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EFFECTS OF APPLICATION METHODS OF BORON AND VARITIES ON WHEAT PRODUCTION

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ABSTRACT

The experiment was conducted at the Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi during the growing season of 2009-10 to study the role of application methods of boron on the yield performance of wheat varieties. The experiment consisted of two factors. Factor A. three wheat varieties (Prodip, Shatabdi and Bijoy.) and factor B. different boron treatments (without B application, basal application of boron and foliar application of boron @ 1 kg/ha). A split plot design was adopted. The treatments were replicated for three times. The crop was harvested at maturity stage. The effect of variety was significant on all the parameters except plant height. Prodip produced the highest grain yield (4.15 t/ha) followed by Bijoy (3.68 t/ha) and Shatabdi (3.29 t/ha). Application methods of boron showed significant effect on the yield of wheat. The highest grain yield (4.54 t/ha) was obtained from the foliar application of B with the basal application of NPK. The basal application of B showed yield (4.38 t/ha) than the foliar application of B and the yield of wheat was 1.83 t/ha when B was not applied. In case of interaction effect, the highest grain yield was found in the combination of variety and boron was (5.12 t/ha), when boron was used as foliar application in Prodip variety with the basal application of NPK at the rates of 220,180 and 50 kg/ha and lowest yield 1.47 t/ha at sotabdi and no fertilizer used plot. So the foliar application of boron is the suitable method for getting higher yield of wheat.

1. Introduction

Wheat (*Triticum aestivum* L.) has been established one of the major cereal crops providing about two-third of the total requirement of the world. It ranks first in area (213.60 million hectares) and third in production (576.317 million metric tons) among the grain crops of the world (FAO, 2000). Low graded wheat is fermented to produce alcohol. Wheat is grown under a wide range of climatic and soil conditions. In Bangladesh, it is grown as rabi crop. Average yield of Bangladesh is low compared to other wheat growing countries of the world. (FAO1999). In Holland, UK, France and Norway, the average yield of wheat is 7.50, 6.20, 5.90 and 4.80 t ha^{-1} respectively, whereas in Bangladesh it is only

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2.6 t/ha (FAO, 1999). In Bangladesh, the area under wheat cultivation was 4.81 lakh hectare and 4.44 lakh hectares in 2005-06 and 2015-16 respectively & the production was 10.50 and 7.72 lakh metric tons in respective years (DAE, 2006) & (DAE 2016).Boron application has both direct and indirect effects on wheat fertilization. Wheat grown in a boron deficient soil exhibits a symptom of grain sterility (Rerkasem *et al.*, 1989). The direct effect of boron is reflected by a close relationship between boron supply and pollen producing capacity of the anthers as well as the viability of pollen grains (Agarwala *et al.*, 1981). Wheat varieties may differ in their sensitivity or tolerance to boron deficiency (Kataki *et al.*, 2001).

2. Materials and methods

The present research work was carried out at the Agronomy Field Laboratory during the period from November 2009 to March 2010, under the department of Agronomy and Agricultural Extension, University of Rajshahi, Bangladesh. Wheat (*Triticum aestivum*) having semi dwarf high yielding characteristics. The experiment consisted of the following two factors: A. Variety Prodip (V_1), Shatabdi (V_2), Bijoy (V_3), factor B. Boron treatment: No fertilizer used (T_0), Only NPK used as basal doses (T_1), NPK& B used as basal doses (T_2), NPK as basal & B used as foliar application (T_3). The experiment was laid out in a split-plot design assigning variety to the main plot and boron treatments in sub-plots with three replications. Each block was divided into three main plots in which three varieties were applied at random. The number of unit plot was 36. The unit plot size was 2m×2 m.

Urea, Triple super phosphate (TSP), and muriate of potash (MP) were applied to the plots at the rate of 180, 220, 50 kg/ha on during final land preparation. Two third Urea and all other fertilizers were applied at the time of final land preparation and one-third of nitrogenous fertilizers at 21 days after sowing (DAS). The basal doses of boron fertilizer were applied at the time of final land preparation and the foliar application of boron was done 55 DAS with a sprayer.

