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Effect of biostimulant (BioBLOOM and NitroKICK) on growth, fruit yield and quality of banana

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Abstract
The present investigation was carried out during the year 2022 - 2023 at Agriculture Research Station, Achalpur under Dr. Panjabrao Deshmukh Krishi Vidyapeeth, (M.S.), India to evaluate the effect of biostimulant on growth, yield and quality of banana crop. The experiment consisted of sixteen different drenching and spraying treatments were repeated two times in RBD. The result indicated that, among the various treatments, banana responded significantly to application of biostimulants (BioBLOOM and NitroKICK). The growth and yield parameters of banana were conspicuously higher with application of biostimulants (BioBLOOM and NitroKICK) as compared to control. Treatment T_{16} (S_3– 3 liter/acre BioBLOOM drenching application at 1, 2, 3, 4 & 5th month + F_3- 500 ml/100 liter of NitroKICK as a spraying in 1, 2 and 3rd month after planting) was recorded significantly highest number of fruits per bunch (150.00), fruit weight (167.00 g), length of fruit (21.00 cm), girth of fruits (12.95 cm), bunch weight (25.85 kg) and yield (114.89 t ha^{-1}) which wear at par with T_{11}, T_{12}, T_{14} and T_{15} treatment. Treatment T_{16} recorded highest gross income (Rs 804230), yield (114.89 t ha^{-1}), increased yield over control (32.62 t ha^{-1}) and percent increase in yield (39.65) over control which wear at par with T_{11}, T_{12}, T_{14} and T_{15} treatment (Table 2). Hence treatment T_{11}, S_2 – 2 liter/acre BioBLOOM drenching application at 1, 2, 3, 4 & 5th month after planting + F_2- 400 ml/100 liter of NitroKICK as a spraying in 1, 2 and 3rd month after planting found best.

Keywords: Biostimulants, BioBLOOM, NitroKICK, yield, bunch weight, banana

Introduction
Banana (*Musa sp.*), is an important fruit crop in sub-tropical and tropical climate. It is originated into tropical south and Southeast Asia, cultivated in the world in an area of 5.49 million ha with global production of 113.28 million metric tons (Anonymous, 2018) [3]. Banana cultivation in India is widespread, in general, in Tamil Nadu, Maharashtra, Gujarat, Andhra Pradesh and Karnataka. Export value of Bananas was 34877.39 lakh rupees from India in 2017-18 (Anonymous, 2018) [3]. In Vidharbha region banana farming become popularized and that region specific particularly under the belt of citrus where citrus fruit yield decline due to number of diseases and also have a market problems. As input cost like fertilizers and pesticides increases, hence there is need to search a crop that become more remunerative. For obtaining quality produce conjunctive use of all agricultural inputs is essential. Therefore, the aim of our study was to improve the production and the quality of banana. It was based on applying the biostimulant to confirm its effect on the growth, yield and quality of banana. Biostimulants have its role as additive to fertilizers and helps in uptake of nutrients, promote plant growth beside increase the tolerance to abiotic stress. A biostimulant is a substance of natural origin/microorganism which improves the condition of crops without causing adverse side effects on normal crop growth.

Materials and Methods
The field experiment was carried out during November 2021 to February 2023 at the Farm of Agriculture Research Station, Dr. P.D.K.V., Achalpur Dist. Amravati (Maharashtra). The experiment was laid out in Randomized Block Design with two replications. The treatment comprised of sixteen treatments of biostimulants viz.

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Sr. No.	Particular	Treatment No	Combinations	Treatment No	Combinations
S	**Drenching application at 1, 2, 3, 4 & 5th month**				
1	S_0 – No Drenching	T_1	$S_0 + F_0$	T_{10}	$S_2 + F_1$
2	S_1 – 1 liter/acre–BioBLOOM	T_2	$S_0 + F_1$	T_{11}	$S_2 + F_2$
3	S_2 – 2 liter/acre-BioBLOOM	T_3	$S_0 + F_2$	T_{12}	$S_2 + F_3$
4	S_3 – 3 liter/acre-BioBLOOM	T_4	$S_0 + F_3$	T_{13}	$S_3 + F_0$
F	**Foliar application at 1, 2, 3rd month**	T_5	$S_1 + F_0$	T_{14}	$S_3 + F_1$
1	F_0- No Foliar application	T_6	$S_1 + F_1$	T_{15}	$S_3 + F_2$
2	F_1 – 300 ml/100 liter-NitroKICK	T_7	$S_1 + F_2$	T_{16}	$S_3 + F_3$
3	F_2 - 400 ml/100 liter- NitroKICK	T_8	$S_1 + F_3$		
4	F_3 – 500 ml/100 liter-NitroKICK	T_9	$S_2 + F_0$		

Tissue culture plants of cv. Grand Naine used and planted with spacing 1.5 m x 1.5 m for experiment. Five plants from each treatment plot were randomly selected, labeled and used for recording observations. Observations were recorded on growth parameters - plant height (cm), stem girth (cm), number of leaves, yield contributing characters- number of fruits per bunch, weight of fruit(g), bunch weight (kg) and yield (t/ha), length and girth of fruits (cm) and quality parameters- TSS, Shelf life of fruits (days) in cv. Grand Naine. RBD analysis was completed as per the method suggested by Panse and Sukatme (1967) [6].

