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Study of Plant Growth Regulators and Micro-Nutrients Response under the Climate Change Scenario in Tomato (*Solanum lycopersicum* L.)

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ABSTRACT

Keywords

Tomato, NAA, Boron, Zinc Salicylic Acid and Date of transplanting

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To evaluate the effect of micronutrients and plant growth regulators on different dates of transplanting in tomato, the field experiment was conducted during the *Rabi* season 2018-19 at the Horticulture Research Complex, Maharajpur, Department of Horticulture. J.N.K.V.V., Jabalpur (M.P.). Significant differences was found for plant height, days to 50% flowering, days to first picking, TSS, ascorbic acid, lycopene, fruit yield per plot and fruit yield per ha. The highest plant height was recorded at T_{25} .The treatment T_{44} was found better for days to 50% flowering and days to first picking. The highest TSS and ascorbic acid was recorded in treatment T_{28} and $T_{45.}$ The maximum lycopene value was recorded in $T_{30.}$ Significance differences were recorded for the fruit yield per plot and fruit yield per ha in treatment $T_{13.}$

Introduction

Tomato is one of the valuable crop under the solanaceae family which produces fruits annually. It is native to Western South America and use as a nutritious edible fruit throughout the world that is grown in both greenhouse and field conditions (Smith, 1994). It is an excellent source of many nutrients and secondary metabolities that are important for human health. In tomato lycopene is an important antioxidant which prevents the different forms of cancers such as prostate and lung cancer with the higher nutritive value it is grown all over the world. In India tomato is largely grown in Andhra Pradesh, Madhya Pradesh and Karnataka but mean yield of tomato in India is not according to the crop potential because climate is constantly changing by the human and natural activities. Tomato is comes under the day neutral plant (A day neutral plants is a plant in which flowers regardless of the amount of daylight it receives). Tomato is a warm climate crop 15^0 to 30^0 C is best temperature range for its better growth and development. For lycopene development 21^0 to 24^0 C temperature is required above 35^0 C is not congenial for its production. Fluctuation of temperature and climate affect the development of crop in grower field.

Plant growth regulators are used extensively in crop production to improve plant growth and yield by increasing fruit set, fruit number and weight (Batlang, 2008). Salicylic acids play important roles in many physiological process like- enhanced plant growth attributes viz., plant height, number of branches, number of leaves, shoot and root length and total dry biomass of plant at different growth stages and it is stimulant or transmitter of the cell to protect from various climatic factors such as dryness, coldness, heat and also enhanced capacity of plant to withstand several types of stress. Naphthalene acetic acid (NAA) comes under the synthetic plant hormones which regulates the growth and development and also affect the biochemical and physiological process of plant. Helps to promote plant growth by enhancing the cell division, cell elongation and cell differentiation which may initiate the development of plant organs. Flower cluster and whole plant spray of salicylic acid and NAA before the flowering, are highly beneficial.

Micronutrients management is essential to boost the crop production and also increased the fruits quality. Boron and zinc important micronutrient for quality tomato fruit production. Zinc regulates growth and also promotes balanced sugar consumption and Boron helps to providing some nutrients and essential for proper development of their fruits and seeds. These micronutrients are more effective when they are applied as foliar spray. In tomato production different transplanting dates significantly influence quality, growth and fruit yield because different temperature range effect morphologically and physiologically activities of plant. So it is necessities to know which range of temperature and dates of transplanting is suitable for increasing the production of tomato crop.

Production and yield is depending upon the micro climate around the crop. So, for knowing the effect of climatic condition around the crop during production period is a main aspect in modern agriculture production system and there is need to develop a strategies to mitigate the climate affect and response of plant growth regulators and micronutrients for achieving higher fruit yield.

Materials and Methods

The field experiment was conducted at the Horticulture Research Complex, Maharajpur, Department of Horticulture. J.N.K.V.V., Jabalpur (M.P.) during *Rabi* season of 2018-2019. The field experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Treatment details of the experiment: $T_{1:}$ Control, $T_{2:}$ Salicylic acid (1.0mM), $T_{3:}$ Salicylic acid (1.5mM), $T_{4:}$ NAA (25ppm), $T_{5:}$ NAA (50ppm), $T_{6:}$ Boron (100ppm), $T_{7:}$ Zinc(100ppm), T_8: Salicylic acid (1.0mM) + Boron (100ppm), T_9: Salicylic acid (1.5mM) + Boron (100ppm), T_{10}: Salicylic acid (1.0mM) + Zinc (100ppm), T_{11}: Salicylic acid (1.5mM) + Zinc (100ppm), T_{12}: NAA (25ppm) + Boron (100ppm), T_{13}: NAA (50ppm) + Boron (100ppm), T_{14}: NAA (25ppm) + Zinc (100ppm), $T_{15:}$ NAA (50ppm) + Zinc (100ppm). These treatments applied at three different dates of transplanting at 15 days of interval (30^{th} Nov.), D_2 (15^{th} Dec.) and D_3 (30^{th} Dec.). The seedlings were transplanted at 60 cm x 50 cm.

