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EFFECT OF FOLIAR APPLICATION OF BORON AND ZINC ON GROWTH AND FRUIT QUALITY PARAMETERS OF TOMATO (*SOLANUM LYCOPERSICON* L.) CV. SHALIMAR 1 UNDER TEMPERATE CONDITIONS IN KASHMIR VALLEY

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ABSTRACT

An experiment was conducted using nine different foliar micronutrient applicatons on Tomato cv. Shalimar 1 under temperate conditions in Kashmir valley. Among all the treatments ,T_8 (boron @ 100 ppm + zinc @ 100 ppm) recorded maximum plant height (55.06cm), fruit length (5.14 cm), fruit width (5.26 cm), average fruit weight (20.90 g), TSS (5.72^{0}B), lycopene (15.72 mg/100g) and dry matter (6.07 g/100g). Plant spread and fruit firmness showed best results in treatment,T_6 (boron @ 100 ppm). The experiment revealed that applications of treatment, T_8 (boron @ 100 ppm + zinc @ 100 ppm) showed significantly better response with respect to growth, yield and quality attributes. However , treatment T_6(boron @ 100 ppm) had beneficial effect on increasing the plant spread as well as shelf life of tomato fruit.

INTRODUCTION

Tomato (*Solanum lycopersicon* L; 2n = 2x = 24), is an important vegetable crop grown throughout the world. Tomato enjoys a significant position based on nutritional point of view and is also a rich source of antioxidant lycopene, which is believed to reduce the risk of prostate cancer (Fadupin *et al.*, 2012). It is one of the paramount fruit vegetables grown throughout the world. India is the fourth largest tomato producer in the world after China, USA and Turkey (Sunil and Kartikeya , 2013). In India, tomato is well adapted to all regions and occupies an area of about 9.20 lac ha with an annual production of 168.26 lac MT. In Jammu and Kashmir, it is grown over an area of 6.3 thousand hectares with an annual production of 139.58 thousand tonnes (Anonymous, 2013b).With the rapid increase in population, the demand of tomato has significantly increased, but the production and productivity has remained low both at national as well as state level in comparison to developed countries. Low production and productivity of tomato can be attributed to number of factors. One of the major factors being depletion of micronutrients in the soil (Nadim *et al.*, 2012).The growth of the plant is restrained due to deficiency of micronutrients, as a result of which the plant becomes susceptible to diseases, thereby causing a deleterious effect on its yield (Das, 2008). Micronutrients, particularly boron and zinc, are very much essential for growth, development and reproduction of plants. These micronutrients are required by plants in very small quantities, yet they are very effective in regulating plant growth, development and reproduction, due to enzymatic action (Singh and Prakash, 2013). In Kashmir, the soils are deficient in boron and zinc (Shaista, 2015). Hence application of proper doses of boron and zinc can lead to the improvement in quality and production of this crop. With regard to the work conducted on effect of boron and zinc on growth, quality and relative economics of tomato, little efforts have been made in India and abroad while, in Kashmir till date no such work has been done.Hence, collecting usable data on spraying of micro nutrients is necessary to the modernized agriculture. Keeping in view of above facts, the present study was undertaken to find out suitable combinations of boron and zinc through foliar feeding towards growth and quality in tomato under Kashmir conditions.

MATERIALS AND METHODS

An experiment was conducted at Experimental Field of Division of Vegetable Science, SKUAST- Kashmir, Shalimar, Srinagar (J&K) under temperate conditions wherein nine treatments *viz.*, T_1 (zinc @ 50 ppm), T_2 (zinc @ 100 ppm), T_3 (boron @ 50 ppm), T_4 (boron @ 50 ppm + zinc @ 50 ppm), T_5(boron @ 50 ppm + zinc @ 100 ppm), T_6(boron @ 100 ppm), T_7(boron @ 100 ppm + zinc @ 50 ppm), T_8(boron @

100 ppm + zinc @ 100 ppm)andT_9(Control) with three replications were applied in randomised complete block design as suggested by Naga Sivaiah *et al.* (2013). Foliar applications of micronutrients (boron and zinc) were applied 15 days after transplanting of seedlings and repeated at 15 days interval. A total of three foliar sprays were carried out during the cropping season as given by Ali *et al.* (2013). The data collected on different traits was statistically analyzed using the standard procedure and the results were tested at five per cent level of significance as given by Gomez and Gomez. (1984).The critical difference was used to compare treatment means.

