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Original Research Article

Effect of Nutrients and Biostimulants on Growth, Yield and Quality of Tomato (*Solanum lycopersicon*)

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Keywords

Nutrients, Biosimulants, Growth, Yield and quality

A B S T R A C T

The experiment was conducted to study the effect of different levels of nitrogen, phosphorus, potassium and bio-stimulants on growth, yield and quality of tomato (*Solanum lycopersicon)* Hy.COTH-2. The treatment bio-stimulant Endo roots soluble 750g (2 split) +100% N and K+50 % P recorded improved the highest plant height (68.9cm) and number of branches per plant (7.2). The highest number of flowers per plant and number of flowers per cluster also recorded in the same treatment. The same treatment also recorded the highest number of fruits per plants, number of fruits per cluster, total soluble sugars and lycopene content. The highest estimated yield per hectare (92 t per ha) was recorded in the treatment 100% N and K + 50 % P combined with endo roots soluble 750g (2 split).

Introduction

Use of commercial inorganic fertilizers has resulted into a major shift in microbial population and whole rhizosphere is getting polluted. Nutrients imbalance, fast depletion in soil fertility and continuous deterioration in physical properties of soil and rich cost are added disadvantages of chemical fertilization. The growth and yield of tomato can be increased by the application of balanced levels of N, P and K. However, growth regulation of any crop is manipulated by the exogenous application of growth regulators. In the recent past, instead of plant growth regulators, biostimulants are being used for crop regulation. The synergistic effect between bio-stimulants and nutrients are utilized for the protein synthesis, eventually resulting in stimulated growth and yield (Dhanasekaran and Bhuvaneswari, 2005). Tomato hybrid COTH-2 has got better market preference because of its size and appealing attractive red colour. With this background, the experiment was conducted to study the effect of Bio-stimulant Endo root soluble on growth, yield and quality in tomato hybrid COTH-2.

Materials and Methods

The field experiment was carried out in tomato hybrid COTH 2 at College Orchard, Horticultural College and Research Institute, Coimbatore during July 2008 to March 2009 under drip irrigation system.

The experiment was laid out in a Randomized Block Design (RBD) with 10

treatments and replicated three times. The field lay out and randomizations of treatments were made with the plot size of 8.5 x 1 m (8.5 m^2). The seedlings were transplanted at a spacing of 60 x 45 cm by accommodating 17 plants in each plot.

Farm Yard Manure was applied @ 25 t ha^{-1} as soil application. The bio-stimulant Endo root soluble contains the widest available range of endo-mycorrhizae and growth stimulants. The bio-stimulants were applied as soil drenching during vegetative, flowering and fruit setting stages.

The treatment details are given below:

T_1- Endo roots soluble 500 g (two split) + 100 % RDF

T_2- Endo roots soluble 500 g (two split) + 100 % N and K + 75 % P

T_3- Endo roots soluble 500 g (two split) + 100 % N and K + 50 % P

T_4- Endo roots soluble 750 g (two split) + 100 % RDF

T_5- Endo roots soluble 750 g (two split) + 100 % N and K + 75 % P

T_6- Endo roots soluble 750 g (two split) + 100 % N and K + 50 % P

T_7- Endo roots soluble 1000 g (two split) + 100 % RDF

T_8- Endo roots soluble 1000 g (two split) + 100 % N and K + 75 % P

T_9- Endo roots soluble 500 g (two split) + 100 % N and K + 50 % P

T_{10}- Recommended dose of fertilizer (RDF) - 200:300:200 kg NPK/ha (Anon, 2004).

The biometrical parameters *viz.,* plant height, number of branches per plant, number of flowers per plant, number of fruits per plant, number of flowers per cluster, number of fruits per cluster, individual fruit weight, fruit set per cent, yield per plant, yield per plot and quality parameters *viz.,* total soluble solids, lycopene content and shelf life at colour breaking stage (mature green stage) were recorded.

The fruit setting percentage was worked out using the following formula.

$$\text{Fruit setting percentage} = \frac{\text{Number of fruits per cluster}}{\text{Number of flowers per cluster}} \times 100$$

The total soluble solids content of fruits was estimated by using the 'Zeiss' hand refractometer and expressed in brix. The lycopene content of fruits was expressed as mg per 100 g of fresh fruit. The statistical analysis was done by adopting the standard procedures of Panse and Sukhatme (1985).

