Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-6: 197-203

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-6 pp. 197-203**
Journal homepage: http://www.ijcmas.com

Original Research Article

Effect of Foliar Application of Some Macro and Micronutrients on Growth and Yield of Tomato (*Solanum lycopersicum* L.) cv. Arka Rakshak

Amit Dixit*, Dhananjay Sharma, Tinku Kumar Sharma and Pappu Lal Bairwa

Department of Vegetable Science, College of Agriculture, IGKV, Raipur (C.G.)-492012, India
**Corresponding author*

A B S T R A C T

A field experiment was conducted to evaluate the possible effect of some macro and micro nutrients with different concentration levels as a foliar application on the vegetative growth, flowering, and yield of tomato cv 'Arka Rakshak'. The experiment was carried out under randomized complete block design (RCBD) with three replicates. The important parameters encompassed in the study were Plant height (cm), Plant girth, Days to first flowering, Days to first fruiting, Days to maturity, No. of fruits per plant, Fruit length (cm), Fruit diameter (cm), Fruit weight (g), Yield per plant (kg) and Yield per ha (q). Although all the treatments showed a positive effect on growth, flowering, and yield but, T5 revealed most significant influence on all parameters under study as compared to T1 (control). Therefore, foliar application is suitable way to feed the tomato crop to enhance the growth, flowering and marketable yield.

Keywords

Tomato cv. Arka Rakshak, Macro and micronutrients, Growth and Yield.

Introduction

Tomato (*Lycopersicon esculentum* Miller, 2n = 2x = 24), popularly known as wolf apple, love of apple or Vilayati baingan is one of the most important vegetable crop, belongs to family Solanaceae, originated in south America (Harlan, 1992). It is a leading vegetable crop grown across the length and breadth of country due to its wide adaptability of various agro-climatic conditions. It is equally liked by both poor and rich and is quite high in nutritive value. Tomato is one of the paramount fruit vegetable grown around the globe and in terms of area it ranks next to potato whereas, as a processing crop it ranks first in the world. Tomato is classified as an annual plant cultivated in warm season with the average optimum growing temperature range of 25°C to 29°C (Ejaz *et al.*, 2011).

Tomato has gained enormous significance as fruit vegetable in the country and is being cultivated on an area of about 0.79 million hectare with a total annual production of around 17.39 million tonnes (Anon., 2015).

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). Crop fertilization is one the most common cultural practice and farmers employ it to maximize yield. It is now becoming obligatory with intensive land use and by agricultural advancement to fertilize farmlands under crop cultivation to achieve satisfactory yield (Williams and Harris, 1986).

All vegetables respond constructively to the application of small quantities of micro as well as macro-nutrients (Naz *et al.*, 2012). Moreover, the present global scenario strongly emphasizes the necessity to adopt sustainable agricultural practices for adequate food production. It is now well known that the cost of inorganic fertilizers has immensely increased to such an extent that these are usually out of the reach of small as well as marginal farmers. SO, farmers usually cannot afford to apply synthetic macro nutrients in large or adequate quantities (Mehdizadeh *et al.*, 2013). Moreover, quality and yield potential of tomato can be enhanced by maintaining adequate level of nutrients by Soil or foliar application. Generally, both macro and micro nutrients play an imperative role in quality tomato production. Tomato crop demands heavy and sufficient amount of fertilizers for high yield. For improving tomato plant growth and development, both organic as well as inorganic manures are essential. It is now well established point that chemical fertilizers increase growth of plants directly. Therefore, based on above facts, supplementary dosages of N, B and Zn with different combinations and concentrations were used as foliar feeding to investigate their possible effects on growth, flowering, and yield of tomato crop.

Materials and Methods

The research study was conducted at Horticulture cum instructional farm in the experimental field of AICRP on vegetable crops, College of Agriculture, IGKV, Raipur (C.G.) during 2016-17. The experiment was laid out according to Randomized Complete Block Design (RCBD). There were 7 treatments along with control having three replications. Seeds of tomato cv. 'Arka Rakshak' were sown in lines approximately 10 cm apart and were covered with Soil to avoid floating of seeds during watering and were instantly irrigated. Seedlings of uniform size, age, free from insect pest and disease infestation were transplanted in sowing plots with row to row and plant to plant distance of 75 and 60 cm apart, respectively.

