Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; SP1: 400-403

Amit Dixit
Department of Vegetable Science, College Of Agriculture, Igkv, Raipur, Chhattisgarh. India

Dhananjay Sharma
Department of Vegetable Science, College Of Agriculture, Igkv, Raipur, Chhattisgarh. India

Tinku Kumar Sharma
Department of Vegetable Science, College Of Agriculture, Igkv, Raipur, Chhattisgarh. India

Pappu Lal Bairwa
Department of Vegetable Science, College Of Agriculture, Igkv, Raipur, Chhattisgarh. India

Correspondence
Amit Dixit
Department of Vegetable Science, College Of Agriculture, Igkv, Raipur, Chhattisgarh. India

To study the effect of calcium and different micronutrients on fruit quality attributes of tomato CV 'Arka Rakshak'

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

Abstract
A field experiment was conducted to evaluate the possible effect of Calcium and some micro nutrients with different concentration levels as a foliar application on the quality attributes 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 shelf life (days), T.S.S (%), acidity (%), reducing sugar (%), non-reducing (%), total sugar (%) and ascorbic acid content (mg). The data clearly showed that the treatment (T_5) exhibited more shelf life (16.63 days), maximum T.S.S (5.25%), acidity (0.42%), reducing (1.68%), non-reducing (2.00%), total sugar (3.63%) and ascorbic acid content (19.94 mg).

Keywords: calcium, micronutrients, quality attributes of tomato CV 'Arka Rakshak'

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) [7]. It is a tropical day neutral plant and it is mainly self-pollinated, but a certain percentage of cross pollination also occurs. The crop is native to Central and South America (Vavilov, 1951). In world, it ranks second in importance after potato, but tops the list of processed vegetables (Chaudhary, 1996) [2]. In India, tomato is grown on an area of 0.79 million hectare with an annual production of 17.39 million tonnes (Anon., 2015) [1]. In Chhattisgarh, tomato is being cultivated in area of 52.89 thousand ha and production of 868.60 thousand tonnes with a productivity of 15.89 tonne/ha (Anon., 2015) [1]. Tomato cultivation had tremendously increased due to its multifarious uses like raw for salads, cooked alone or mixed with other vegetables and processed in many forms such as soup, sauce catch-up and preservative etc. The high market price is attributed to the heavy demand from the urban consumers. There is a good demand for export too. The export market needs fruits with longer shelf life, attractive colour with good taste. However, the supply is inadequate due to the low productivity of the crop (Sezen *et al.* 2006) [18]. Tomato being a moderate nutritional crop is considered as an important source of Vitamin A, C and minerals which are important ingredients for table purpose, sambar preparation, chutney, pickles, ketchup, soup, juice, pure etc. (Sekhar *et al.*, 2010) [17]. The fruits are eaten either raw or cooked. It is used directly as raw vegetable in the sandwiches, juice, soup, salad etc (Joshi and Kohli, 2006) [9]. The macro and micronutrients seems to be one of the factors that may enhance fruit quality and yield. Though micronutrients are required in small quantities yet they play a significant role in modifying various physiological functions of the plant. They act as stimulants and catalysts in many metabolic processes of the plants. Some of them act as enzyme formers and are needed in small quantities. There for effect of Calcium and different micronutrients on fruit quality attributes of tomato cv 'Arka Rakshak' were tested under the present study.

Material 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-ZnSO4 @ 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 study were shelf life (days), T.S.S (%), acidity (%), reducing sugar (%), non-reducing (%), total sugar (%) and ascorbic acid content (mg). 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) [13].

Results and Discussion

Shelf life

The data presented on shelf life (days) of tomato as influenced by different micronutrients spray are presented in Table 1. The findings indicated that shelf life was significantly affected by different treatments. The assessment of data revealed that shelf life varied from 11.08 to 16.63 days. Among the treatments, maximum shelf life was recorded in T5-mixture of all spray (16.63 days), which was significantly superior over other treatments and statistically at par with T6-Calcium nitrate @ 0.2% + ZnSO4 @ 0.2% (15.88 days), T4-ZnSO4 @ 0.2% (15.66 days), T2- Calcium nitrate @ 0.2% (15.24 days), T3- Boron @ 0.1% (15.19 days), T7-Calcium nitrate @ 0.2% + Boron @ 0.1% (14.94 days) and T1- FeSO4 @ 0.2% (14.78 days). Whereas, minimum shelf life (days) was observed in T8-control (11.08 days). With respect to shelf life, the present experiment showed that maximum shelf life was recorded by mixture spray of micronutrients (T5). This is in line with the findings of Salam *et al*. (2010) [16] and Punith Raj *et al.* (2012) [14]. Increased storage ability of tomato fruits might be dueto the increased ascorbic acid and acidity content of fruits (Chaurasia *et al*., 2006) [3].

