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EFFECT OF BORON ON GRAIN SET, YIELD AND SOME OTHER PARAMETERS OF WHEAT CULTIVARS

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ABSTRACT: Three identical field experiments were conducted to examine the effect of B on grain set, yield and some other parameters of wheat cultivars grown in the agroecological region of Old Brahmaputra Floodplain. The selected wheat varieties were Aghrani, Kanchan and Sonalika. The B treatments comprised 0, 1, 2, 3 and 4 kg B/ha. The experiment was set up in split plot design with a random distribution of varieties to the main-plots and B treatments to the sub-plots. The results showed that B had a marked influence on grain set and yield. Considerable effect of B was also noticed in case of some other parameters. The results also varied between the varieties and between the locations. In general, the variety Kanchan and the B rate 3 kg/ha did the best. It is apparent that grain yield of wheat was highly dependent on the number of grains per spike. The whole results suggest that an application of B @ 3 kg/ha is essential for optimum wheat production in the Old Brahmaputra Floodplain region.

Key words: Boron, Grain set, Wheat cultivars

INTRODUCTION

Grain set failure appears to be a major cause of low wheat yield in Bangladesh. This problem may arise in wheat due to deficiency of B as reported in China (Li *et al.*, 1978), Thailand (Rerkasem *et al.*, 1989), India (Mandal and Das, 1988) and Nepal (Sthapit, 1988). From some recent in-country studies, it is also apparent that B had a remarkable contribution on grain set and yield of wheat. Rahman (1989) reported from a missing element trial that omission of B from the complete treatment had reduced wheat yield by 20.4%. Razzaque and Hossain (1991) identified B deficiency as one of the limiting factors of higher wheat yield. Jahiruddin *et al.* (1992) observed in their field trials at BAU farm and Rangpur soils that both grain set and yield were remarkably improved after B treatment.

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In fertilizer schedule, an inclusion of B often decides the success and failure of the crop (Dwivedi *et al.*, 1990). Gupta *et al.* (1985) reported that the ranges between deficiency and toxicity of B are quite narrow and that an application of B can be extremely toxic to plants at concentrations only slightly above the optimum.

Wheat varieties may differ in their tolerance to B deficiency. Rerkasem *et al.*, (1993) observed that among the eight genotypes tested, Sonora 64 was found tolerant and SW 41 susceptible. As stated by Gupta (1979) crop susceptibility to B deficiency is controlled by a single recessive gene. Thus, the present study was undertaken to examine the main and interaction effects of B treatments and wheat varieties on grain set, yield and some other agronomic components of wheat.

MATERIALS AND METHODS

Three identical field trials with wheat were conducted during the winter of 1992-93. The experimental sites were BAU farm, Kishoreganj and Muktagachha under the agroecological region of Old Brahmaputra Floodplain. The experiment consisted of three wheat varieties and five B doses. A split-plot design with a distribution of varieties to the main-plots and B to the sub-plots was used. There were three fold replications of each factors. The selected wheat varieties were Aghrani, Kanchan and Sonalika, and the B doses being 0, 1, 2, 3 and 4 kg B/ha. A basal dose of 100 kg N, 60 kg P_2O_5, 40 kg K_2O and 20 kg S per hectare was applied to every plot. Fertilizers such as urea, triple superphosphate, muriate of potash, gypsum and boric acid were used as sources of N, P, K, S and B, respectively. Intercultural operations such as weeding and irrigation were done as and when required. The crop was harvested at maturity and data on yield and yield parameters were recorded. These data were statistically analyzed to examine the main and interaction effects of B and variety on wheat following F-test.

RESULTS AND DISCUSSION

Grain yield: Grain yield of wheat was markedly influenced by B treatment. The yield depending on the B doses varied from 2697 to 3272 kg/ha in BAU farm, 1739 to 2061 kg/ha in Kishoreganj and 1930 to 2459 kg/ha in Muktagachha (Tables 1-3). In all the locations the highest yield was

obtained in B_3 treatment and the lowest in B_0 (control). In BAU and Muktagachha soils, the rate of 3 kg B/ha (B_3) gave statistically similar yield with that of 2 kg B/ha (B_2), while in Kishoreganj soil the treatment B_3 ranked first superseding all other B treatments. Such result, thus, endorses the superiority of B_3 treatment among the lot. Concerning the varietal effect on grain yield, it appears that Kanchan performed better than the others (Aghrani and Sonalika). The yield performance of later two varieties were not consistent in all soils. There was no interacting effect of B and variety on grain yield of wheat indicating that B had similar effect on all varieties.

Table 1. Effect of variety and B treatments on wheat at BAU farm

Treatments	Plant height (cm)	Tillers/ plant (no.)	Spike length (cm)	Grains/ spike (no.)	1000-grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Variety							
Aghrani	88.1	3.8	10.4	38.0	40.7	3352	7589
Kanchan	96.6	3.9	3.7	40.3	41.7	3258	7806
Sonalika	93.5	3.7	10.7	31.1	40.9	2316	6617
LSD (P=0.05)	4.6	NS	NS	2.7	NS	382	697
Boron							
B_0	90.7	3.6	10.3	31.5	38.6	2697	6810
B_1	92.2	3.7	10.4	34.6	39.8	2783	7361
B_2	93.0	3.7	10.4	36.1	40.9	3149	7616
B_3	94.5	4.2	10.7	40.2	41.3	3272	7598
B_4	93.2	3.9	10.8	39.9	44.8	2975	7301
LSD (P=0.05)	NS	0.3	NS	3.0	3.4	211	550

Grain set: There was a significant improvement in grain set of wheat after B application to soil. In all the locations B_3 treatment contributed the highest and the treatment without B (control) did the lowest. The number of grains per spike at BAU farm varied from 31.5 to 40.2, Kishoreganj from 34.7 to 38.9 and Muktagachha from 31.9 to 34.4 (Tables 1-3). The highest record obtained in B_3 treatment was statistically identical with that of B_4 treatment. As far as wheat variety is concerned, Kanchan was the best since, its contribution towards grain set improvement was either significantly higher or comparable with Aghrani over the trials. Interaction effect of variety and B treatment on grains/spike was insignificant meaning that B had an identical influence on grain formation in different varieties of wheat.