All the cultural practices were similar for each block including weeding, irrigation, disease and pest control measures. The nutrients solution were made with respective concentrations and were applied with knap sack sprayer as a foliar feeding to each block 15 days after transplanting and 2nd dose was applied 21 days after transplanting with treatment *viz.*, T1- FeSO4 @ 0.2% spray, T2-Calcium nitrate @ 0.2% spray, T3-Boron @ 0.1% spray, T4-$ZnSO_4$ @ 0.2% spray, T5-mixture of all spray, T6-T2+T4 spray, T7-T2+T3 spray. While, in case of T8-control, merely tap water was applied as a foliar application.

The important parameters encompassed in the research study were Plant height (cm), Plant girth (cm), Days to first flowering, Days to first fruiting, Days to maturity, No. of fruits per plant, Fruit length (cm), Fruit diameter (cm), Fruit weight (g), Yield per plant (kg) and Yield per ha (q). The data collected from five randomly selected plants for above said parameters were subjected to analysis of variance technique (ANOVA) and least significance difference test was applied to separate different treatment means (Panse and Sukhatme, 1967).

Results and Discussion

Growth and earliness traits

Data related to growth and earliness traits are present in Table 1.

Plant height (cm)

The data presented on plant height of tomato at final stage of crop growth as influenced by foliar spray of micronutrients are presented in Table 1. The findings indicated that plant height was significantly affected by different treatments at final stage of crop growth.

Plant height varied from 93.75 to 135.75 cm.The maximum plant height was recorded in T_5- mixture of all spray (135.75 cm), which was significantly superior over other treatments but at par to treatment T_6- Calcium nitrate @ 0.2% + $ZnSO_4$ @ 0.2% (123.24 cm) and T_7- Copper sulfate@ 0.2% + Boron @ 0.1% (127.50 cm), whereas minimum plant height was recorded in T8-control (93.75 cm. The possible reason for maximum plant height in T5 may be accredited to availability of macro (Ca) and some micronutrients (B and Zn) which increased the overall tomato plant height. Similarly, Davis *et al.,* (2003) also reported somewhat similar findings regarding tomato plant height in response to different micronutrients. They found that tomato plant height ranged from 122 to 137 cm.

Plant girth

Plant girth ranged from 2.14 to 3.20 cm and among the treatments, maximum stem girth was recorded in T5- mixture of all spray (3.20 cm) followed by T4- $ZnSO_4$ @ 0.2% (2.75 cm), T1- $FeSO_4$ @ 0.2% (2.58 cm), T3- Boron @ 0.1% (2.58 cm), T7- Calcium nitrate @ 0.2% + Boron@ 0.1% (2.52 cm), T2- Calcium nitrate @ 0.2% (2.51 cm) and T6- Calcium nitrate @ 0.2% + $ZnSO_4$ @ 0.2% (2.48 cm). Whereas, minimum stem girth recorded by T8-control (2.14 cm). These findings are similar with the results of Govindan (1952), Bhatt *et al.,* (2006) and Patil *et al.,* (2008).

Days to first flowering

The perusal of data for days taken to first flowering ranged from 24.29 (T5) to 33.02 days (T8). Among the treatments, Earliest flowering (29.75 days) was recorded in T5-mixture of all spray, which was significantly superior over other treatments followed by T1- $FeSO_4$ @ 0.2% (26.50 days), T7-Calcium nitrate @ 0.2% + Boron @ 0.1% (26.75 days), T2-Copper sulfate@ 0.2% (27.05 days) and T6-Copper sulfate@ 0.2% + $ZnSO_4$ @ 0.2% (27.54 days). While, maximum number of days to first flowering was showed by T8- Control (33.02 days).

Days to first fruiting

The perusal of data for days taken to first fruiting ranged from 35.33 (T5) to 44.81 days (T8). The earliest fruiting (35.33 days) recorded in T5- mixture of all spray, which was significantly superior over other treatments. Whereas, maximum days to first fruiting recorded by T8-Control (44.81 days). Former was found statistically at par with T1- $FeSO_4$ @ 0.2% (38.50 days), T7-Calcium nitrate @ 0.2% + Boron @ 0.1% (38.79 days) and T2- Calcium nitrate @ 0.2% (38.83 days). While, later was statistically at par with T3- Boron @0.1% (40.31 days) and T4- $ZnSO_4$ @ 0.2% (40.80 days). Earliness in T5, T7, T2 and T1 flowering might be because of better absorption of the nutrients which involved in the metabolic activity and also activated the hormone which influence the earliness in these treatments. Similar results had also

been reported by Naz *et al.,* (2012) and Ali *et al.,* (2013) in Tomato.

