INFLUENCE OF BORON AND ZINC ON THE GROWTH OF CHLLI UNDER THE AGRO CALIMATIC CONDITION OF SWAT

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ABSTRACT

The research entitled "Influence of boron and zinc on the growth of chilli under the agro climatic condition of swat" was carried out at Agriculture Research Institute Mingora (ARI) in summer 2016 in Randomized Complete Block Design (RCBD) having two factors, three replications. First factor was boron levels (0, 1.0, 2.0 and 3.0 Kg ha^{-1}) while other was zinc levels (0, 1.5 and 3.0 Kg per hectares). Foliar spray of boron at vary concentrations significantly influenced all parameters. Maximum days to flowering (40.50), maximum plant height (97.11 cm), number of branches plant per plant (10.01), single fruit weight (5.43 g) and fruit diameter (0.81 cm) were observed by the foliar spray of boron @ of 3 kg per hectares. While with zinc highest days to flowering (40.24), maximum plant height (98.70 cm), number of branches per plant (9.96), number of fruits per plant (113.99), single fruit weight (5.76 g), fruit diameter (0.84 cm), were recorded in the plots to which foliar spray of zinc @ of 3 kg per hectares were sprayed. It is concluded from the results that foliar application of boron and zinc should be used @ of 3 kg per hectares for better and outstanding growth and maximum chilli production of the swat agro-climatic condition.

Keywords: Boron, Zinc and Chilli; Agro agro-climatic condition of swat

Introduction

Chilli (*Capsicum annum* L.) is a important crop of family Solanaceae. Center of origin was Brazil and tropical America and is domesticated from 6000 years. It has 20 species in which four species are in cultivation that is *Capsicum pubescens* and *Capsicum pendulum* are rarely grown in South and Central America while *Capsicum annum* and *Capsicum frutescens* are grown all over the worldwide (Bhuvaneswari *et al*., 2013). It is grown as a cash crop on commercial level in Pakistan (Anonymous, 2000). The total area under chilli cultivation are 4.26 million ha in the world with total production of 34.5 million tons (FAO Statistics 2018). It is third most growing vegetable after tomato and potato (Naz *et al*., 2006). It is a good source of nutritive values and, also uses in many medicinal goods and have plenty of medicinal properties

(Chowdhury, 2005). Gren chillies is a rich source of vitamin C and A and traces of starch in done in the seed contain (Saimbhi et al., 2006) Due to its appealing color it is used in curry (Udoh *et al.*, 2005). Zinc is one of the most important micronutrient which is very necessary for the development, growth and physiological function of plant and also involved in the formation indole acetic acid, enzymatic reactions and a number of enzymes, i.e. dehydrogenase, aldolase, isomerases, proteinase, peptidase and phosphohydrolase (Mousavi, 2011). Zinc enhances the fruit set and increases the number of flowers. However excessive application of zinc can adversely affect the ionic homeostatic system which interferes with the uptake, transport and osmotic regulation of essential ions leading to disruption of normal metabolic processes such as photosynthesis, transpiration and enzymatic activities related to metabolism (Sainju *et al*., 2003). Zinc promotes yield, due to its role in carbonic enzyme, in the biosynthesis particularly in chlorophyll (Ali *et al*., 2008). Zinc also serves as co-factor or functional element of different enzymes associated with Carbohydrate metabolism, auxin metabolism, formation of anther, pathogens resistance (Alloway *et al*., 2008). Based on the importance of zinc and boron in plant growth and physiological functions the current experiment was design to elevate the best levels of zinc and boron for improving yield and yield components of chilli. Micronutrient such as boron is the important elements with specific and essential physiological functions in plants; required in small quantities for normal growth and development. The most important micro-nutrient are boron which is the vital for carbohydrate metabolism, nitrogen and cell division as well as help in the water relation of plant growth (Brady, 1990). The response of different crops to boron application has been studied extensively (Smriti *et al*., 2002). Boron plays an important role in cell wall synthesis and structure, membrane stability, growth and development of new cells in plants meristems (Goldbach *et al*., 2001). It improves the lowering, fruit sets, fruit formation and fruit quality (Rawaa *et al*., 2014). Reproductive organs are developed by boron (Huang *et al*., 2000). Boron increases the yield of fruits (Nabi *et al*., 2006). Translocation of sugar, starches, nitrogen, phosphorus, synthesis of amino acids and proteins are also influenced by boron (Rawaa *et al*., 2014). Due to its appealing color it is used in curry (Udoh *et al.*, 2005). The most important micro- nutrient are boron which is the vital for carbohydrate metabolism, nitrogen and cell division as well as help in the water relation of plant growth (Brady, 1990). The response of different crops to boron application has been studied extensively (Smriti *et al*., 2002).

