

Research Article

## Influence of plant bioregulators on finger characters, yield and economics of banana cv. Monthan under the Cauvery delta region of Karaikal, Puducherry

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### Article Info

[https://doi.org/10.31018/](https://doi.org/10.31018/jans.v15i4.4934)

[jans.v15i4.4934](https://doi.org/10.31018/jans.v15i4.4934)

Received: July 27, 2023

Revised: December 8, 2023

Accepted: December 13, 2023

### How to Cite

Manonmani, S. *et al.* (2023). Influence of plant bioregulators on finger characters, yield and economics of banana cv. Monthan under the Cauvery delta region of Karaikal, Puducherry. *Journal of Applied and Natural Science*, 15(4), 1701 - 1705. <https://doi.org/10.31018/jans.v15i4.4934>

### Abstract

Banana, a climacteric fruit crop of the humid tropical ecosystem, has economic value worldwide in domestic and export markets. Recently, plant bio-regulators have been proven to modulate the growth and/or any physiological actions from its production site and are active in minor concentrations. The plant bio-regulators encompass several plant growth hormones to promote commercial fruit production when applied externally at the right stage with appropriate concentration. However, the response of banana cv. Monthan with the foliar application of plant bio-regulators in the Cauvery delta region of Karaikal, Puducherry, is less explored. Hence, the study was initiated to assess the potentiality of plant bio-regulators in commercial banana production in the region to support the banana growers of the track to obtain better returns. The experiment was laid out in Randomized Block Design (RBD) with six treatments (T<sub>1</sub> - GA3 50ppm, T<sub>2</sub> - CPPU 2ppm, T<sub>3</sub> - 2,4-D 25 ppm, T<sub>4</sub> - Brassinosteroid 1 ppm, T<sub>5</sub> - Seaweed extract 0.1% and C - control) of four replications. Two Bunch sprays of treatments were given at the time of opening of the last hand and 20 days later, the first spray. Results obtained revealed that the bunches fortified with 'T<sub>5</sub>' Seaweed extract (0.1%) rendered significance with hand weight (1.72 kg), finger girth (15.88 cm), pulp width (5.05 cm) and lesser duration between the last hand open and harvest (73.00 days), yield per hectare (20.55 t/ha). Economic analysis evidenced that the treatment of seaweed extract (0.1%) hampered the highest net returns (Rs. 2,91,138 per hectare), including the benefit-cost ratio (1.89). Hence, the pre-harvest bunch spray with 0.1% seaweed extract is a cost-effective treatment and that may be recommended to farmers to increase the banana productivity in this region.

**Keywords:** Bio-regulators, Economics, Monthan, Pre-harvest spray, Seaweed extract, Yield

### INTRODUCTION

Banana generally constitutes a necessary fruit crop of the tropical ecosystem since they serve as a hub for vital nutrients that tends to have tremendous potential in balancing the multilevel functioning of the human body over a century. Banana, a climacteric fruit crop of humid tropical ecosystem, has economic value worldwide both in domestic and export markets. They remain a staple food that ensures food security in household as well a cash crop in revenue generation plat-

form. In such a way, they have a pivotal role in the least developed and low-income, food-deficit countries (FAO, 2023). This is the fourth most important food in terms of gross value after paddy, wheat and milk products ( Kumar *et al.*, 2022). In Indian conditions, banana supported numerous people's livelihood with its potential benefits. More than 1000 varieties of bananas exist in the world (FAO, 2023). Though its diversification in numerous parts of the nation, several predominant varieties dominate its performance by registering a potentiality with wider cultivable preferences. Plant bio-regulators

dominate any commercial fruit crop production programme worldwide (Biswas and Lemtur, 2014).

In recent years, it has attracted the farming community with its numerous positive mechanisms for the enhancement of production and quality in several fruit crops. (Haider *et al.*, 2012). Preharvest practices with foliar bio-regulator sprays performed during the growth and development of bunches were observed to express remarkable changes. (Thanaa, *et al.*, 2016). Moreover, the foliar applications were known to hasten the rate of nutrient uptake. (Sandhya *et al.*, 2018). Several crops bound characters of bunching and finger characters that were observed to positively impact the yield and quality of banana. Hence, the practice delivers a remarkable value to conserving the farmer's economy, including with scientific studies of investigators. The banana cultivar Monthan is one of the predominant cultivars that are widely grown on a large commercial scale in the Cauvery delta region. The reason might be due to the existing topographical region, nature of crop, soil type and environmental factors, and regional preferences, including some market value at domestic level.