Days to maturity

The minimum days to maturity (63.33 days) recorded in T5-mixture of all spray, which was significantly superior over other treatments and statistically at par with T7-Calcium nitrate @ 0.2% + Boron @ 0.1% (65.28 days) T6 Calcium nitrate @ 0.2% + $ZnSO_4$ @ 0.2% (67.75 days) and T2-Calcium nitrate @ 0.2% (68.80 days). Whereas, maximum days to maturity recorded by T8-control (44.81 days). The reason for maturity in T7, T6, T5 and T2 might be due to rapid initial plant growth because of favorable environment and due to proper and appropriate concentrations of micronutrients. These findings are in conformity with the results of Bhatt *et al.,* (2004) and Patil *et al.,* (2008).

Yield and yield attributing characters

Data related to yield and attributing characters are presented in Table 2

No. of fruits per plant

The number of fruits per plant varied from 50.53 to 72.07. The maximum number of fruits per plant was recorded in treatment T_5-mixture of all spray (72.07), followed by T2-Calcium nitrate @ 0.2% (65.31), T6-Calcium nitrate @ 0.2% + $ZnSO_4$ @ 0.2% (64), T4-$ZnSO_4$ @ 0.2% (61.56), T1-$FeSO_4$ @ 0.2% (59.50) and T3- Boron @ 0.1% (59.28). The minimum value of number of fruits per plant was recorded in treatment T_8-control (50.53). The possible reasons for maximum number of average tomato fruits in T5 was attributed due to more fruit setting and retention due to the availability of macro (Ca) and micronutrients (boron & Zinc, Fe) as a foliar feeding. Upendra *et al.,* (2003) also reported that mineral nutrition of tomato increase the yield of tomato no. of fruits per plant.

Fruit length (cm)

The assessment of data revealed that fruit length varied from 3.83 to 5.66 cm. Among the treatments, maximum fruit length was recorded in T5-mixture of all spray (5.66 cm), which was significantly superior over other treatments and statistically at par with T6-Calcium nitrate @ 0.2% + $ZnSO_4$ @ 0.2% (5.28 cm). Whereas, the minimum fruit length was recorded in T8 (3.83 cm) and it found statically at par with T1-$FeSO_4$ @ 0.2% (4.37 cm) and T2- Calcium nitrate @ 0.2% (4.02 cm). The maximum fruit length was recorded in the treatment T_5 (mixture of all spray) and T_6 Calcium nitrate @ 0.2% + $ZnSO_4$ @ 0.2%. These treatments showed equal value for fruit length. The increase in fruit length might be due to more accumulation of photosynthates which were synthesized in the leaf and translocated towards the fruit. The increased and accumulation of photosynthesis was probably due to more vigour growth. These results were also supported by Salam *et al.,* (2010) and Ali *et al.,* (2013).

Fruit diameter (cm)

The assessment of data revealed that fruit diameter (cm) ranged from 3.66 to 4.77 cm. Among the treatments, maximum fruit diameter was observed in T5-mixture of all spray (4.77 cm), which was significantly superior over other treatments and statistically at par with T4- $ZnSO_4$ @ 0.2% spray (4.57 cm) and T6- Calcium nitrate @ 0.2% + $ZnSO_4$ @ 0.2% (4.34 cm). Whereas, the minimum diameter (cm) was recorded in T8-control (3.66 cm) and it was found statically at par with T3- Boron@0.1% (4.07), T1-$FeSO_4$ @ 0.2% (4.03 cm) and

T2- Calcium nitrate @ 0.2% (3.91 cm). The maximum fruit diameter was recorded in the treatment T_5 (mixture of all spray) and, T_4 ($ZnSO_4$ @ 0.2% spray) and T_6 Calcium nitrate @ 0.2% + $ZnSO_4$ @ 0.2%. These treatments showed equal value for fruit diameter. The increase in fruit diameter might be due to more accumulation of photosynthates which were synthesized in the leaf and translocated towards the fruit. The increased and accumulation of photosynthesis was probably due to more vigour growth. These results were also supported by Salam *et al.,* (2010) and Ali *et al.,* (2013).