Materials and Methods

Research experiment was performed at the Agriculture Research Institute (North) Mingora Swat in the summer season (2016) to evaluate the result of Zn and B levels on growth and yield of Chilli crop. The trial was designed on RCBD with factorial arrangement which have replicated three times. Total plot area was 9 m^2. Distance was 60 cm kept row to row whereas plant to plant distance were kept 30 cm. First sowing was done in the first week of May for seedling of Jawala cultivar of chilli and then transplanted intofield in the mid of June. In the experiment Zinc Sulphate and Boric Acid was used as a source of zinc and boron. For all treatments all other standards practices were taken uniformly.

The levels for Boron and Zinc were

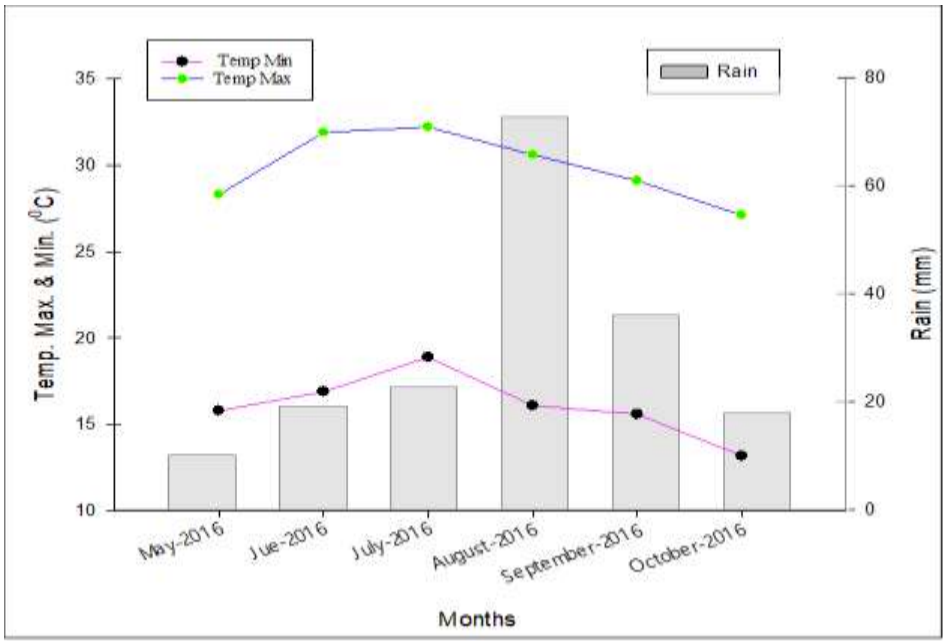
Factor A: Boron levels (kg ha^{-1})	**Factor B: Zinc levels (kg ha^{-1})**
Control (0), 1.0, 2.0, 3.0	Control (0), 1.5, 3

Land preparation

The field was prepared first, then the plats are shifted from nursery to open field. Then we applied NPK fertilizer at recommended rate of 50:25:25 kg per hectares, then for equal water irrigation ploughing of soil is done. Before transplanting the plants in to field split dose of Nitrogen and full dosses of P and K were given at recommended rate. The treatments combination was applied in the whole field. Uniform height of seedling were transplanted and the field was irrigated. All cultural practices were uniformly performed at proper time.

Statistical analysis

Statistical analysis was carried out through computer software Statistic package 8.1 as prescribed by Jindal Scientific (1991) and by using LSD at 0.5(%) level of probability and the Means was evaluated using LSD test and orthogonal differences was used.



Results and Discussion

In this study we found that foliar application of zinc and boron significantly affected all the studied attributes. Where the interactive effect was found non-significant for zinc and boron.

