**Evaluation of Boron Levels for Improving the Growth and Yield of Wheat Crop (*Triticumaestivum* L.)**

**Abstract**

The experiment comprising of six levels of boron, *i.e*., 0, 0.5, 1.0, 1.5, 2.0 and 2.5 kg ha-1 was conducted to investigate the effect of different level of boron on growth and yield of wheat [*Triticumaestivum*(L.)] cv. HUW 234. The treatments were laid out in randomized block design with three replications. The results revealed that plant height, tillers plant-1, Ear length (cm), Fertile spikelets ear-1, Grains ear head-1 and 1000 seed weight, were increased significantly up to 2.0 kg ha-1boron. Maximum plant height was recorded with T4 (2.0 kg B ha-1) and was at par with T5 (2.5 kg B ha-1).T4 and T5 were significantly superior over lower doses and control. Thus, effect of boron was significant for all the growth and yield attributing parameters.

**Keyword:** *Boron level, Plant height, Tillers, Test weight, Ear length*

**Introduction**

Among cereals wheat (*Triticumaestivum*L.) is the most widely cultivated crops of the world and in India it is the second important crop after rice (*Oryza sativa* L*.*) in acreage and production. India is the 2ndlargest producer of wheat in the world having area of 341.57 hectare with production of 93.90 million tonnes and productivity 3.37 tonns ha-1 (PIB, 2023). It has proved to be the most potent crop in breaking stagnation in food grain production. It is rather most important crop which has the potentiality to provide food security for all. In fact, it is increase in wheat production that led down the foundation of green revolution in India in general and Uttar Pradesh particular. In order to steep up food production in India at present, the best way is to explore possibilities of increasing and maintaining wheat productivity. Micronutrients have an important role in increasing in crop production in modern agriculture (Singh *et al.,* 2021; Panhwar*et al*., 2011). At several places normal yield of crops could not be achieved despite, judicious application of NPK fertilizers due to micronutrients deficiency in the soil. In to come, the deficiency problem of micronutrients will go on intensifying because the land has to be cultivated more intensively to produce extra food to meet the requirement of bourgeoning population (Shukla *et al*., 2012). Hence, there is great need to have regular monitoring of micronutrient through soil and plant analysis for sustaining the crop productivity.

Boron (B) is one of the seven essential micronutrients required for normal growth and development of plants. Currently B has emerged as second limiting micronutrient after zinc because the spectacular response have been, noticed on several crops e.g. the problem of non-setting of grains in spike of wheat, sparse flowering and fruiting in chickpea and other pulses crops (Muhammad *et al*., 2020). Browning and rotting of cauliflower curds, heart rot of sugar beet and premature fruit drop in litchi and coconut have been reported to be solved by its application (Takkar and Randhawa, 1978) resulting in appreciable enhancement in crop yields. Boron performs a number of important functions in plants. It is known to be required for proper development and differentiation of tissues particularly in growing tips. It enhances cell division and helps in the growth and germination of pollen grains and also the development of pollen tubes, facilitating fertilization in plants and seed formation. It also helps in sugar translocation by forming sugar borate complex which pass more rapidly through cell membrane than do free sugars (Prasad *et al.*, 2014). Its inadequacy is often associated with sterility and malformation of reproductive organs.Keeping in view the above facts, the present study was carried out to investigate the effects of different levelof boron on growth and yield of wheat.

