International Journal of Agriculture and Nutrition

ISSN Print: 2664-6064
ISSN Online: 2664-6072
Impact Factor: RJIF 5.2
IJAN 2022; 4(1): 34-38
www.agriculturejournal.net
Received: 12-02-2022
Accepted: 18-03-2022

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Effect of micronutrients on yield attributes of tomato

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DOI: https://doi.org/10.33545/26646064.2022.v4.i1a.51

Abstract
A field experiment was conducted at the Instructional Farm of Sardar Patel University, Balaghat (M.P.), during *rabi* season of 2020-21, To evaluate the influence of "Study the effect of micronutrients on growth and yield parameters of tomato (*Solanum lycopersicum* L.)" Totally 10 different treatments consisting of different micronutrient foliar spray, alone and in both combination have been tried. Among the different micronutrients practices, The application of micronutrient management significantly enhanced yield parameters *viz.* number of fruit per plant, length of fruit (cm), diameter of fruit (cm), weight of fruit (g), fruit yield per hectare (q) were also significantly superior in the $T_1 + T_3 + T_5 + T_7$ (Copper Sulphate @ 75 ppm + Boric Acid @ 75 ppm + Ferrous Sulphate @ 75 ppm + ZnSo4 @ 75 ppm) followed by treatment T_4 Boric Acid @150 ppm. On the basis of above findings, treatment $T_1 + T_3 + T_5 + T_7$ (Copper Sulphate @ 75 ppm + Boric Acid @ 75 ppm + Ferrous Sulphate @ 75 ppm + ZnSo4 @ 75 ppm) stand first in position and T_4 Boric Acid @150 ppm stand in second order of preference.

Keywords: Micronutrients, attributes of tomato

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 percent 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.

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). In Madhya Pradesh, tomato is grown in an area of 96925.97 hectare, with an annual production of 27,88,577.47 metric tons and the productivity of tomato crop in is 24.36 MT/Ha of fruits per hectare which is less than the national average (Anonymous, 2019-2020). Madhya Pradesh is the largest tomato producing state of the country. Existing export network in Pakistan, UAE, Bangladesh, Nepal, Oman, Maldives, KSA, Bahrain, Qatar and Malaysia. Year round production peak harvest season is the winter season wherein in the months of October, November, December & January, over 70% is harvested. Moreover, tomato enjoys a significant position based on nutritional view point as its 100 g encompasses virtually 48 mg calcium, 27 mg ascorbic acid, 20 mg phosphorus, 3.6 g carbohydrates, 0.9 g proteins, 0.8 g fiber, 0.4 mg iron, 0.2 g fats and 20 K calories of energy. Besides these nutrients it also comprises β-carotene and Lycopene pigments. Lycopene is extremely vital as it is responsible for the respective red colour characteristics of tomatoes. Tomatoes also keep the blood vessels in healthy condition and prevent scurvy (Ejaz *et al.*, 2011) [5]. It is being realized that the productivity of crop is being affected in different areas due to deficiencies of micronutrients observed primarily due to intensive cropping and imbalanced fertilization (Bose and Tripathi, 1996) [4]. Micronutrients are vital to the growth of plants, acting as catalyst in promoting various organic reactions taking place within the plant. Tomato being a heavy feeder and exhaustive crop removes substantial amount of micronutrients from soil.

To maintain sustainability in its production and nutritive value, it is becoming essential to replenish the depleting reserve of the micronutrients in the soil or apply it through foliar spray to meet the immediate need of the crop. In the present study, an attempt has been made to study the effect of foliar applied micronutrients on the nutrient accumulation in tomato fruits and shoot. Adequate supply of nutrients can increase the yield, fruit quality, fruit size, keeping quality, colour and taste of tomato. Micronutrients also play an important role in tomato production. Among the microelements, boron and calcium play an important role directly and indirectly in improving the yield and quality of tomato in addition to checking various diseases and physiological disorder (Magalhaes 1981) [6].

