BORON APPLICATION USING OPTIMIZING DOSE AND TIME THROUGH FOLIAR APPLICATION FOR ENHANCING YIELD OF WHEAT

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ABSTRACT: *Boron is one of the essential elements for plant growth and development. Foliar application provides micronutrients to the soil and advances the phenological processes. The present experiment was placed on different boron treatments applied on the cultivated wheat variety Hamal to evaluate the effect of boron fertilizer on yield and on its associated traits. The field study was conducted at Agronomy Section, ARI, Tando Jam during Rabi season 2014-15 with three replications having RCBD design. The treatments consisted of: No Boron (Control), Boron 0.2%: Tillering stage, Boron 0.3%: Tillering stage, Boron 0.2%: Booting stage, Boron 0.3%: Tillering stage, Boron 0.2%: Tillering stage+0.2%:Booting stage, Boron 0.3%: Tillering stage+0.3%: Booting stage. The analysis of variances indicated that foliar application of Boron fertilizer at different time and rates exerted significant (P<0.05) positive effects on growth and yield traits of wheat as compared to control. The result showed Boron 0.3%: Tillering stage+0.3%: Booting stage gave maximum tillers (401.4 m^{-2}), plant height (103.8 cm), number of grains $spike^{-1}$ (41.8), and grain yield (4745 kg ha^{-1}), closely followed by Boron 0.2%: Tillering stage+0.2%: Booting stage with 399.4 m^{-2} tillers m^{-2}, plant height (102.3 cm), grains $spike^{-1}$ (41.7) and grain yield (4669 kg ha^{-1}). Boron 0.3%: Tillering stage, Boron 0.2%: Booting stage, Boron 0.2%: Booting stage, Boron 0.2%: Tillering stage ranked 5^{th}, 4^{th}, 3^{rd} and 2^{nd} in their efficacy particularly grain yield (4529, 4395, 4279 and 4170, respectively). However, No Boron (Control) resulted in minimum tillers m^{-2} (382.3 m^{-2}), plant height (94.1 cm), and grains $spike^{-1}$ (33.9). Moreover, statistically the differences among Boron 0.3%: Tillering stage, Boron 0.2%: Tillering stage+0.2%: Booting stage, Boron 0.3%: Tillering stage+0.3%: Booting stage were non-significant. Hence Boron 0.3%: Tillering stage proved most suitable treatment for obtaining optimum yield of wheat under agro-ecological conditions of Tando Jam.*

Keywords: Boron, tillering stage, booting stage, wheat, foliar application

INTRODUCTION

Food security is one of the main issues in the modern area throughout the world [1]. It can only be achieved by increasing crop productivity; the (*Triticum aestivum* L.) is an important cereal crop as a source of staple food and thus the most important crop in food security.It's share 10.1 percent to the value added in agriculture, 2.2 percent to GDP and was cultivated on an area of 8.693 million hectares during 2012-13 [2]. It has the largest acreage of any crop, which is grown on 38% of all the cultivated area; constitutes 60 percent of the average daily diet of the common man with average per capita consumption of 125 kg [3] . yields in Pakistan can be improved by developing new high yielding varieties and adoption of proper package of technology [4]. The production of cereal stood at 25.286 million lots during 2013-14 against 24.211 million piles endmost year display 4.4 percent gain; while the earn ha^{-1} in 2013-14 remained 2797 kg. The amount of need form it is greater than the locally cultivars. Therefore, getting the maximum productivity as well as cultivated highly recommended the require the specific doses of the certain nutrients in different form at a properly time, for the batter growth and production [5] .As we know that the macro-micronutrients is the most important for batter growth and yield. Thesenutrients are added to the soil, their availability will be affected by the soil environmental factors. Nitrogen (N), phosphorus (P) and potassium (K), these are primary essential nutrient, have prime importance in crop nutrition. N is the concentration of protein and thus all enzyme, the role of P is involved in almost all biochemical pathways as a part of energy carrier compound. ATP and ADP. Mostly the six micronutrients are require to higher plant population, these have been documented to involved in photosynthesis, N-fixation, respiration and other biochemical pathways. Boron is the most important micronutrient for the plant growth and batter yield and yield components [6] the main role of B as to related that, cell wall formation, nitrogen fixation, sugar transportation, phenol, nucleic acid, membrane stability carbohydrate, indolic acetic acid (IAA) metabolism. Flower retention and pollen formation and germination also are affected by boron. The deficiency of B as affected the reproductive and biomass yield. with low supplement of B is reduced the seed and grain production, and the requirement of B for increase appear is the more reproductive development than for vegetative growth [7] . Foliar application is one of the best method to supply the nutrients, and the foliar supplying of micronutrients is very beneficialfor the batter plant growth, when the root cannot be provide or observed nutrients [8]. The soil pollution would be a major problem for micronutrient soil application because people are concerned with plant leave uptake the nutrient batter as compare to soil application [9]. Several the studies showed that foliar application of micronutrients on wheat crop has had significant positive effect on plant growth and yield components. Therefore, the objective of this study was to investigate the application of foliar fertilizer at different levels of boron on the growth parameters of wheat.

