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Effect of foliar application of micronutrients on yield attributes of tomato (*Solanum lycopersicum* L.) cv. Kashi Adarsh (VRT-1201)

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Abstract
A field experiment was conducted at the Horticulture Research cum Instructional Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Sarkanda, IGKV, Bilaspur, (C.G.). During *rabi* season of 2021-22 with a view to study the "Effect of Foliar Application of Micronutrients on Yield attributes of Tomato (*Solanum lycopersicum* L.) cv. Kashi Adarsh (VRT-1201)". The tomato variety Kashi Adarsh (VRT-1201) was used to grown and treatment was replicated three times in randomized block design (RBD). The soil of experimental site was clay loam soil. There were four nutrients Copper Sulphate, Boric Acid, Ferrous Sulphate and $ZnSo_4$ which were applied at different concentrations in tomato in ten treatment *viz*., T_1: - Copper Sulphate @ 50 ppm, T_2:- Copper Sulphate @ 100 ppm, T_3:- Boric Acid @ 50 ppm, T_4:- Boric Acid @100 ppm, T_5:- Ferrous Sulphate @ 50 ppm, T_6:- Ferrous Sulphate @ 100 ppm, T_7:- $ZnSo_4$ @ 50 ppm, T_8:- $ZnSo_4$ @ 100 ppm, T_9:- Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm and T_{10}:- Control. The yield parameters *i.e.*, number of fruits per cluster, yield per plot (kg), yield per hectare (q) were significantly superior in the treatment T_9 (Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm). On the basis of above findings, treatment T_9 (Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm) stand could be better performance first in position and T_4 (Boric Acid @100 ppm) stand in second order of preference. However, treatment T_8 ($ZnSo_4$ @ 100 ppm) comes in next in order. Therefore, it may be concluded that treatment T_9 (Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm) may be prefer for higher growth and yield in tomato.

Keywords: Yield parameter, Kashi Adarsh (VRT-1201), clay loam soil, nutrient, Copper Sulphate, Boric Acid, Ferrous Sulphate, $ZnSo_4$

1. Introduction
Tomato (*Solanum lycopersicum* L.) is one of the most widely grown vegetable in India and has become popular in the last six decades. It is grown in small home gardens and market gardens for fresh consumption as well as processing purposes. It is consumed raw, cooked or processed as puree, ketchup, sauce etc. Although, a ripe tomato has 94 per cent water, being a good source of vitamin A and B and excellent source of vitamin C and has a good nutritive value. It is very appetizing, removes constipation and has a pleasing taste.

Its belong to family solanaceae having chromosome number 2n=2x=24. It is cultivated everywhere in the world. The main producing countries are China and the United States. At present there exists a great range of varieties, cultivated all the year round, with fruits of different sizes, shapes and colours besides. It is rich in fiber and low in calories, supplying vitamins and minerals. The tomato is the vegetable product of greater economic importance. More than 90 million tons are produced every year everywhere in the world. Apart from the raw consumption, it is also cooked, stewed, fried, in pickling, as sauce or combining with other foodstuffs. The greatest yield is produced in warm climates with good illuminance. The summer must be long, with temperatures between 23 and 24 ºC during the day and 14 ºC at night. Tomatoes prefer slightly acid soils. For fiscal year 2020, the volume of tomato production in India amounted to over 21 million metric tons.

Tomato is mainly grown in India, America, Pakistan, China, Nepal and Bangladesh, etc. In India, it is commercially grown in Rajasthan, Gujarat, Madhya Pradesh, Haryana, West Bengal, Punjab and Maharashtra, Rajasthan etc. In India, tomato is grown on an area of 0.79 million hectare with an annual production of 19.33 million tones. (Anon., 2018-19) [2, 3].

In Chhattisgarh, tomato is grown in an area of 64,717 hectare, with an annual production of 11,82,648 metric tonnes and the productivity of tomato crop in Chhattisgarh is 16.42 MT/Ha of fruits per hectare which is less than the national average (Anonymous, 2020-21) [4]. The

major tomato producing districts are Raipur, Durg, Bastar, Balod and Jaspur. Majority of Indians are vegetarian, with a per capita consumption of 135 g per day as against the recommended 300 g vegetable per day. It is still very less than recommended diet level.