Total Soluble Solid (%)

The data presented on total soluble solid (%) of tomato as influenced by different micronutrients spray are presented in Table 1. The findings indicated that total soluble solid (%) was significantly affected by different treatments. Total soluble solid (%) ranged from 4.08 to 5.28%. Among the treatments, maximum total soluble solid (%) was recorded in T5-mixture of all spray (5.28%), which was significantly superior over other treatments but at par with T7- Calcium nitrate @ 0.2% spray + Boron @ 0.1% spray (5.07%), T4-ZnSO4 @ 0.2% spray (4.78%) and T2- Calcium nitrate @ 0.2% (4.77%). Whereas, the minimum total soluble solid (%) was observed in T8-control (4.08%) and it was found statically at par withT1-FeSO4 @ 0.2% (4.53%) and T3-Boron @ 0.1% (4.51%). `In the present experiment T5-mixture of all spray was recorded maximum total soluble solid content followed by T7- Calcium nitrate @ 0.2% spray + Boron @0.1% spray, T4- ZnSO4 @ 0.2% spray and T2- Calcium nitrate @ 0.2%. The increase in TSS content of fruits may be attributed to growth promoting substances which could have accelerated 39 synthesis of carbohydrates, vitamins and other quality characters. This is in line with the findings of Fageria *et al.* (2002) [6], Chaurasia *et al.* (2006) [3] and Punith Raj *et al.* (2012) [14].

Acidity (%)

The data recorded for acidity (%) have been presented in the table 1. Acidity (%) value ranged from 0.35 to 0.42% and among the treatments, maximum acidity (%) was recorded in T5- mixture of all spray (0.42%), which was significantly superior over all treatments but at par with T7- Calcium nitrate @ 0.2% + Boron @ 0.1% (0.41%), T3- Boron @ 0.1% (0.41%), T1- FeSO4 @ 0.2% (0.39%), T2- Calcium nitrate @ 0.2% (0.38%), T6- Calcium nitrate @ 0.2% + ZnSO4 @ 0.2% (0.38) and T4- ZnSO4 @ 0.2% (0.38%). Whereas, minimum acidity (%) recorded by T8-control (2.14 cm). With respect to acidity, the present experiment showed that maximum acidity was recorded by mixture spray of micronutrients (T5), followed by T7- Calcium nitrate @ 0.2% + Boron @ 0.1%, T3- Boron @ 0.1%, T1- FeSO4 @ 0.2%, T2- Calcium nitrate @ 0.2%, T6- Calcium nitrate @ 0.2% + ZnSO4 @ 0.2% and T4- ZnSO4 @ 0.2%. Similar results were obtained by Verma *et al.* (1995) [21], Dube *et al.* (2003) [4] and Harris and Lavanya (2016) [8] in tomato.This might be due to application of zinc, Cu and other micronutrients had increased the titratable acidity in fruits. The fruit juice constitutes a weak acid and strong base buffer system consisting of anions and cations and the increased acidity may be therefore attributed to an increase in the concentration of cations especially zinc and copper brought about by their application.

Reducing sugar (%)

The data presented on reducing sugar (%) of tomato as influenced by different micronutrients spray are presented in table 1. The findings indicated that reducing sugar (%) was significantly affected by different treatments. Reducing sugar (%) ranged from 1.20 to 1.68%. Among the treatments, maximum reducing sugar (%) was recorded in T5-Mixture of all spay, which was significantly superior over other treatments but at par with, with T6- Calcium nitrate @ 0.2% spray + ZnSO4 @ 0.2% spray (1.63%) and T4- ZnSO4 @ 0.2% spray (1.60%).Whereas, the minimum reducing sugar (%) was observed in T8- control (1.20%).