Even though most of the cultural practices were standardized for this cultivar, the information on their performance analysis over the foliar applications of several bio-regulators is very limited and mostly lacking in the region. Hence, an attempt was made to study the performance of banana cultivar Monthan to the pre-harvest sprays of certain potential plant bio-regulators over finger, yield and including its cost economics in order to streamline the cultivation with more of a scientific way of supporting the banana growers of the track to obtain better returns. Among the plant bio-regulators, the role of GA3, CPPU, 2,4-D, and Brassinolide in commercial fruit production is inevitable. Biswas and Lemtur (2014); Pujari, *et al.*, (2010); Lijun, *etal.*, (2017); (Sathish *et al.*, 2021). The beneficial effects of the application of seaweed extract have been extensively reported in various scientific literature. It was observed that seaweed application significantly impacts the enhancement of yield and quality-related traits in banana (Ravi *et al.*, 2018). The post-shoot spraying on banana bunch has impact in improving the yield-related characters, including bunch and finger qualities in banana cv. Grand Naine. Kumar and Kumar (2010). Gibberellins comprise a large number of chemical particles which are fashioned naturally within plant system that is supportive in mobilization of food particles used for cell growth and supports fruit quality enhancement (Gurung *et al.*, 2016). The application of GA3 (80 ppm) at flag leaf stage improved the finger characters (Yadlod and Kadam, 2008), while Garasangi *et al.* (2018) found GA3 (25ppm) enhanced finger characters viz., finger weight, hand weight, finger length, finger girth, pulp peel ratio in banana cv. Rajapuri. Likewise, in banana cv. Ney Poo-

van, 2, 4-D (30 ppm) showed positiveness over the finger characters, yield and quality (Sathish *et al.*, 2021). Pujari *et al.* (2010) also observed that the bunch spray treatment with 2,4-D (10 ppm) in banana cv. Grand Naine results in better the finger count. Brassinolide, a new generation plant bio-regulator tends to stimulate plant growth and enhance the crop yield in several fruit crops. According to Rajan *et al.*, (2017) application of Brassinosteroid (2ppm) influenced the bunch and finger characters and quality traits in banana cv. Grand Naine. Mulagund, *et al.*, (2015) observed increased finger characters and higher B:C ratio with the application of SOP (2%) + Brassinosteroid (2 ppm) in post-shooting of banana. In addition, brassinosteroid advances photosynthesis efficiency in plant systems through photosynthetic pigment biosynthesis and protection mechanism from damaging effects of reactive oxygen species with enhanced accumulation of osmolytes and improved antioxidant enzyme activity (Wang *et al.*, 2016). CPPU, a potential synthetic cytokinin tends to regulate various physiological process of chlorophyll biosynthesis, cell division, and cell expansion that have tremendous effect over the enhancement of fruit set and fruit enlargement process in various fruit crops. Foliar application of CPPU stimulates the fruit set and yield traits in various fruit crops. Rajan, *et al.*, (2017) noticed banana fruit quality and shelf life were enhanced through the bunch application of CPPU (2 ppm). Seaweed (*Ascophyllum nodosum* L.), a potential source of plant bio-regulator performs a tremendous role in regulating metabolism and crop productivity (Khan *et al.*, 2009). It expressed positiveness over Williams banana CV's growth characteristics, yield, and quality-related traits (Gomaa and Ibrahim, 2020) The extract of seaweed has the potency to create a positive impact on yield and finger characters in cultivars of banana (El-Kholy, 2017). Similarly, Nethravathi *et al.* (2021) registered maximum finger weight, finger length, finger girth, third-hand weight, including bunch yield and quality-related traits with the pre-harvest spray of seaweed extract (0.3%) during 6<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> month after transplanting in banana cv. Grand Naine. With this background, the present study aimed to assess the influence of preharvest spray of plant bioregulators on banana cv. Monthan fingers, yield and economics under the Cauvery delta region.

