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EFFECT OF BORON ON THE YIELD AND CRUDE PROTEIN CONTENT OF WHEAT (Triticum aestivum L.)

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Abstract. The effect of boron on 1000 kernel weight, yield of grain and crude protein content of wheat (cultivar' Tarnab-70') was studied on clay loam soil of pH 8.1 at Peshawar during the two year period of 1975-77. It was found that all the three parameters were significantly affected by boron application. Two kg of boron per hactare resulted in maximum grain yield and crude protein per unit area.

Introduction

Wheat *(Triticum aestivum* L.*)* is a major food crop and an economical source of protein and calories. It is a staple diet of the people of Pakistan. In order to overcome food scarcity and malnutrition problems in the country, production of the wheat crop must be increased per unit area. The use of commercial fertilizers is very common and is one of the best means of increasing yield of the crop. The importance of nutrients other than the major fertilizer elements (N,P and K) has been recognized.[4] Boron is one of the most noteworthy of the so-called 'Trace Elements'. Its role in crop production has been pointed out by many investigators.[8,17] The deficiency of boron in our soil is expected and may be attributed to the use of high purity fertilizer, less use of manures, continuous and intensive cropping and to the high yielding genotypes which may require more boron than the older cultivars.

It has been reported that the yield and protein content of wheat grain can be improved by boron application.[2,6,9,13] Latif *et al.*[10] recorded the response of wheat to boron application in four field experiments at Punjab. The requirement, utilization, and availability of boron varies, depending upon the soil and climatic conditions and the crop cultivar.[3] No work has been done regarding the response of wheat to boron application in the North West Frontier Province. The present investigation was undertaken to study the effect of boron on the yield and protein content of wheat (cultivar 'Tarnab-70') under irrigated conditions of Peshawar region.

Material and Methods

Field experiments were conducted at Agriculture Research Institute Tarnab (Peshawar) for two successive seasons during the years 1975-76 and 1976-77. The soil was clay loam with a pH value of 8.1 and alluvial in nature. The total boron content of the soil as determined by the method[5] was 125 ppm. A basal dose of 120 kg of nitrogen, 80 kg of P_2O_5 and 50 kg K_2O per hactare in the form of urea, superphosphate and potassium sulphate, respectively was applied to the soil surface and incorporated with the final ploughing.

A randomized block design was used for the field layout. Boron in the form of borax (sodium tetraborate) which contains 10.6% boron[15], was applied at the rate of zero, one, two and three kg per hactare. These doses were thoroughly incorporated in the soil prior to planting. Each treatment was replicated four times in both years. Wheat was sown on each sub-plot of 6 x 3 meter in size, out of which a net plot of 5.4 x 2.4 meter was harvested for yield evaluation. One thousand grains from each treatment were randomly collected for seed weight determination.

Oven dried samples of wheat grain were finely ground

and analysed for nitrogen content by the micro-Kjeldhal method of A.O.A.C.[1] Crude protein content of the grains was calculated by multiplying the nitrogen content by 5.71. The results were statistically analysed by the method of Paterson.[11]

Results and Discussion

Treatment evaluation (Table 1) indicate that 1000 kernel weights of wheat were significantly ($P > 0.1$) increased by boron application. The increased over control was maximum with 2 kg boron/ha. The higher dose (3 kg/ha) showed a trend for a decrease in 1000 grain weight when compared to the lower dose (2 kg/ha), although this decrease was not statistically significant, this can be expected according to the law of diminishing return. Significant difference ($P > 0.1$) between the year means was found. However, the treatment X year interaction was non-significant at either levels of probability, which indicate that the treatments had maintained the same relative position in both the years.

TABLE 1. EFFECT OF BORON ON THE 1000 KERNEL WEIGHT OF WHEAT.

Treatment	1000 kernel weight (g)			% increase over control
	1975-76	1976-77	Means*	
B_0 (Control)	40.60	39.42	40.01^{A}	–
B_1 (1 kg/ha)	41.74	41.06	41.40^{B}	3.47
B_2 (2 kg/ha)	43.24	42.62	42.93^{Ca}	7.30
B_3 (3 kg/ha)	42.60	41.44	42.02^{Ca}	5.02
*Mean:	42.05^{A}	41.14^{B}	41.60	–

*Means followed by the same letters are not significant. Capital letters indicate the difference at 1% while small letters at 5% level of probability.
Interaction: Treatment X year was not significant at either level of probability.