Fruit weight (g)

Fruit weight of tomato varied from 60.22 g (T8) to 80.06 (T5). The maximum fruit weight (80.06 g) recorded in T5- mixture of all spray, which was significantly superior over other treatments. Whereas, minimum fruit weight showed by T8-control (60.22 g). Former was found statistically at par with T1- $FeSO_4$ @ 0.2% (72.01 g), T3- Boron @ 0.1% (72.89 g), T4-$ZnSO_4$ @ 0.2% (73.56 g) and T6- Calcium nitrate @ 0.2% + $ZnSO_4$ @ 0.2% (74.55 g).

The improvement in this character may be because of better absorption of micronutrient which ultimately increase the accumulation of carbohydrate in the fruits and provide better environment for growth and developmental processes, thus, better results were obtained due to the availability of favourable conditions in these treatments. The results of present investigation are in accordance with the finding of Rafique *et al.,* (2004) and Bhatt *et al.,* (2006).

Yield per plant (kg) and yield per ha (q)

Yield per plant (kg) and per ha (q) ranged from 2.04 to 4.77 kg, 275.61 to 562.57 q, respectively. Among the treatments, maximum yield per plant (kg) and per ha (q) was recorded in T5-mixture of all spray (4.77 kg, 562.57 q), which was significantly superior over other treatments and followed by T6- Copper sulfate@ 0.2% + $ZnSO_4$ @ 0.2% (3.78 kg, 452.73 q), T4- $ZnSO_4$ @ 0.2% spray (3.52 kg, 412.93 q), T2- Calcium nitrate @ 0.2% (3.45 kg, 389.25 q), T3- Boron @ 0.1% (3.32 kg, 383.05 q) and T1- $FeSO_4$ @ 0.2% (3.27 kg, 373.78 q). Whereas, the minimum yield per plant (kg) and per hectare was observed in T8-control (2.04 kg, 2.75.61 q, respectively).

The possible reason for more yield in T5 might be due to overall attribution by fruit length, width, weight and no of fruits, which may be increased by foliar feeding of macro and micronutrients. These findings are similar with the results of Patnaik *et al.,* (2001) and Singh *et al.,* (2003).

It is clear from results that foliar spray of T5 was found much effective over control. The findings revealed that treatment T5-mixture of all spray recorded the maximum plant height (cm), plant girth (cm), no. of fruits per plant, fruit length (cm), fruit diameter (cm), fruit weight (g), yield per plant (kg) and yield per plant (kg).

This improvement in growth, and yield might be due to the availability of essential nutrients (Ca, Fe, B and Zn), and easiness of absorbing them via leaves that fulfill the optimal nutritive requirements of tomato plants.

Acknowledgement

The main author is highly grateful to Department of Vegetable science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.), for providing the facilities and technical support for research work.

Table.1 Growth and earliness attributing traits of tomato affected by foliar spray of macro and micronutrients

Treatment	Plant height (cm)	Plant girth (cm)	Days to first flowering	Days to first fruiting	Days to maturity
T1	99.75	2.58	26.50	38.50	69.25
T2	102.50	2.51	27.05	38.83	68.80
T3	111.08	2.58	28.31	40.31	68.25
T4	105.25	2.75	28.07	40.31	69.30
T5	135.75	3.20	24.29	35.33	63.33
T6	123.24	2.48	27.54	39.57	67.75
T7	127.50	2.52	26.75	38.79	65.28
T8	93.75	2.14	33.02	44.81	76.96
MEAN	112.35	2.60	27.69	39.56	68.62
SE(m±)	4.021	0.08	1.34	1.43	1.96
CV	13.15	6.79	9.71	7.11	6.73
CD (p≤0.05)	7.15	0.29	4.40	4.69	5.9

Table.2 Yield and yield attributing traits of tomato affected by foliar spray macro and micronutrients