**Material and Methods**

This experimental study was conducted at Research farm of the department of Agricultural Chemistry and Soil Science, UdaiPratap Autonomous College, Varanasi, India during *rabi* season of 2012-13. The soil of experimental plot was sandy loam and having high calcium carbonate ranges from 20-25%. The soil was medium in organic carbon (0.54%) and contained 214.8, 16 and 130 kg ha-1 available nitrogen, phosphorus and potassium, respectively and pH 7.6 and EC 0.29 dSm-1. The experiment comprised with six treatments viz. 0.0, 0.5, 1.0, 1.5, 2.0 and 2.5 kg B ha-1. The crop in all treatment received uniform application of 120:80:60, N:P2O5:K2­O kg ha-1 except in T0 (absolute control). The variety Malviya (HUW 234) was sown in mid of December with a spacing of 20×10 cm using 100 kg ha-1 seed. In order to achieve the recommended dose of nitrogen, phosphorus, potassium and boron as per treatment were applied. Half of the dose of required N, full doses of P and K were applied as basal. At the same time the boron was also applied in soil. Remaining half of N was applied in two equal splits at tillering and panicle initiation stages. For crop studies, five selected plants were tagged for taking observations of growth and yield parameters of wheat. The results were analysed as per statistically standardized principle of ANOVA technique described by Gomez and Gomez (1984) at 5% level of significance.

**Result and Discussion:**

A perusal of data (Table 1 and Fig.1) revealed that plant height at 30 DAS under various treatments ranged from 17.33 to 21.63 cm. Application of recommended dose of N,P and K with various levels of boron showed significant superiority over to (no nutrient application) treatment. However, level of boron showed no significant difference on plant height of wheat between the level of boron.The data indicates that plant height at 60 DAS under various treatments ranged from 30.58 to 56.07 cm. Increasing levels of boron significantly influenced the plant height. Significantly higher plant height has been noticed with T4 which was at par to T5. Similar results have also been recorded at 90 DAS stage due to different levels of boron application. Pachauri *et al*. (2024) also reported that application of B @ 2 kg per ha-1 produced higher crop growth rate and net assimilation rate. Similar achievements have also been reported by Khan *et al.* (2011) and Mete *et al*. (2005).

**Table 1:** Effect of different treatments on plant height and tillers plant-1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Plant height (cm)** | | | **Tillers plant-1** | | |
| **30 DAS** | **60 DAS** | **90 DAS** | **30 DAS** | **60 DAS** | **90 DAS** |
| **T0** | 17.33 | 30.58 | 50.63 | 1.97 | 3.85 | 5.35 |
| **T1** | 21.37 | 50.03 | 80.50 | 3.46 | 5.15 | 6.63 |
| **T2** | 21.60 | 52.53 | 82.63 | 3.55 | 6.76 | 8.25 |
| **T3** | 21.53 | 53.67 | 84.17 | 3.65 | 8.23 | 9.73 |
| **T4** | 21.40 | 56.33 | 87.46 | 3.83 | 9.88 | 11.18 |
| **T5** | 21.63 | 56.07 | 86.83 | 3.73 | 10.23 | 10.93 |
| **SEm** | 0.39 | 0.55 | 0.55 | 0.16 | 0.31 | 0.26 |
| **CD** | 1.24 | 1.74 | 1.76 | 0.52 | 0.99 | 0.80 |

**Note:** T0= Control (no input), T1= B @ 0.5 kg ha­-1, T2= B @ 1.0 kg ha­-1, T3= B @ 1.5 kg ha­-1, T4= B @ 2.0 kg ha­-1, T5= B @ 2.5 kg ha­-1

A favourable and positive effect was found due to application of boron levels with the recommended dose of nitrogen, phosphorous and potassium on the number of tillers at different growth stages of wheat crop. At 30 DAS maximum numbers of tillers per plant were recorded with T4 (3.83) which were statistically at par to different levels of boron application. However, T0 (absolutely control) recorded significantly lower tillers per plant at this stage. At 60 and 90 DAS maximum number of tillers was noticed with T4 (9.88 and 11.18 tillers per plant) respectively, which was statistically at par to T5 and superior to lower levels of boron application. T0 gave significantly lower number of tillers per plant than all other treatments in the experimentation. A similar trend was found with respect of number of ear head m-­2 or number of effective tillers m-­2 at harvest. This finding is in close conformity with the results obtained by the Prabhakar (2002), Mete *et al. (*2005), Khan *et al*. (2011) and Nadim*et al*. (2012).