MATERIALS AND METHODS

The present research was conducted at Agronomy Section, Agriculture Research Institute, Tando Jam during season Rabi, 2014-15. The experiment was laid out in a randomized complete block design with three replications. Three different doses supplied in foliar application of boron in the form of Boric acid were used at certain concentrations. The recommended dose of NPK fertilizers through soil was applied as usual in all the experimental units. All P and K alongwith 1/3 of N was supplied at the time of seedling while remaining nitrogen was divided into two equal splits and was applied at booting milky stages. The seedling was done with the help of single line hand source drills speed, Sowing was done by man driven hand drill with plant to plant and row to row distance of 3 cm and 5 cm, respectively. The net plot size of 5m × 3m ($15m^2$). A recommended seed rate of 50 kg ha^{-1} of wheat variety "Hamal" was used. The foliar spray of Boron (a commercial liquid fertilizer for foliar application) was applied as per treatments at tillering stage in addition to the recommended dose of Boron fertilizers.The detail of treatments is given as underT1 = No boron (control),T2 = Boron 0.2%: Tillering stage,T3 = Boron 0.3%: Tillering stage, T4 = Boron 0.2%: Booting stage, T5= Boron 0.3%: Tillering stage, T6 = Boron 0.2%: Tillering stage+0.2%: booting stage, T7 = Boron 0.3%: Tillering stage+0.3%: booting stage. The characters studied werefive competitive plants were chosen randomly from equally spaced plants from in each replicate for observations on plant height (cm), tillers $plant^{-1}$, number of grains $spike^{-1}$and grain yield (kg ha^{-1}).

RESULTS AND DISCUSSIONS

Plant Height (cm)

Data regarding of plant height (cm) are shown in Fig. 1. Analysis of the data revealed that foliar application of boron were significantly ($P<0.05$) effect by different level of Boron fertilizer. To applied the doses of integrated application of boron 0.3%: tillering stage + 0.3%: booting stage produced maximum value of plant height (103.8 cm), were closely followed by foliar application of Boron 0.2%: Tillering stage+0.2%: Booting stage and Boron 0.3%: Tillering stage with 102.3 and 100.0 Plant hight (cm), subsequently. The Plant height declined to 99.3, 97.6, and 96.5 m^{-2} when crop was fertilized with Boron 0.2%: Booting stage, Boron 0.3%: Tillering stage and Boron 0.2%: Tillering stage, respectively. Therefore, the minimum Plant height (94.1 cm) was recorded in No boron (Control). Moreover, the overall results concluded that although numerical maximal Plant height (cm) was recorded in Boron 0.3%: Tillering stage+0.3%: Booting stage but statistically it differed non with Boron 0.2%: Tillering stage+0.2%: Booting stage and Boron 0.3%: Tillering stage. Guenis *et al.*, [12] have also reported significant variations for plant height (cm) for foliar application of boron. Similarly, Kenbaev and Sade [10] reported increase in number of plant height (cm) for application of boron.