The details observations recorded on different growth parameters namely plant height at 90 days, days to 50% flowering, days to first picking, TSS (brix), ascorbic acid (mg/100gm), lycopene (mg/100gm), fruit yield per plot (kg) and fruit yield per ha (q/ha).The analysis was done as per procedure given by Panse and Sukhatme (1967).

Results and Discussion

The results of the present investigation are presented in Table: 1. The analysis of variance showed the significant differences for all the characters studied (Fig. 1).

The maximum plant height (152.17 cm) was recorded in the treatment T_{25} (D_2 + Salicylic acid (1.0mM) + Zinc (100 ppm)) followed by T_{15} (148.37 cm) and T_{30} (143.23 cm) as compare to other treatments. Similar result found by Ahmed Abou El-Yazied (2011) suggested that foliar spraying with salicylic acid at 100 ppm and chelated zinc at 50 ppm can be used to increase the final yield and fruit quality of sweet pepper plant during the low temperatures of autumn plantations and Choudhary *et al.,* (2016). Among all the treatments, the minimum plant height 114.34 cm was noticed in the $T_{4.}$

The significant days to minimum 50% flowering (58.67 days) was observed in T_{44} (D_3 + NAA (25 ppm) + Zinc (100 ppm) followed by T_{43} (59 days) and T_{42} (59.67 days). Similarly days to first picking (67.67 days) recorded earliest in T_{44} (D_3 + NAA (25 ppm) + Zinc (100 pm) followed by T_{45} (69 days) and T_{43} (69.33 days). The significant maximum TSS value (5.22) was found in T_{28} (D_2 + NAA (50 ppm) + Boron (100 ppm) followed by T_{43} (5.12) and T_{30} (4.93) and lower value was found in T_{37} (3.66). Gupta *et al.,* (2018) observed that when crop spray with (NAA @ 100 ppm + Boron @ 75 ppm) gave the highest TSS value in tomato. The high ascorbic acid (30.42) was noticed in T_{45} (D_3 + NAA (50 ppm) + Zinc (100 ppm) followed by T_{29} (29.68) and T_{42} (29.45), while lower value was found in T_{16} (21.60) (Gupta *et al.,* (2018). Similarly highest lycopene (6.00) was recorded in T_{30} (D_2 + NAA(50 ppm) + Zinc (100 pm) followed by T_{15} (5.97) and T_{11} (5.90), while lower value was found in T_{31} (3.10) Pargi *et al.,* (2014). The result showed that the highest fruit yield per plot (27.447 kg) was noticed in T_{13} (D_1 + NAA (50 ppm) + Boron (100 pm) followed by treatment T_{30} (27.163 kg) and T_{28} (26.920 kg) while the lowest value was found in T_{31} (11.730) (Ali *et al.,* 2015).

