



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(11): 506-510
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www.thepharmajournal.com

Received: 24-09-2022

Accepted: 28-10-2022

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Effect of micronutrients and plant growth regulators on growth parameters of banana cv. Rajapuri (Ratoon I)

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Abstract

The present study was carried out to observe the effect of micronutrients and plant growth regulators on growth parameters of banana cv. Rajapuri (Ratoon I) during 2021-2022. The experiment was laid out in the Randomized Complete Block Design with thirteen treatments which are replicated thrice. Significant differences among the different treatments in growth parameters was observed. The results revealed that application of IIHR Banana Special (Micronutrient Mixture) @ 0.5% + CPPU 4 ppm spraying at 6th, 7th, 8th, 9th and 10th months after planting (MAP) observed the highest pseudostem height (248.38 cm), pseudostem girth (104.82 cm), number of functional leaves (19.21), leaf area (25.52 m²) and number of suckers (11.80).

Keywords: Micronutrients, Rajapuri, CPPU, banana special, plant growth regulators

1. Introduction

Banana *Musa* spp is one of the most significant fruit crops grown in India. Millions of people use it as a dessert, because of its plentiful and easily digestible carbohydrates and it is a staple dish in many different regions. It has many therapeutic properties and is a great source of vitamins and minerals. The edible banana is believed to have originated in hot tropical regions of South-East Asia (Yadold and Kadam, 2008) [20, 21]. India is the largest producer of bananas with an area of 8.78 lakh hectares, production of 315.04 lakh metric tonnes and productivity of 36.243 metric tonnes per hectare (Anon, 2020) [4]. It is a significant, nutrient-rich fruit crop grown for both domestic and international trade. The banana is a great lover of essential micronutrients and uses up enormous amounts of both macro- and micronutrients from the soil, it demands continuous supply. It requires a continuous supply of water and nutrients at proper growth stages for enhanced yield and it responds well to applied nutrients. Farmers that grow bananas use nonscientific management techniques that result in inefficient use of fertilisers and water which results in low output. (Nisarga *et al.*, 2022) [16]. Hence, efficient use of micronutrients and plant growth regulators as foliar spray at correct growth stage leads to attaining the higher yield. In this view, an investigation was conducted to find out the effect of micronutrients and plant growth regulators on growth parameters of banana cv. Rajapuri (Ratoon I).

2. Material and Methods

The experiment was conducted at ICAR-AICRP on Fruits, Kittur Rani Channamma college of Horticulture, Arabhavi, Gokak Taluk, Belagavi District, Karnataka, during 2021-2022 in a Ratoon crop of banana cv. Rajapuri. The experiment was laid out in Randomized Complete Block Design with three replications and ten treatments *viz.*

T₁: Control

T₂: IIHR Banana Special (MM) @ 0.5% spraying at 6th, 7th, 8th, 9th and 10th (MAP)

T₃: IIHR Banana Special (MM) @ 0.5% GA₃ 40 ppm spraying at 6th, 7th, 8th, 9th and 10th (MAP)

T₄: IIHR Banana Special (MM) @ 0.5% GA₃ 80 ppm spraying at 6th, 7th, 8th, 9th and 10th (MAP)

T₅: IIHR Banana Special (MM) @ 0.5% BA 20 ppm spraying at 6th, 7th, 8th, 9th and 10th (MAP)

T₆: IIHR Banana Special (MM) @ 0.5% BA 40 ppm spraying at 6th, 7th, 8th, 9th and 10th (MAP)

T₇: IIHR Banana Special (MM) @ 0.5% NAA 20 ppm spraying at 6th, 7th, 8th, 9th and 10th (MAP)

T₈: IIHR Banana Special (MM) @ 0.5% NAA 40 ppm spraying at 6th, 7th, 8th, 9th and 10th (MAP)

T₉: IIHR Banana Special (MM) @ 0.5% CPPU 2 ppm spraying at 6th, 7th, 8th, 9th and 10th (MAP)

T₁₀: IIHR Banana Special (MM) @ 0.5% CPPU 4 ppm spraying at 6th, 7th, 8th, 9th and 10th (MAP)

