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EVALUATION OF BIO-EFFICACY AND PHYTOTOXICITY STUDIES OF BIO-STIMULANT ON GROWTH, DEVELOPMENT AND YIELD OF TOMATO (*LYCOPERSICON ESCULENTUM* L.)

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ABSTRACT

A field experiment was conducted to study the effect of application of various biostimulants on growth and yield of tomato crop. The experiment was laid out in Randomized Block Design (RBD) with three replications. To evaluate the efficacy of bio stimulants AbdA drip (Coromandel), Drip zyme (Godrej Agrovet) and Biozyme drip plus (Biostadt India) in tomato cultivation. The experiment involved seven treatments including an untreated control. The tomato variety Shivam was used. Among the different treatments, the maximum growth parameters, viz., plant height (125.21 cm), number of branches (15.06) and stem girth (5.08 cm), were recorded with AbdA drip applied @ 300 ml/100 L of water. However, AbdA drip @ 250 ml/100 L also recorded statistically similar results, with plant height of 123.66 cm, number of branches 14.86 and stem girth 4.85 cm. The highest number of flowers per plant (80.21) was observed with AbdA drip @ 300 ml/100 L of water, closely followed by AbdA foliar @ 250 ml/100 L (79.86). The number of fruits per plant was highest with AbdA drip @ 300 ml/100 L (27.89), statistically similar to the 250 ml/100 L treatment (26.69). Ten-fruit weight was also maximized in the AbdA drip 300 ml/100 L treatment (1.21 kg), with the 250 ml/100 L dose showing comparable results (1.19 kg). Other treatments, such as Drip zyme and Biozyme drip plus @ 500 ml/100 L, showed a decreasing order of merit, while the untreated control recorded the lowest growth and yields. Application of all biostimulants drip of water (2X dose) did not show any sign or symptoms of phytotoxicity and proved safe at different growth stages of Tomato crop.

***Keywords*: Tomato, *Lycopersicon esculentum*, Biostimulants, Growth, Flower and Yield.**

Introduction

Tomato (*Lycopersicon esculentum* L.), a member of the Solanaceae family, stands as one of the world's most widely cultivated and popular vegetables, ranking second only to potato globally (Wako *et al.*, 2022). Its popularity stems from its high nutritive value, appealing taste, vibrant colour and vast suitability for diverse culinary uses, both fresh and processed. The crop's wide adaptability and high-yielding potential make it a staple warm-season fruit vegetable grown across the globe, including throughout the year in India. Tomatoes are an excellent source of essential micronutrients, including Vitamin A and C and minerals like iron and phosphorus (Gondal *et al.*, 2012). Furthermore, they are unique for their high concentration of lycopene, a natural antioxidant responsible for the fruit's characteristic red colour, which has been shown to be effective in inhibiting the growth of cancerous cells (Przybylska *et al.*, 2022).

The heavy reliance on commercial inorganic fertilizers has critically detrimental effects, resulting in a drastic reduction in the soil microbial population and generalized pollution of the rhizosphere (Atieno *et al.*, 2020). Further disadvantages of continuous chemical fertilization include the deterioration of soil physical properties, nutrient imbalance and rapid depletion of overall soil fertility (Bhatt *et al.*, 2019). While the growth, development and final yield of crops like tomato are often maximized by the balanced application of major nutrients like N, P and K (Mengistu *et al*., 2017), traditional crop regulation strategies have relied on the exogenous application of synthetic plant growth regulators (PGRs) (Kupke *et al*., 2022). Bio-stimulants are a diverse group of substances or microorganisms that, when applied to crops or the rhizosphere, stimulate natural processes to enhance plant growth, development and resilience, independent of their purely nutritional content (du Jardin, 2015). They represent a crucial component of sustainable, low-input agriculture by providing an eco-friendly alternative to traditional chemical practices.

This compilation serves as a high-standard scientific resource, detailing the principles and practices of plant biostimulants. It will facilitate knowledge exchange across all stakeholders including researchers, industry and farmers leading to a deeper comprehension of the physiological and molecular mechanisms and practical application procedures in diverse agricultural systems. Given the necessity for sustainable alternatives, this field study was undertaken to assess the influence of applied biostimulants on enhancing tomato growth and productivity. With the above facts in mind, the present investigation was carried out to study the effect of application of various biostimulants on growth and yield of tomato crop.

