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Effect of humic acid and nutrients mixture on quality parameter of Tomato (*Lycopersicon esculentum* Mill.) under polyhouse condition

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Abstract: An experiment was conducted on Effect of humic acid and nutrients mixture on growth and yield parameter of Tomato (*Lycopersicon esculentum* Mill.) under polyhouse condition at Rajasthan College of Agriculture, Udaipur (Raj.). The data was analyzed statistically following completely randomized design. The results revealed that treatment T_7 [(RDF + humic acid 10 kg/ha soil application + humic acid 0.1% foliar spray + nutrient mixture foliar spray (0.2% Ca + 0.5% Mg + 0.2% B + 0.5% Zn)] was recorded superior to enhance leaf nutrients analysis Ca (1.656%), Mg (0.763%), Zn (25.07ppm) and B (61.94ppm), fruit nutrient analysisCa (1.904%), Mg (0.877%), Zn (58.98ppm) and B (61.84ppm), total Soluble Solids (TSS) (6.020%), ascorbic acid content (39.85mg/100g), lycopene content (3.75 mg/100g) and cost benefit ratio (4.81).

Keywords: Humic acid, Nutrients Mixture, Quality, Tomato

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) belongs to family Solanaceae having chromosome number (2n=24); it is a self-pollinated crop. Tomato is one of most popular and nutritious fruit vegetables, widely grown around the world and ranked second after potato. The protected vegetable cultivation technology can be utilized for the year round production of high value quality vegetable crops, with high yield. Increasing photosynthetic efficiency and reduction in transpiratory loss are major advantages of protected cultivation, both these are of vital importance for healthy and luxuriant growth of crop plants. This technology is highly suitable for farmers in peri-urban areas of the country, especially in northern plains of India. But protected cultivation requires careful planning and attention including selection of varieties, suitable production technology like spacing, time of planting, water and nutrient management and plant protection to produce economic yield of good quality. (Abraham *et al*., 2002)

Tomato is consumed fresh and also in processed form of which one-third is used as processed products and two-third of tomato fruit is consumed fresh. Tomato is a rich source of vitamins, minerals, organic acids, sugars, ascorbic acids, acidity and lycopene. Nutritive value varies in different cultivars depending upon the agro-climatic condition. Consumption of tomato and its products can significantly reduce the risk of developing colon, rectal, and stomach cancer. Recent studies suggest that tomatoes contain the antioxidant lycopene, which markedly reduces the risk of prostate cancer (Kucuk, 2001).

Humic acids im-prove soil fertility and increase the availability of nutri-ent elements by holding them on mineral surfaces. The humic substances are mostly used to remove or decrease the negative effects of chemical fertilizers from the soil and have a major effect on plant growth, as shown by many sci-entists (Ghabbour and Davies, 2001). Humic acids promote the conversion of mineral nutrients into forms available to plants. It also stimulates seed germination and viability, and its main effect usually being more prominent in the roots.

This can result from direct availability of nutrients from the humic substances. To improve the yield and quality of the product, it is necessary to pay attention on the optimum balanced use of nutrients through fertilizer application (Varanini and Pinton, 1995). Plants require mineral elements for normal growth and development. Plants require to essential elements for the normal life processes of plants and are needed in very small amounts are called trace elements or minor elements.

Boron (B) plays an essential role in the development and growth of new cell in the plant meristem, improves the fruit quality and fruit set. Demoranville and Deubert. 1987), reported that fruit shape, yield, and shelf life of tomato were also affected by boron nutrition. Boron deficiency in fresh-market tomatoes is a wide-

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spread problem that reduces yield and fruit quality (Davis *et al.*, 2003).

Zinc, as one of the essential nutrients in plants is necessary for plant growth and development and is involved in many enzymatic activities and IAA formation to increase flower number and fruit set. Zinc plays an important role in chlorophyll formation, cell division, meristematic activity of tissue expansion of cell and formation of cell wall. Zinc application also helps in increasing the uptake of nitrogen and potash. Application of zinc sulphate, copper sulphate and ammonium molybdate stimulates chlorophyll synthesis and improves fruit quality of tomato (Kalloo, 1985). However, excessive Zn in plants can profoundly affect normal ionic homeostatic systems by interfering with the uptake, transport and osmotic regulation of essential ions and results in the disruption of metabolic processes such as transpiration, photosynthesis and enzyme activities related to metabolism (Sainju*et al.,* 2003).

Magnesium is required for many processes including transfer of energy and protein synthesis. With 20-25 % of the plant's total magnesium localized in the chloroplasts, it is particularly important for chlorophyll production.High levels of Mg in the root zone seem to be beneficialfor tomato. Hao *et al.* (2000), report that 50–80 ppm Mg in the nutrient solution results in the best overall yield and fruit quality in rockwool-grown tomato.