Data were recorded on time taken days to plant height (cm), total tillers per plant, effective tillers per plant, length of spike(cm), spikelets per spike, fertile spikelets per spike, seeds per spike, weight of thousand grains (g), grain yield (t/ha), straw yield (t/ha), biological yield (t/ha), harvest index (%).The data were analyzed statistically by Duncan's New Multiple Range Test (Gomez and Gomez, 1984) with the help of MSTAT-C.

3. Results and Discussions

Plant height (cm): Effect of variety on Plant height was non-significant, but effect of boron application method, interaction between variety and the boron application methods was significant. The highest plant height (98.69 cm) was recorded in Shatabdi, the lowest plant height (96.38 cm) was obtained from the variety Prodip (Table 1).Height may become a primary determinant of individual plant's success in dense plant stands resulting in higher yields (Weiner and Fishman 1994). The highest plant height (102.07 cm) was observed in the foliar spray of boron application. The lowest one (91.57 cm) was observed, where no fertilizer was used but only with NPK the plant height was 96.74 cm (Table 2). The tallest plant (102.90 cm) was obtained from Bijoy with foliar application of boron

and the shortest one (86.33 cm) from Shatabdi at no fertilizer use (Table 3).

Number of total tillers per plant: Significant variation was observed among the varieties and different boron application methods in respect of no. of total tiller per plant. Result presented in the highest number of tillers per plant (5.28) was recorded in Prodip variety and the lowest number of tillers per plant (4.49) was recorded in Shatabdi (Table 1). Shatabdi was best followed by Kanchan, Gourab and Sourav. Shatabdi produced significantly ear length total tillers per plant then Kanchan, Gourab and Sourav. This variety also exceeded the yield of other varieties by 10-12 % (BARI 2000). The maximum number of total tillers per plant (5.33) was recorded at foliar application of boron. The minimum one was (3.90) found from T_0 where no fertilizer used (Table 2). There was non-significant effect in respect of total tillers per plant of wheat due to interaction of variety and boron. Numerically the highest number of total tillers per plant (5.70) was recorded from Prodip at the foliar application of boron and the lowest one (3.10) was obtained from Shatabdi when no fertilizer used (Table 3).

Effective tiller per plant: Individual effect of variety and boron application methods was significant in respect of effective tillers per plant but interaction between them was non-significant. The highest number of effective tillers per plant (4.73) was obtained from Bijoy where the lowest value (3.92) was produced by Shatabdi (Table 1). The highest number of effective tillers per plant (4.93) was observed at foliar application of boron the lowest one (3.19) was observed when no fertilizer used (Table 2). In case of interaction effect of variety and boron application methods the maximum number of effective tillers per plant (5.13) was obtained from Bijoy at the foliar application of boron and the minimum one was obtained from Shatabdi (2.53) at no fertilizer use (Table 3).

Length of spike (cm): The length of spike varied significantly due to varietal effect. The longest spike (19.84 cm) was produced by Prodip variety and the shortest spike (17.96 cm) was produced by Shatabdi which was statistically similar with the variety Bijoy (17.97 cm). (Table1) The wheat varieties influenced plant height, length of spike, number of spikelets spike^{-1}, number of fertile grains spike^{-1}, grain and straw yield (Khan 1993). Spike length significantly influenced by boron application methods. The highest length of spike (19.72 cm) was produced by foliar application of boron and the lowest (15.89 cm) was observed by using no fertilizer (Table 2). The interaction between variety and boron application methods failed to produce non-significant variation in case of spike length. The highest spike length (21.12 cm) was given by the Prodip at foliar application of boron where the lowest spike length (15.51 cm) was given by the Shatabdi at no fertilizer use (Table 3).