Materials and Methods

A field experiment was conducted at Palavadi village, Dharmapuri District, Tamil Nadu, using a Randomized Block Design (RBD) to evaluate the efficacy of bio stimulants AbdA drip (Coromandel), Drip zyme (Godrej Agrovet) and Biozyme drip plus (Biostadt India) in tomato cultivation. The experiment involved seven treatments including an untreated control. The tomato variety Shivam was used. Standard agronomic practices were followed as per University recommendations throughout the crop season. The biostimulant treatments were applied through drip irrigation thrice: the first application was at the flower initiation stage, followed by two subsequent applications at 15-day intervals. Observations related to growth and yield parameters were recorded at the final harvest to assess the efficacy of each treatment.

Treatment details:

Tr no.	Treatment	Dose ml /100 litres
T1	AbdA drip	150
T2	AbdA drip	200
T3	AbdA drip	250
T4	AbdA drip	300
T5	Drip zyme	500
T6	Biozyme Drip Plus	500
T7	Untreated Control	---

Biometric Observations

Growth attributes of tomato plants were recorded from 10 randomly selected plants per replication. Observations included plant height at flowering (cm), number of primary branches per plant, number of flowers per plant and stem girth. Plant height was measured from the base to the apex of the main stem at the flowering stage and the average was calculated for each treatment. The number of primary branches and flowers per plant were counted for each selected plant and the mean values were determined. Stem girth was measured at the basal portion of the stem from the same sampled plants.

Yield Components

The number of fruits per plant was recorded by counting fruits from 10 randomly selected plants at each harvest and the mean number was calculated after consolidating data from all pickings. The weight of 10 randomly selected fruits per harvesting was measured and expressed in grams. Total fruit yield per plot was recorded at each harvest and the final yield was expressed in quintals per hectare (q ha^{-1}) after summing all pickings.

Phytotoxicity Study

Phytotoxicity of AbdA drip applied at two concentrations (250 ml/ L water and 300 ml/ L water) was assessed alongside an untreated control. Five randomly selected hills per plot were observed for phytotoxic symptoms including leaf injury at tips or surface, vein clearing, necrosis, epinasty, and hyponasty. Symptoms were recorded on 0, 1, 3, 5, 7 and 10 days post application and severity was graded using a 0–10 scale based on the extent of leaf damage.

Score	Phytotoxicity (%)	Score	Phytotoxicity (%)
0	No Phytotoxicity	6	51-60
1	01-10	7	61-70
2	11-20	8	71-80
3	21-30	9	81-90
4	31-40	10	91-100
5	41-50	–	–

Result and Discussion

Efficacy of AbdA Drip on the growth parameters of Tomato

In general, enhanced growth parameters were observed after application of AbdA drip plant growth regulator compared to the untreated control (Table 1). Among the different treatments, the maximum growth parameters, viz., plant height (125.21 cm), number of branches (15.06) and stem girth (5.08 cm), were recorded with AbdA drip applied @ 300 ml/100 L of water. However, AbdA drip @ 250 ml/100 L also recorded statistically similar results, with plant height of 123.66 cm, number of branches 14.86 and stem girth 4.85 cm. These were followed by treatments with AbdA foliar @ 200 ml/100 L, Drip zyme @ 500 ml/100 L and Biozyme drip plus @ 500 ml/100 L in decreasing order of efficacy. The lowest growth parameters were observed in the untreated control (Table1).

The significant enhancement in tomato growth parameters following AbdA drip application directly supports recent research affirming the positive role of exogenous plant growth regulators (PGRs) like GA3 and NAA in boosting growth of the plants (Kumar *et al.*, 2024). The high performance of the AbdA drip aligns with studies on biostimulants, particularly those involving PGR-producing microorganisms (e.g., generating IAA and gibberellins), which promote plant vigor and soil health (Gomasta, 2024; Yan *et al.*, 2024). 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). The finding that the untreated control exhibited the lowest growth underscores the necessity of external regulatory input for optimal tomato development, confirming results from studies demonstrating that exogenous applications of plant growth regulators (PGRs) or biostimulants are essential for maximizing tomato growth (Choudhary *et al.*, 2024).

Efficacy of AbdA Drip on yield parameters of Tomato

The application of the biostimulant AbdA drip significantly improved tomato yield parameters compared to the untreated control. The highest number of flowers per plant (80.21) was observed with AbdA drip @ 300 ml/100 L of water, closely followed by AbdA foliar @ 250 ml/100 L (79.86). The number of fruits per plant was highest with AbdA drip @ 300 ml/100 L (27.89), statistically similar to the 250 ml/100 L treatment (26.69). Ten-fruit weight was also maximized in the AbdA drip 300 ml/100 L treatment (1.21 kg), with the 250 ml/100 L dose showing comparable results (1.19 kg). Fruit yield per hectare was significantly increased by AbdA drip applications, with the 300 ml/100 L dose yielding 438.46 q/ha and the 250 ml/100 L dose closely behind at 436.49 q/ha. Other treatments, such as Drip zyme and Biozyme drip plus @ 500 ml/100 L, showed a decreasing order of merit, while the untreated control recorded the lowest yields (312.66 q/ha) (Table 2).