## MATERIALS AND METHODS

### Study area and methodology

The experiment was conducted on banana cv. Monthan fingers at the Cauvery delta region, Karaikal (Puducherry) during 2020-2021. The experiment was laid out in randomized block design having six treatments (T1 - GA3 50ppm, T2 - CPPU 2ppm, T3 - 2,4-D 25 ppm, T4 - Brassinosteroid 1 ppm, T5 - Seaweed

extract 0.1% and T6 – control (water spray) and four replications. The treatments with optimum concentration were prepared and two bunch sprays were given after mixing with a wetting agent using a hand-operated pressure sprayer. After the female phase, the male bud was removed from the inflorescence and different treatments were implied over the bunch. The pre-harvest foliar spray were given two times, one is at the time of denavelling and the second was at 20 days after the first spray. Observation on the parameter of finger characters *viz.*, finger length (cm), finger girth (cm), hand weight (Kg), number of fingers per hand, pedicel length (cm), pulp width (cm), duration between last hand opening and harvest (days) and yield (t/ha) related traits were measured. The standard cost concepts was used for estimation of cost of economics analysis which was carried out by calculating the total cost of cultivation (Rs./ha), gross income (Rs./ha), net return (Rs./ha) and formulated benefit-cost ratio by dividing gross return by total cost of cultivation. The statistical analysis was executed by adopting the nominal procedures as framed by Panse and Sukhatme (1985).

### Statistical analysis

The Agres statistical software was used for statistical analysis. Different treatments were compared accordingly after working out the standard errors and critical difference at 0.05 per cent significance level.

## RESULTS AND DISCUSSION

Several finger characters *viz.*, hand weight, finger length, finger girth, pedicel length, pulp width, and duration between last hand open and harvest were accessed in the fortified bunches with pre-harvest bio-regulator through foliar mean. From the results obtained, it was clear that variations were found to persist among the treated bunches over the untreated control in the majority of parameters in the banana cultivar Monthan. Among all, the bunches of banana cultivar

Monthan rendered with 'T5' Seaweed extract (0.1%) sprays registered significance with hand weight, finger girth, pulp width and duration between last hand open and harvest (Table 1).

For other characters, 'T1' of GA3 (50ppm) performed well with finger and pedicel length parameters. Fortification of fingers in bananas with seaweed extract rendered potential value with its enhanced source of bioactive secondary metabolites that resulted from significant value that encouraged the development of novel functional constituents (Gomaa *et al.*, 2020). In accordance, pre-harvest foliar applications with seaweed causes the stimulation of the reproductive phase in crop developmental times which nourished the yield of fruits additionally with the partial pseudostem translocation of essential nutrients in banana (Tabet, *et al.*, 2021). The greater number of fingers per hand and higher hand weight was recorded in 'T5' 0.1% Seaweed extract spray (11.75 and 1.72 Kg, respectively) among all other treatments. Roshdy (2014) also finds the same results when treated in banana cv. Grand Naine with seaweed extract (0.05%) and potassium silicate (0.05%) combination treatments. The GA3-fortified treatments impacted in greater finger length (17.43 cm) and pedicel length (2.90 cm) characters. Same influence of GA3 on finger length were obtained by Garasangi *et al.* (2018) when applied at 25ppm in banana cv. Rajapuri. The GA3 treatment increases cell division and cell elongation, leading to increased finger and pedicel length in cultivar Monthan (Moore, 1979).

For the finger characters *viz.*, finger girth (15.88 cm) and pulp width (5.05 cm), the seaweed extract registered greatest among all other treatments, including untreated treatments. The present study findings coincide with Nethravathi *et al.* (2021) findings wherein seaweed extract was applied through foliar nutrition at 0.3% concentration. It was noted that there was a reduction in the duration of fruit maturity in seaweed extract-treated bunches. The duration between last hand open and harvest was lesser in T5 (73.00 days), which

**Table 1.** Effect of plant bioregulator sprays on finger characters in banana cv. Monthan

Treatments	Duration between last hand open and harvest (days)	Pulp width (cm)	Number of hands per bunch	Number of fingers per hand	Finger length (cm)	Finger girth (cm)	Pedicel length (cm)	Hand weight (Kg)	Yield per hectare (t/ha)
T1	86.00	4.47	4.90	11.66	17.43	14.03	2.90	1.60	18.78
T2	84.00	4.29	4.90	10.33	13.50	13.47	2.25	1.10	14.85
T3	78.00	4.23	5.05	10.25	14.50	13.30	2.40	1.48	17.33
T4	73.50	4.00	5.10	9.75	13.03	12.57	2.03	1.14	16.63
T5	73.00	5.05	5.20	11.75	15.00	15.88	2.23	1.72	20.55
T6	98.00	4.71	4.70	11.25	14.87	14.80	2.40	1.19	14.65
MEAN	82.08	4.46	4.98	10.83	14.72	14.01	2.37	1.37	17.13
Sed	1.64**	0.09**	0.10**	0.21**	0.29**	0.28**	0.05**	0.03**	0.33**
CD (0.05%)	3.49	0.19	0.20	0.45	0.61	0.59	0.10	0.06	0.07