RESULTS AND DISCUSSION

The results revealed that maximum plant height of 55.06cm was observed with T_8 (boron @100ppm + zinc @ 100 ppm) which was significantly superior to rest of the treatments. The increase in plant height was due to role of zinc in the synthesis of auxin (IAA). Auxin plays an important role in apical dominance and inhibits the growth of lateral buds thus increases the plant height. Also boron is associated with the cell differentiation and development of cell wall that helps in shoot growth resulting in increased plant height. Similarly, Singh and Tiwari (2013) also reported somewhat similar findings regarding tomato plant height in response to different micronutrient application as a foliar feeding. They found that tomato plant height ranged from 66.6 to 80.4 cm in Allahabad conditions of India. The slight variation might be due to different climatic conditions and cultivar. Plant spread was recorded maximum in treatment T_6(boron @100ppm) viz., 27.62 cm. It is attributed to enhancement of nutrient absorption and Ca metabolism in cell wall thereby increasing the plant spread. Decrease in plant spread in treatment, T_8 (boron @100ppm + zinc @100ppm) is due to the fact that zinc leads to apical dominance as a result of which lateral growth is suppressed. Similar results were given by Rab and Haq (2012) in tomato, who reported that combined application of boric acid @ (100ppm) after 30 days of transplanting of seedlings resulted in the maximum number of branches per plant (7.21) and plant spread (30.02cm).

Among all the treatments, T_8 (boron @ 100 ppm + zinc @ 100 ppm) resulted in maximum fruit length and fruit width of 5.14 cm and 5.26 cm, respectively .The study also revealed significantly highest fruit weight of 20.90g in treatment,T_8(boron @ 100 ppm + zinc @ 100 ppm). This is because foliar application of boron leads better utilisation of minerals accompanied with enhanced photosynthesis, metabolic activity and greater diversion of food material to fruits. Zinc is important in activation of certain plant growth hormones particularly auxin L. K. Mishra. (2012). These plant hormones increases the mobilisation of assimilates to the developing fruits and also stimulate the transport of nutrients through phloem, modify the strength of sink by stimulating its growth and increase the ability for sugar unloading from the phloem. In an experimental findings of Rab and Haq (2012) suggesting that foliar application of boron and zinc significantly increased the fruit length, fruith width and fruit weight. The foliar application of boron (H_3BO_3) at 100 ppm increased the fresh weight of fruits per plant(88%) than that of control. Increase in fruit size and fruit weight by application of micronutrients particularly boron and zinc have been reported by Verma and Amarchandra (2003).

Data presented in Table-1 clearly showed that foliar application of boron and zinc played significant role in directly affecting the firmness of a fruit. The maximum fruit firmness was recorded in treatment,T_6 (boron @ 100 ppm) viz., 4.40 kg cm^{-2} which was statistically at par with treatment, T_7 (boron @ 100 ppm + zinc @ 50 ppm) *viz.*, 4.33 kg cm^{-2}.Boron is important for calcium metabolism and pectin synthesis in cell wall and is important for maintaining structural integrity. These results have also been supported by Grusak (2004) by depicting that boron nutrition facilitates calcium absorption thus promoted cellwall integrity and delayed cell wall degradation. The TSS content of the fruits is a major quality parameter Ali *et al.* (2004). Among different treatments, T_8 (boron @ 100 ppm + zinc @ 100 ppm) registered maximum TSS of 5.72 ^{0}Brix which was statistically superior to all other treatments and lowest TSS was recorded in control viz., 4.83 ^{0}Brix. These results might be attributed to higher synthesis of carbohydrates at higher zinc and boron levels, since zinc and boron have an important role in photosynthesis and related enzyme activity which might have lead to increase in sugar and decrease in acidity. These results are in accordance with the findings of Mishra *et al.* (2007). Preharvest boron and zinc application may affect the chemical composition of fruits Sathya *et al.*(2010).The TSS

Table 1: Effect of foliar application of boron and zinc on plant growth and fruit quality of tomato cv. Shalimar 1 under temperate conditions in Kashmir valley