The significant increase in tomato yield due to biostimulant application is well supported by recent studies. Shahid *et al.* (2022) reported that biostimulants enhanced tomato yield by improving the concentration of key minerals (Ca, K, Mg, P), photosynthetic rate and enzymatic activities, boosting productivity by up to 76% compared to controls. Patanè *et al.* (2025) found biostimulant treatments increased tomato productivity by 39–57%, attributed to enhanced physiological processes and stress mitigation. Similarly, Iacuzzi *et al.* (2024) documented a notable increase in marketable tomato yield over two years following biostimulant application. Moreover, organic biostimulants like fish protein hydrolysate were shown by Dewang (2021) to increase tomato yield by up to 48%, demonstrating the value of natural biostimulants in sustainable agriculture. These studies collectively indicate that biostimulants promote nutrient availability, hormonal balance and metabolic activity, resulting in increased fruit number, size and overall yield in tomato crops.

Phytotoxicity

The results of phytotoxicity studies of AbdA drip in comparison with untreated control are presented in Table 3. The use of AbdA drip is found to be safe to tomato crop and none of the symptoms like chlorosis, necrosis, scorching, epinasty and hyponasty were recorded even at the double dosage of treatment viz., 500 ml/100 lit. of water (2X dose) and up to ten days after third application (Table 3).

Table 1 : Efficacy of AbdA Drip on the growth components of Tomato

Tr. No	Treatments (Dose/ha)	Plant height (cm)	No. of branches	Stem girth (cm)
T1	AbdA drip @ 150 ml/100 lit of water	112.66	13.21	03.88
T2	AbdA drip @ 200 ml/100 lit of water	119.21	13.86	04.20
T3	AbdA drip @ 250 ml/100 lit of water	123.66	14.86	04.85
T4	AbdA drip @ 300 ml/100 lit of water	125.21	15.06	05.08
T5	Drip zyme drip @ 500 ml/100 lit of water	121.33	14.21	04.45
T6	Biozyme Drip Plus @ 500 ml/100 lit of water	120.49	14.09	04.31
T7	Untreated control	100.79	10.12	03.26
	S.Ed	0.74	0.14	0.12
	C.D.(p=0.05)	1.85	0.31	0.29

Table 2 : Efficacy of AbdA drip on the yield components of Tomato

Tr. no	Treatments (Dose/ha)	No. of flowers/ plant	No. of fruits/ plant	10 fruit weight (kg)	Fruit yield (q/ha)	Per cent increase over control
T1	AbdA drip @ 150 ml/100 lit of water	70.33	21.46	1.06	406.21	29.92
T2	AbdA foliar @ 200 ml/100 lit of water	73.21	23.33	1.12	419.21	34.07
T3	AbdA foliar @ 250 ml/100 lit of water	79.86	26.69	1.19	436.49	39.60
T4	AbdA foliar @ 300 ml/100 lit of water	80.21	27.89	1.21	438.46	40.33
T5	Drip zyme @ 500 ml/100 lit of water	76.98	24.49	1.18	423.33	35.39
T6	Biozyme Drip Plus @ 500 ml/100 lit of water	76.33	24.16	1.16	421.34	34.75
T7	Untreated control	64.72	19.32	0.96	312.66	--
	S.Ed	0.20	0.60	0.01	0.98	--
	C.D.(p=0.05)	0.41	1.30	0.03	2.01	--

Table 3 : Phytotoxicity of different biostimulants drip on Tomato crop

Tr. No	Treatments	Phytotoxicity Symptoms / Days after application																														
		Dose	Chlorosis						Necrosis						Scorching						Epinasty						Hyponasty					
		ml/ha	0	1	3	5	7	10	0	1	3	5	7	10	0	1	3	5	7	10	0	1	3	5	7	10	0	1	3	5	7	10
1	AbdA Drip	250 ml/100 lit of water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	AbdA Drip	300 ml/100 lit of water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Drip zyme	500 ml/100 lit of water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Biozyme Drip Plus	500 ml/100 lit of water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Untreated Control	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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