Materials and Methods

Field experiment will be carried out during year 2020-21 Rabi season at Instructional Farm of Sardar Patel University, Balaghat (M.P.). Balaghat District is located in the southern part of Jabalpur Division. It occupies the south eastern portion of the Satpura Range and the upper valley of the Wainganga River. The district extends from 21°19' to 22°24' north latitude and 79°31' to 81°3' east longitude. The total area of the district is 9,245 km2. Climatologically Balaghat is characterized as slightly moist hot and humid subtropical climate zone. An average annual rainfall of 1100.6 mm is generally appeared and mostly concentrated during the period from June to September. The major portion of the rainfall is received by South-Western monsoon. The May and December is the hottest and coolest month of the year respectively. In general, weekly maximum temperature goes upto 47 °C during the summer season and minimum temperature falls upto 10 °C during the winter season.

The experiment consisted of 10 treatments *viz*. T_1: Copper Sulphate @ 75 ppm, T_2: Copper Sulphate @ 150 ppm, T_3: Boric Acid @ 75 ppm, T_4: Boric Acid @150 ppm, T_5: Ferrous Sulphate @ 75 ppm, T_6: Ferrous Sulphate @ 150 ppm, T_7: ZnSo4 @ 75 ppm, T8: ZnSo4 @ 150 ppm, T9: T_1 + T_3 + T_5 + T_7 and T_10: Control which was arranged in Randomized Block Design with three replications. The seedlings were brought up in earthen pots, the dirt blend was readied in the proportion of 1:1:1 of soil, sand and well bad FYM, which was topped off in the seedlings raising structures. The seeds were treated with Bavistin @ 3g/kg of seeds for raising of solid seedlings. The watering was done by water rose can. Thereafter the seedlings were inundated adequately as and at the point when required. Vital control measures were taken for bugs and sickness. The manures, at the pace of 60:80:60 kg NPK ha-1, were applied individually. The entire amounts of P2O5 and K2O in form of Single Super Phosphate and Muriate of Potash were applied as a basal portion. Half amount of nitrogen, in form of Urea, was applied three weeks after planting and half portion at blossoming stage. Nitrogen, Phosphorus and Potassium were applied through Urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP), individually. The uniform and healthy seedlings were chosen for planting. Light watering was given before removing seedlings from the nursery beds so that least harm was occured to root system of the seedlings. Transplanting of seedling was finished on 24 November 2020 by keeping maintain 60 cm row to row and 45 cm plant to plant planting distance. Immediately after transplanting light establishment irrigation was given. As per the treatment details, 1 g of borax dissolved in 1litre of water to prepare the concentration of 0.1 percent. Similarly, 1 g of Zinc sulfate, Copper Sulphate and Ferrous Sulphate in 1 litre of water to prepare the concentration of 0.1 percent and. The solutions were sprayed at 30 and 45 days after transplanting by using hand sprayer. For the control of aphids, Imidachloropid 17.8% (SL) was sprayed; and for the control of alternaria solani, Hexaconazole 4% + Zineb 68% WP was sprayed.

Results and Discussion Yield attributes

Fruit length (cm), Fruit diameter (cm) and Fruit weight (g)

The data on various yield attributes *viz*. fruit length (cm), fruit diameter (cm) and fruit weight (g) as influenced by the integrated micronutrients management practices were recorded and presented in Table 1 and figure 1, 2 and 3. Significantly higher fruits length was observed in treatment T_1 + T_3 + T_5 + T_7 (Copper Sulphate @ 75 ppm + Boric Acid @ 75 ppm + Ferrous Sulphate @ 75 ppm + ZnSo4 @ 75 ppm) (7.53 cm) followed by treatment T_4 Boric Acid @150 ppm (7.37 cm), T_2 Copper Sulphate @ 150 ppm (7.17 cm), T8 ZnSo4 @ 150 ppm (7.00 cm), T_6 Ferrous Sulphate @ 150 ppm (6.80 cm), T_3 Boric Acid @ 75 ppm (6.60 cm), T_1 Copper Sulphate @ 75 ppm (6.33 cm), T_7 ZnSo4 @ 75 ppm (6.13 cm), T_5 Ferrous Sulphate @ 75 ppm (5.92 cm). And significantly less height was recorded in treatment T_10 (Control Plot) (5.73 cm).