Fig.1 Presentation of highest significant value of yield contributing tarits

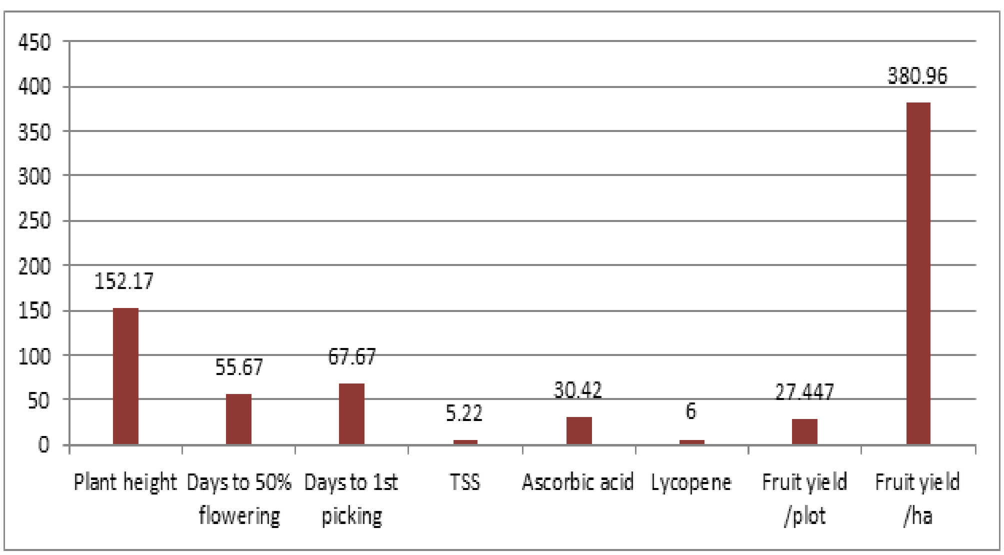

Table.1 Effect of plant growth regulators, micro-nutrients and date of transplanting on tomato

