Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6163

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (2):** 929-934 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Effect of Foliar Application of Micronutrients on Growth and Yield Parameters in Tomato (*Solanum lycopersicon* L.)

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Received: 13.01.2018 | Revised: 19.02.2018 | Accepted: 27.02.2018

ABSTRACT

In order to explore the response of foliar application of micronutrients as a supplement for good growth and yield of tomato cultivars Arka saurabh and Arka vikas, a field experiment was conducted at vegetable farm, College of Horticulture, Anantharajupeta, A.P. during rabi-2015-2016. The treatments consist of boron, zinc, molybdenum, copper, iron, manganese, mixture of all and control and the experiment was laid out in RBD with three replications. All the micronutrients except manganese were applied at 250 ppm in three sprays at an interval of ten days starting from 30 days after transplanting. Manganese sprayed @50 ppm. All the treatments recorded superior performance in plant growth characteristics viz. plant height, number of primary branches and compound leaves and yield parameters viz., tender and mature fruits per plant in both the varieties over control. In tomato cv. Arka sourabh, maximum growth rate (85.7 %) was observed with application of zinc, followed by micronutrients mixture (78.2 %) and boron (77.5 %). However in tomato cv. Arka vikas, maximum increase in branches per plant was observed with the application of manganese (148.7 %) followed by micronutrient combination (144.1 %). In Arka sourabh, the fruit yield per plant ranged from 1.336 kg to1.867 kg and in Arka vikas, it ranged from 1.500 kg to 1.967 kg. This study proves that foliar application of micronutrients produced the good growth and maximum fruit yield in tomato.

Key words: *Tomato, Micro nutrients, Foliar application, Growth, Yields.*

INTRODUCTION

Tomato (*Solanum lycopersicon* L. 2n=24), is a popular solanaceous vegetable cultivated throughout the world. It occupies prime place amongst the processed vegetables. It is one of the most highly praised vegetables consumed in salad as well as curry. In India, tomato is grown throughout the country. The leading tomato growing states are Karnataka, Andhra Pradesh, Orissa, Bihar and West Bengal. Tomato is a high yielding crop, for a good stand and yield of tomato, a rich and fertile soil is necessary.

Cite this article: Datta Reddy G.P., Reddy, S.S. P, Reddy, C.G. and Sivaram, T.G., Effect of Foliar Application of Micronutrients on Growth and Yield Parameters in Tomato (*Solanum lycopersicon* L.), *Int. J. Pure App. Biosci.* **6(2):** 929-934 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6163

Although in recent times balanced nutrition to the crop plants is being advocated through the use of organic manures, but that may be helpful only for low yield levels. For harnessing the higher yield potential, supplementation of micronutrients is essential. Amongst the vegetables, tomato is highly responsive to the application of micronutrients. Micronutrients improve the chemical composition of fruits and general condition of plants and are known to act as catalyst in promoting organic reactions taking place in plants[12]. Applications of micro- nutrients i.e. zinc and boron have been reported in increasing growth and seed yield in tomato. However very little information is available with regards to the effect of other micro-nutrients on vegetative and reproductive growth parameters of tomato. In order to study the effect of different micro nutrients viz., zinc, boron, molybdenum, copper, iron and manganese, on tomato growth parameters, the present investigation was initiated.

MATERIAL AND METHODS

A field experiment was conducted during rabi, 2015 to find out the response of foliar application of micronutrients on growth yield and parameters of two tomato cultivars viz, Arka sourabh and Arka vikas at vegetable farm, College of Horticulture, Anantharajupeta, A.P. The treatments consisted of boron, zinc, molybdenum, copper, iron, manganese, mixture of all and control. The experiment was laid in RBD with 3 replications. Seedlings of each variety were transplanted in a 4-row plot of 7.0 m2 area (2.8 m x 2.5 m) with a spacing of 70 cm x 50cm.

Micronutrients application

There were eight treatments involving six micronutrients (Zn, Mo, B, Cu, Mn and Fe), applied through foliar spray individually and in full combination as a mixture along with control @ 250 ppm each except Mn (@ 50 ppm). All the micronutrients were applied as foliar spray starting from 30 days after transplanting. A total of three sprays were given at an interval of 10 days.

