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Effect of Bio-stimulants on Growth, Development and Yield of Tomato (*Lycopersicon esculentum* L.)

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ABSTRACT: Biostimulants are products that reduce the need for fertilizers and increase plant growth, resistance to water and abiotic stresses. In small concentrations, these substances are efficient, favoring the good performance of the plant's vital processes, and allowing high yields and good quality products. In addition, biostimulants applied to plants enhance nutrition efficiency, abiotic stress tolerance and/or plant quality traits, regardless of its nutrient contents. A field experiment was conducted during December 2018 to April 2019 at the Students farm, Department of Agriculture Science & Rural Development, Loyola Academy to know the effect of bio-stimulants on growth and yield of Tomato hybrid US-440. The experiment was laid out in Randomized Block Design (RBD) and the treatments comprised of T_1- Folicist @ 3 ml/L, T_2 – Fylloton @ 3 ml/L, T_3 – Globalga @ 3 ml/L, T_4 – Tata Bahar @ 2.5 ml/L, T_5 – Neo-Alpha @ 2.5 ml/L, T_6 – Daiwik @ 2.5 ml/L, T_7 – Recommended dose of NPK, T_8 – Control. Biostimulants were applied as foliar spray at pre-flowering, flowering and fruit setting stages. From the results of the experiment, it was observed that all the growth parameters i.e., plant height (71.5, 69.5 cm), number of branches (6.8 and 6.5) and number of leaves/plant (285 and 280) were significantly increased by the application of Folicist @ 3.0 ml/L and Tata Bahar @ 2.5 ml/L compared to other treatments and control. Same treatment application resulted in significant increase in terms of number of flowers/plant (71 and 68), number of fruits/plant (42 and 39) and % fruit set (77% and 75%). The highest number of fruits/plant, fruit weight (105 and 101 g), yield/plant (5.8 kg) were recorded in foliar application of Folicist @ 3 ml/L closely followed by Tata Bahar (5.6 kg) and Daiwik (5.4 kg) and the lowest values were observed in control (3.8 kg). Application of biostimulants significantly increased the Total Soluble Solids (TSS) and lycopene content of fruits.

Keywords: Biostimulants, Growth and yield, Tomato.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is one of the most popular and widely consumed vegetable crops all over the world (Mohamed *et al*., 2018), and high-quality yield is an essential prerequisite for its economic success in India. Tomato has been recently gaining attention in relation to the prevention of some human diseases (Zhu *et al.,* 2020). This interest is due to the presence of carotenoids and particularly lycopene, which is an unsaturated alkylic compound, that appears to be an active compound in the prevention of cancer, cardiovascular risk and in slowing down cellular aging (Sabarinath *et al.,* 2020). It is used in culinary and other preparations due to its nutritive value, and grown commercially in India. Application of commercial inorganic fertilizers has resulted in drastic reduction in soil microbial population and whole rhizosphere is getting polluted (Atieno *et al*., 2020). Continuous deterioration in soil physical properties, nutrient imbalance and rapid depletion of soil fertility are added disadvantages of chemical fertilization (Bhatt *et al.,* 2019). The growth, development and yield of tomato can be increased by the balanced application of N, P and K nutrients (Mengistu *et al.,* 2017). However, growth regulation of any crop is manipulated by the exogenous application plant growth regulations (Kupke *et al.,* 2022). But in the recent past instead of PGR, biostimulants are being used for crop regulation. The

synergistic and complementary effect of biostimulants and essential nutrients is utilized for the synthesis of proteins which eventually leads to stimulated growth and yield (Dhanasekaran and Bhuvaneshwari 2005). High yielding varieties and hybrid tomatoes has got good market preference due to its size and appealing attractive red colour. With this backdrop, the present field experiment was conducted to study the effect of biostimulants on growth, yield and quality of tomato.

MATERIALS AND METHODS

The present investigation was conducted at student's farm, Department of Agriculture Sciences and Rural Development, Loyola Academy Degree and PG College, Alwal, Secunderabad (TS) during December 2018 to April 2019. The topography of the experimental field was uniform with adequate irrigation and drainage facility. The experimental soil was red sandy loam texture, medium organic carbon (0.7%), slightly alkaline pH(7.7), medium in available-N and P, high in available K. The experiment was laid out in Randomized Block Design (RBD) with 8 treatments replicated thrice. The field layout and randomization of treatments were made with plot size of 3 × 3 m ($9.0m^2$). The seedlings of tomato hybrid US-440 of one month old were obtained from Centre of Excellence, dept of Horticulture, Jeedimetla, Secunderabad. They were transplanted in the well prepared main field at a spacing of 60 × 45 cm. Farm yard manure was applied @20t/ha as soil application at last ploughing. NPK nutrients were applied @ 100-60-40 kg/ha to all the treatments except control. Nitrogen was applied in two split doses, i.e., half as basal and the remaining as top dressing. Entire dose of P and K were applied as basal. The crop was raised under protected irrigation. Weeding, intercultivation and timely plant protection measures were taken up. The biostimulants were supplied by M/S Sowbhagya Biotech Pvt Ltd, Secunderabad. They were applied as foliar spray at pre-flowering, flowering and fruit setting stages. The treatments of this trial consist of T_1- Folicist @ 3 ml/L, T_2 – Fylloton @ 3 ml/L, T_3 – Globalga @ 3 ml/L, T_4 – Tata Bahar @ 2.5 ml/L, T_5 – Neo-Alpha @ 2.5 ml/L, T_6 – Daiwik @ 2.5 ml/L, T_7 – Recommended dose of NPK, T_8 – Control. The biometrical parameters *viz,* plant height, number of branches per plant, number of leaves, number of flowers per plant, number of fruits per plant, % fruit set, fruit weight (g), yield per plant and yield per plot were recorded. The TSS content of the fruit was estimated by using hand refractometer and expressed in Brix. The lycopene content of fruits was expressed as mg/100g fresh fruit. The statistical analysis was done as per the procedure outlined by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Growth Parameters. Plant height was significantly increased by the application of biostimulants along with recommended NPK. Among the treatments, Folicist @3ml/L (T_1) and Tata Bahar @2.5 ml/L (T_4) recorded the highest plant height (71.5 and 69.5 cm) compared to other treatments and the lowest (48 cm) was observed in control (Table 1). This might be due to the accelerated cell division and cell expansion as N, P and K nutrients plays an important role in cell division and multiplication which ultimately results in maximum vegetative growth (Anbukkarasi *et al.*, 2018). Number of leaves and branches per plant contributes greatly to the growth and development of the crop(Table 1). Application of Folicist @3ml/L (T_1) and TataBahar @2.5 ml/L (T_4) significantly increased the number of branches (6.8 and 6.5) and leaves (285 and 280) per plant compared to other treatments and less in control (4 and 170). This increased number of branches and leaves is due to easy transfer of nutrients, increased meristemetic activity and enhanced supply of photosynthates (Dhanasekharan and Bhuvaneshwari 2005).