Sym.	Treatment details	Pl. ht. at 90 Days	Days to 50 flowering	Days to first picking	TSS (Brix)	Ascor-bic acid (mg/100gm)	Lycopene (mg/100gm)	fruit yield/ plot (kg)	fruit yield /ha(q)
T_{1}	D_1 + Control	116.97	68.67	84.67	3.94	21.61	3.87	17.093	237.26
T_{2}	D_1 + Salicylic acid (1.0mM)	121.71	68.33	81.00	4.22	25.07	5.33	18.040	250.40
T_{3}	D_1 + Salicylic acid (1.5mM)	123.12	68.67	80.00	4.32	25.90	5.47	18.930	262.75
T_{4}	D_1 + NAA (25 ppm)	114.34	66.00	79.67	3.86	27.67	5.33	19.550	271.36
T_{5}	D_1 + NAA (50 ppm)	121.29	67.00	80.33	4.62	26.71	5.23	21.300	295.64
T_{6}	D_1 + Boron (100 ppm)	125.52	70.00	80.67	3.96	26.90	4.07	21.557	299.21
T_{7}	D_1 + Zinc (100 ppm)	122.51	70.33	81.33	3.78	26.32	3.70	20.597	285.88
T_{8}	D_1+Salicylic acid (1.0mM)+ Boron (100 ppm)	124.86	67.33	81.00	4.46	26.00	5.63	21.970	304.94
T_{9}	D_1+Salicylicacid (1.5mM) + Boron (100 ppm)	130.35	68.00	79.00	4.38	25.19	5.80	23.930	332.15
T_{10}	D_1+Salicylic acid (1.0mM) + Zinc (100 ppm)	135.03	70.67	81.67	4.01	24.56	5.67	23.067	320.16
T_{11}	D_1+Salicylicacid (1.5mM) + Zinc (100 ppm)	129.29	68.33	81.33	4.30	25.77	5.90	25.893	359.40
T_{12}	D_1 + NAA(25ppm) + Boron (100 ppm)	134.17	70.00	81.00	4.33	27.09	5.10	26.373	366.06
T_{13}	D_1 +NAA(50 ppm) + Boron (100 ppm)	130.72	66.67	79.00	4.49	27.86	5.30	27.447	380.96
T_{14}	D_1 + NAA(25ppm) + Zinc (100 ppm)	134.39	68.67	80.00	3.87	28.79	5.10	23.440	325.35
T_{15}	D_1 +NAA(50 ppm) + Zinc (100 ppm)	148.37	68.00	79.00	4.03	29.35	5.97	26.490	367.68
T_{16}	D_2 + Control	119.30	71.33	81.00	3.86	21.60	4.03	17.273	239.75
T_{17}	D_2 + Salicylic acid (1.0mM)	122.03	68.33	79.67	4.04	25.03	5.40	18.403	255.44
T_{18}	D_2 + Salicylic acid (1.5mM)	125.53	68.00	80.33	4.30	23.38	5.33	18.660	259.00
T_{19}	D_2 + NAA (25 ppm)	120.83	68.00	79.00	3.89	26.98	5.50	19.023	264.04
T_{20}	D_2 + NAA (50 ppm)	121.93	67.33	78.00	4.24	26.06	5.23	21.443	297.63
T_{21}	D_2 + Boron (100 ppm)	126.20	68.00	78.33	3.71	26.96	5.10	20.557	285.33
T_{22}	D_2 + Zinc (100 ppm)	126.17	67.67	79.33	3.67	27.17	5.13	21.030	291.90
T_{23}	D_2 +Salicylic acid (1.0mM)+Boron (100 ppm)	127.27	67.67	80.00	4.48	25.44	5.60	21.270	295.23
T_{24}	D_2 +Salicylicacid (1.5mM) +Boron (100 ppm)	131.23	66.33	78.00	4.65	25.46	5.87	24.123	334.83
T_{25}	D_2 +Salicylic acid (1.0mM)+Zinc (100 ppm)	152.17	69.67	78.00	4.10	25.92	5.70	23.283	323.17
T_{26}	D_2 +Salicylicacid (1.5mM) +Zinc (100 ppm)	130.17	69.33	76.33	4.07	26.38	5.70	25.940	360.05
T_{27}	D_2 + NAA (25ppm) + Boron (100 ppm)	130.83	68.67	80.00	4.47	28.07	5.50	26.853	372.72
T_{28}	D_2 + NAA (50 ppm)+ Boron (100 ppm)	133.03	69.00	76.00	5.22	29.01	5.73	26.920	373.65
T_{29}	D_2 + NAA (25ppm) + Zinc (100 ppm)	136.63	68.67	79.00	4.44	29.68	5.40	24.040	333.67
T_{30}	D_2 + NAA (50 ppm)+ Zinc (100 ppm)	143.23	69.33	76.67	4.93	29.35	6.00	27.163	377.03
T_{31}	D_3 + Control	116.57	66.00	74.67	4.12	22.33	3.10	11.730	162.81
T_{32}	D_3 + Salicylic acid (1.0mM)	121.90	65.33	72.33	4.23	26.23	4.40	14.223	197.42
T_{33}	D_3 + Salicylic acid (1.5mM)	121.83	64.33	71.67	4.44	26.45	4.73	12.860	178.50
T_{34}	D_3 + NAA (25 ppm)	117.83	63.33	75.67	4.00	27.02	4.77	13.530	187.80
T_{35}	D_3 + NAA (50 ppm)	122.53	63.00	72.33	4.89	27.48	4.60	14.603	202.69
T_{36}	D_3 + Boron (100 ppm)	123.00	62.33	73.00	3.94	27.24	4.47	16.227	225.23
T_{37}	D_3 + Zinc (100 ppm)	123.83	62.00	75.00	3.66	27.09	4.20	13.890	192.79
T_{38}	D_3+Salicylic acid (1.0mM) + Boron (100 ppm)	123.93	60.33	72.67	4.79	23.65	4.60	16.540	229.58
T_{39}	D_3+Salicylicacid (1.5mM) + Boron (100 ppm)	125.63	61.33	72.00	4.77	26.35	4.93	19.247	267.15
T_{40}	D_3+Salicylic acid (1.0mM) + Zinc (100 ppm)	141.37	60.67	71.33	4.35	25.26	4.90	17.127	237.72
T_{41}	D_3 +Salicylicacid (1.5mM) + Zinc (100 ppm)	126.13	61.33	71.00	4.54	26.19	4.87	21.857	303.37
T_{42}	D_3 +NAA (25ppm) + Boron (100 ppm)	134.63	59.67	71.67	4.86	29.45	4.87	19.320	268.16
T_{43}	D_3 +NAA (50 ppm)+ Boron (100 ppm)	127.17	59.00	69.33	5.12	29.38	4.73	22.290	309.38
T_{44}	D_3 +NAA (25ppm) + Zinc (100 ppm)	131.07	58.67	67.67	4.29	27.09	4.87	17.497	242.86
T_{45}	D_3 +NAA(50 ppm) + Zinc (100 ppm)	139.50	60.00	69.00	4.80	30.42	5.27	20.107	279.08
	SEm ±	**3.23**	**1.57**	**1.46**	**0.13**	**0.72**	**0.26**	**1.23**	**17.19**
	C.D. at 5% level	**9.13**	**4.46**	**4.15**	**0.38**	**2.04**	**0.75**	**3.50**	**48.64**

The maximum fruit yield per ha (380.96 q/ha) was noticed in treatment T_{13} (D_1 + NAA (50 ppm) + Boron (100pm) followed by T_{30} (377.03 q/ha) and T_{28} (373.65 q/ha), while lower was found in T_{13} (162.81q/ha). Londhe, Mahadev Bapu (2018) noticed that the maximum yield (360.82 q/ha) was recorded in treatment where NAA + Boric acid 0.2% was applied.

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