Research Article

Effect of zinc and boron on the growth and yield of chilli under the agro climatic condition of Swat

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Abstract

The present study entitled “effect zinc and boron on the growth and yield of chilli” was carried out at Agriculture Research Institute Mingora (ARI) Swat in summer 2016 in Randomized Complete Block Design (RCBD) having two factors replicates three times. Four levels boron (0, 1.0, 2.0 and 3.0 Kg ha⁻¹) and three levels of zinc (0, 1.5 and 3.0 Kg per hectares). Foliar application of boron significantly influenced all parameters. Maximum number of fruits plant⁻¹ (117.01), fruit length (8.98 cm), fruit weight plant⁻¹ (622.21 g), yield tons ha⁻¹ (2.71 tons) and 1000 seed weight (3.47 g) were observed by the foliar spray of boron @ of 3 kg per hectares. While in case of zinc maximum number of fruits per plant (113.99), fruit length (9.45 cm), fruit weight plant⁻¹ (660.19 g), yield tons ha⁻¹ (2.85 tons ha⁻¹) and 1000 seed weight (3.54 g) were recorded in the plot to which received zinc @ of 3 kg per hectares. It is concluded from the results that foliar application of boron and zinc should be used @ of 3 kg per hectares for better chilli production in the agro-climatic conditions of Swat.

Keywords: Zinc; Boron 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 [1]. It is grown as a

cash crop on commercial level in Pakistan [2]. The total area under chilli cultivation are 4.26 million ha in the world with total production of 34.5 million tons [3]. It is third most growing vegetable after tomato and potato [4]. It is a good source of nutritive values and, also uses in many medicinal goods and have plenty of medicinal properties [5]. Green chillies is a rich source of vitamin C and A and traces of starch in

done in the seed contain [6, 7]. Due to its appealing color it is used in curry [8].

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 micronutrient are boron which is the vital for carbohydrate metabolism, nitrogen and cell division as well as help in the water relation of plant growth [9]. The response of different crops to boron application has been studied extensively [10]. Boron plays an important role in cell wall synthesis and structure, membrane stability, growth and development of new cells in plants meristems [11-13]. It improves the flowering, fruit sets, fruit formation and fruit quality [14]. Reproductive organs are developed by boron [15] boron increases the yield of fruits [16, 17]. Translocation of sugar, starches, nitrogen, phosphorus, synthesis of amino acids and proteins are also influenced by boron [14].

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 [18]. 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 [19]. Zinc promotes yield, due to its role in carbonic enzyme, in the biosynthesis particularly in chlorophyll [20]. Zinc also serves as co-factor or functional element of different enzymes associated with

carbohydrate metabolism, auxin metabolism, formation of anther, pathogens resistance [21].

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.

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 m². 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 transported to the field 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)

Control (0), 1.0, 2.0, 3.0

Factor B: Zinc levels (kg ha⁻¹)

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 doses 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.

Figure 1. Weather data for the research site during season (2016)

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.

Number of fruits plant⁻¹

Mean table (Table 1) shows that maximum number of fruits plant⁻¹ (117.01) were observed in plots, which received 3.0 kg ha⁻¹ boron spray, while minimum fruits plant⁻¹ (93.59) were noted in control plots. In case of foliar application of zinc, maximum fruits per plant (113.99) was noted in that plots which were treated by ZnSO₄ foliar spray at the rate

of 3.0 kg ha⁻¹, while minimum fruits plant⁻¹ (97.58) were noted in untreated plots.

The analysis of the given data showed that zinc and boron significantly effect on chillies growth and production. In control plots the number of fruits plant⁻¹ was increased as comparing with the plants treated with foliar application of boron and zinc which might be utilized by plants more efficiently and effectively. Boron foliar application also work in a respiration rate and mobilization of plants nutrients and other certain metabolic activities. This results also supported the findings of [22]. Similar results were also reported by [23] who noted that highest number of fruits and tomato crop was due to

the application of boron at the level of 106 ppm. While [24] also supported these findings that 1250 ppm level of boron result in higher no of fruits per plant in tomato crop [24]. This result is also similar to [20, 25] who reported that the effect of zinc which is essential for the carbonic enzyme and photosynthesis, resulting in increase in translocation of photosynthesis in fruits; and has positive effect on retaining flowers and fruits of the plant.

Fruit length (cm)

The statistical analysis of data presented in (Table 1) clarified that higher fruit length (8.98 cm) was observed in plots, which received 3.0 kg ha⁻¹ boron as foliar application, while least fruit length (7.29 cm) were observed in control plots. When zinc is applied as foliar spray the maximum fruit length (9.45 cm) was observed in plots which were sprayed with ZnSO₄ foliar application at the rate of 3.0 kg ha⁻¹, while least fruits length (6.67 cm) were noted in untreated plots.

Zinc and boron significantly affect fruit length. The increase in fruit length and fruit diameter might be due to more accumulation of photosynthesis which were synthesized in the leaf and translocated towards the fruit. The increased and accumulation of photosynthesis was probably due to more vigor and growth [26, 27]. Zinc and boron significantly increase in fruit length [28]. Treatment also enhance both the size and no. of cell in plant [29, 30] also observed that fruit length was increased by foliar spray of micronutrients at flowering stage. Similar result was also obtained by [31] found similarity through foliar spray of macro and micro nutrients in chilli resulted significantly longer fruits in green chilli.

