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Foliar application of micronutrient mixture on yield enhancement of Banana (*Musa AAB*) cv. Nendran

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Abstract

The aim of the experiment was to study the effect of foliar application of micronutrient mixture on yield enhancement of banana (*Musa AAB*) cv. Nendran. A field experiment was carried out at Regional Agricultural Research Station farm, Nileswar during the year 2015-16 employing randomized Block design having thirteen treatments replicated thrice such that four plants were maintained in each replication. Micro-nutrient mixture (1%, 2%, 3% and 4%) was foliar sprayed at 2nd, 4th and 6th month after planting. The vegetative characters such as pseudostem girth (52.08 m) at the time of shooting and number of leaves at 4 month after planting and at the time of shooting were significantly improved with the foliar application of micronutrient mixture mostly at 2 per cent mixture in three sprays. Bunch weight of the plant is the major economic factor considered in banana cultivation. All the treatments were found to be superior over control on which T₁₁ recorded highest bunch weight (12.76 kg) and control T₁₃ (control) recorded lowest bunch weight (8.32 kg). There was significant difference between the treatments with respect to number of finger per bunch, average weight of fingers and finger length. T₁₁ (3% micronutrient mixture as 3 sprays) produced highest average weight of fingers of 282.64 g, finger length of 23.05 cm. Effect of treatment application on bunch maturity period (from the day of bunch emergence to harvest) of banana also found to be significant. 3% micronutrient mixture as 3 sprays took lowest bunch maturity period of 82 days which was on par with T₁₀ (2% micronutrient mixture as 3 sprays) and T₉ (1% micronutrient mixture as 3 sprays) while control took highest days to maturity with 105.50 days. Foliar spraying of 2 and 3 percent micronutrient mixture as 3 sprays enhances the growth and yield parameters of Nendran banana.

Keywords: Micronutrient mixture, Banana, Nendran, foliar application, vegetative characters, and yield attributes

Introduction

Banana is the fourth most important fruit crop in the world after rice, wheat and maize and it is the second most important fruit crop in India next to mango. It is rich source of carbohydrates, vitamins and minerals which are essential components of human diet. Because of their commercial status, banana and plantains are referred usually as “Poor man’s apple”. India is world’s leading producer of banana with an annual production of 297.24 lakh tonnes which accounts for 33.4 percent of total fruit production with a productivity of 37.0 MT/ha. In Kerala banana is grown in 34.46 (000’ha) with a production of 528.21(000’MT) and productivity of 15.32 MT/ha (Saxena, 2015) [15] and the productivity is low. Plantains (*Musa sp. AAB*) group of banana’s are one of the important staple foods in the tropical and sub-tropical regions of the world (Englberger *et al.*, 2006) [6]. They require high amounts of nutrients for optimum growth and production but these nutrients are often partly supplied from soil and resulted in soil fertility depletion (Lahav, 1995) [11].

Application of essential nutrients in an appropriate balance is fundamental for various physiological processes in plants. Primary nutrients play a vital role in promoting the plant vigour and productivity, whereas micronutrients like zinc, boron, copper and molybdenum perform a specific role in the growth and development of plant, quality of produce and uptake of major nutrients. Micronutrients such as Zn, B, Mo and Cu had been reported to be essential for the growth and development of banana plants (Srivastava, 1964a and 1964b) [16, 17]. Deficiencies of these micronutrients affect the growth and production of banana (Charpentier and Martin, 1965) [5].

The fertilizers applied through soil are needed in higher quantities because some portion leaches down and some does not become available to the plants due to complex chemical reactions happening in soil or adverse soil conditions hindering uptake. The foliar application,

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therefore, offer a viable alternative way of applying nutrients to fruit plants in such conditions. Micronutrients availability can be enhanced by foliar application of the appropriate mineral forms (Alloway, 1986; House and Welch, 1989) [2, 8]. Micronutrient content and uptake by plants is better enhanced with foliar application. Hence the present investigation was carried out to study the effect of foliar application of micronutrient mixture on growth and yield of banana cv. Nendran.