Thousand grain weight: Boron had a significant effect on 1000-grain weight of wheat. In Kishorganj and Muktagachha trials, grain set was improved irrespective of B doses from 1 through 4 kg B/ha and such enhancement was statistically similar over the B doses. On the contrary in trial at BAU farm, grain weight was not improved following B treatment with the rate of 1, 2 or 3 kg/ha application and was only improved when B was incorporated to soil at the rate of 4 kg/ha (Tables 1-3). It is noted that in recording 1000-grain weight the rate of 3 kg B/ha which gave the highest result in case of grain set and grain yield did not supersede the other B levels. This result indicates that when grain set was improved after B treatment, grain weight tended to decline but still their cumulative effect on grain yield was positive. When the results of wheat varieties are looked into, 1000-grain weight did not vary between the varieties in any of the three trials. There was no interaction effect of B X variety on this parameter.

Table 2. Effect of variety and B treatments on wheat at Kishoreganj site

Treatments	Plant height (cm)	Tillers/ plant (no.)	Spike length (cm)	Grains/ spike (no.)	1000-grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Variety							
Aghrani	86.4	3.0	8.8	38.0	38.1	1793	4323
Kanchan	93.3	3.6	9.4	37.4	33.4	1933	5415
Sonalika	90.8	3.3	8.9	34.1	35.8	1927	5150
LSD (P=0.05)	NS	0.4	0.4	3.0	NS	136	NS
Boron							
B_0	89.4	3.2	9.0	35.3	33.7	1739	5733
B_1	91.3	3.1	9.1	35.4	37.2	1956	4800
B_2	89.6	3.4	8.5	34.7	34.7	1917	4967
B_3	90.2	3.5	9.4	38.9	38.6	2061	4672
B_4	90.5	3.3	9.1	38.1	34.6	1750	4642
LSD (P=0.05)	NS	0.3	0.6	2.3	3.3	65	NS

Other plant characters: The other plant characters under study were plant height, tillers/plant, spike length and straw yield. Of them, tillering was significantly influenced by B treatment in all soils, while plant height remained unaffected by B application. In the case of other two parameters, B effect was not consistent over the soils. Boron had positive effect on spike length in Kishoreganj soil but such effect was not noticed in case of other two soils. Similarly, straw yield at Kishoreganj site was not affected by B, while at the other two sites the effect of B on straw yield was encouraging. The effect of wheat varieties on these parameters were not identical in all soils. In general, the variety, Kanchan and the treatment, 3 kg B/ha had better effect on these plant characters (Tables 1-3).

Table 3. Effect of variety and B treatments on wheat at Muktagachha site

Treatments	Plant height (cm)	Tillers/ plant (no.)	Spike length (cm)	Grains/ spike (no.)	1000-grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Variety							
Aghrani	92.5	3.1	9.3	31.6	37.5	2157	2961
Kanchan	94.9	3.4	11.4	38.4	35.5	2320	3193
Sonalika	101.8	3.6	9.3	29.2	35.7	2305	2994
LSD (P=0.05)	4.9	NS	1.2	2.6	NS	NS	NS
Boron							
B_0	95.2	2.9	9.7	31.9	33.8	1930	2732
B_1	96.1	3.3	9.9	32.0	35.7	2326	3153
B_2	95.1	3.3	10.0	33.2	36.4	2203	3041
B_3	98.5	3.8	10.0	34.4	37.6	2459	3178
B_4	97.2	3.5	10.3	33.9	37.6	2385	3143
LSD (P=0.05)	NS	0.4	NS	1.2	2.3	333	266

Path coefficient analysis: Correlation statistics followed by path coefficient analysis were made in order to examine the relationship as well as contribution of a growth or yield parameter to grain yield of the crop. This test was made on BAU experiment and the results are reported in Table 4. It appears that grain yield was significantly and positively correlated with per spike grain number ($r=0.813$, $P<0.001$) and also with tillers/spike ($r=0.559$, $P<0.05$). Correlation of grain yield with other plant parameters such as plant height, spike length and 1000-grain weight was insignificant. The path coefficient analysis which has partitioned the direct and indirect contribution of a parameter to grain yield, shows that the number of grains per spike had maximum direct effect on grain yield. Such result, thus, indicates that B had significant positive effect on grain set which in turn resulted in higher grain yield.

Table 4. Path coefficient analysis showing the contribution of component character to wheat yield in BAU farm

Characters	Indirect effects through					Correlation with grain yield
	Plant height	Tillers/ plant	Spike length	Grains/ spike	1000-grain weight	
Plant height	**-0.1155**	0.0225	-0.1292	0.1686	0.0144	0.0392
Tillers/plant	-0.0413	**0.0629**	-0.0594	0.5703	0.0268	0.5591*
Spike length	-0.0344	0.0086	**-0.4333**	0.1278	0.0420	0.2893...
Grains/spike	-0.0238	0.0437	-0.0675	**0.8198**	0.0405	0.8127***
1000-grain/weight	-0.0226	0.0229	-0.2472	0.4510	**0.0735**	0.2776

Residual effect (R) = 0.1483; *, $P<0.05$; ***, $P<0.001$.
Bold figures denote direct effect.

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