The yield of grain (Table 2) was significantly ($P > 0.1$) increased over control by all levels of boron application. Lowest yield was recorded in control and the highest with 2 kg boron/ha. This shows that the increase in grain yeild was in concert with the increase in 1000 kernel weight. Year means were significantly ($P > 0.1$) different than one another. The 1975-76 season was better than 1976-77 for wheat crop. The treatment X year interaction with respect to the grain yield was non-significant at both levels of significance. These results are in agreement to those of Agaev[2], Latif *et al.*[10] and Ryakhovskaya *et al*·[13] who also found that boron application increased the yeild of wheat grain.

TABLE 2. EFFECT OF DIFFERENT LEVELS OF BORON ON THE YIELD OF WHEAT.

Treatment	Yield of grain (kg/ha)			% increase over control
	1975-76	1976-77	Mean*	
B_0 (Control)	3694	3372	3533^{A}	–
B_1 (1 kg/ha)	4268	3980	4124^{Bb}	16.73
B_2 (2 kg/ha)	4582	4320	4451^{Bb}	25.98
B_3 (3 kg/ha)	4263	4027	4145^{Bb}	17.32
*Mean	4202^{A}	3925^{B}	4064	

*Means followed by the same letters are not significant. Capital letters indicate the difference at 1% while small letters at 5% level of probability.
Interaction: Treatment X year was not significant at either levels of probability.

It has been reported[16] that boron deficiency in wheat result minute chlorotic spots on older leaves which later develop an orange tint. These enlarge and coalesce to form large irregular areas of bright orange yellow colour in the middle lamina. Orange yellow spots appear on the middle leaves and the young leaves become stiff and upright. In other cases boron deficiency cause pale green and twisted appearance of the leaves or the death of the young leaves.[15] In the present investigation, the positive yield response to applied boron indicate the deficiency of available boron in the soil for wheat. However, no visible deficiency symptoms was observed. The general appearance of the crop in control and in boron treatment was almost the same. This suggests that in case of wheat boron deficiency can occur with regard to yield without showing any visible deficiency symptoms. These observations are in confirmity with those of Gupta[7] who also recorded boron deficiency in many soils with respect to the yield without observing any visible deficiency symptoms in case of barley.

The protein percentage (Table 3) of grain was significantly ($P > 0.5$) increased over control by 2 and 3 kg boron per hactare, while the increase by 1 kg boron was not significant at either levels of probability. Significant

TABLE 3. EFFECT OF VARIOUS DOSES OF BORON ON THE CRUDE PROTEIN CONTENT OF WHEAT GRAIN.

Treatment	Protein percentage			% increase over control	Protein (Kg/ha)
	1975-76	1976-77	Mean*		
B_0 (Control)	11.86	12.54	12.20^{Aa}	–	431
B_1 (1 kg/ha)	12.40	12.82	12.61^{Ab}	3.36	520
B_2 (2 kg/ha)	12.80	13.06	12.93^{Ab}	5.98	576
B_3 (3 kg/ha)	13.06	13.30	13.18^{Ab}	8.03	546
*Mean:	12.53^{A}	12.93^{B}	12.73		518

*Means followed by the same letters are not significant. Capital letters indicate the difference at 1% B level while the small letters at 5% level of probability. Interaction: Treatment X year was significant at 5% level of significance.

differences ($P>0.1$) between the year means existed. The protein content of grain of the treatments in 1975-76 was low as compared to the treatments of the next year. This may be due to excessive rainfall or plenty supply of water in the year 1975-76 which resulted higher yield and lower protein percentage of the grain.[12] The year X treatment interaction was significant at 5% level of probability.

Dani *et al.*[6] and Kurguzav[9] also observed an increase in the protein content of wheat grain due to boron application. The increase in the protein content was expected as boron is believed to be necessary for protein synthesis.[16] Also protein degradation has been reported in boron deficient plants.[14]

Though the highest protein percentage was recorded with 3 kg boron per hactare, the per unit area yield of protein was maximum with a dose of 2 kg boron per hactare. Based on the findings of this two year study, it is suggested that 2 kg per hactare of boron should be added to the basal dose of fertilizer in Peshawar area. This rate of application should increase the per hactare yield and crude protein content of wheat grain. However, in order to have confirm results more data is needed in this regard, so that a proper boron dose can be recommended for maximum yield return of wheat crop.

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