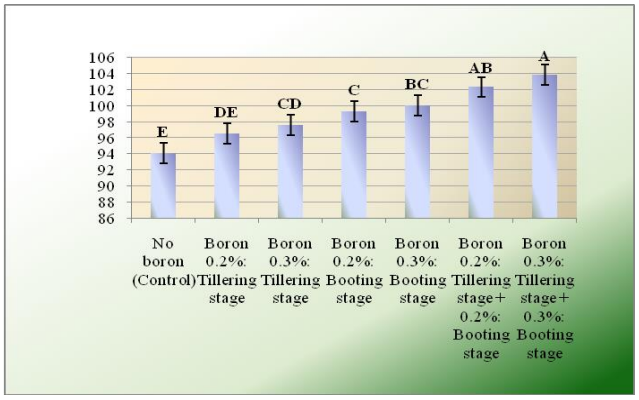

Figure 1. Foliar application of boron for plant height (cm)

Number of tillers m^{-2}

Tillering capacity of a plant depends on the genotype and environment. The data pertaining to number of tillers revealed that micronutrients had significant effect on number of tillers (Table-4). Among various treatments, Boron 0.3%: Tillering Stage+0.3%: Booting Stageproduced maximum tillers (401.4 m^{-2}). It was followed by sole application followed by foliar application of boron 0.2%: tillering stage+0.2%: booting stage and boron 0.3%: tillering stage with 399.6 and 398.4 tillers m^{-2}, subsequently. The tillers declined to 388.0, 386.0, and 384.0 m^{-2} when crop was fertilized with Boron 0.2%: Booting stage, respectively. However, minimum tillers (382.3 m^{-2}) were recorded in no boron (Control). Moreover, the overall results concluded that although numerical maximal tillers m^{-2} were recorded in boron 0.3%: tillering stage+0.3%: booting stage but statistically it differed non with boron 0.2%: tillering stage+0.2%: booting stage and boron 0.3%: tillering stage. Manal *et al.*, [11] obtained increased number of tillers with the foliar application of Boron.

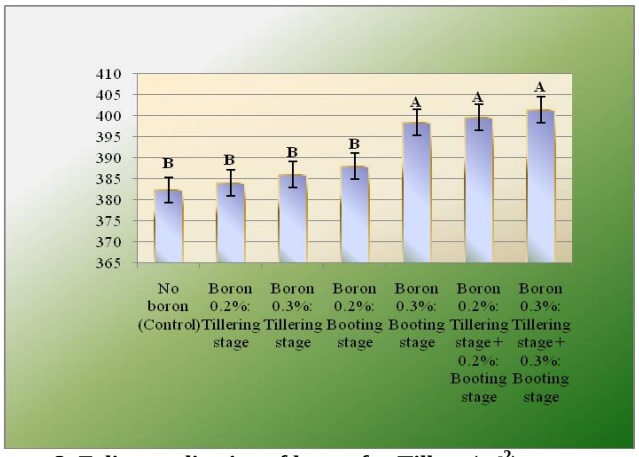

Figure 2. Foliar application of boron for Tillers (m^{-2})

Grain $Spike^{-1}$

Statistical analysis of the data showed that number of grains spike-1 was significantly affected by foliar application of zinc and boron, during both growing seasons (Fig. 2). Highest number of grains spike^{-1}(41.8) was produced by foliar application of Boron 0.2%: Tillering stage+0.2%: Booting stage and were closely followed Boron 0.3%: Tillering stage with 41.7 and 41.3 number of grains spike-1, subsequently. The number of grains spike-1 declined to 40.5, 40.0, and 35.1 m^{-2} when crop was fertilized with Boron 0.2%: Booting stage, Boron 0.3%: Tillering stage and Boron 0.2%: tillering stage, respectively. Therefore, the minimum number of grains spike^{-1}(33.9) was recorded in No boron (Control). Moreover, the overall results concluded that although numerical maximal number of grains spike-1 was recorded in Boron 0.3%: Tillering stage+0.3%: Booting stage but statistically it differed non with Boron 0.2%: Tillering stage+0.2%: Booting stage and Boron 0.3%: Tillering stage. Guenis *et al.*, [12] have also reported significant variations for number of grains spike-1for foliar application of boron. Similarly, Kenbaev and Sade [10] reported increase in number of grains spike-1 for application of boron.