The recommended dose of fertilizer followed in the experiment is 200:100:300 g NPK/plant/year (As per the Package of Practice of UHS, Bagalkot, Karnataka) for all the treatments. The 5 g IIHR banana special was accurately measured and mixed in one litre of water. 0.04 g and 0.08 g progib (GA₃) was measured and mixed in one litre of water. 0.02 g and 0.04 g of BA was weighed and mixed in one litre of water. 0.4 ml and 0.8 ml of planofix (NAA) was measured and mixed in one litre of water. 1.6 ml and 3.33 ml of sitofex (CPPU) was measured and mixed in one litre of water. The required concentrations of micronutrients and plant growth regulators were prepared by directly mixing quantity of micronutrient and plant growth regulators in water and spray solutions were used for spraying immediately after preparation. Application of micronutrients and plant growth regulators done on the leaves on both sides during flag stage *i.e.* just before flowering by using a hand sprayer.

Results and Discussion

Pseudostem height (cm)

All the treatments were found significantly superior over the control. Among the all the different treatments, the treatment T₁₀ - (IIHR Banana Special (MM) @ 0.5% + CPPU @ 4 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP) recorded the highest pseudostem height of (185.38, 217.33, 237.94 and 248.25 cm

respectively) at 6th, 7th, 8th MAP and at shooting stage which was found equivalent with the treatment T₉ (182.58, 215.66, 232.62 and 243.62 cm respectively). The minimum pseudostem height (145.41, 173.73, 205.77 and 218.28 cm respectively) was observed at 6th, 7th, 8th MAP and at shooting stage in T₁ (control).

Pseudostem girth (cm)

Among all various treatments T₁₀ - (IIHR Banana Special (MM) @ 0.5% + CPPU @ 4 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP) recorded the greater pseudostem girth (88.51, 95.53, 98.33 and 104.82 cm respectively) at 6th, 7th, 8th MAP and at shooting stage, which was found statistically equivalent with the treatment T₉ (82.59, 93.19, 96.23 and 100.41 cm). The least pseudostem girth (66.72, 73.37, 81.15 and 84.64 cm respectively) was exhibited in T₁ (control) at 6th, 7th, 8th MAP and at shooting stage.

Leaf area (m²)

The effect of micronutrients and plant growth regulator on leaf area was tabulated under Table 4. Among the different treatments, treatment T₁₀ - (IIHR Banana Special (MM) @ 0.5% + CPPU @ 4 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP) was reported the highest leaf area (15.20, 19.11, 24.43 and 25.52 m² respectively) at 6th, 7th, 8th MAP and shooting stage, which was statistically similar with treatment T₉ (14.86, 18.63, 23.38 and 24.35 m² respectively). Whereas, the least leaf area (8.28, 14.64, 15.54 and 18.21 m² respectively) was recorded in the T₁ (control) at 6th, 7th, 8th MAP and shooting stage. When compared to the control, all the different treatments were confirmed to be significant.

Table 1: Effect of micronutrients and plant growth regulators on pseudostem height (cm), Pseudostem girth (cm) and Leaf area (m²) of banana cv. Rajapuri (Ratoon I).