Non-reducing sugar (%)

The data presented on non-reducing sugar (%) of tomato as influenced by different micronutrients spray are presented in table 1. The findings indicated that nonreducing sugar (%) was significantly affected by different treatments. Data revealed that non-reducing sugar (%) varied from 1. 40 to 2%. Among the treatments, maximum non-reducing sugar (%) was recorded in T5-mixture of all spray (2%),which was significantly superior over other treatments but at par with T4- ZnSO4 @ 0.2% spray (1.90%) and T6-Calcium nitrate @ 0.2% + ZnSO4 @ 0.2% (1.89%). While, lowest content of non-reducing sugar (%) was observed in T8-control (1.40%) and it was found statically at par with T1- FeSO4 @ 0.2% spray @ 0.2% (1.50%).

Total sugar (%)

The data recorded for **total sugar (%)** have been presented in the table 1. Total sugar (%) value ranged from 2.60-3.63% and among the treatments, maximum total sugar (%) was observed in T5- mixture of all spray (3.63%), which was

significantly
superior over all treatments and at par with T6- Calcium nitrate @ 0.2% + ZnSO4 @ 0.2% (3.57%) and T4- ZnSO4 @ 0.2% (3.50%). Whereas, minimum total sugar (%) was observed in T8-control (2.60%) and it was statistically at par with T (2.73%). Maximum Sugar content (reducing, non-reducing and total sugar) under present study was recorded in treatment T5- mixture of all spray, which was significantly superior but at par with T4- ZnSO4 @ 0.2%, T6- Calcium nitrate @ 0.2% + ZnSO4 @ 0.2%. These results were in accordance with the findings of Raffo *et al.* (2002) [15] and Singh. The perceptible increase in sugar contents through the foliar feeding of micronutrients might be due to the active synthesis of tryptophan in the presence of zinc, the precursor of auxin, which in turn causes an increase in the rate of chlorophyll synthesis which ultimately accelerates the photosynthetic activity.

Ascorbic acid (mg/100gm)

The data presented on ascorbic acid (mg) of tomato as influenced by different micronutrients spray are presented in Table 1. The findings indicated that ascorbic acid (mg) was significantly affected by different treatments. Ascorbic acid (mg) of tomato varied from 16.61 to 19.94 (mg). The highest ascorbic acid content (19.94 mg) recorded in T5- mixture of all spray, which was significantly superior over other treatments. Whereas, lowest ascorbic acid showed by T8-control (16.61 mg). Former treatment was found statistically at par with T1-FeSO4 @ 0.2% (19.90 mg), T6- Calcium nitrate @ 0.2% + ZnSO4 @ 0.2% (19.82 mg), T2- Calcium nitrate @ 0.2% (19.70 mg). The highest ascorbic acid content recorded in T5 (mixture of all spray) followed by T1 (FeSO4 @ 0.2%) and T6 (Calcium nitrate @ 0.2% + ZnSO4 @ 0.2%).The increase in ascorbic acid might be due to enhancement of enzymatic activity of ascorbic acid oxidase which enhances the ascorbic acid content in fruits and also as micronutrients is involved in carbohydrate metabolism and exists positive and close relationship with formation of ascorbic acid. The results obtained are in conformity with the findings of Tamilselvi *et al.* (2002) [19] and Kumari (2012) [10] in tomato.

Table 1: Mean performance of quality traits of tomato

Treatment	Shelf life (days)	TSS (%)	Acidity (%)	Reducing sugar (%)	Non reducing sugar (%)	Total sugar (%)	Ascorbic acid (mg/100 g)
T1	14.78	4.53	0.39	1.23	1.50	2.73	19.90
T2	15.24	4.77	0.38	1.33	1.63	2.96	19.70
T3	15.19	4.51	0.41	1.30	1.60	2.90	18.53
T4	15.66	4.78	0.38	1.60	1.90	3.50	18.71
T5	16.63	5.28	0.42	1.68	2.00	3.63	19.94
T6	15.88	4.62	0.38	1.63	1.89	3.57	19.82
T7	14.97	5.07	0.41	1.47	1.77	3.24	18.18
T8	11.08	4.08	0.35	1.20	1.40	2.60	16.61
MEAN	14.93	4.71	0.39	1.43	1.71	3.14	18.92
SE(m±)	0.74	0.16	0.01	0.04	0.04	0.07	0.34
CD(P=0.05)	2.42	0.53	0.04	0.12	0.11	0.22	1.12