Significantly higher fruits diameter was observed in treatment T_1 + T_3 + T_5 + T_7 (Copper Sulphate @ 75 ppm + Boric Acid @ 75 ppm + Ferrous Sulphate @ 75 ppm + ZnSo4 @ 75 ppm) (5.38 cm) followed by treatment T_4 Boric Acid @150 ppm (5.20 cm), T_2 Copper Sulphate @ 150 ppm (4.93 cm), T8 ZnSo4 @ 150 ppm (4.73 cm), T_6 Ferrous Sulphate @ 150 ppm (4.48 cm), T_3 Boric Acid @ 75 ppm (4.30 cm), T_1 Copper Sulphate @ 75 ppm (4.03 cm), T_7 ZnSo4 @ 75 ppm (3.80 cm), T_5 Ferrous Sulphate @ 75 ppm (3.53 cm). And significantly less height was recorded in treatment T_10 (Control Plot) (3.42 cm).

Significantly higher weight of fruit was observed in treatment T_1 + T_3 + T_5 + T_7 (Copper Sulphate @ 75 ppm + Boric Acid @ 75 ppm + Ferrous Sulphate @ 75 ppm + ZnSo4 @ 75 ppm) (85.93 gm) followed by treatment T_4 Boric Acid @150 ppm (83.93 gm), T_2 Copper Sulphate @ 150 ppm (81.83 gm), T8 ZnSo4 @ 150 ppm (78.67 gm), T_6 Ferrous Sulphate @ 150 ppm (76.33 gm), T_3 Boric Acid @ 75 ppm (74.00 gm), T_1 Copper Sulphate @ 75 ppm (70.83 gm), T_7 ZnSo4 @ 75 ppm (68.67 gm), T_5 Ferrous Sulphate @ 75 ppm (67.30 gm). And significantly less height was recorded in treatment T_10 (Control Plot) (65.93 gm).

Number of fruits per cluster and Yield per hectare (q)

The effect of integrated micronutrients management practices on number of fruits per plant and yield per hectare (q). The data presented in Table 2 and Figure 4 and 5 depicts that Significantly higher fruits was observed in treatment T_1 + T_3 + T_5 + T_7 (Copper Sulphate @ 75 ppm + Boric Acid @ 75 ppm + Ferrous Sulphate @ 75 ppm + ZnSo4 @ 75 ppm) (4.25) followed by treatment T_4 Boric Acid @150 ppm (4.19), T_2 Copper Sulphate @ 150 ppm (4.13), T8 ZnSo4 @ 150 ppm (4.08), T_6 Ferrous Sulphate @ 150 ppm (4.00), T_3 Boric Acid @ 75 ppm (3.88), T_1 Copper Sulphate @ 75 ppm (3.72), T_7 ZnSo4 @ 75 ppm (3.55), T_5

Ferrous Sulphate @ 75 ppm (3.55). And significantly less height was recorded in treatment T_10 (Control Plot) (3.05).
Significantly higher fruit yield per hactere was observed in treatment $T_1 + T_3 + T_5 + T_7$ (Copper Sulphate @ 75 ppm + Boric Acid @ 75 ppm + Ferrous Sulphate @ 75 ppm + ZnSo4 @ 75 ppm) (96.93 q) followed by treatment T_4 Boric Acid @150 ppm (91.00 q), T_2 Copper Sulphate @ 150 ppm (85.00 q), T8 ZnSo4 @ 150 ppm (80.00 q), T_6 Ferrous Sulphate @ 150 ppm (74.33 q), T_3 Boric Acid @ 75 ppm (70.00 q), T_1 Copper Sulphate @ 75 ppm (66.50 q), T_7 ZnSo4 @ 75 ppm (62.00 q), T_5 Ferrous Sulphate @ 75 ppm (61.00). And significantly less height was recorded in treatment T_10 (Control Plot) (60.47 q). More or less the present findings are similar with the findings of Umalaxmi Thingujam *et al.,* (2016) [7] who carried out a field experiment at the Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India to study the effects of integrated nutrient management on the nutrient accumulation (dry weight recoveries) in Brinjal and plant nutrient status of the post- harvest soil of Brinjal under Nadia conditions.