Materials and Methods

The field experiment was conducted at Regional Agricultural Research Station farm, Nileshwar to evaluate the effect of foliar application of micronutrient mixture on growth and yield of tissue culture banana var. Nendran. The experiment was conducted in randomized block design with thirteen treatments and three replications such that four plants were maintained in each replication. Nitrogen, phosphorus and potassium application and other cultural practices were followed as per POP, KAU (2011) [10] uniformly for all the treatments. The treatments consisted of 4 levels of micronutrient mixture (1%, 2%, 3% and 4%) sprayed at 3 different intervals. The 3 different spray scheduled were one spray was given at 2 MAP, two sprays at 2 and 4 MAP and three sprays at 2, 4 and 6 MAP. T₁, T₂, T₃ and T₄ - one spray, T₅, T₆, T₇ and T₈ - two sprays and T₉, T₁₀, T₁₁ and T₁₂ - three sprays of 1, 2, 3 and 4% concentration respectively and T₁₃ was control.

Biometric observations like pseudostem height, pseudostem girth at 90 cm height and number of leaves were recorded at 4 MAP and at the time of shooting. Weight of male bud, bunch weight, number of hands, number of fingers, average weight of fingers, finger length and finger breadth and number of suckers at harvest were recorded at the time of harvest. Days to bunch emergence, days to harvest and days to ripening of fruits were also taken account. The data obtained were analyzed statistically and tested for its significance using WASP 2.0 software given by ICARGOA.

Results

Effect on vegetative characters

The effect of micronutrient mixture on pseudostem height, pseudostem girth and number of leaves were found to be significant (Table 1). It shows that micronutrients could make

substantial effect on the above growth parameters of banana cv. Nendran. The height of the pseudostem was significantly influenced by treatment application at 4 months after planting. T₁₂ recorded maximum plant height of 1.47 m while T₅ recorded the lowest height of 1.18 m. T₁₂ was statistically on par with T₁₀, T₁, and T₈. At the time of shooting, there was no notable difference between the treatments on pseudostem height.

At 4 months after planting, the treatments found to be non significant with respect to pseudostem girth at 90 cm height. But at the time of shooting, there was notable difference in pseudostem girth between the treatments (Table 1). T₁₀ recorded maximum girth of 52.08 m which was statistically on par with T₆, T₁, T₅ and T₁₁ whereas minimum pseudostem girth was found in T₃ (47.67 cm). The beneficial effect of micronutrients on pseudostem height and girth might be due to micronutrients especially Zn which is the activator of the enzymes involved in protein synthesis and had direct effect on the level of IAA in plants (Ram and Bose, 2000) [14], Copper activates several enzymes in plants and helps chlorophyll synthesis and involve in carbohydrate and protein metabolism (Ram and Bose, 2000) [14] and Boron increases photosynthetic activity and respiration in plants and thus improves the growth (Lal and Rao, 1954) [12].

Number of leaves at both stages of observation exhibited significant differences among the treatments. At 4 MAP T₆ recorded highest number of leaves (11.67) which was statistically on par with T₁, T₉, T₃, T₁₀, T₂, T₈ and the lowest number of leaves was produced in control T₁₃ (9.58). At the time of shooting, T₆ recorded highest number of leaves (12.75) which was on par with T₁₁, T₁, T₄ while T₁₃ (10.25) recorded lowest number of leaves. Increase in number of leaves may be due to Zn stimulates photosynthetic activity and its presence is important for protein synthesis which in turn can enhance the rate of leaf production.

These results are in harmony with those obtained by Anjali *et al.* (2013) [3] in banana cv. Grand naine, Yadav and Patel (2013) [21] in banana cv. Grand naine, Yadlod and Kadam (2008c) [23] in banana cv. Ardhapuri, Pathak *et al.* (2011) [13] in banana cv. Martaman (AAB, Silk), Jeyabaskaran and Pandey (2008) [9] in Karpuravalli banana. There was no considerable difference between the treatments with respect to number of suckers at harvest. Similar result was observed in banana cv. Grand naine (Yadav *et al.*, 2010) [20].