Results and Discussion

Biostimulants become emerged as a supplement to mineral fertilizers and to some extent hold a promise to improve the yield and a quality of crop. Also found to stimulate phenological variables and result with increased or earlier flowering, growth and yield of the crop.

Growth Parameters

The effect of biostimulant (BioBLOOM and NitroKICK) treatment on plant height, stem girth and number of leaves of banana plant at harvest is presented in Table 1. The biostimulant (BioBLOOM and NitroKICK) treatments had significant influence on plant height, stem girth and number of leaves as compared to control. Treatment T_{16} were recorded highest plant height (210.25 cm), stem girth (60.10 cm) and number of leaves (29.00) which are at par with T_{14} and T_{15} in plant height, T_6 to T_8, T_{10} to T_{12}, and T_{14} in stem girth and T_6 to T_{15} in number of leaves of banana plant. Dibut *et al.* (1996) [4] reported that the Azotoryza, a biopreparation elaborated from Azatroya chroococcum, bacterial inoculation i.e @ 20 liters per hectare stimulated all phenological variables like plant height, number of leaves, shoots and pseudostem diameter in banana cv's 'Giant Cavendish' and 'Burro CEMSA'.

Yield and quality Parameters

Number of fruits per bunch and fruit weight were significantly influenced by biostimulant (BioBLOOM and NitroKICK) application (Table1). Maximum number of fruits per bunch and fruit weight were observed in T_{16} (150.00 and 167.00 g) which was at par with T_{12}, T_{14} and T_{15} in case of number of fruits per bunch and T_6 to T_8, T_{10} to $_{12}$ and T_{14} and T_{15} with respect to fruit weight.

Length and girth of fruits was significantly influenced by biostimulant (BioBLOOM and NitroKICK) application. Longer (21.00 cm) and wider (12.95cm) fruits were produced by the T_{16} treatment which is at par with T_7, T_8, T_{10} to T_{12}, T_{14} and T_{15} in length of fruits and T_{14} and T_{15} in girth of fruits. Abubakar *et al.*, (2013) [2] conducted an experiment on effect of biostimulants on pomegranate cv. Kandhari Kabuli and concluded that the highest fruit length, diameter, weight, volume and minimum fruit cracking were recorded in trees treated with spic cytozyme (4 ml/l) as compare to other treatments. Roshdy, (2014) [8] reported on Grand Naine banana that, foliar application of potassium silicate + seaweed extract each at 0.1 % gave significantly maximum bunch weight (29.6 and 29.8 kg), average weight of hand (1.99 and 2.11 kg), finger weight (98.0 and 99.0 g), finger length (24.1 and 24.3 cm), finger diameter (10.0 and 10.8 cm), Pulp (70.7 and 70.3%) and TSS (19.3 and 19.6 %), in 2011-12 and 2012-13, respectively. Ravi *et al.*, (2018) [7] evaluated the effect of different seaweed bio-formulations on growth, yield and quality of Banana cv. Grand Naine and observed that, number of hands and fingers per bunch also increased to 5.78% and 6.6% respectively with LBS6S @ 1 ml/l treatment over control.

Bunch weight differed significantly between the treatments of biostimulant (BioBLOOM and NitroKICK) application (Table 1) and heaviest bunches 25.85 kg was recorded in T_{16} treatment which was at par with T_{11}, T_{12}, T_{14} and T_{15} treatment. The yield of plant cv. Grand Naine was significantly influenced by the biostimulant (BioBLOOM and NitroKICK) application (Table 1). Statistically maximum yield (114.89 t ha^{-1}) was recorded with T_{16} treatment which is at par with T_{11}, T_{12}, T_{14} and T_{15} treatment. Ravi *et al.* (2018) [7] evaluated the effect of different seaweed bio-formulations on growth, yield and quality of Banana cv. Grand Naine and observed that foliar application of LBS6S @ 1 ml/L improved the bunch weight significantly by 25.24% over control followed by LBS3 @ 5 ml/L with12.62% over water control.

Studies on the effect of foliar spray of 'Goemar' a biostimulant in crops like apples, pears, nectarines, apricots, plum and cherries resulted in an increase in fruit set and size before thinning, at harvest and final weight as compared to untreated or control plants (Kloareg *et al.*, 1996) [5]. Abubakar *et al.* (2012) [1] studied the effect of foliar application of plant biostimulants in pomrgranate and reported that, plant biostimulants significantly improved flowering, yield, return bloom and reduced the fruit drop. Aziz *et al.*, (2013) [9] revealed that, the application of plant biostimulants significantly improved flowering, yield also reduced the fruit drop in pomegranate.