Table 1: Fruit length (cm), Fruit diameter (cm) and Fruit weight (g)

Tr. No.	Treatment Details	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)
T_1	Copper Sulphate @ 75 ppm	6.33	4.03	70.83
T_2	Copper Sulphate @ 150 ppm	7.17	4.93	81.83
T_3	Boric Acid @ 75 ppm	6.60	4.30	74.00
T_4	Boric Acid @150 ppm	7.37	5.20	83.93
T_5	Ferrous Sulphate @ 75 ppm	5.92	3.53	67.30
T_6	Ferrous Sulphate @ 150 ppm	6.80	4.48	76.33
T_7	ZnSo4 @ 75 ppm	6.13	3.80	68.67
T8	ZnSo4 @ 150 ppm	7.00	4.73	78.67
T9	$T_1 + T_3 + T_5 + T_7$	7.53	5.38	85.93
T_10	Control	5.73	3.42	65.93
S.Em (±)		0.33	0.20	3.80
CD (5%) =		0.98	0.61	11.30
CV =		8.58	8.15	8.74

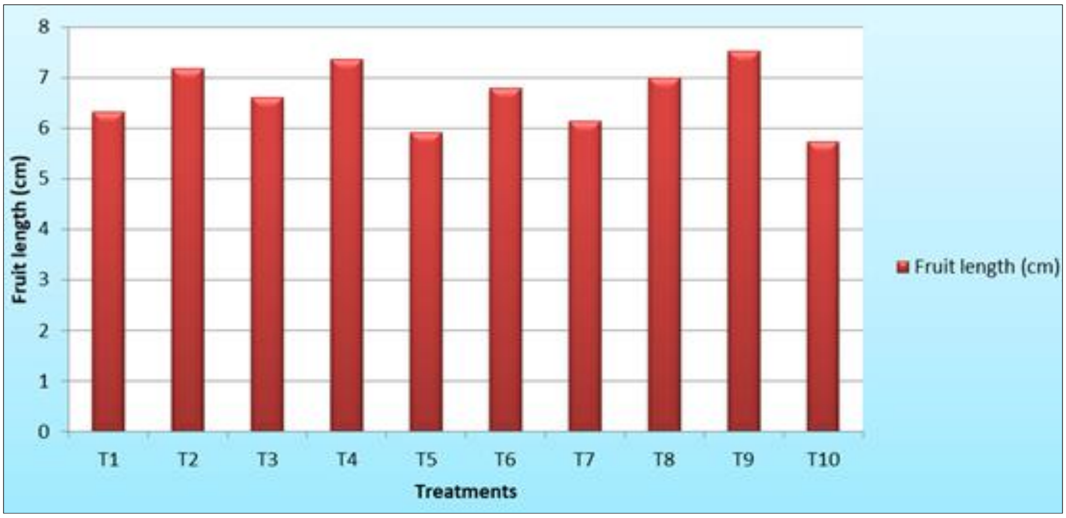

Fig 1: Fruit length (cm)