Table 1: Effect of foliar application of micronutrient mixture on growth parameters of banana

Treatments	Pseudostem height (m)		Pseudostem girth (cm)		Number of leaves		Number of suckers at harvest
	4 MAP	At the time of shooting	4 MAP	At the time of shooting	4 MAP	At the time of shooting	
T1	1.36	2.75	28.28	51.12	11.58	11.92	6.00
T2	1.30	2.79	24.70	49.17	11.00	11.08	6.08
T3	1.24	2.70	24.23	47.67	11.17	11.33	6.83
T4	1.21	2.68	24.08	48.75	10.58	11.83	5.83
T5	1.18	2.77	23.75	50.71	10.83	11.50	6.33
T6	1.24	2.85	26.01	51.54	11.67	12.75	6.25
T7	1.26	2.69	26.15	48.46	10.83	11.50	6.83
T8	1.35	2.83	28.23	48.42	10.92	11.17	6.42
T9	1.25	2.73	26.84	48.89	11.17	11.42	6.75
T10	1.39	2.84	28.96	52.08	11.00	11.25	7.33
T11	1.25	2.84	26.87	49.96	10.50	12.25	6.25
T12	1.47	2.76	29.64	48.50	10.67	11.08	7.33
T13	1.32	2.69	25.07	47.96	9.583	10.25	5.83
SEm (±)	0.006	0.011	8.054	2.579	0.216	0.458	0.678
CD (0.05)	0.130	NS	NS	2.706	0.784	1.140	NS

Effect on yield and yield attributes

In the present study, foliar application of micronutrient mixture in tissue culture banana cv. Nendran has shown positive and significant influence in the yield characteristics of the crop. Increased in yield may be attributed to important role of micronutrients in enhancing cell elongation and division, photosynthetic activity and increased production and accumulation of carbohydrates (Abdel-Kader *et al.*, 1992) [1]. Treatment application has significantly increased the weight of male bud, bunch weight, number fingers, average weight of fingers and finger length which are of paramount importance from the economic point of view.

There was a significant difference among the treatments with respect to weight of male bud (Table 2). T₅ recorded highest male bud weight of 1.54 kg while lowest male bud weight was found in T₁ (1.12 kg). Bunch weight of the plant is the major economic factor considered in banana cultivation. There was significant influence of treatments on bunch weight. All the treatments were found to be superior over control on which T₁₁ recorded highest bunch weight (12.76 kg) and control T₁₃ recorded lowest bunch weight (8.32 kg) which was on par with T₃. T₁₁ was statistically on par with T₁₀, T₉, T₆, T₇, T₈ and T₅. The possible reason for increase in bunch weight with the application of micronutrients might be

due to faster loading and mobilization of photo assimilates to fruits and involvement in cell division and cell expansion which ultimately reflected into more weight of fruit in treated plants.

There was significant difference between the treatments with respect to number of finger per bunch, average weight of fingers and finger length. T₉ recorded higher number of fingers per bunch of 54.39 and T₁₃ recorded lowest number of fingers per bunch. T₁₁ produced highest average weight of fingers of 282.64 g whereas lowest was found in T₁ with 222.50 g which was statistically on par with T₅ and control T₁₃. The highest finger length was recorded in with 23.05 cm while control T₁₃ recorded lowest length of 17.94 cm. Treatment effects on finger breadth at the middle portion was found to be non significant. These results are in line with those obtained by Yadlod and Kadam (2008a) [22] in banana cv. Grand naine, Pathak *et al.* (2011) [13] in banana cv. Martaman, Suresh and Savithri (2001) [19] in Nendran banana. Foliar spraying of micronutrient mixture might have helped the crop to increase in chlorophyll content of leaves, photosynthetic efficiency, translocation of metabolites from the source to sink as and when needed by the crop and it may be responsible for retaining more number of fruits, increase in weight of fruit and productivity as compared to control.