Observations recorded

Observations on various growth and yield parameters like plant height, number of primary branches per plant, number of compound leaves per plant, number of tender fruits per plant, number of mature fruits per plant, fruit weight, fruit yield per plant and fruit yield per hectare were recorded on five randomly selected plants for each treatment in each replication of both the verities. Average values were computed and the data was subjected to statistical analysis[10].

RESULTS AND DISCUSSION

Growth parameters

The analysis of variance for main shoot length measured at 30, 40, 50, 60 and 70 days after transplanting revealed significant differences among the treatments in both the tomato varieties. As evident from the mean values of both the varieties (Table 1) the maximum plant height was recorded with the spray of micronutrients mixtures (T8) in both varieties which is at par with zinc and boron in both the varieties respectively. In tomato cv., Arka sourabh maximum growth rate (85.7 %) was observed with application of zinc, followed by micronutrients mixture (78.2 %) and boron (77.5 %). While in tomato cv. Arka vikas, growth rate was maximum (74.4 %) with application of micronutrients mixture followed by zinc (72.2 %) and copper (72.0 %). Application of zinc, boron, and micronutrient mixture has been reported to be increasing the plant height of tomato[7]. Increase in plant height might be attributed to the role of zinc in auxin synthesis and association of boron with development of cell wall and cell differentiation which helps in root and shoot growth of plants[2]. According to Das and Mahapatra[4] and Das and Sahoo [5] foliar application of boron at 0.5 and 105 ppm to potato and brinjal crops, respectively gave significant increase in plant height, number of branches and leaves and main stem thickness. Similarly Popushoi and Shatrova[11] reported that treatment of egg plants with boron at 0.15% stimulated growth and development. Das and Dash[3] reported micronutrient spray in tomato enhanced higher plant growth and

development compared to control. The rate of increase in number of primary branches per plant at different growth stages after application of micronutrients indicated maximum response of micronutrient mixture (156.7 %) at 70 days after transplanting in tomato cv. Arka sourabh. However, in tomato cv. Arka vikas maximum increase was observed with the application of manganese (148.7 %) followed by micronutrient combination (144.1 %). Significant increase in number of branches per plant has been reported by application of boron[2] , Zinc[8] and micronutrient mixture[7]. Combined application of Zn, Fe, B at 1.0 % as foliar spray was found effective in respect of number of branches per plant (11.2), stem diameter (1.54) and spread of plant (53.54) in chilly[7]. At the final growth stage (70 DAT), the maximum number of leaves (108.4 and 106.0) was observed in micronutrient mixture followed by application of boron (106.6 and 105.0) in tomato varieties, Arka sourabh and Arka vikas respectively. The rate of increase in number of leaves per plant at different stages of growth after application of micronutrients (Table 2) showed similar effect in both the varieties. Application of micronutrient mixture resulted in maximum increase in the number of leaves in Arka vikas(216.9 %) and in Arka sourabh (220.2 %) at the final growth stage. Application of boron also showed significant effect next to micronutrient mixture (213.5 % and 207.0 %) in Arka sourabh and Arka vikas respectively. Influence of boron either singly or in combination with other micronutrients has been reported to increase the number of leaves per plant in several crops[9]. Increase in plant growth characters viz. plant height, number of branches and leaves per plant by application of micronutrients may be due to their involvement in chlorophyll formation, which might have helped to favour cell division, meristematic activity in apical tissue, expansion of cell and formation of new cell wall[13].