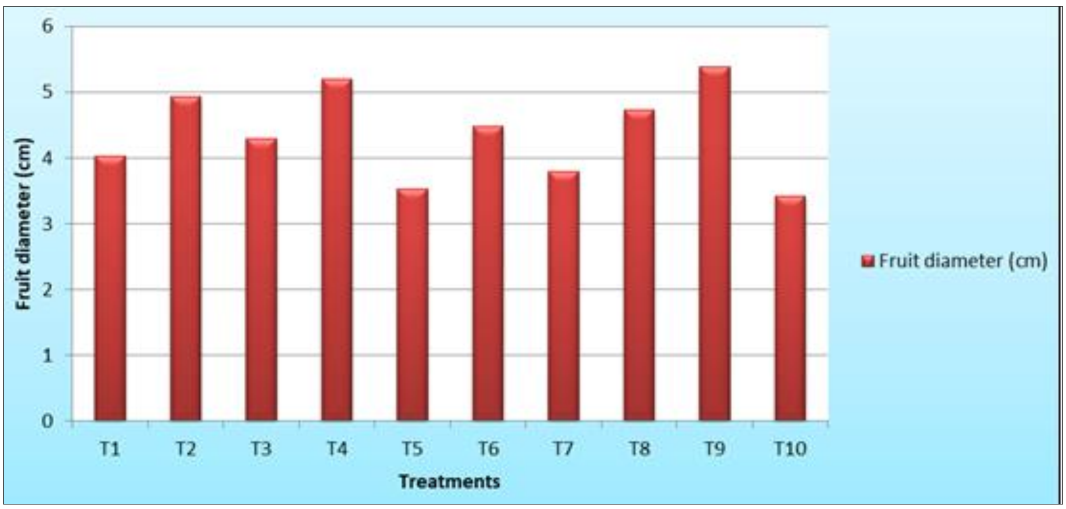

Fig 2: Fruit diameter (cm)

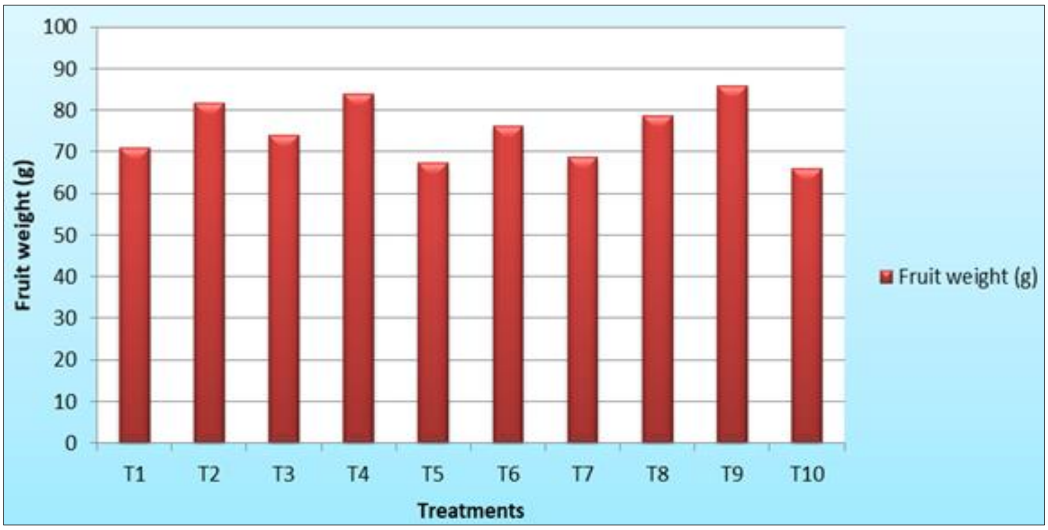

Fig 3: Fruit weight (g)

Table 2: Number of fruits per cluster and Yield per hectare (q)

Tr. No.	Treatment Details	Number of fruits per cluster	Yield per hectare (q)
T_1	Copper Sulphate @ 75 ppm	3.72	66.50
T_2	Copper Sulphate @ 150 ppm	4.13	85.00
T_3	Boric Acid @ 75 ppm	3.88	70.00
T_4	Boric Acid @150 ppm	4.19	91.00
T_5	Ferrous Sulphate @ 75 ppm	3.35	68.00
T_6	Ferrous Sulphate @ 150 ppm	4.00	74.33
T_7	ZnSo4 @ 75 ppm	3.55	62.00
T8	ZnSo4 @ 150 ppm	4.08	80.00
T9	$T_1 + T_3 + T_5 + T_7$	4.25	96.93
T_10	Control	3.05	60.47
S.Em (±)		0.19	3.69
CD (5%) =		0.57	10.97
CV =		8.70	8.56