Symbol	Treatment	Plant height (cm)	Plant spread (cm)	Fruit length (cm)	Fruit width (cm)	Fruit firmness (kg cm^{-2})	Average fruit weight(g)	Total soluble solids (^{o}Brix)	Dry matter (g/100g)	Lycopene content (mg/100g)
T_1	zinc @50ppm	48.09	24.18	3.53	3.90	3.52	19.00	5.27	4.72	13.10
T_2	zinc@100ppm	51.21	23.90	3.91	4.12	3.26	19.70	5.58	5.00	13.73
T_3	boron@50ppm	46.18	24.96	3.80	4.03	3.80	19.21	5.18	4.86	13.13
T_4	boron@50ppm + zinc @50ppm	53.16	24.00	4.41	4.38	4.13	20.17	5.50	5.18	13.92
T_5	boron @50ppm + zinc @100ppm	54.29	23.18	4.98	4.84	3.68	20.39	5.66	5.70	14.53
T_6	boron @100ppm	49.90	27.62	4.01	4.28	4.40	20.26	5.40	5.73	15.00
T_7	boron @100ppm + zinc @50ppm	53.98	26.15	5.01	5.21	4.33	20.78	5.60	6.00	15.11
T_8	boron @100ppm + zinc @100ppm	55.06	26.10	5.14	5.26	4.00	20.90	5.72	6.07	15.72
T_9	Control	45.12	23.06	3.29	3.76	3.00	18.60	4.83	4.09	13.00
	C.D($p \leq 0.05$)	4.21	2.86	0.30	0.60	0.19	0.46	0.08	0.30	0.35

contents of tomato fruit have been shown to correlate with available boron and are increased by both soil and foliar application of boron Sathya *et al*. (2010).Exogenous application of boric acid and zinc sulphate increased the amount of fruit soluble solids materials (Brix index).Plants treated with boric acid and zinc sulphate had significantly higher Brix index(9.2) compared to non-treated plants (control).This can be attributed to the role of boron and zinc to improve membrane permeability, absorption and utilization of mineral nutrients. Some researchers suggested that these micronutrients increased membrane permeability that would facilitate absorption and utilization of mineral nutrients and transport of assimilates. Mahdi Javaher. (2012).

Highest dry matter was recorded in treatment combination, T_8 (boron @ 100 ppm + zinc @ 100 ppm) viz., 6.07g/100g and lowest dry matter content was recorded in T_9 (control) viz., 4.09 g/100g. Increased photosynthesis and translocation of photosynthesis to sink and higher uptake of phosphorous by plant might have improved dry matter percentage. The beneficial effect of Zn on dry matter content was due to the role in the biosynthesis of chlorophyll molecules which in turn increased the carbohydrate content. Boron increases the rate of transport of sugars, which are produced by photosynthesis, to actively developing fruits. The results are in conformity with those of Farzana. (2011). The experimental findings of Bhatt and Srivastava, (2005) showed that the fresh and dry matter yield of fruits was significantly influenced by the foliar application of boron and zinc.The combination of micronutrients showed a 33 per cent increase in yield over the control and proved significantly superior to all the other treatments. This would also contribute towards enhancing the capacity of the treated plants for biomass production as is reflected in the observed increase in fresh and dry weight of plants .Among different treatments, T_8 (boron @ 100 ppm + zinc @ 100 ppm) recorded maximum lycopene content of 15.72 mg/100g which was statistically superior than all other treatments. It was observed that lycopene content of the fruit gradually increased with the increasing boron and zinc levels. This is because micronutrients viz., boron and zinc have stimulatory effect on most of the physiological and metabolic processes and enzymatic activities of plant that might have helped the plants in absorption of nutrients from the soil and their translocation to different plant parts, which ultimately increased the lycopene content of tomato fruit. Application of boron and zinc increased the fruit lycopene content so that tomato transplants treated with (boron 100 ppm + zinc @ 100 ppm) had significantly higher lycopene content (6.4 mg per 100 g fruit fresh weight) compared to untreated control (4.23.mg per 100 g fruit fresh weight). Moharekar *et al*. (2003) reported that boric acid activated the synthesis of carotenoids and xanthophylls. These results are in conformity with Dube *et al*. (2003).

REFERENCES

Ali, M. S., Nakano, K. and Maezawa, S. 2004. Combined effect of heat treatment and modified atmosphere packaging on the color development of cherry tomato. *Pos. Har. Bio.Tech.* **34:** 113-116.

Ali, S., Rehman, R. N., Sabir, I. A., Naeem, M. S., Siddiqui, M. Z., Saeed, D. A. and Nawaz, M. A. 2013. Foliar application of some macro and micro nutrients improves tomato growth, flowering and yield. Intern. *J. Bio. Sci.* **3(10):** 280-287.