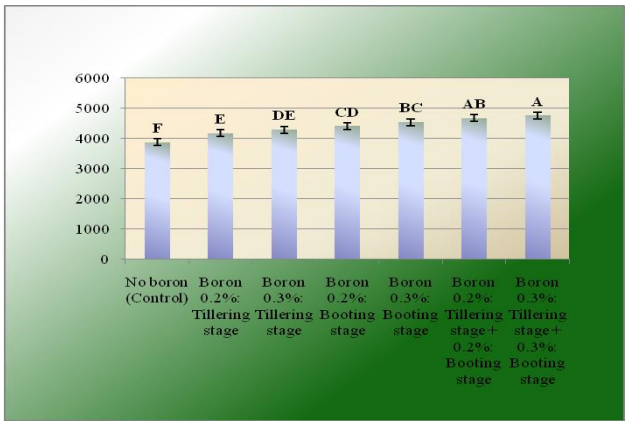

Figure 3. Foliar application of boron for Grain Spike^{-1}

Grain yield (kg ha^{-1})

Data on grain yield indicated significant increase for foliar application Boron over control treatments. Mean grain yields of the treatments during cropping seasons 2015-16 are presented in Fig. 4. Maximum grain yield was recorded in foliar application of Boron 0.3%: Tillering stage+0.3%: Booting stageproduced maximum Grain yield (4745) were closely followed by foliage applied of Boron 0.2%: Tillering stage+0.2%: Booting stage and Boron 0.3%: Tillering stage with 4669 and 4529 Grain yield, respectively. The Grain yield declined to 4395, 4279, and 4170 when crop was fertilized with Boron 0.2%: Booting stage, Boron 0.3%: Tillering stage and Boron 0.2%: Tillering stage, respectively. Recently, none the less Grain yield 3864 was recorded in No boron (Control). Moreover, the overall results conducted that although numerical maximal Grain yield were recorded in Boron 0.3%: Tillering stage+0.3%: Booting stage but statistically it differed non with Boron 0.2%: Tillering stage+0.2%: Booting stage and Boron 0.3%: Tillering stage.These results agree with, Zorita *et al.*, [13], Abedin *et al.*,[14] , and Rerkasem *et al.*, [15] obtained higher yield of wheat with the application

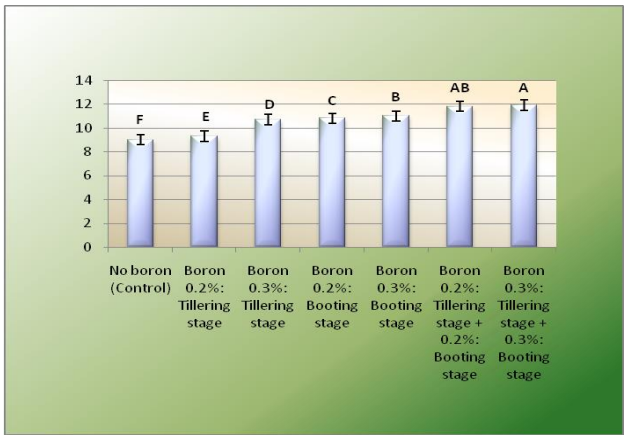

Figure 4. Foliar application of boron for Grain yield (kg ha^{-1})

of B. The results are in accordance with Hussain *et al.*, [16] and Arif *et al.*, [17].

CONCLUSION

It is concluded from the results that all the treatments of boron fertilizer showed positively significant effect on growth and yield of wheat. Foliar application of boron @ 0.2%: tillering stage +0.2% booting stage for achieving optimal grain yield of wheat variety Hamal proved most suitable treatment due to having non-significant (P>0.05) statistical differences with boron 0.3%: tillering stage+0.3%: booting stage.

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