Table 2: Effect of foliar application of micronutrient mixture on yield parameters of banana

Treatments	Weight of male bud (kg)	Bunch weight (kg)	No. of hands per bunch	No. of fingers per bunch	Average weight of fingers (g)	Average Finger length (cm)	Average finger breadth (cm)
T1	1.12	10.60	5.33	51.33	222.50	21.15	13.26
T2	1.40	10.22	4.83	51.08	233.34	20.78	14.68
T3	1.25	9.55	5.44	53.33	237.38	21.28	14.00
T4	1.35	10.48	4.89	50.89	247.98	21.11	14.48
T5	1.54	11.45	5.17	53.89	225.88	20.62	14.38
T6	1.24	12.19	5.44	53.00	271.65	20.55	14.60
T7	1.35	12.07	5.44	53.67	268.80	22.38	14.94
T8	1.38	11.90	5.33	51.67	256.13	22.15	14.15
T9	1.24	12.23	4.97	54.39	271.75	22.50	13.99
T10	1.30	12.73	5.00	53.94	275.00	22.69	15.25
T11	1.48	12.76	5.11	54.06	282.64	23.05	15.25
T12	1.25	11.02	5.00	50.44	245.06	21.75	14.16
T13	1.18	8.32	5.00	46.68	230.00	17.94	13.02
SEm (±)	0.007	0.766	0.127	4.345	306.077	0.633	0.653
CD (0.05)	0.177	1.475	NS	3.513	38.122	1.734	NS

Effect of treatment application on the number of days taken from planting to bunch emergence was found to be non significant which is presented in Table 3. But there was a remarkable difference between the treatments with respect to number days taken from planting to harvest. T₁₃ (control) showed maximum days from planting to harvest (303.17 days) while T₁₁ took minimum of 270.67 days. T₁₁ was statistically on par with T₁₀ and T₉.

Effect of treatment application on bunch maturity period (from the day of bunch emergence to harvest) of banana also found to be significant. Figure 1 shows the effect of foliar spraying of micronutrient mixture on bunch maturity period of banana. T₁₁ took minimum maturity period of 82 days

which was on par with T₁₀ and T₉ while control T₁₃ took maximum days to maturity with 105.50 days. This might be due to reduced flowering and maturity duration which could be attributed to enhancing effect of zinc in enzymatic reaction, cell division as well as in growth (Supriya and Bhattacharyya, 1993; Yadav and Patel, 2013) [18, 21]. Similar findings were noted by Ghanta and Mitra (1993) [7] in banana cv. Giant Governor, Yadav *et al.* (2010) [20] banana cv. Grand naine, Babu and Singh (2002) [4] in mandarin orange, Yadlod and Kadam (2008c) [23] in banana cv. Ardhapuri. Treatments found to be non significant in influencing the days to ripening. T₄ was recorded with minimum of 4 days to ripening while T₁₃ took 6 days.

Table 3: Effect of foliar application of micronutrient mixture on Days to bunch emergence, days to harvest, bunch maturity period and days to ripening of banana

Treatments	Days to bunch emergence	Days to harvest	Bunch maturity period (days)	Days to ripening
T1	190.83	283.67	92.83	5.50
T2	190.67	293.33	102.67	4.83
T3	194.78	286.67	91.89	5.50

T4	195.83	289.00	93.17	4.33
T5	195.67	290.33	94.67	5.83
T6	191.11	282.67	91.56	6.00
T7	191.00	283.33	92.33	5.00
T8	190.67	283.67	93.00	6.07
T9	185.83	274.00	88.17	4.67
T10	185.72	271.67	85.94	5.65
T11	188.67	270.67	82.00	5.42
T12	191.08	283.33	92.25	5.67
T13	197.67	303.17	105.50	6.00
SEm (\pm)	22.870	25.982	25.918	1.176
CD (0.05)	NS	8.590	8.580	NS