Anonymous. 2013b. Indian Horticulture Data Base. *Publ. by NHB. Gurgaon.*

Das, P. C. 2008. Plant Nutrients. In: Manures and Fertilizers, P.C. Das (Eds). *Kalyani Publ.* New Delhi. p. 26.

Dube, B. K., Sinha, P. and Chatterjee, C. 2003. Effect of zinc on yield and quality of tomato. *Ind. J. Hort.* **60(1):** 59-63.

Fadupin, G. T., Osadola, O. T. and Atinmo, T. 2012. Lycopene Content of Selected Tomato Based Products, Fruits and Vegetables Consumed In South Western Nigeria. *Afr. J. Biomed. Res.* **15:** 187-191.

Farzaneh, N., Gholchin, A. and Majid, K. H. 2011. The effect of nitrogen and boron on growth, yield and concentration of some nutrient elements of tomato. *J. Sci. Tech. Gh. Cul.* **1(2):** 19-29.

Gomez, K. A. and Gomez, A. A. 1984. Stat. *Pro. Agr. Res.(2nd Edn.). J. Willey and Sons,* New York, USA. pp. 28-92.

Grusak, M. A. 2004. Field application of chelated calcium: postharvest effects on cantaloupe and honeydew fruit quality. *Hort.Tech.* **14:** 29-38.

Lalit, B. and Srivastava, B. K. 2005. Effect of foliar application of micronutrients on nutrient uptake in tomato. *Veg. Sci.* **32(2):** 158-161.

Mahdi, J., Kambiz, M., Alireza, D. and Fateme, Z. T. 2012. Effects of salicylic acid on yield and quality characters of tomato fruit (Lycopersicum esculentum Mill). *Int.J. Agr. C. Sci.* pp.14-16.

Mishra, B. K. and Nandi, A. K. 2007. Effect of micronutrients spray on growth and yield of tomato cv. *Utkal Urbashi (BT-12). Or. J. Hort.*

Mishra, L. K. 2012. Effect of phosphorus and zinc fertilization on biochemical composition of wheat. *The Bioscan.* **7(3):** 445-449.

Moharekar, S. T., Lokhande, S. D., Hara, T. and Chavan, P. D. 2003. Effect of salicylic acid on chlorophyll and carotenoid contents of wheat and moong seedlings. *Photosynthetica.* **41(2):** 315-317.

Nadim, M. A., Awan, I. U., Baloch, M. S., Khan, E. A., Naveed, K. and Khan, M. A. 2012. Response of wheat (*Triticum aestivum* L.) todifferent micronutrients and their application methods. *J. Ani. Pl. Sci.* **22:** 113-119.

Naga, S. K., Swain, S. K., Raju, B. and Sandeep, V. 2013. Effect of micronutrients foliar application on seed yield in tomato (*Lycopersicon esculentum* MILL.) *Int. J. Dev. Res.* **3(11):**191-195.

Rab, A. and Haq, I . 2012. Foliar application of calcium chloride and borax influences plant growth, yield, and quality of tomato (Lycopersicon esculentum Mill.) fruit. *Turk. J. Agric. For.* **36:** 695-701.

Sathya, S., Mani, S., Mahendran, P. P. and Arulmozhiselvan, K. 2010. Effect of application of boron on growth, quality and fruit yield of pkm 1 tomato. *Ind. J. Agri. Res.* **44(4):** 274-280.

Shaista, 2015. Adsorption and desorption of boron as influenced by soil properties in temperate soils of lesser Himalayas. *Comm. S. Sci Pl. Ana.* **39:** 231-238.

Singh, H. M. and Tiwari, J. K. 2013. Impact of micronutrient spray on growth, yield and quality of tomato (*Lycopersicon esculentum Mill). Hort. Flo. Res. Spe*. **2(1):** 87.

Singh, P. N. and Prakash, Y. 2013. Effect of foliar fertilization of boron, zinc and iron on fruit growth and yield of low-chill peach cv. Sharbati Int. *J. Scie. Res. Pub.* **3(8**).

Sunil, K. and Kartikeya, S. 2013. Screening of tomato genotypes against early blight (*Alternaria Solani*) under field condition.*The Bioscan.* **8(1):** 189-193.

Verma, B. K. and Amarchandra. **2003.** Effect of boron and calcium on plant growth and seed yield of tomato. *Jaw. Neh. Kri. Vish. Vid. Res. J.* **37(2):** 13-14.