Results and Discussion

Growth parameters

The treatments receiving inorganic nutrients along with bio-stimulant T_6 (Endo root soluble 750g (two split) + 100 % N and K + 50 % P) recorded the highest plant height in all the four stages of plant growth (Table 1).

This might be due to the utilization of readily available nutrients, due to basal application of N, P and K. This may be due to the accelerated cell division and cell expansion as nitrogen, phosphorous and potassium plays an important role in cell division and cell multiplication which ultimately results in maximum vegetative growth (Lale *et al.*, 2003; Ryagi and Nalwadi, 1996; Patel, 1998).

Table.1 Effect of nutrients and bio-stimulants on plant height and number of branches per plant at different stages of growth in tomato hybrid COTH 2

Treatments	Plant height (cm)				Number of branches per plant			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
T1	33.3	46.2	56.7	61.1	3.3	4.2	5.7	6.5
T2	26.9	32.1	44.9	50.9	3.1	3.5	4.6	5.8
T3	30.7	29.0	37.4	43.5	2.8	2.9	4.8	6.1
T4	32.3	36.5	46.5	48.9	3.3	4.3	5.4	5.7
T5	41.0	49.8	58.9	64.5	3.5	4.8	5.9	6.8
T6	44.7	56.2	62.3	68.9	4.4	4.9	6.7	7.2
T7	40.6	30.7	39.0	44.2	3.0	3.9	3.9	5.9
T8	37.9	41.7	49.1	53.9	3.3	3.6	4.5	6.3
T9	37.1	33.4	40.5	51.0	2.8	3.6	4.9	6.2
T10	25.6	37.1	44.0	46.3	2.1	3.0	4.7	5.6
Mean	35.02	38.93	47.9	53.31	3.21	3.86	5.11	6.21
SEd	1.02	7.75	7.39	6.76	0.21	0.46	0.38	0.24
CD(P=0.05)	2.14	16.28	15.54	14.21	0.44	0.97	0.81	0.49

DAP – Days after planting

Table.2 Effect of nutrients and bio-stimulants on floral characters of tomato hybrid COTH 2

Treatments	No. of flowers per plant				No. of fruits per plant			No. of flowers per cluster	No. of fruits per cluster	Fruit set (%)
	30 DAP	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP			
T1	25.9	46.2	56.7	61.1	13.7	20.1	25.9	4.3	3.3	77.1
T2	22.7	32.1	44.9	50.9	10.9	16.5	20.1	4.4	2.9	68.0
T3	22.4	29.0	37.4	43.5	10.7	16.4	21.0	4.5	3.0	68.2
T4	23.9	36.5	46.5	48.9	10.4	16.9	21.1	3.9	2.7	71.0
T5	22.8	49.8	58.9	64.5	14.2	21	35.9	5.6	3.7	71.9
T6	24.9	56.2	62.3	68.9	16.2	24.9	38.2	5.9	4.1	71.7
T7	22.4	30.7	39.0	44.2	8.2	15.3	25.2	4.5	3.4	77.6
T8	22.1	41.7	49.1	53.9	13.3	19.9	28.1	3.9	3.1	72.7
T9	22.7	33.4	40.5	51.0	9.8	18.1	27.0	4.4	2.7	65.3
T10	21.8	37.1	44.0	46.3	11.1	18.0	25.0	4.1	2.5	61.4
Mean	23.17	38.93	47.92	53.31	11.69	18.71	26.75	4.55	3.14	70.47
SEd	0.97	7.75	7.39	6.76	2.48	2.28	2.01	0.51	0.31	4.99
CD(P=0.05)	2.03	16.28	15.54	14.21	5.21	4.78	4.22	1.08	0.64	10.48

Table.3 Effect of nutrients and bio-stimulants on yield attributes of tomato hybrid COTH 2

Treatments	Individual fruit weight (g)			Yield per plant (kg)	Yield per plot (kg)	Estimated yield per ha (t)
	60 DAP	90 DAP	120 DAP			
T1	75.29	82.43	86.57	3.40	57.80	68.00
T2	70.97	78.10	82.35	3.90	66.30	78.00
T3	75.49	83.70	86.75	3.70	63.18	74.30
T4	78.41	84.70	87.17	3.70	62.33	73.30
T5	88.25	98.60	100.99	4.10	69.42	81.70
T6	91.77	104.5	107.9	4.60	78.20	92.00
T7	61.65	69.50	73.53	3.22	54.68	64.30
T8	77.71	86.52	89.56	2.95	50.15	59.00
T9	64.30	71.60	77.23	2.82	47.88	56.30
T10	44.83	49.58	83.53	2.27	38.53	45.30
Mean	72.87	80.98	87.57	3.46	58.85	69.23
SEd	6.01	6.19	5.97	0.37	6.22	7.32
CD(P=0.05)	12.62	13.01	12.55	0.77	13.07	15.38