Treatments	Pseudostem height (cm)					Pseudostem girth (cm)					Leaf area (m ²)				
	Before treatment imposition	6 MAP	7 MAP	8 MAP	At shooting	Before treatment imposition	6 MAP	7 MAP	8 MAP	At shooting	Before treatment imposition	6 MAP	7 MAP	8 MAP	At shooting
T ₁	138.40	145.41	173.73	205.77	218.28	57.61	66.72	73.37	81.15	84.64	6.63	8.28	14.64	15.54	18.21
T ₂	143.86	164.73	206.33	220.37	223.67	54.95	73.52	83.21	94.65	96.15	6.43	10.62	16.67	19.92	20.43
T ₃	140.20	168.37	199.25	221.63	232.49	54.66	77.26	87.14	94.30	98.38	6.45	13.04	17.22	21.37	22.03
T ₄	143.93	169.42	207.67	223.12	238.35	59.05	78.30	90.23	95.60	100.16	6.48	14.35	17.99	21.71	22.44
T ₅	139.53	153.17	197.66	220.47	223.43	56.10	73.75	84.14	92.87	96.40	5.97	12.02	16.40	18.61	19.04
T ₆	146.20	156.91	196.17	221.70	224.48	57.33	75.84	86.56	89.47	93.56	6.77	12.37	17.87	20.84	21.54
T ₇	142.33	151.57	190.61	218.05	222.98	59.40	73.06	77.79	89.26	97.50	7.17	9.88	16.24	19.30	21.35
T ₈	145.20	163.27	194.14	218.66	225.81	55.00	73.58	78.37	93.34	95.95	8.68	10.77	17.09	19.65	22.34
T ₉	144.53	182.58	215.66	232.62	243.62	60.40	82.59	93.19	96.23	100.41	7.98	14.86	18.63	23.38	24.35
T ₁₀	146.60	185.38	217.33	237.94	248.25	64.80	88.51	95.53	98.33	104.82	8.58	15.20	19.11	24.43	25.52
S.Em ±	9.32	1.83	1.49	1.79	1.56	4.41	1.99	0.85	0.75	1.69	0.78	0.13	0.17	0.37	0.41
CD @ 5%	NS	5.48	4.46	5.36	4.68	NS	5.94	2.49	2.18	4.93	2.32	0.38	0.49	1.07	0.19

Treatments

T₁ - control

T₂ - IIHR Banana Special (MM) @ 0.5% spraying at 6th, 7th, 8th, 9th and 10th MAP

T₃ - IIHR Banana Special (MM) @ 0.5% + GA₃ 40 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP

T₄ - IIHR Banana Special (MM) @ 0.5% + GA₃ 80 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP

T₅ - IIHR Banana Special (MM) @ 0.5% + BAA 20 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP

T₆ - IIHR Banana Special (MM) @ 0.5% + BAA 40 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP

T₇ - IIHR Banana Special (MM) @ 0.5% + NAA 20 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP

T₈ - IIHR Banana Special (MM) @ 0.5% + NAA 40 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP

T₉ - IIHR Banana Special (MM) @ 0.5% + CPPU 2 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP

T₁₀ - IIHR Banana Special (MM) @ 0.5% + CPPU 4 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP

MAP- Months after planting, MM – Micronutrient Mixture

Table 2: Effect of micronutrients and plant growth regulators on number of leaves and number of suckers per plant of banana cv. Rajapuri (Ratoon I).

Treatments	Number of functional leaves					Number of suckers per plant				
	Before treatment imposition	6 MAP	7 MAP	8 MAP	At shooting	Before treatment imposition	6 MAP	7 MAP	8 MAP	At shooting
T ₁	10.73	12.15	15.07	16.28	16.52	5.12	6.61	8.06	8.46	8.61
T ₂	12.53	14.09	17.20	17.61	18.30	4.39	9.30	9.67	9.76	9.81
T ₃	11.73	14.23	17.78	17.83	18.45	5.03	9.59	10.13	10.26	10.32
T ₄	12.20	14.35	17.82	17.89	18.63	4.53	10.26	10.35	10.57	10.67
T ₅	11.20	13.10	16.74	17.29	18.15	5.55	7.99	9.08	9.46	9.83
T ₆	11.86	14.09	17.42	17.49	18.23	4.85	8.02	9.62	9.78	10.09
T ₇	11.13	13.25	17.50	17.55	18.03	5.68	8.00	9.46	9.60	9.73
T ₈	12.46	14.00	17.65	17.68	18.17	6.60	8.06	9.63	9.75	9.80
T ₉	11.86	14.51	18.01	18.05	18.84	6.61	10.60	10.63	10.72	10.84
T ₁₀	12.46	15.44	18.38	18.42	19.21	6.91	11.30	11.61	11.70	11.80
S.Em ±	0.59	0.32	0.13	0.14	0.15	0.88	0.24	0.34	0.33	0.37
CD @ 5%	NS	0.94	0.38	0.39	0.45	NS	0.71	1.00	0.99	1.11

