	45.3	3.11 b	4.0 b
B_2	9.21 a	24.4 a	45.6	3.44 a	4.3 a
B_3	9.00 a	23.1 b	45.5	3.43 a	4.09 b
$S\bar{x}$	0.12	0.28	0.23	0.04	0.05
CV (%)	4.73	4.56	4.73	4.83	4.65

In a column, figures with same letter(s) or without letter(s) do not differ significantly as per DMRT

Different B levels showed significant effect on the number of grains $spike^{-1}$. The B effect was not significant in case of 1000-grain weight (Table 2). The highest number of grains $spike^{-1}$ (24.4) was produced by application of 2 kg B ha^{-1} and the lowest (17.5) was found at control. The highest number of grains $spike^{-1}$ was probably done to reduction of sterility of wheat as B reduces male sterility of wheat. Similar results was reported by Mandal and Das (1988). Numerically the highest 1000-grain weight (45.6 g) was noted at 2 kg B ha^{-1} and the lowest (45.2g) at 0 kg B ha^{-1} indicates boron had influenced grain set, not 1000-grain weight.

The grain and straw yields were influenced significantly due to different levels of B application. The highest grain yield (3.44 t ha^{-1}) was observed at 2 kg B ha^{-1} which was statistically identical with 3 kg B ha^{-1} (Table 2).The lowest grain yield (2.93 t ha^{-1}) was obtained from the control treatment. The highest straw yield (4.30 t ha^{-1}) was obtained from 2 kg B ha^{-1} and the lowest straw yield (3.33 t ha^{-1}) from control. The present result concurs with the findings observed by Rahman (1989) and Jahiruddin *et al.* (1995).

The interaction of nitrogen and boron showed non-significant effect on spike length (Table 3). The longest spike (9.63 cm) was found in $N_{120}B_2$ treatment and the shortest (6.94 cm) in N_0B_0

Interaction effect N and B showed significant variation on the number of grains $spike^{-1}$ (Table 3). The number of grains $spike^{-1}$ varied form 11.5 to 29.4 depending on the various treatments used. The treatment $N_{120}B_2$ produced the highest number of grains $spike^{-1}$ (29.4) and the lowest results (11.5) was obtained from control treatment. Interaction between N and B was not-significant for 1000-grain weight (Table 3). However, the highest 1000-grain weight (46.1 g) was obtained from N_{180} B_2 treatment and the lowest 44.2 g was found from control treatment.

Interaction effect of N and B was significant regarding grain and straw yields. The highest grain yield (4.08 t ha^{-1}) was recorded in N_{120} B_2 treatment , which was similar to $N_{120}B_1$, $N_{120}B_3$, $N_{180}B_2$ and $N_{180}B_3$ treatment combinations and the lowest yield (1.75 t ha^{-1}) was found from control. From the interaction treatments it is clear that N_{120} B_2 produced the highest straw yield (Table 3). Treatments $N_{60}B_0$, $N_{120}B_0$, $N_{120}B_3$, $N_{180}B_2$ were statistically similar. The lowest performance in respect of straw yield (3.08 t ha^{-1}) found in N_0B_2 treatment.

Table 3. Interaction effect of nitrogen and boron on the yield and yield contributing characters of wheat (cv. Shatabdi)

Treatment N x B (kg ha^{-1})	Spike length (cm)	No. of grains spike^{-1}	1000 grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
N_0B_0	6.94	11.5 h	44.2	1.75 h	3.33 fg
N_0B_1	8.00	13.8 g	44.4	1.83 h	3.25 fg
N_0B_2	8.30	15.8 f	45.0	1.91 gh	3.08 g
N_0B_3	8.28	14.8 fg	45.2	2.16 g	3.42 fg
$N_{60}B_0$	8.91	18.5 e	45.2	3.00 f	4.75 ab
$N_{60}B_1$	9.16	18.7 e	45.5	3.15 f	4.42 bcd
$N_{60}B_2$	9.49	24.8 c	45.6	3.75 bcd	4.08 de
$N_{60}B_3$	9.28	21.5 d	45.6	3.67 cd	3.50 f
$N_{120}B_0$	8.77	18.2 e	45.7	3.73 bcd	4.83 a
$N_{120}B_1$	9.15	22.6 d	45.6	3.95 abc	4.33 cde
$N_{120}B_2$	9.63	29.4 a	45.7	4.08 a	5.03 a
$N_{120}B_3$	9.28	27.8 ab	45.3	3.95 abc	4.75 ab
$N_{180}B_0$	9.44	21.6 d	45.7	3.25 ef	4.42 bcd
$N_{180}B_1$	9.37	26.2 bc	45.8	3.50 de	4.00 e
$N_{180}B_2$	9.43	27.8 ab	46.1	4.00 ab	5.00 a
$N_{180}B_3$	9.15	28.3 a	45.7	3.95 abc	4.67 abc
$S\bar{x}$	0.24	0.56	0.45	0.09	0.11
CV (%)	4.73	4.56	4.73	4.83	4.65

In a column, figures with same letter(s) or without letter(s) do not differ significantly as per DMRT

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