Treatment	No of fruits per plant	Fruits length (cm)	Fruit diameter (cm)	Fruit weight (g)	Yield per plant (kg)	Yield/ha (q)
T1	59.50	4.37	4.03	72.01	3.27	373.78
T2	65.31	4.02	3.91	66.67	3.45	389.25
T3	59.28	4.89	4.07	72.89	3.32	383.05
T4	61.56	4.77	4.57	73.56	3.52	412.93
T5	72.07	5.66	4.77	80.06	4.77	562.57
T6	64.00	5.28	4.34	74.55	3.78	452.73
T7	60.25	4.85	4.07	71.07	3.55	399.36
T8	50.53	3.83	3.66	60.22	2.04	275.61
MEAN	61.56	4.71	4.18	71.38	3.46	406.16
SE(m ±)	2.60	0.21	0.18	2.72	0.21	30.50
CV	9.79	9.31	8.72	7.50	12.65	14.90
CD (P=0.05)	7.60	0.72	0.59	9.66	0.64	90.33

References

Ali, W., Jilani, M.S., Naeem, N., Waseem, K., Khan, J., Ahmad, M.J. and Ghazanfarullah. 2013. Evaluation of different hybrids of tomato under the climatic conditions of Peshawar. *Sarhad Journal of Agriculture*, 28(2), 207–212.

Anonymous, 2015. Horticultural Statistics at a Glance, Horticulture statistics division department of agriculture, cooperation and farmers welfare ministry of agriculture and farmers welfare government of India.

Bhatt, L., Srivastava, B.K. and Bhatt Singh, M.P. 2004. Studies on effect of application of micronutrients on

nutrients uptake in tomato. *Prog. Hort*., 36(2): 331-334.

Davis, J.M., Sanders, D.C., Nelson, P.V., Lengnick, L. and Sperry, W.J. 2003. Boron improves growth, yield, quality, and nutrients contents of tomato. *Journal of American Society for Horticultural Science*, 128(3), 441–446.

Ejaz, M., Rehman, S.U., Waqas, R., Manan, A., Imran, M. and Bukhari, M.A. 2011. Combined efficacy of macro-nutrients and micro-nutrients as a foliar application on growth and yield of tomato grown by vegetable forcing. *International Journal for Agro Veterinary and Medical Sciences*, 5(3), 327–335.

Govindan, P.R. 1952. Influence of boron on yield and content of carbohydrates in tomato fruits. *Curr. Sci*., 21:14-15.

Harlan, J.R. 1992. Crops and Man. 2nd ed. American society of Agronomy, Crop Sciences of America, Madison, WI.

Mehdizadeh, M., Darbandi, E.I., Naseri-Rad, H., and Tobeh, A. 2013. Growth and yield of tomato (*Lycopersicon esculentum* Mill.) as influenced by different organic fertilizers. *International Journal of Agronomy and Plant Production*, 4(4), 734–738.

Naz, F., Haq, I.U., Asghar, S., Shah, A.S. and Rahman, A. 2011. Studies on growth, yield and nutritional composition of different tomato cultivars in Battal Valley of District Mansehra, Khyber Pakhtunkhwa, Pakistan. *Sarhad Journal of Agriculture*, 27(4), 569–571.

Panse, V.G. and Sukhatme, P.V. 1967. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, India, 152-161 pp.

Patil, B.C., Hosamani, R.M., Ajjappalavara, P.S., Naik, B.H., Smitha R.P. and Ukkund, K.C. 2008. Effect of foliar application of micronutrients on growth and yield components of tomato (*Lycopersicon esculentum* Mill.). *Karnataka J. Agric. Sci*., 21(3): 428-430.

Patnaik, M.C., Bhupal, R.G. and Reddy, I.P., 2001. Response of tomato (*Lycopersicon esculentum*) to zinc and iron. *Veg. Sci*., 28: 78-79.

Rafique, Abdul, Abdul, M. and Ahmed, A. 2004. Effect of micronutrient supplement in growth and development of okra (*Abelmoschus esculentus* L. Moench) *Bangladesh. Journal of Botany*, 33(2):129-131.

Salam, M.A., Siddique, M.A., Rahim, M.A., Rahman, M.A. and Saha, M.G. 2010. Quality of tomato (*Lycopersicon esculentum* Mill.) as influenced by Boron and Zinc under different levels of NPK fertilizers. *Bangla. J. Agril. Res.*, 35 (3): 475-488.

Upendra, M, Dris, S.R. and Singh B. 2003. Mineral nutrition of tomato. *Journal of Food, Agriculture and Environment*, 1(2), 176–183.

Williams, L.B. and Harris, G. 1986. Fertilizer marketing in Nigeria. *Fertilizer International*, 225, 45–49.