Calcium is a key component of cells holding the structure of cell walls and stabilizing cell membranes. It also has a direct influence on the salt balance within plant cells and activates potassium to regulate the opening and closing of stomata to allow water movement from the plant.Calcium also enhances pollen germination; regulates some enzyme systems; and influences the growth and health of cells and conductive tissues. It has a key specific influence on tomato fruit quality especially Blossom End Rot (BER). BER is caused by a local deficiency of Ca in the distal part of the fruit, which results in a disruption of tissue structure in that area (Adams 2002). Recent research has revealed that a low calcium level in the root zone is rarely a limiting factor for the vegetative growth of tomato (Del Amor and Marcelis 2006).

MATERIALS AND METHODS

The experiment was conducted during 2014-15 at the Hi-Tech Horticulture Unit, Department of Horticulture, Rajasthan College of Agriculture, Udaipur. Udaipur is situated at 24°34'N latitude and 73°42'E Longitude at an elevation of 582.17 meters above mean sea level. The region falls under agro climatic zone IV a (Sub Humid Southern Plain and Aravali Hills) of Rajasthan. The average rainfall of this tract ranges from 76 to 90 cm per year. More than 90 per cent of rainfall is received during mid June to September with scanty shower during winter months.The experiment was conducted in a completely randomized design involving T_1RDF (control), T_2RDF + Humic acid 10kg/ha (Soil application), T_3RDF + Humic acid 0.1 per cent (Foliar spray), T_4 RDF + Humic acid 10 kg /ha + Humic acid 0.1% (Foliar application), T_5RDF +Humic acid 10kg/ha + Nutrients mixture (Foliar application), T_6RDF + Humic acid 0.1% + Nutrients mixture (Foliar spray) and T_7RDF +Humic acid10 kg/ha+ Humic acid 0.1 % +Nutrients mixture (Foliar spray).

RESULTS AND DISCUSSION

Effect of of humic acid and nutrients mixture on quality parameter: Quality characteristics such as leaf nutrient analysis for (Ca, Mg, B, and Zn content), fruit nutrient analysis for (Ca, Mg, B, and Zn content), total soluble solids (TSS) and lycopene content were recorded and data are presented in Table-1 to 4.

Leaf nutrient status (Ca, Mg, B, and Zn content) are presented in Table-1 reveals that highest leaf nutrient was recorded for treatment T_7 [(RDF + humic acid 10 kg/ha soil application + humic acid 0.1% foliar spray + micronutrient mixture foliar spray (0.2% Ca + 0.5% Mg + 0.2% B + 0.5% Zn)] with value 1.66% Ca, 0.76% Mg, 61.94 ppm B, and 25.07 ppm Zn. Followed by T_6. This is due to interaction effect of humic acid and micronutrient mixture, which enhanced the mineral absorption and root growth.Application of zinc sulphate, copper sulphate and ammonium molybdate stimulates chlorophyll synthesis and fruit quality of tomato (Kalloo, 1985).

Fruit nutrient analysis: The data presented in Table-2 indicated that effect of humic acid and micronutrients mixture were found significantly on fruit nutrient quality for (Ca, Mg, B, and Zn content). Highest fruit nutrient were recorded in treatment T_7 [(RDF + humic acid 10 kg/ha soil application + humic acid 0.1% foliar spray + micronutrient mixture foliar spray (0.2% Ca + 0.5% Mg + 0.2% B + 0.5% Zn)] with value 1.90% Ca, 0.87% Mg, 61.94 ppm B, and 58.98 ppm Zn. Minimum fruit nutrient (1.01% Ca, 0.54 Mg, 45.16 ppm B, and 26.56 ppm Zn.) in T_1 (control). This might be due to combining effect of humic acid and nutrients .Singh and Tiwari (2013) also reported that application of T_8 (Boric acid + Zinc) was found to be significant among various observation like plant height, number of leaves per plant, number of flowers per plant, number of fruits per plant, fruit yield per plot, T.S.S. (%) and ascorbic acid (mg/100 g).

Total soluble solids (TSS): The data pertaining to effect of humic acid and micronutrients mixture had significant on TSS content of tomato under polyhouse. The maximum TSS content (6.02 %) was recorded for treatment T_7 [(RDF + humic acid 10 kg/ha soil application + humic acid 0.1% foliar spray + micronutrient mixture foliar spray (0.2% Ca + 0.5% Mg + 0.2% B + 0.5% Zn)], where as minimum TSS (4.26 %) was rec-

Table 1. Effect of humic acid and micronutrients on leaf nutrient status of tomato under polyhouse condition.

	Leaf nutrient analysis			
Treatment	**Ca (%)**	**Mg(%)**	**Zn(ppm)**	**B(ppm)**
T_1	0.883	0.477	20.52	33.95
T_2	0.925	0.491	21.57	40.34
T_3	0.937	0.500	22.58	44.02
T_4	1.116	0.612	23.28	50.23
T_5	1.219	0.700	24.74	55.93
T_6	1.204	0.652	24.10	51.27
T_7	1.656	0.763	25.07	61.94
SEm±	0.020	0.013	0.442	33.950
CD at 5 %	0.062	0.039	1.339	40.344

Table 2. Effect of humic acid and micronutrients on fruit analysis of tomatounder polyhouse condition.