Reference

1. Anonymous. Horticultural Statistics at a Glance, Horticulture statistics division department of agriculture, cooperation & farmers welfare ministry of agriculture & farmers welfare government of India, 2015.
2. Chaudhary B. Exploitation of heterosis in tomato yield and components. South Indian Horticulture. 1996; 49:59-85.
3. Chaurasia SNS, Singh KP, Mathura Rai. Response of tomato to foliar application of water soluble fertilizers. Veg. Sci. 2006; 33(1):96-97.
4. Dube BK, Sinha P, Chatterjee C. Effect of zinc on yield and quality of tomato. Ind. J. Hort. 2003; 60(1):59-63.
5. Ejaz M, Rehman SU, Waqas R, Manan A, Imran M, Bukhari MA. 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. 2011; 5(3):327-335.
6. Fageria NK, Baligar VC, Clark, RB. Micronutrients in crop production. Adv. Agro. 2002; 77:185-268.
7. Harlan JR. Crops and Man. 2nd ed. American society of Agronomy, Crop Sciences of America, Madison, WI. 1992.
8. Harris KD, Lavanya L. Influence of Foliar Application of Boron, Copper and their Combinations on the quality of Tomato. Res J. of Agriculture and Forestry Sci. 2016; 4(7):1-5.
9. Joshi A, Kohli UK. Combining ability and gene action studies for processing quality attributes in tomato (*Lycopersicon esculentum* Mill.). Indian J. Hort. 2006; 63:289-93.
10. Kumari S. Effect of micronutrients on quality of fruit and seed in tomato (*Solanum lycopersicum* L.) Int. J. of Farm Sci. 2012; 2(1):43-46.
11. Mehdizadeh M, Darbandi EI, Naseri-Rad H, Tobeh A. Growth and yield of tomato (*Lycopersicon esculentum* Mill.) as influenced by different organic fertilizers. International Journal of Agronomy and Plant Production. 2013; 4(4):734-738.
12. Naz RMM, Muhammad S, Hamid A, Bibi F. Effect of boron on flowering and fruiting of tomato. Sarhad J. Agric. 2012; 28(1):37-40.
13. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, India. 1967; 152-161.
14. Punith Raj TS, Nagraja MS, Dumgond P, Reddy S, Shivakumar. Effect of foliar application of secondary and micronutrients on yield and quality of tomato. An Asian J. Soil Sci. 2012; 194-149.
15. Raffo A, Leonardi C, Fogliano V, Ambrosino P, Salucci M, Gennaro L *et al.* Nutritional value of cherry tomatoes (*Lycopersicon esculentum* Cv. Naomi F1) harvested at different ripening stages. Journal of Agricultural and Food Chemistry. 2002; 50:6550-6556.
16. Salam MA, Siddique MA, Rahim MA, Rahman MA, Saha MG. Quality of tomato (*Lycopersicon esculentum* Mill.) as influenced by Boron and Zinc under different

levels of NPK fertilizers. Bangla. J. Agril. Res. 2010; 35 (3):475-488.
17. Sekhar L, Prakash BG, Salimath PM, Channayya P, Hiremath Sridevi O, Patil AA. Implication of heterosis and combining ability among productive Single cross Hybrids in tomato. Electronic Journal of Plant Breeding. 2010; 1(4):706-711.
18. Sezen SM, Yazar A, Eker S. Effect of drip irrigation regimes on yield and quality of field grown bell pepper. Agricultural Water Management. 2006; 81: 115-131.
19. Tamilselvi P, Vijayakumar RM, Nainar P. Studies on the effect of foliar application of micronutrients on quality of tomato (*Lycopersicon esculentum* Mill.) Cv. pkm-1.Indian Hort. 2002; 53:272-275.
20. Vavilov NI. Studies on the Origin of Cultivated Plants. Leningrad: Institut Botanique Appliqui et d'Amelioration des Plantes, 1926.
21. Verma SK, Singh SS, Awasthi CP. Response of zinc and boron fertilization on yield and quality of tomato fruits of different stages of picking. Veg. Sci. 1995; 22(1):5- 8.
22. Williams LB, Harris G. Fertilizer marketing in Nigeria. Fertilizer International.1986; 225:45-49.