Days to flowering

Mean table showed that highest number of days to flowering (40.50 days) were observed in plots, which received 3.0 kg ha^{-1} boron spray, while minimum number of days to flowering (35.90) were noted in control plots. (Table 1). In case of foliar application of zinc, highest days to flowering (40.24) were noted in plots which were sprayed with $ZnS0_4$ foliar spray @ 3.0 kg per hectares while less days to flowering (36.61 days) were noted in untreated plots.

Flowering in chilli was delayed due to the high concentration of zinc and boron foliar application because these nutrients are related to the better plant growth. The application of micronutrient might have helped for better vegetative growth resulted delayed flowering. The application of micronutrients might have help for better vegetative growth resulted delayed flowering. When the crop growth is wearker it's resulted in early initiation of flower. The crop treated with high level of B as well as Zn resulted earlier flowering. Same results were obtained by kalroo *et al*. (2014). These results also supported the work of Satpute *et al*. (2013) who had a significant effect on number of days flowering.

Plant height (cm)

The data showed that among foliar application of boron maximum plant height (97.11 cm) was noted in plots treated with foliar application @ 3.0 kg ha^{-1} followed by (93.97 cm) in plots treated with foliar application @ 2.0 kg ha^{-1}, whereas minimum plant height (89.14 cm) was observed in in control plots (Table 1). With the treatments of zinc foliar spray, maximum plant height (98.70 cm) was observed in plots treated with zinc @ 3.0 kg ha^{-1} sprayed, while the minimum plant height (87.76 cm) was noted with no spray (Table 1).

The resulted heighted chilli plants as a result of boron and zinc foliar application could be due to the reason that zinc helps in synthesis of auxin and boron helps in cell differentiation and cell elongation of plants. The increase in height of plant might be due to effective role of micronutrients. Zinc play an important role in growth because it is precursor of IAA by which it stimulates the growth in plant tissues. In the presence of zinc active synthesis of tryptophan, and amino acid beside the zinc, boron has also a necessary role in the plant for the growth and development of new cells. For synthesis of amino acids and protein boron is very necessary for plants also help in regulation of metabolism and carbohydrate (Dyar and Webb, 2000). It helps in photosynthesis which might have resulted in better vegetative growth. These results confirm the findings reported by Hatwar *et al.* (2003). The results are in partial agreement with the findings of kiran *et al.* (2010). Our findings are also in lined with the results of Singh and Tiwari (2013), who stated tomato crop height effected by the foliar spray of various micronutrients. By the application of various levels and various types of nutrients tomato height changes from 122.0 to 137.0 cm ranged (Davis, 2003).

Number of branches $plant^{-1}$

Regarding the foliar application of boron, maximum numbers of branches (10.01) were recorded where boron spray at the rate of 3 kg ha^{-1} was applied to plots, while minimum numbers of branches (7.42) were noted in untreated plots (Table 1). Applying zinc treatment, maximize the number of branches $plant^{-1}$ (9.96) were noted where 3 kg ha^{-1} spray of zinc was applied, while lowest number of branches per plant (7.52) were noted in plants which were not sprayed (Table 1).

Application of zinc and boron as a foliar spray had significant influence on the number of branches $plant^{-1}$ as mentioned by Denre *et al*. (2014) also who reported that zinc and boron also help in

meristematic growth of plants. By the foliar spray of boron, the significant increase was noted in branches. When plant height is good it develops maximum branches, our findings are also related with the study of Basavarajeshwar *et al*. (2008). Our results are also same with the research of Bose and Tripathi (1996) who concluded tomato cultivars Pusa Ruby have maximum branches with the treatments of boron and zinc also said that tomato crop maximizes the branches when boron is applied at high dose as compared to lower dose. The similar results were reported by Malawadi (2003) by treating the chilli seedlings with micro nutrients. Hatwar *et al.* (2003) also reported that the combined spraying of zinc, boron along with recommended dose of NPK caused maximum number of branches per plant.

Fruit diameter (cm)

The research work resulted that highest fruit diameter ((0.81 cm) were noted in plants treated with the application of boron @ 3 kg ha^{-1} while the minimum fruit diameter (0.59 cm) was noted in un sprayed plants (Table 1). In case of zinc application, maximum fruit diameter (0.84 cm) was obtained when zinc was sprayed @ 3 kg ha^{-1} while the minimum fruit diameter (0.60 cm) was noted in unsprayed plants (Table 1).