It is also evident from data that, statistically significant value of TSS of banana fruits was found to be highest (25.00) in T_{16} treatment application followed by T_{15} treatment which were at par. Highest shelf life of banana fruits was found in T_{16} treatment (10.55) followed by T_{12}, T_{14} and T_{15} treatment which was at par.

Economics

Treatment T_{16} recorded highest gross income (Rs 804230), yield (114.89 t ha^{-1}), increased yield over control (32.62 t ha^{-1}) and percent increase in yield (39.65) over control which wear at par with T_{11}, T_{12}, T_{14} and T_{15} treatment (Table 2). Abubakar *et al.*, (2012) [1] studied the effect of foliar application of plant biostimulants in pomrgranate and reported the highest return bloom was observed with the application of vipul (15 ml/l).

Table 1: Effect of biostimulant (BioBLOOM and NitroKICK) on growth, fruit yield, quality and economics of banana Var. Grand Naine

Treatment No	Plant height (cm)	Stem Girth (cm)	No. of leaves	Number of fruits per bunch	Fruit Weight (g)	Length of fruit (cm)	Girth of fruit (cm)	Bunch weight (kg)	Fruit Yield t/ha	TSS	Shelf life of fruits (days)	Gross income (Rs/ha)	Increased yield over control (t/ha)	Percent increase in yield over control
T_1	173.15	50.00	20.10	124.00	148.50	15.20	8.68	18.51	82.27	23.60	8.60	575890	0	0
T_2	175.50	52.03	22.20	125.00	150.00	15.60	8.79	18.96	84.26	23.65	8.60	589820	1.99	2.42
T_3	175.00	53.10	24.30	126.30	150.20	16.00	9.21	19.27	85.64	23.70	8.75	599480	3.37	4.10
T_4	178.00	54.20	25.20	127.80	152.30	16.30	10.36	19.87	88.28	23.70	8.90	617960	6.01	7.31
T_5	180.00	55.10	26.10	130.00	154.00	16.50	10.40	20.52	91.20	23.80	9.00	638400	8.93	10.85
T_6	190.00	55.80	27.20	134.20	160.00	19.50	10.96	22.07	98.08	24.10	9.70	686560	15.81	19.22
T_7	192.00	56.00	27.30	136.20	163.00	20.00	11.68	22.83	101.46	24.20	9.80	710220	19.19	23.33
T_8	195.00	56.12	27.50	138.20	165.00	20.20	11.76	23.45	104.22	24.28	10.00	729540	21.95	26.68
T_9	180.00	55.20	27.00	131.00	156.00	17.00	10.59	21.03	93.48	23.90	9.50	654360	11.21	13.63
T_{10}	198.00	56.20	27.75	140.80	166.30	20.30	11.90	24.10	107.12	24.40	10.10	749840	24.85	30.21
T_{11}	199.50	56.40	27.90	142.30	166.50	20.35	12.00	24.39	108.40	24.55	10.20	758800	26.13	31.76
T_{12}	200.00	57.00	28.00	144.40	166.90	20.45	12.10	24.83	110.33	24.60	10.30	772310	28.06	34.11
T_{13}	185.00	55.60	27.10	132.00	158.00	18.00	10.68	21.47	95.42	24.00	9.60	667940	13.15	15.98
T_{14}	204.25	58.90	28.30	146.20	166.93	20.60	12.30	25.15	111.77	24.63	10.45	782390	29.5	35.86
T_{15}	207.00	59.00	28.50	148.50	167.04	20.80	12.50	25.59	113.72	24.90	10.50	796040	31.45	38.23
T_{16}	210.25	60.10	29.00	150.00	167.00	21.00	12.95	25.85	114.89	25.00	10.55	804230	32.62	39.65
SE (M) ±	3.13	1.49	0.89	2.28	2.35	0.39	0.26	0.50	2.23	0.08	0.08	15578.57		
CD @ 5%	9.38	4.46	2.67	6.84	7.04	1.16	0.78	1.50	6.67	0.24	0.25	46699.56		

Selling rate of banana= Rs 7000/ton

Conclusions

The T_{16} (S3– 3 liter/acre BioBLOOM drenching application at 1, 2, 3, 4 & 5th month + F_3- 500 ml/100 liter of NitroKICK as a spraying in 1, 2 and 3rd month after planting) treatment recorded the highest plant height (210.25 cm), pseudostem girth (60.10 cm), number of leaves at harvest (29.00), number of fruits per bunch (150.00), fruits weight (167.00 g), bunch weight (25.85 kg), length of fruits (21.00 cm), girth of fruits (12.95 cm), yield (114.89 t/ha), TSS (25.00), shelf life of fruits (10.55), Gross income (804230.00 Rs/ha) and percent increase in yield over control (39.65). The treatment T_{16} was at par with T_{11}, T_{12}, T_{14} and T_{15} treatments. Hence treatment T_{11}, S_2 – 2 liter/acre BioBLOOM drenching application at 1, 2, 3, 4 & 5th month after planting + F_2- 400 ml/100 liter of NitroKICK as a spraying in 1, 2 and 3rd month after planting found best in banana cv. Grand Naine.

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