Number of spikelets per spike: Variety had significant influence on number of spikelets per spike .The highest number of spikelets per spike (21.42) was obtained from Prodip variety. The lowest spikelets number (17.69) obtained from Shatabdi (Table 1). Varietal differences regarding the number of spikelets per spike were due to their differences in genetic makeup. Significant variation was observed in respect of number of spikelets per spike due to different application method of boron. The highest number of spikelets (21.79) was observed in foliar application of boron and the lowest (15.56) was observed when wheat produced without fertilizer (Table 2). The interaction of variety and born application methods was non-significant on the number of spikelets per spike. Numerically the

highest number of spikelets per spike (23.19) was recorded due to interaction of Prodip variety at foliar application of boron and the lowest number of spikelets (13..95) was obtained on interaction of Shatabdi and no use of fertilizer (Table 3).

Number of fertile spikelets per spike: There was significant variation among varieties and in term of fertile spikelets per spike. The highest number of fertile spikelets per spike (18.62) was obtained from Prodip variety where lowest value was obtained from Shatabdi (16.66) (Table 1). Significant variation was observed on the number of fertile spikelets per spike due to different application methods of boron. The highest number of fertile spikelets per spike (19.35) was obtained at the foliar application of boron the lowest (12.76) was obtained from T_0 where no fertilizer was applied (Table 2). Non-significant effect was observed on the number of fertile spikelets per spike due to the interaction of variety and boron application methods. The highest number of fertile spiketets (20.98) was given by Prodip at foliar application of boron and the lowest (11.75) was given by Shatabdi at the zero fertilizer was applied (Table 3).

1000-grain weight (g): Weight of 1000-grain affected significantly due to variety and boron application methods. The highest 1000-grain weight (56.27 g) was obtained from the variety Prodip and the lowest weight of 1000 grain was obtained from the variety Shatabdi (52.73 g), (Table 1). From foliar application of boron the maximum 1000-grain weight (56.33 g) was obtained. The lowest weight (51.39 g) was observed by zero fertilizer treatment (Table 2). 1000-grain weight non-significantly influenced the interaction of variety and boron application methods. Numerically the highest weight of 1000-grain (59.47 g) was obtained from the treatment combination Prodip and foliar application of boron and the lowest weight (51.00 g) was obtained from the combination of Shatabdi and by using no fertilizer (Table 3).

Number of grains per spike: Individual effect of Variety and boron application methods has significant variation in terms of grains per spike. The number of highest grains per spike (51.26) was produced by Prodip variety and the lowest numbers of grains per spike (45.57) was produced by Shatabdi(Table 1). Prodip gave highest grains per spike (Krishi Projucti Hath Boi BARI, 2006). In case of boron application methods the maximum number of grains (55.44) was observed in foliar application and the lowest one (33.77) was observed when no fertilizer used (Table 2). The boron fertilizer increased the production of more grains per spike and increased individual grain weight which might be the cause of more grain yield. (Abedin *et al.*1994). The effect of variety and boron application methods on the number of grains per spike was non-significant. It was observed that Prodip produced the maximum number of grains per spike (58.33) when boron was used as basal application and Prodip produced the minimum (32.45) when no fertilizer was used (Table 3).

Grain yield (t/ha): The highest grain yield (4.15 t/ha) was produced by Prodip. Lowest grain yield (3.29 t/ha) was obtained from Shatabdi. Grain yield variation was significant among varieties (Table 1). From different five varieties Prodip produce the highest grain yield (BARI 2010). Boron application methods exerted significant influence on grain yield of wheat. The maximum grain yield (4.54 t/ha) was obtained with the application of foliar spray of boron. The lowest yield (1.83 t/ha) was obtained when no fertilizer used(Table 2). Foliar fertilization treatment of boron caused a significant

grain yield increase and the average yield increment ranged between 9 and 15% (Jolanta K. 2008). The combined effect of variety and boron application methods on grain yield was non-significant. Numerically the highest grain yield (5.12 t/ha) was recorded from Prodip and foliar application of boron and the lowest grain yield (1.47 t/ha) was noted from the variety Shatabdi at by using no fertilizer (Table 3).