2. Materials and Methods

A field experiment was conducted at Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (Chhattisgarh) university of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). The Research Farm is situated at 22.09˚N latitude, 82.15˚E longitude and at an altitude of 298 m above mean sea level. The region falls under the Eastern plateau and hill region (Agro-climatic zone-VII) of India. Chhattisgarh state is classified into three agro-climatic zones, of which Bilaspur falls under the Chhattisgarh plains zone of the state. The texture of soil of experimental field was clay loam soil. The soil was neutral in reaction, medium in organic carbon, low in nitrogen and medium in phosphorus and potash content.

The manures, at the pace of 60:80:60 kg NPK ha^{-1}, were applied individually. The entire full dose of P_2O_5 and K_2O in form of Single Super Phosphate and Muriate of Potash were applied. Half amount of nitrogen as a basal portion use of Urea, and remaining dose of nitrogen was applied split two application of 35 DAT and 45 DAT at blossoming stage. Nitrogen, Phosphorus and Potassium were applied through Urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP), individually. Observations were recorded on single plant basis from five randomly tagged competitive plants of each treatment for all the traits separately. Recorded observations were averaged over replication to get treatment mean.

3. Results and Discussion

Data pertaining to yield attributes influenced by various treatment has been given in table 1 and fig 1, 2 and 3.

Number of fruits per cluster was observed significantly highest (4.05) in treatment T_9 (Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm) which remained at par with treatment T_4 (Boric Acid @100 ppm) (3.88) and T_8 ($ZnSo_4$ @ 100 ppm) (3.74). Significantly lowest number of fruits per cluster (3.09) was observed in treatment T_{10} (Control). Also, similar result found by Kazemi (2013) [9], evaluated the effects of the foliar application of zinc (50 and 100 mg/L) and iron (100 and 200 mg/L) and their combination on vegetative, reproductive growth, fruit quality and yield of tomato plants in completely randomized block design with four replications. His results showed that high Zn (100 mg/L) and Fe (200 mg/L) and their combination significantly promoted vegetative and reproductive growth. Foliar application of Zn (100 mg/L) + Fe (200 mg/L) resulted in the maximum fruits per cluster (5.2), thus it was recommended to apply foliar spray of Zn and Fe in order to improve growth, flower yield, quality and chemical constituents in tomato plants.

Significantly highest yield per plot (kg) (900.10kg) was observed in treatment T_9 (Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm) which remained at par with treatment T_4 (Boric Acid @100 ppm) (891.00kg) and T_8 ($ZnSo_4$ @ 100 ppm) (886.00kg), Significantly lowest yield per plot (kg) (750.00kg) was observed in treatment T_{10} (Control). Also, similar result found by Murlee *et al.* (2006) conducted a study at Allahabad and reported that the highest number of fruits per plant (44.0), number of fruits per plot (704.0), yield per plant (0.79 kg), yield per plot (12.78 kg) and yield/ha (319.50 quintal) were obtained with 0.20 percent boron, whereas the greatest fruits weight (27.27 g) was recorded for 0.10 percent boron.

Yield per hectare (q) was observed significantly highest (460.33) in treatment T_9 (Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm) which remained at par with treatment T_4 (Boric Acid @100 ppm) (449.00) and T_8 ($ZnSo_4$ @ 100 ppm) (443.00), Significantly lowest yield per hectare (q) (400.00) was observed in treatment T_{10} (Control). Similar result was reported by Davis *et al.* (2003) [6], reported that regardless of the application method (soil or foliar application) B was associated with increased tomato growth, improved fruit set, total yield, fruit self-life, fruit formation and N uptake by tomato. The results obtained in the present studies are also support by the Patil *et al.* (2008) [13], who reported that maximum vegetative growth, yield traits and yield of 38.80 t/ha in plants was due to sprayed of 0.5% calcium and ethephon 1000ppm and followed by plants sprayed with 0.05% zinc and ethephon 1000ppm.

Table 1: Effect of Foliar Application of Micronutrient on Yield of Tomato

Tr. no.	Treatment details	Number of fruits per cluster	Yield per plot (kg)	Yield per hectare (q)
T_1	Copper Sulphate @ 50 ppm	3.12	759.00	411.00
T_2	Copper Sulphate @ 100 ppm	3.50	876.11	433.00
T_3	Boric Acid @ 50 ppm	3.43	871.00	428.00
T_4	Boric Acid @100 ppm	3.88	891.00	449.00
T_5	Ferrous Sulphate @ 50 ppm	3.29	863.67	417.00
T_6	Ferrous Sulphate @ 100 ppm	3.61	881.00	438.33
T_7	$ZnSo_4$ @ 50 ppm	3.36	867.00	422.33
T_8	$ZnSo_4$ @ 100 ppm	3.74	886.00	443.00
T_9	Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm	4.05	900.10	460.33
T_{10}	Control	3.09	750.00	400.00
SEm (±)		0.20	3.77	2.72
CD (5%)		0.60	11.22	8.11
CV (%)		9.97	0.77	1.10