**Figure 1:** Effect of different treatments on plant height and Tillers per plant

Maximum length of ear head (Table 2 and Fig.2) of wheat (10.63 cm) was recorded with T5 which was at par to T4 (10.50 cm) and both were significantly higher over lower levels of boron application and control (T0). The influence of boron on the fertility of anther and ovary is well recognized. Deficiency of boron results formation of ear head without grain specially in wheat crop. Application of 2 kg and 2.5 kg B ha-1 recorded almost at par number of fertile spicklet per ear head in wheat crop and both were significantly higher than T3, T2, T1 and T0. T0 (absolute control) recorded too significantly poor number of spikelets. The data (table 2) revealed that significantly higher unfertile spikelets were observed with T0 (without nutrient application). After addition of B, starting from lower to higher dose (0.5 to 2.5 kg B ha-1) recorded decreasing trend in unfertile spikelet's and appreciable results have been noticed with T4 (2.0 kg B ha-1) and T5 (2.5 kg B ha-1) application. Commensurating with the grains ear head-1 against boron doses application, significantly lower number of grains ear head-1 was recorded with T0 (20.64) while under different levels of boron application registered magnificently higher number of grain ear head-1 than control (T0). Application of 2 kg B ha-1 (T4) recorded significantly higher grains ear head-1 which was at par with T5 treatment. Maximum 1000 grain weight was recorded with T4. Significantly lower 1000 grain weight was obtained with T0 treatment. All the B levels showed the superiority over T0 (table 2). Significantly higher number of grain spike­-1, 1000 grain weight, biological yield and other characters have been reported by Nadeem*et al.* (2019) and Khan *et al.* (2011) with the application of 2 kg B ha-1 in wheat crop. Ali *et al*. (2009); Rahmatullah*et al.* (2006) observed enhancement of yield component of wheat through foliar application of Zn and B. Thus, these findings support the results of present experimentation with respect of yield attributing characters by the application of B @ 2 kg ha-1 in wheat crop.

**Table 2:** Effect of different treatments on yield attributing character

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Ear length (cm)** | **Fertile spikelets ear-1** | **Unfertile spikelets ear-1** | **Grains ear head-1** | **1000 grain weight** |
| **T0** | 5.24 | 7.90 | 5.90 | 20.64 | 30.20 |
| **T1** | 8.67 | 16.47 | 2.37 | 30.30 | 36.15 |
| **T2** | 9.20 | 16.98 | 1.77 | 31.80 | 36.65 |
| **T3** | 9.60 | 18.58 | 1.17 | 34.07 | 37.15 |
| **T4** | 10.50 | 19.43 | 0.67 | 36.17 | 39.65 |
| **T5** | 10.63 | 19.68 | 0.57 | 36.11 | 39.48 |
| **SEm±** | 0.09 | 0.25 | 0.18 | 0.49 | 0.72 |
| **C.D.** | 0.30 | 0.80 | 0.57 | 1.58 | 2.30 |

**Note:** T0= Control (no input), T1= B @ 0.5 kg ha­-1, T2= B @ 1.0 kg ha­-1, T3= B @ 1.5 kg ha­-1, T4 = B @ 2.0 kg ha­-1, T5= B @ 2.5 kg ha­-1

**Figure 2:** Effect of different treatments on yield attributing character

**Conclusion:**

Based on the result of the field experiment, it can be inferred that application of Boron could improve the growth (plant height, tillers plant-1, Ear length) and yield attributing characteristics in wheat and may be recommended to the farmers for improving growth and yield of wheat.

**References:**

Gomez, K.A. and Gomez, A.A. (1984).Statistical Procedures for Agricultural Research.John wiley and sons.

Pachauri, S.P., Shukla, A.K., Srivastava, P.C., Behara, S.K., Butail, N.P, Thakur, P., Thakur, P., Anjali, Sharma, M., Sharma, P.K., Sahu, A. and Kumar, P. (2024).Effect of boron fertilization on productivity and sustainability of rice-wheat cropping system in Tarai region, North-West India. *Journal of Environmental Management*, *359*, 121084.https://doi.org/10.1016/j.jenvman.2024.121084

Takkar, P.N. and Randhawa, N.S. (1978).Micronutrients in Indian Agriculture (A review).*Fertilizer News****,*** 23, 8-26.