	Fruit nutrient analysis			
Treatment	**Ca (%)**	**Mg(%)**	**Zn(ppm)**	**B(ppm)**
T_1	1.015	0.548	26.56	45.16
T_2	1.064	0.563	29.95	46.04
T_3	1.078	0.575	33.53	47.16
T_4	1.283	0.704	40.34	50.53
T_5	1.402	0.805	55.93	56.03
T_6	1.385	0.750	50.65	51.53
T_7	1.904	0.877	58.98	61.84
SEm±	0.027	0.014	0.885	1.003
CD at 5 %	0.081	0.042	2.684	3.009

Table 3. Effect of humic acid and micronutrients on total soluble sugar (TSS) , ascorbic acid and lycopene content of tomato under polyhouse condition.

Treatment	**TSS(%)**	**Ascorbic acid (mg/100gm)**	**Lycopene content (mg/100g)**
T_1	4.265	24.23	3.07
T_2	4.469	30.90	3.42
T_3	4.550	32.00	3.57
T_4	5.250	32.50	3.60
T_5	5.850	36.89	3.65
T_6	5.620	32.00	3.84
T_7	6.020	39.85	3.75
SEm±	0.101	0.646	0.041
CD at 5 %	0.305	1.959	0.123

Table 4. Treatment wise cost of cultivation of tomato per hectare and benefit cost ratio.

Treatment	**Total cost (per ha)**	**Total yield (t /ha)**	**Price selling (Rs/t)**	**Gross return**	**Net return Rs/ha**	**Benefit cost ratio**
T_1	153088.00	51.01	10 000	510170.00	357082.00	2.33
T_2	157674.98	59.19	10 000	591960.00	434286.00	2.75
T_3	162964.98	67.01	10 000	670160.00	507196.00	3.11
T_4	168864.98	65.77	10 000	657740.00	488876.00	2.89
T_5	176114.98	91.19	10 000	911920.00	735806.00	4.17
T_6	186664.98	71.28	10 000	712810.00	526146.00	2.91
T_7	205264.98	119.26	10 000	1192620.00	987356.00	4.81

orded in T_1 (control).

Ascorbic acid content (mg/100g): Ascorbic acid content of tomato as influenced by different treatment of humic acid and micronutrients mixture are presented in Table-3. Result reveals that treatment had significant effect on ascorbic acid content. The maximum ascorbic acid content (39.85 mg/100g) was recorded for treatment T_7 [(RDF + humic acid 10 kg/ha soil application + humic acid 0.1% foliar spray + micronutrient mixture foliar spray (0.2% Ca + 0.5% Mg + 0.2% B + 0.5% Zn)], followed by T_5 (36.89 mg/100g) and minimum (24.23 mg/100g) in T_1 (control).Singh and Tiwari (2013) also reported that application of T_8 (Boric acid + Zinc) was found to be significant among various observation like plant height, number of leaves per plant, number of flowers per plant, number of fruits per plant, fruit yield per plot, T.S.S. (%) and ascorbic acid (mg/100 g).

Lycopene content (mg/100g): Lycopene content of tomato as influenced by different treatment of humic acid and micronutrients mixture are presented in Table3. Result reveals that treatment had nonsignificant effect on lycopene content. The maximum lycopene content (3.84 mg/100g) was recorded for treatment T_6 [(RDF + humic acid 0.1% foliar spary + micronutrient mixture foliar spray (0.2% Ca + 0.5% Mg + 0.2% B + 0.5% Zn)] followed by T_7 (3.75 mg/100g) and minimum (3.07 mg/100g) in T_1 (control). Sher and Rab (2013) concluded that tomato plants should be treated with fertilizers, humic acid and nitrogen at the rate of 5 kg and 125 kg ha^{-1}, respectively to obtain maximum and quality yield.

Economics of the treatments: The data presented in Table-4 observed Maximum net returns (Rs.987356 / ha) and benefit: cost ratio (4.81) was observed in T_7 [(RDF + humic acid 10 kg/ha soil application + humic acid 0.1% foliar spray + micronutrient mixture foliar spray)], followed by T_5, T_3, T_6 and T_2, where as minimum net returns (Rs.357082 /ha) and B:C (2.33) was recorded in T_1(control).Basavarajeshwari*et al.,*2008 reported maximum benefit ratio of 1.80 was obtained with application of boron recording Rs. 97,850 /ha of net returns followed by mixture of micronutrients (1.74) recording Rs 88,900 /ha net returns compared to control (1.40) which recorded minimum net returns of Rs 53,250 /ha.

Conclusion

It can be concluded from the study that among the treatments used in experiment, treatment T_7 [RDF+ humic acid 10 kg/ha (soil application) + humic acid 0.1% foliar spray + nutrient mixture (foliar spray) (0.5% Zn + 0.2% B + 0.5% Mg + 0.2% Ca)] was found best as it gave superior on quality parameter of tomatolike leaf nutrients analysis, fruit nutrient analysis, total Soluble Solids (TSS), ascorbic acid content (mg/100g), lycopene content (mg/100g). As far as economics is concerned maximum gross return (Rs.1192620 /ha), net return (Rs.987356 /ha) and B.C ratio (4.81) were obtained in same treatment.

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