Fruit weight (g)

We concluded from the data presented in (Table 1) that highest weight of fruit per plant (622.21 g) was obtained from plants where boron @ 3 kg ha⁻¹ was sprayed, followed by (571.86 g) in plants which was sprayed @ 2

kg ha⁻¹, while minimum fruit weight per plant (454.05 g) was recorded in control plot.

Foliar application of zinc with boron improves weight of chilli, because boron and zinc expanded the cells and cell division, and work in the volume of intercellular space in mesocarpic cells in addition to quick translocation of metabolites and to sink fruits [32] and effect of zinc, which is necessary for the carbonic enzymes that is present in all photosynthetic tissues, and needed for chlorophyll biosynthesis, thus increased the translocation of photosynthetic assimilates [33] found the results that weight of fruit maximize by the treatments of boron and zinc applied as foliar. Boron also maximize the Photosynth ate which promote fruit weight [34]. Boron and Zinc also help in the preparing tryptophan that is amino acids which helps in the biosynthesis of proteins and auxins that is plant growth regulators which result in the improving of fruit growth [28]. Similar finding was documented in chilli by [35] as reported by the previous author [36, 37] who reported that the improvement in the weight of fruit is 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. It also improved the metabolic reaction and diversion of fruit occur by which size and mass of fruit improved.

Fruit yield (ton ha⁻¹)

The mean table shows the highest fruit yield (2.71 tons ha per hectare) was recorded in plants sprayed with boron @ 3 kg ha⁻¹, while the lowest fruit yield (1.98 tons ha per hectare) was noted in control plot. In case of Zinc application, maximum yield (2.85 tons ha⁻¹) was obtained when foliar application of zinc was applied @ 3 kg ha⁻¹, while the minimum yield (2.03 tons ha⁻¹) were recorded in control plot.

Micronutrient foliar application improves photosynthesis and other metabolic activities, which help in increasing of cell division and elongation [38]. Foliar application of B and Zn increased the yield of chilli significantly as it enhanced the vegetative growth, retention of flowers and fruits, speeds up the process of photosynthesis which resultantly increased the photosynthates (CH₂O) by the result of which it increased the no. and weight of fruits and ultimately increased the yield. Almost similar results were also clarified by [39, 40] in vary vegetable crops. [38] also said that treatment of micronutrients viz.; Zn and B were used together which give the improvement of growth and yield of chilli. These consequences are also in agreement with the findings of [41, 42] who found higher fruit yield with zinc application. This results are also same with the experiment [43] who reported an in increase in yield tons ha⁻¹ in various vegetable crops.

1000 seed weight (g)

The experimental result estimated that highest 1000 seed weight (3.47 gram) was recorded in plants sprayed with boron @ of 3 kg ha⁻¹ while the minimum 1000 seed weight

(2.62 gram) was noted in unsprayed plants. In case of zinc application, maximum 1000 seed weight (3.54 gram) was get when zinc was sprayed @ 3 kg ha⁻¹ while the least 1000 seed weight (2.64 gram) was noted in unsprayed plants.

Zinc and boron influenced 1000 seed weight (g) significantly. This result is supported with the work done by [24] who reported that application of micro nutrient mixture in tomato increase (0.352 g) 100 seed weight of tomato as compared to the control. The maximum effect was also observed in 100 seed weight by the application of micronutrients mixture in the investigations of [37]. The similar findings with the application of zinc have also been recorded by [44] in vary vegetable crops that various concentration of zinc treatments significantly influenced the 1000 seed weight of lentil. Sakal *et al.* [45] also recorded the same result [46] also observed that the yield parameters including seed weight were improved by the treatments of combined nutrients. Abdo [47] conducted a research work and he also clarified our findings with the use of boron and zinc.

Table 1. No. of fruits plant⁻¹, Fruit length (cm), Fruit weight plant⁻¹ (g), Fruit yield (tons ha⁻¹) and 1000 seed weight (g) of chilli as affected by zinc and boron application

Boron kg ha ⁻¹	PARAMETERS				
	No. of fruits plant ⁻¹	Fruit length (cm)	Fruit weight plant ⁻¹ (g)	Fruit yield (tons ha ⁻¹)	1000 seed weight (g)
0	93.95c	7.29c	454.05c	1.98c	2.62c
1.0	102.62b	7.97b	539.64b	2.34b	2.92b
2.0	108.63b	8.43b	571.86b	2.48b	3.15b
3.0	117.01a	8.98a	622.21a	2.71a	3.47a
LSD (P≤0.05)	6.77	0.470	50.347	0.230	0.235
Zinc kg ha ⁻¹					
0	97.58c	6.67c	465.86c	2.03c	2.64c
1.5	104.81b	8.38b	514.77b	2.26b	2.94b
3.0	113.99a	9.45a	660.19a	2.85a	3.54a
LSD (P≤0.05)	5.86	0.407	43.602	0.199	0.203
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 yield of chilli crop in Swat Khyber Pkhtunkhwa.

Authors' contributions

Conceived and designed the experiments: A Rab, Performed the experiments: MN Khan, Analyzed the data: MN Khan, Contributed materials/ analysis/ tools: MW Khan, I Din, MA Khan, MA Khan & M Ahmad, Wrote the paper: MW Khan.

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