Treatments

T₁ - controlT₂ - IIHR Banana Special (MM) @ 0.5% spraying at 6th, 7th, 8th, 9th and 10th MAPT₃ - IIHR Banana Special (MM) @ 0.5% + GA₃ 40 ppm spraying at 6th, 7th, 8th, 9th and 10th MAPT₄ - IIHR Banana Special (MM) @ 0.5% + GA₃ 80 ppm spraying at 6th, 7th, 8th, 9th and 10th MAPT₅ - IIHR Banana Special (MM) @ 0.5% + BAA 20 ppm spraying at 6th, 7th, 8th, 9th and 10th MAPT₆ - IIHR Banana Special (MM) @ 0.5% + BAA 40 ppm spraying at 6th, 7th, 8th, 9th and 10th MAPT₇ - IIHR Banana Special (MM) @ 0.5% + NAA 20 ppm spraying at 6th, 7th, 8th, 9th and 10th MAPT₈ - IIHR Banana Special (MM) @ 0.5% + NAA 40 ppm spraying at 6th, 7th, 8th, 9th and 10th MAPT₉ - IIHR Banana Special (MM) @ 0.5% + CPPU 2 ppm spraying at 6th, 7th, 8th, 9th and 10th MAPT₁₀ - IIHR Banana Special (MM) @ 0.5% + CPPU 4 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP

MAP- Months after planting, MM – Micronutrient Mixture

Number of functional leaves

The Table 3 data shows the use of micronutrients and plant growth regulator greatly affected the number of functional leaves. All the treatments were statistically superior over control. The treatment T₁₀ - (IIHR Banana Special (MM) @ 0.5% + CPPU @ 4 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP) recorded the highest functional leaves (15.44, 18.38, 18.42 and 19.21 cm respectively) at 6th, 7th, 8th MAP and at shooting stage which was comparable with the treatment T₉ (14.51, 18.01, 18.05 and 18.84 respectively). The least number of functional leaves (12.15, 15.07, 16.28 and 16.52 cm respectively) was recorded in the treatment T₁ (control) at 6th, 7th, 8th MAP and at shooting stage.

Number of suckers

The effect of micronutrients and plant growth regulator on number of suckers were illustrated in the Table 5. Among the different treatments, treatment T₁₀ showed the highest number of suckers (11.30, 11.61, 11.70 and 11.80 respectively) at 6th, 7th, 8th and at shooting stage. Which was found statistically equivalent with treatment T₉ (10.60, 10.63, 10.72 and 10.84 respectively). Whereas, the least number of suckers (6.61, 8.06, 8.46 and 8.61 respectively) were found in T₁ (control).

Discussion

The micronutrient spray using IIHR Banana Special had effect on cell enlargement and metabolic process in the cell which led to the pseudostem height achievement. These conclusions are supported by the report of Kumar and Jeyakumar (2001) [15] in cv. Robusta. The findings of Yadlod and Kadam (2003) [19] in banana cv. Grand Naine, Krishnamoorthy and Noorjahan (2017) [13] in banana cv. Poovan who recorded the highest pseudostem height banana by foliar application of micronutrients. The recorded data are confirmed with the report of (Fathi *et al.*, 2011) [9] in

persimmon cv. Coastata. The maximum shoot length observed after application of sitofex with findings of Asaad (2014) [5] in apple cv. Anna. It might be due to CPPU helped in the physiological processes of controlling growth and development of the fruit and also promotes chlorophyll biosynthesis, cell division and cell expansion which is resulted in pseudostem height achievement.

These findings were in harmony with results reported by the Bashma *et al.* (2019) [6] in banana cv. Nendran, Hazarika *et al.* (2018) [11] in banana cv. Grand Naine, Krishnamoorthy and Noorjahan (2017) [13] in banana cv. Poovan, Pathak *et al.* (2011) [17] in banana cv. Martaman and Yadlod and Kadam (2008) [20, 21] in banana cv. Ardhapuri who recorded the highest pseudostem girth. It might be due to beneficial effect of the micronutrients which helped in synthesis of auxins in the plants that aids in cell elongation, photo synthetic activity and respiration in plants thus improves the growth led to pseudostem girth increment. The present study was in harmony with the findings of (Ali *et al.*, 2020) [1] in grape cv. Thompson Seedless, (Al-Qassam *et al.*, 2019) [2] in olive cv. Khudeiry, Hamdullah (2018) [10] in olive cv. Nebali, Asaad (2014) [5] in apple cv Anna and in lemon recorded the maximum shoot diameter by application of CPPU (Ali *et al.*, 2020) [1]. It might be due to CPPU helped in increase the absorption of mineral elements from the soil and also stimulates the nucleic acids, notably RNA, proteins and enzymes production processes responsible for elongation and division of the cell which helps in increment of pseudostem girth.