YIELD PARAMETERS

Total numbers of developing tender fruits on the sampled plants were recorded at three different stages of plant growth (50, 60 and 70 DAT) after application of micronutrients. The results (Table 3) indicated significant variation among the treatments at three growth stages except on 50 DAT in tomato cv. Arka vikas. Application of micronutrients mixture resulted in maximum number of tender fruits at all three growth stages in both the varieties. Application of boron was also found effective next to micronutrients combination in increasing the fruit set and fruit development. Since the quality of seed largely depends upon the fruit quality, in this experiment only good quality mature and ripe fruits were plucked for extraction of seed. Total number of mature fruits (Tables 3) differed significantly among the treatments (22.27 to 29.09 and 24.30 to 30.50) in Arka sourabh and Arka vikas receptively. The maximum numbers of mature fruits were obtained with combined application of micronutrients in both the varieties. However percentages of rejected fruits calculated as the ratio of total number of mature and tender fruits, were minimum in Zinc and Boron treatments in both the varieties. Increases in the number of mature fruits per plant in tomato have been reported by application of zinc and /or boron by several workers[14]. Among the micro nutrients, application of boron and mixture of micronutrients alone enhanced the fruit weight while, other micronutrients did not show any positive effect. The increase in fruit weight might be due to better mineral utilization of plants accompanied with enhancement of photosynthesis, other metabolic activity and greater diversion of food material to fruits. Increase in fruit size and weight by application of micronutrients have been reported by Bajpai *et al*[1]. Fruit yield calculated on per plant and per hectare basis, was significantly affected by micronutrient treatments as depicted by analysis of variance and the mean values in both the tomato varieties (Table 4). The fruit yield per plant ranged from 1.336 kg to 1.867 and from 1.500 kg to 1.967 kg in Arka sourabh and Arka vikas, respectively. Similarly, fruit yield per hectare ranged from 27.00 t to 35.5 t, 27.1 t to 37.4 t in Arka sourabh and Arka vikas, respectively. In both the varieties, combined application of micronutrients produced the maximum fruit yield followed by

application of boron and zinc. Increased yield due to micronutrient application might be attributed to enhanced photosynthetic activity, resulting into the increased production and accumulation of carbohydrates and favorable effect on vegetative growth and maximum retention of flowers and fruits, which might have increased the number and weight of fruits. Increased yield in response to micronutrients (B, Zn and mixture) have been reported by Davis *et al*.[6] and Basavarajeswari *et al.*[2] in different vegetable crops.

Table 1: Effect of foliar application on plant height (cm) at different growth stages of tomato varieties

Treatment	Arka sourabh					Arka vikas				
	30 DAT	40 DAT	50 DATY	60 DAT	70 DAT	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
Control	37.5	39.4	49.3	58.7	61.9	42.8	45.5	57.2	66.8	70.8
B	38.7	41.6	53.4	65.1	68.7	42.7	47.8	59.8	69.8	72.9
Zn	38.0	42.7	55.1	67.4	70.6	41.9	47.1	58.0	69.0	72.1
Mo	36.8	39.8	50.3	59.7	62.3	42.7	47.1	58.5	68.6	71.6
Cu	37.5	38.8	50.1	59.7	62.1	41.8	46.0	57.9	68.3	72.0
Fe	37.5	39.5	48.9	57.8	62.6	42.7	44.3	54.9	65.8	70.5
Mn	38.3	40.5	52.2	63.2	64.4	42.5	46.0	59.0	68.0	72.6
Mixture	39.6	42.8	55.8	67.2	70.6	42.7	48.6	60.7	71.0	74.5
S. EM±	1.11	1.07	0.799	1.134	0.993	0.893	0.806	0.962	0.963	0.621
C. D. at 5 %	NS	NS	2.426	3.440	3.013	NS	2.445	2.920	2.923	1.884
C. V(%)	5.07	4.58	2.67	3.15	2.63	3.64	2.920	2.86	2.44	1.49

Table 2: Effect of foliar application micronutrients on number of compound leaves per plant at different stages of growth of tomato