The increase in fruit length and frit dimeter might be due to more accumulation of photosynthates which were synthesized in the leaf and translocated towards the fruit. The increased in accumulation of photosynthesis was probably due to more vigour growth Trehan and Gre wal (2007). This result is also agreement Wojcik and Wojcik (2003) and (Khayyat *et al. (2007*) who reported that fruit dimeter was significantly increased by zinc and boron treatment improved the no. and size of cell. This result is also supported by the work done by Ali *et al.* (2015) reported the combined foliar spray of boron and zinc nutrients improved fruit dimeter and summer tomato. These results confirmed the findings of Kiran *et al.* (2010), Mohsen (2013) and Yadav *et al.* (2003) who also reported increased fruit size with increasing rates of micronutrients.

Single fruit weight (g)

Mean table resulted the highest single weight of fruit (5.43 g) were obtained in plants where boron @ 3 kg ha^{-1} was applied, while lowest single weight of fruit (3.96 g) were noted as control. (Table 1). When zinc application is applied it resulted, highest single weight of fruit (5.76 g), were noted in plants sprayed with foliar application of zinc @ 3 kg per hectare, and lowest single weight of fruit (4.06 g) were noted in un-sprayed plants (Table 1).

The crop of chilli has adversely affected by zinc and boron applied as a foliar spray because cells division and expansion is caused due to the application of boron and zinc. Boron and zinc foliar spray also improved inter cellular space between mesocarpic cells and, also source and sink process occur easily (Brahmachari *et al.* (2001). Effect of zinc, which is necessary for the carbonic enzyme that is present in all photosynthetic tissues, and needed for chlorophyll biosynthesis, thus increased the translocation of photosynthetic assimilates in fruits (Ali *et al.* (2008). Sindhu *et al.* (1999) found the results that weight of fruit maximize by the treatments of boron and zinc applied as foliar. Boron also maximize the photosynthates which promote fruit weight (Shukha, (2011). B and Zn also help in the preparing of tryptophan that is amino acids which help in the biosynthesis of proteins and auxin that is a plant growth regulator which result in the improving of fruit growth (Wojcik and Wojcik, (2003). (Abdollahi *et al.* (2010) reported that higher fresh weight of fruits per plant were noted in strawberry with the foliar spray of 100 ppm of ZnSo4, which is two and half times lesser than the level used in this study. Similar findings were documented in chilli by (Kalroo *et al.* (2014), is reported by the previous author, yadav *et al*. (2001) and Sivaiah. (2013), who reported that the improvement in the weight of fruit as because of the best effected used of zinc and boron. The size and weight of fruit improved by zinc and boron foliar spray because it is associated equally in the improvement of photosynthesis.

Table 1. Days to flowering, plant height (cm), Number of branches plant^{-1}, Fruit diameter (cm), Single fruit weight (g) of chilli as affected by zinc and boron application.

Boron kg ha^{-1}	PARAMETERS				
	Days to flowering	plant height (cm)	Number of branches plant^{-1}	Fruit diameter (cm)	Single fruit weight (g)
0	35.90 c	89.14 c	7.42 c	0.59 c	3.96 c
1.0	37.92 b	91.41 bc	8.62 bc	0.68 b	4.70 b
2.0	38.63 b	93.97 ab	8.75 b	0.75 b	4.98 b
3.0	40.50 a	97.11 a	10.01 a	0.81 a	5.43 a
LSD (P≤0.05)	1.08	3.78	1.22	0.065	0.443
Zinc kg ha^{-1}					
0	36.61 c	87.76 c	7.52 c	0.60 c	4.06 c
1.5	37.86 b	92.27 b	8.62 b	0.69 b	4.49 b
3.0	40.24 a	98.70 a	9.96 a	0.84 a	5.76 a
LSD (P≤0.05)	0.94	3.27	1.057	0.056	0.383
Interaction (Zn× B)	ns	ns	ns	ns	ns

Conclusion and Recommendations

It was concluded that foliar application of zinc and boron @ of 3 kg per hectare resulted better performance in terms of growth and production of chilli crop in Swat Khyber Pkhtunkhwa.

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