T1: GA3 (50 ppm) ; T2 : CPPU (1 ppm) ;T3 : 2,4-D (25 ppm); T4 : Brassinosteroid (1 ppm); T5 : Seaweed extract (0.1%); T6 : Control (water spray) SEd: Standard error deviation; CD (0.05%): Critical difference @ 0.05% level

**Table 2.** Effect of plant bio-regulator sprays on cost of cultivation, gross income, net return and benefit cost ratio in banana cv. Monthan

Treatments	Yield per hectare (t/ha)	Cost of treatment (Rs./ha)	Cost of cultivation (Rs./ha)	Gross income (Rs./ha)	Net return (Rs./ha)	Benefit cost ratio (BCR)
T1	18.78	7500	330362	563250	232888	1.70
T2	14.85	2400	325262	445500	120238	1.37
T3	17.33	1000	323862	519750	195888	1.60
T4	16.63	25250	348112	498750	150638	1.43
T5	20.55	2500	325362	616500	291138	1.89
T6	14.65	0	322862	439500	116638	1.36

Treatment details: T1: GA3 (50 ppm); T2 : CPPU (1 ppm); T3 : 2,4-D (25 ppm); T4 : Brassinosteroid (1 ppm); T5 : Seaweed extract (0.1%); T6 : Control (water spray)

was on par with T4 (73.50 days) and greater the duration between last hand open and harvest registered in control T6 (98.00 cm). Moreover, the implications of seaweed on a bunch of bananas enhanced cell division and cell expansion due to DNA and RNA synthesis that influenced the growth (Nethravathi *et al.*, 2021).

In any crop production programme in fruit crops, especially banana, yield estimation be an essential parameter in analyzing the practical production values for the nominal benefit to the farmers. The trait on yield per hectare estimation revealed impact among treatments in the banana cultivar Monthan (Table 1.) and the significance was observed with 'T5' Seaweed extract (0.1%) yielded 20.55 t/ha. This result conforms to the study made by Karthikeyan and Shanmugam (2014, 2016) and Ravi *et al.* (2018), which revealed that seaweed extract application impacted the yield and quality traits of several banana cultivars, namely Robusta, Njali poovan, Red banana, Nendran, Karpooravalli, Rasthali, Naadu, Ottu, and Grand Naine.

In the cost economics analysis of the present study, the treatment 'T5', *i.e.*, Seaweed extract (0.1%) recorded the highest net returns and benefit-cost ratio (Table 2.). The above treatment registered the highest net return of Rs. 2,91,138 per hectare and benefit-cost ratio of 1.89 and the control recorded the minimum net return of Rs. 1,16,638 per hectare and the lowest benefit-cost ratio of 1.36. Working of cost economics evidenced that the treatment 'T5' of Seaweed extract (0.1%) impacted the highest net returns, including benefit-cost ratio in banana Monthan. The potentiality of higher gross and net returns, including the benefit-cost ratio in the cultivar Monthan, might be due to enhanced fruit yield that became the treatment effect. Similar results of highest gross income, net income, and B:C ratio were obtained from the treatment, which produced higher yields than other treatments (Nethravathi *et al.* 2021; Sathish *et al.* 2021).

## Conclusion

The present study concluded that pre-harvest foliar application of plant bio-regulators proved its potentiality in the enhancement of the yield and profit of banana

cultivation under the Cauvery delta region of Karaikal, Puducherry. The study revealed that the pre-harvest bunch spray with Seaweed extract (0.1%) immediately after the last hand opening and 20 days after the first spray improved the yield (20.55 t/ha) and ensured better returns (B:C ratio 1.89). Therefore, the eco-friendly plant bio-regulator, a pre-harvest spray in banana cv. Monthan under Cauvery delta region of Karaikal may be recommended to the farmers. Furthermore, the impact of plant bioregulators on the quality traits of banana cv. Monthan needs attention from the future research point of view.

## Conflict of interest

The authors declare that they have no conflict of interest.

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