Treatments	cv. Arka sourabh					cv. Arka vikas				
	30 DAT	40 DAT	50 DATY	60 DAT	70 DAT	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
Control	33.70	50.80	68.60	83.30	99.1	33.20	49.90	66.80	84.90	100.50
B	34.00	54.90	71.30	91.20	106.6	34.20	53.20	70.50	91.10	105.00
Zn	33.50	54.00	70.50	88.00	104.8	32.90	49.50	67.80	84.00	100.50
Mo	34.00	52.00	68.90	84.20	100.8	33.90	50.90	67.10	84.20	99.00
Cu	35.00	53.10	68.20	84.00	101.1	34.70	53.10	67.30	83.40	102.60
Fe	33.70	53.40	68.30	83.10	101.7	33.20	52.20	67.40	83.20	101.90
Mn	34.70	53.30	69.70	84.90	102.2	33.60	53.50	67.00	83.20	103.00
Mixture	34.20	56.33	72.50	92.60	108.4	33.10	1.15	72.80	93.00	106.00
S. EM±	0.925	1.19	0.920	0.946	0.996	1.18	3.507	1.07	0.980	0.858
C. D. at 5 %	NS	NS	2.79	2.872	2.963	NS	3.507	3.260	2.973	2.593
C. V(%)	4.70	3.86	2.29	1.90	1.64	6.10	3.84	2.72	1.98	1.45

Table 3: Effect of foliar application on number of tender and mature fruits per plant in tomato

Treatments	Arka sourabh				Arka vikas			
	Number of Tender fruits			No of mature fruits/ plant	Number of Tender fruits			No of mature fruits/ plant
	50 DAT	60 DAT	70 DAT		50 DAT	60 DAT	70 DAT	
Control	24.34	26.80	29.70	22.27(25.0)	24.70	26.60	32.8	24.60(25.0)
B	28.90	33.40	36.50	28.467(22.0)	29.80	32.50	37.20	29.380(21.0)
Zn	26.40	29.30	33.06	26.050(21.2)	27.80	32.10	34.30	26.75(22.0)
Mo	25.60	27.60	31.70	24.11(23.9)	26.63	30.50	33.60	25.53(24.0)
Cu	26.30	27.50	31.30	24.120(22.9)	25.70	30.70	33.40	25.38(24.0)
Fe	24.40	26.50	31.30	23.780(24.0)	24.60	27.20	32.40	24.30(25.0)
Mn	26.10	29.60	33.20	24.90(25.0)	25.90	30.00	33.90	25.76(24.0)
Mixture	30.067	33.90	37.50	24.09(22.4)	30.40	32.80	39.20	30.57(22.0)
S. EM±	0.907	0.887	1.11	1.074	1.54	1.219	1.28	1.656
C. D. at 5 %	2.753	2.692	3.386	3.258	NS	3.70	3.89	5.025
C. V(%)	5.93	5.24	5.85	7.34	9.92	6.97	6.43	10.81

Table 4: Effect of foliar application of micronutrients on fruit yield characteristics of tomato varieties

Treatments	Per fruit weight(g)		Fruit yield/ plant(kg)		Fruit yield/ ha(tons)	
	Arka sourabh	Arka vikas	Arka sourabh	Arka vikas	Arka sourabh	Arka vikas
Control	61.00	60.00	1.500	1.336	28.90	27.00
B	65.00	65.00	1.757	1.750	35.80	34.90
Zn	63.00	62.00	1.683	1.627	32.50	32.50
Mo	59.00	61.00	1.627	1.570	31.00	29.40
Cu	60.00	58.00	1.523	1.408	29.63	28.20
Fe	58.00	59.00	1.409	1.403	27.63	28.00
Mn	60.00	61.00	1.533	1.518	29.80	30.30
Mixture	65.00	64.00	1.967	1.867	37.40	35.50
S. EM±	5.35	5.690	0.102	0.102	0.804	0.939
C. D. at 5 %	NS	NS	0.322	0.311	NS	2.848
C. V(%)	15.10	16.09	11.33	11.39	4.97	5.29

CONCLUSION

In the present investigation, it was apparent that foliar application of micronutrients either alone or in combination, enhanced most of the plant growth characteristics viz; plant height, number of primary branches and compound leaves. Among the treatments, application of micronutrients mixture produced the highest fruit yield per ha of 35.5 and 37.4 ton in Arka sourabh in Arka vikas respectively. Even individual treatments like boron and zinc were equally effective in augmenting the fruit yield over the untreated control.

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