Floral characters and yield parameters. Number of flowers per plant was significantly influenced by the application of bio-stimulants. Among the treatments, Folicist @3ml/L (T_1) and Tata Bahar @2.5 ml/L (T_4) recorded the highest number of flowers per plant (71 and 68) followed by Fylloton and Daiwik applied plots and lowest in control (40). The significant increase in flower production is due to combined application of inorganic nutrients and biostimulatns which has led to the synthesis of auxins and their translocation towards reproductive growth to promote flower production (Netam and Sharma 2014). The highest number of fruits per plant, fruit weight (g) and yield per plant were observed in treatment Folicist followed by Tata Bahar and Daiwik. Percent fruitset was recorded the highest in Folicist (77%) and Tata Bahar (75.5 %) applied plots and the lowest was recorded in the Control (52%). Fruit yield per plant was recorded the highest (5.8 kg) in Folicist applied plants closely followed by Tata Bahar (5.6 kg) and Daiwik (5.4 kg) and the lowest was observed in control (3.8 kg). The increased yield components and yield could be explained that upon onset of flowering phase, there was improvement of anabolic activities as well as redistribution of metabolites. Thus, the nitrogen which was earlier utilized by vegetative parts was translocated towards reproductive organs to form amino acids, which upon condensation formed proteins and ultimately used for increasing the number of flowers per plant and weight of the fruits (Vandana and Verma 2014).

Table 1: Effect of biostimulants on growth parameters and flowering of Tomato.

Treatment	Plant height (cm)	No. of Branches /Pl	No. of Leaves/pl	No. of flowers /pl
T_1- Folicist @ 3 ml l^{-1}	71.5	6.8	285	71
T_2 – Fylloton @ 3 ml l^{-1}	63.00	6.1	250	60
T_3 – Globalga@ 3 ml l^{-1}	55.00	5.8	245	58
T_4 – Tata Bahar @ 2.5 ml l^{-1}	69.50	6.5	280	68
T_5 – Neo-Alpha @ 2.5 ml l^{-1}	57.60	6.0	245	61
T_6 – Daiwik @ 2.5 ml l^{-1}	58.50	6.0	265	63
T_7 - Recommended dose of NPK	54.50	5.5	200	50
T_8 – control	48.00	4.0	170	40
SEd	1.40	0.12	6.0	1.2
CD (p = 0.05)	3.22	0.25	13.2	2.48

Table 2: Effect of bio stimulants on fruit set, yield and quality parameters of Tomato.

Treatment	No. of Fruits /Pl	% Fruit set	Avg. Fruit Weight (g)	Fruit Diameter (Cm)	Yield /Pl (Kg)	Yield /Plot (kg)	TSS (Brix)	Lycopene (mg / 100 g fruit)
T_1- Folicist @ 3 ml l^{-1}	42	77	105	7.8	5.8	116	4.5	5.68
T_2 – Fylloton @ 3 ml l^{-1}	36	74	92	6.5	5.2	104	4.0	3.7
T_3 – Globalga@ 3 ml l^{-1}	30	71	80	6.2	4.8	96	3.8	3.3
T_4 – Tata Bahar @ 2.5 ml l^{-1}	39	75.5	101	7.5	5.6	112	5.7	5.2
T_5 – Neo-Alpha @ 2.5 ml l^{-1}	32	70	86	7.1	5.3	106	4.1	4.32
T_6 – Daiwik @ 2.5 ml l^{-1}	36	73	96	6.8	5.5	110	4.2	4.7
T_7 - Recommended dose of NPK	28	64	75	6	4.5	90	4.1	4.5
T_8 – control	22	52	55	5.2	3.8	76	2.8	1.9
SEd	1.01	0.65	2.52	0.06	0.04	2.21	0.18	0.80
CD (p = 0.05)	2.20	1.44	6.0	0.14	0.11	4.48	0.37	1.72

Quality parameters. Application of biostimulants significantly influenced the quality of the fruits (Table 2). The TSS and lycopene content was found to be improved with Folicist and Tata Bahar application compared to other treatments.

CONCLUSIONS

From the present experimental findings, it can be concluded that application of biostimulants along with balanced application of inorganic nutrients will help in increasing growth, yield and quality of tomato and fetch remunerative price to the farmers.

FUTURE SCOPE

In futurology, application of biostimulants alone can be done by avoiding or limit the application of the inorganic fertilizers. There is a scope of combine application of biostumulants as well as foliar nutrition to bring down the cost of cultivation and also find the effectiveness in combination.

Conflict of Interest. None.

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