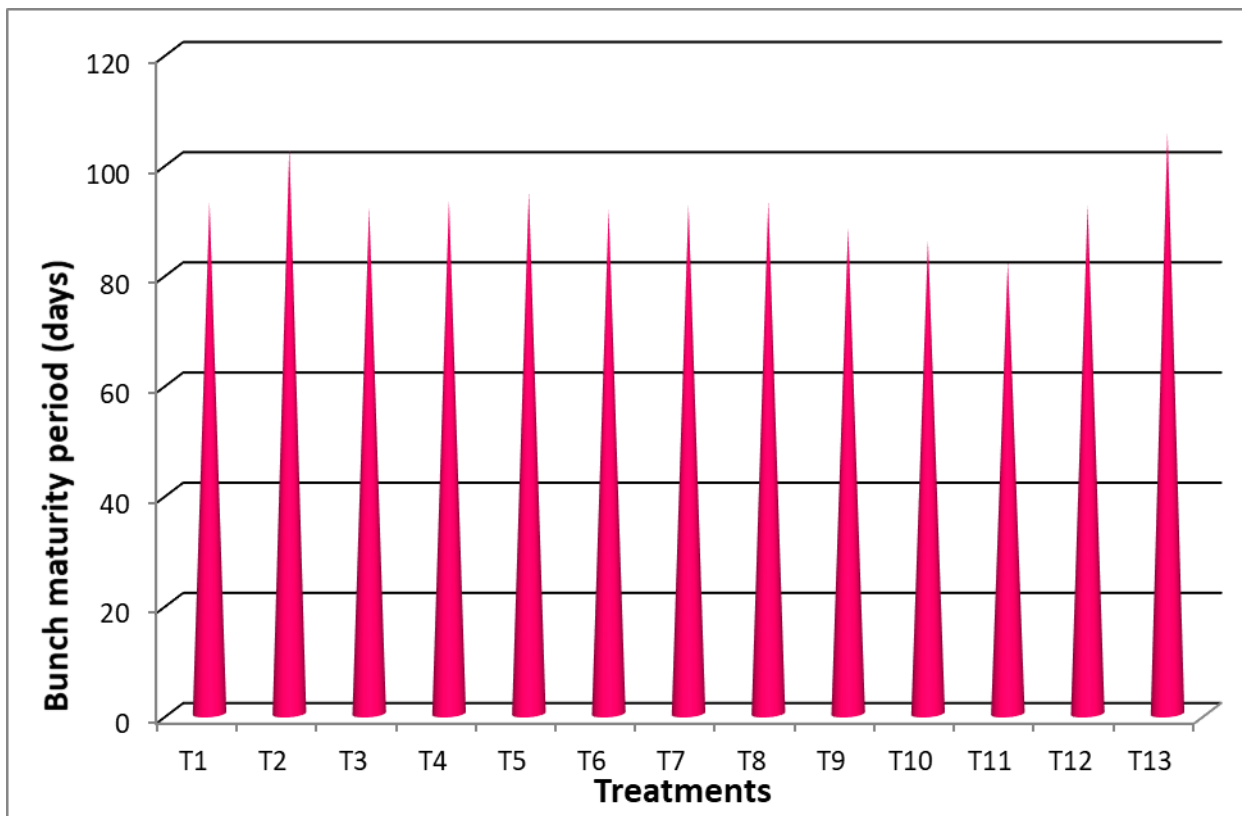


Fig 1: Effect of micronutrient mixture on bunch maturity period of Banana

Conclusion

The results indicated that foliar application of micronutrient mixture as 2 and 3 percent micronutrient mixture (T11) and as 2 percent micronutrient mixture (T10) with 3 times of spraying at 2, 4 and 6 months after planting significantly enhances the vegetative characters and yield attributes of Nendran banana. Application of micronutrient mixture ensures the balanced supply of micronutrients which in turn helps in improving growth and yield of Nendran banana.

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