Straw yield (t/ha): The straw yield was significantly influenced by variety and boron application methods. The height straw yield (6.92 t/ha) was produced by Bijoy, the lowest straw yield (6.00 t ha^{-1}) was obtained from Shatabdi (Table 1). Four varieties studied varied significantly in grain and straw yields (Duffera *et al.* 1991). The highest straw yield (7.70 t/ha) was produced by foliar application of boron and the lowest (3.53 t/ha) was obtained by using no fertilizer (Table 2).The interaction effect between variety and boron application methods was non-significant. The highest straw yield (8.62 t/ha) was obtained from the combination of Prodip and foliar application of boron and the lowest one (3.05 t/ha) was obtained from Shatabdi and by using no fertilizer (Table 3).

Biological yield (t/ha): Biological yield was significantly influenced by varietal effect. Bijoy produced highest (10.59 t/ha) biological yield and the lowest biological yield (9.30 t//ha) was obtained from Shatabdi (Table 1). A significant variation was observed on the biological yield of wheat due to boron application. The highest biological yield (12.24 t/ha) was obtained with the foliar application of boron and lowest yield (5.36 t/ha) was obtained when fertilizer was not used (Table 2). The combined effect of variety and boron application methods on biological yield was non-significant. The highest biological yield was obtained (13.09 t/ha) due to the interaction of Bijoy and foliar application of boron and the lowest one (4.52 t/ha) due to the interaction of Shatabdi and by using no fertilizer (Table 3).

Harvest index (%): Variety has significant variation on harvest index. The height harvest index (38.90 %) was recorded in Prodip variety may be due to the higher grain yield and lower straw yield in this particular variety and lowest harvest index obtained by Bijoy (34.68 %), (Table 1). Harvest index was not significantly influenced due to the application methods of boron. The highest harvest index (37.19 %) was obtained with the foliar application of boron and the lowest (34.07 %) was found by using no fertilizer (Table 2). The combined effect was non-significant. The highest Harvest index was obtained (40.41 %) from the interaction of Prodip and foliar application of boron and the lowest one (32.48 %) from interaction of Shatabdi and by using no fertilizer (Table 3).

Correlation between effective tillers per plant versus grain yield

The result revealed that effective tillers $plant^{-1}$ and grain yield have a significant positive relationship at 1% level of significance. The correlation coefficient r = 0.854**. The positive slope indicates positive relationship, which means that an increase in the number of effective tillers $plant^{-1}$ will lead to an increase in grain yield of wheat. (Figure 1)

Correlation between fertile spikelets per spike versus grain yield

The result revealed that fertile spikelets $spike^{-1}$ and grain yield have a significant positive relationship at 1% level of significance. The correlation coefficient r = 0.887**. The positive slope indicates positive relationship, which means that an increase in the number of fertile spikelets $spike^{-1}$ will lead

to an increase in grain yield of wheat. (Figure 2)

Correlation between 1000-grain weights versus grain yield

The result revealed that 1000-grain weight and grain yield have a significant positive relationship at 1% level of significance. The correlation coefficient r = 0.563**. The positive slope indicates positive relationship between 1000-grain weight and grain yield of wheat. (Figure 3)

Correlation between grain spike^{-1} versus grain yield

The result revealed that grain spike^{-1} and grain yield have a significant positive relationship at 1% level of significance. The correlation coefficient r = 0.894**. The positive slope indicates positive relationship between grain spike^{-1} and grain yield of wheat. (Figure 4)

5. Conclusion

The present research work was carried out at the Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi during the period from November, 2009-10. The experiment contains three modern varieties viz. Prodip, Shatabdi and Bijoy. A split-plot design was used for the experiment. The treatments were replicated for three times. The recorded data of yield and yield contributing characters were analyzed statistically and the mean differences among the treatments were adjudged by Duncan's New Multiple Range Test (DMRT). Variety had significant effects on the all yield contributing characters and yield except length of spike and fertile spikelets spike^{-1}. The highest total tillers plant^{-1}, effective tillers plant^{-1}, spike length, spikelets spike^{-1}, fertile spikelets spike^{-1}, grains spike^{-1}, 1000-grain weight, grain yield, and harvest index were obtained from Prodip variety. The three varieties tested, Prodip performed the best giving the highest yield. So, Prodip can be regarded as a breeding material for development of new wheat varieties which give satisfactory yield.

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