Application of IIHR Banana Special act as catalyst or part of an enzyme system associated with chlorophyll formation resulted in increase of number of leaves which is harmony with the findings of Kumar and Jeyakumar, (2001) [15] in banana cv. Robusta. Yadlod and Kadam (2003) [19] in banana cv. Grand Naine, Pathak *et al.* (2011) [17] in banana cv.

Martaman, Angali *et al.* (2013) ^[3] in banana and Krishnamoorthy and Noorjahan (2017) ^[13] in banana cv. Poovan were supportive to the above results. Rashid and Mondal (2007) ^[18] in banana cv. Amritsagar recorded the highest number of leaves (32.23). Yadlod and Kadam (2008) ^[20, 21] in banana cv. Ardhapuri also observed highest number of leaves (14.15) by application of micronutrients.

The above results are in agreement with (Al-Qassam *et al.*, 2019) ^[2] in olive cv. Khudeiry, (Ali *et al.*, 2020) ^[1] in grape cv. Thompson Seedless. This was due to CPPU plays role in stimulating the new leaves by formation of buds this may have increased the production of hormones, especially since it is mainly built in the tops of shoots and leaves. According to the report of (Jeyabaskaran and Pandey, 2008) in banana cv. Karpuravalli, Bashma *et al.* (2019) ^[6] in banana cv. Nendran, Krishnamoorthy and Noorjahan (2017) ^[13] in banana cv. Poovan, Hazarika *et al.* (2018) ^[11] in banana cv. Grand Naine, Nisarga *et al.* (2022) ^[16] in banana cv. Rajapuri mentioned that micronutrients play an crucial role in the synthesis of critical auxins, protein and also enhances the photosynthetic activity that increase in the cell division and chlorophyll content in leaf which increase the leaf area.

The increased number of leaves and leaf area due to sparying of CPPU, as it increases ratio of the total chlorophyll which led to increase in leaf area. Thus increasing food processing, storing surplus in the branches, activating roots and withdrawing nutrients (Ali *et al.*, 2020) ^[1] in grape cv. Thompson Seedless. The results were in line with findings of Bhat *et al.* (2011) ^[8] in grape cv. Tas-A-Ganesh, Fathi *et al.* (2011) ^[9] in persimmon cv. Coastata, Asaad (2014) ^[5] in apple cv. Anna.

Nutrient utilisation efficiency is increased by timely foliar application of micronutrients at the proper stage of crop growth, which may have accelerated banana plant growth and sucker formation which is similar with findings of (Bindu, 2019) ^[22] in banana, (Yadav *et al.*, 2010) ^[23] in banana cv. Grand Naine.

The effect of CPPU was positive on the number of suckers production in the present study due to the increased plant growth by uptaking the efficient nutrients which is accordance with the findings of (Bhat *et al.*, 2011) ^[8] in grape cv. Tas-A-Ganesh, Fathi *et al.* (2011) ^[9] in persimmon cv. Coastata, Asaad (2014) ^[5] in apple cv. Anna.

Conclusion

In this present investigation application of IIHR Banana Special (MM) @ 0.5% + CPPU @ 4 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP *i.e.* T₁₀ recorded the highest growth parameters which was on par with the T₉ (IIHR Banana Special (MM) @ 0.5% + CPPU @ 2 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP). Finally it can be concluded that application of of IIHR Banana Special (MM) @ 0.5% + CPPU @ 4 ppm spraying at 6th, 7th, 8th, 9th and 10th MAP leads to achieving the higher plant growth of banana cv. Rajapuri (Ratoon I).

Acknowledgement

Authors extend thanks to ICAR-AICRP on Fruits, KRC College of Horticulture, Arabhavi for providing necessary facilities required for the study.

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