Table.4 Effect of nutrients and bio-stimulants on quality attributes and shelf life of tomato hybrid COTH 2

Treatments	TSS (Brix)		Lycopene (mg per 100g fruit)	Shelf life at colour breaking stage (days)											
				R I				R II				R III			
	3rd day	6th day		1	3	6	9	1	3	6	9	1	3	6	9
T1	3.0	3.1	4.79	G	O	R	R	G	O	R	R	G	O	R	R
T2	4.0	4.1	3.87	G	O	R	R	G	O	R	R	G	O	R	R
T3	4.0	4.0	3.27	G	O	R	R	G	O	R	R	G	O	R	R
T4	4.0	4.0	2.46	G	O	R	R	G	O	R	R	G	O	R	R
T5	2.7	4.0	4.48	G	O	R	R	G	O	R	R	G	O	R	R
T6	5.7	4.8	5.84	G	O	R	R	G	O	R	R	G	O	R	R
T7	3.0	4.2	4.48	G	O	R	R	G	O	R	R	G	O	R	R
T8	4.0	4.0	2.06	G	O	R	R	G	O	R	R	G	O	R	R
T9	4.0	4.0	3.09	G	O	R	R	G	O	R	R	G	O	R	R
T10	4.0	4.0	1.88	G	O	R	R	G	O	R	R	G	O	R	R
Mean	3.83	4.0	3.62												
SEd	0.22	0.16	0.88												
CD(P=0.05)	0.46	0.34	1.85												

Number of branches per plant contributes greatly to the growth and development of the crop (Table 1). Application of Endo root soluble 750g (two split) + 100 % N and K + 50 % P (T_6) significantly increased number of branches per plant when compared to other treatments and control. The increased number of branches might be due to easy transfer of nutrients, increased meristematic activity in the plant and also due to the enhanced supply of photosynthates (Jayaprabha and Shakila, 2002).

Floral characters and yield parameters

The floral characters like number of flowers per plant, number of flowers per cluster (Table 2) were significantly influenced by the combined application of Endo root soluble 750g (two split) + 100 % N and K + 50 % P (T_6). This treatment recorded the highest number of flowers per plant, number of flowers per cluster. The significant increase in floral characters might be due to the combined application of inorganic fertilizers along with bio stimulants which would have led to production of auxins that resulted in increased cell division and cell elongation. Increased number of flowers per plant was significantly influenced by the application of inorganic fertilizers and bio-stimulants. The increased yield due to nitrogen application could be explained that upon the onset of flowering phase, there was improvement of anabolic activities as well as modification and redistribution of metabolites. Thus, the nitrogen which was earlier utilized by vegetative part was translocated towards reproductive organs, where it formed amino acids. On condensation, these amino acids formed proteins which ultimately increased the production of number of flowers per plant and weight of the fruits. The highest number of fruits per plant, yield per plant and number of fruits per cluster were observed in the treatment T_6 Endo root soluble 750g (two split) + 100 % N and K + 50 % P. There was significant increase in fruit yield per plot due to the combination of inorganic fertilizers along with bio-stimulants. The plant which received T_6 (Endo roots soluble 750g (2 split) +100% N and K+50 % P) produced the highest yield of fruits per plot (78.20 kg plot^{-1}) which was followed by T_5 (69.42 kg plot^{-1}) (Table 3). The treatment T_{10} (100 % RDF) recorded the lowest yield of fruits per plot (38.53 kg plot^{-1}).

Quality parameters

The treatments significantly influenced the quality of the fruits. The treatment T_6 (Endo root soluble 750g (two split) + 100 % N & K + 50 %P) was found to be improving the quality parameters *viz*., TSS and lycopene content. This treatment recorded the highest lycopene content when compared to control (Table 4). This might be due to the fruits that received more nutrients would have thickened cells and thereby the increased shelf life.

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