Khan, R.U., Gurmani, A.R., Khan, M., Din J. and Gurmani, A. H.(2011).Residual, direct and cumulative effect of boron application on wheat and rice yield under rice wheat system.*Sarhad Journal of Agriculture****,*** 27, 219 - 223

Mete, P.K. Bhattachayay, P., De, M. (2005). Effect of boron and lime on growth and yield of wheat (*Triticumaestivum* L.) in alluvial soils of West Bengal *Journal of Interacademicia*,9, 544 -549.

Manikant, P. (2002). Differential reaction of some wheat genotype to boron stress in calcareous soils. (M.ScThesis ).Department of Soil Science ***RAU, Pusa, Bihar****.*

Nadim, M.A; Awan, I.V, Baloch, M.S., Khan,E.A., Naveed, K. and Khan, M.A.(2012). Response of wheat (*Triticumaestivum* L.)to different micronutrients and their application method. *The Journal of Animal and Plant Sciences****,*** 22, 113-119.

Nadeem, F., Farooq, M., Nawaz, A., and Ahmad, R. (2019). Boron improves productivity and profitability of bread wheat under zero and plough tillage on alkaline calcareous soil. *Field Crops Research*, *239*, 1-9.

Ali, S.,  [Shah, A., Arif,M.,](http://agris.fao.org/?query=%2Bauthor:%22Shah,%20A.%22) [Miraj, G.](http://agris.fao.org/?query=%2Bauthor:%22Miraj,%20G.%22),  [Ali, I.,](http://agris.fao.org/?query=%2Bauthor:%22Ali,%20I.%22) [Sajjad, M.,](http://agris.fao.org/?query=%2Bauthor:%22Sajjad,%20M.%22) [Farhatullah,](http://agris.fao.org/?query=%2Bauthor:%22Farhatullah%22) [M.Y. Khan and](http://agris.fao.org/?query=%2Bauthor:%22Khan,%20M.Y.%22)Khan, N.M. (2009). Enhancement of wheat grain yield and yield components through foliar application of zinc and boron.*Sarhad Journal of Agriculture***,** 25, 15-19.

Singh, A., Shahi, U.P., Dhyani, B.P., Kumar, A., Kumar, S., Vivek and Kumar, A. (2021).Response of bread wheat and nutrient removal with new micronutrient molecules fertilization.*Indian Journal of Agricultural Sciences*, 91(5): 708– 712.

Rahmatullah, K., Gurmani, A.H., Gurmani, A.R. and Zia, M.S. (2006).Effect of Boron Application on Rice Yield under Wheat Rice System.*International Journal of Agriculture & Biology*, 1560-8530/2006/08-6-805-808.

Panhwar, Q.A1.,Radziah, O., Khanif, Y.M. and Naher, U.A. (2011). Application of boron and zinc in the tropical soils and its effect on maize (*Zea mays*) growth and soil microbial environment.*Australian Journal of Crop Science,* 5(12): 1,649– 1,654

PIB (2023). Final estimates of production of major crops released for the year 2022–23. Ministry of Agriculture & Farmers Welfare Release ID: 1968931

Prasad, R., Kumar D., Shivay, Y.S. and Rana, D.S. (2014).Boron in Agriculture–A Review.*Indian Journal of Agronomy* 59(4): 511–517.

Muhammad, S., Tahir, A.M., Ahmad, T. and Tahir, M.N. (2020). Foliar application of boron improved the yield and quality of wheat (*Triticumaestivum* L.) in a calcareous field. *Soil Environment*, 39(1): 59–66.

Shukla, A.K., Behera, S.K., Shivay, Y.S., Singh, Pooja and Singh, A.K. (2012). Micronutrients and field crop production in India: A review. *Indian Journal of Agronomy*, 57(3): 123–130.