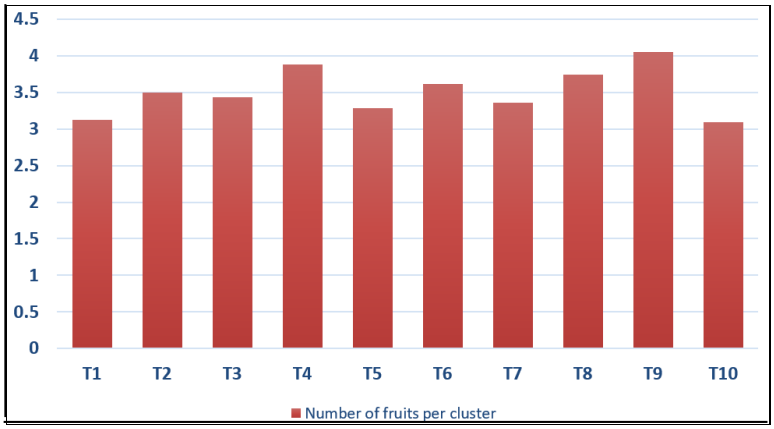

Fig 1: Number of fruits per cluster

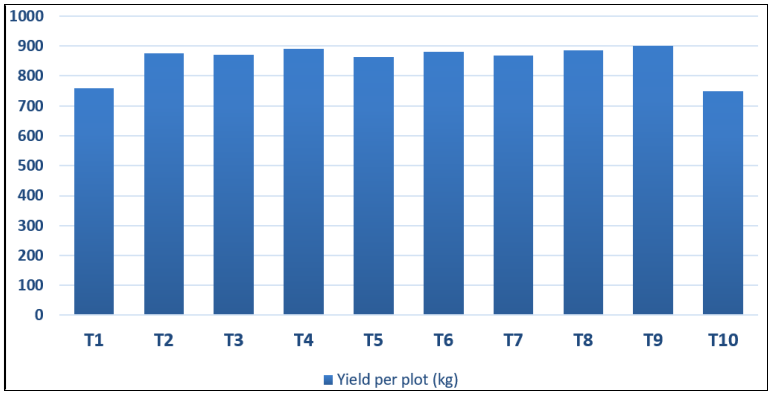

Fig 2: Yield per plot (kg)

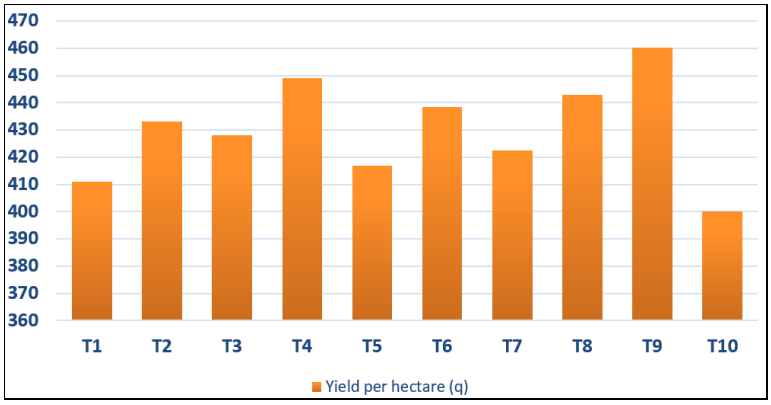

Fig 3: Yield per hectare (q)

4. Conclusion

The yield parameters *i.e.*, number of fruits per cluster, yield per plot (kg), yield per hectare (q) were significantly superior in the treatment T_9 (Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm).

On the basis of above findings, treatment T_9 (Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm) stand could be better performance first in position and T_4 (Boric Acid @100 ppm) stand in second order of preference. However, treatment T_8 ($ZnSo_4$ @ 100 ppm) comes in next in order. Therefore, it may be concluded that treatment T_9 (Boric Acid @100 ppm + $ZnSo_4$ @ 100 ppm) may be prefer for higher growth and yield in tomato.

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