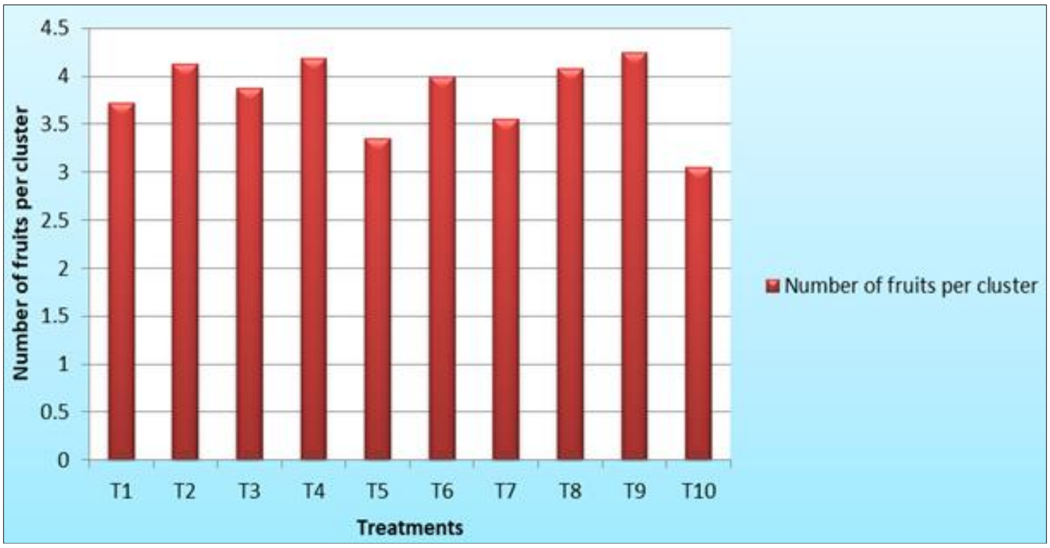

Fig 4: Number of fruits per cluster

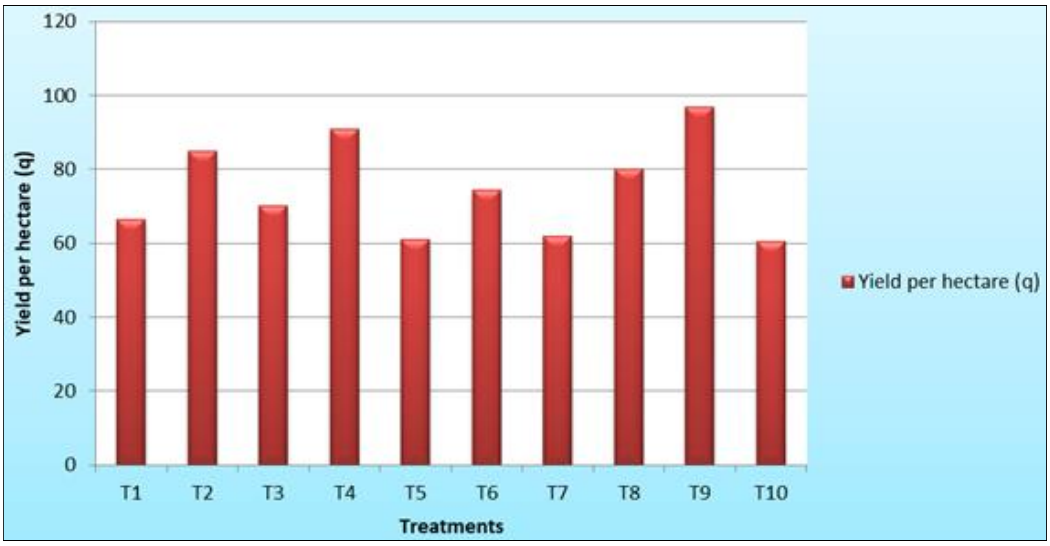

Fig 5: Yield per hectare (q)

Conclusion

On the basis of above findings, treatment $T_1 + T_3 + T_5 + T_7$ (Copper Sulphate @ 75 ppm + Boric Acid @ 75 ppm + Ferrous Sulphate @ 75 ppm + ZnSo4 @ 75 ppm) stand first in position and T_4 Boric Acid @150 ppm stand in second order of preference.

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