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Effect of micronutrients, chemicals and plant growth regulators on growth and yield of Banana Cv. Grand Naine

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Abstract
The investigation was conducted to know the effect of micronutrients, chemicals and plant growth regulators on growth and yield attributes of banana Cv. Grand Naine during 2017. The experiment was laid out in Randomized Block Design with three replications and eight treatments. The foliar application of combination with different concentrations of micronutrient mixture (Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%)) and different concentration plant growth regulators like GA_3 (200 and 300 ppm), Benzyle Adenine (10 and 20 ppm) and Potassium Dihydrogen Phosphate (0.5 and 1%) were given at 5th and 7th month after planting and emergence of last hand. The results revealed that growth attributes such as height of plant (189.48 cm) and girth of stem (65.38 cm), length of finger (17.99 cm), number of hands per bunch (9.08) was found significantly maximum in treatment T_4 *i.e.* spraying of Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + GA_3 (300 ppm) 18.69, 24.48, 21.96 and 27.17 per cent, respectively more as compared to control. Maturity attended at crop duration 344.65 days, which was found minimum (5.48%) in treatment T_6 *i.e.* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + BA (20 ppm) than the control (364.67 days). The significantly the highest yield attributes *i.e.* weight of bunch (26.04 kg and 25.82 kg) and average yield (116.38 Mt and 112.63 Mt/ha) in the treatment T_6 *i.e.* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + BA (20 ppm) and T_7 *i.e.* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + KH_2PO_4 (0.5%), respectively, as compared to control. which had significant increment *i.e* 45.78 and 41.08 per cent, respectively. It is inferenced that the foliar application of micronutrients with GA_3 was found the best to improve the growth and with BA and KH_2PO_4 showed the best response in increasing the yield in banana.

Keywords: Banana, micronutrients, chemicals, growth, yield

Introduction
Banana (*Musa sp*.) is an important fruit crop of tropical countries like India, China, Brazil, Philippines etc., belongs to Musaceae family and *Musa* genus to the order Zingiberales. Banana is native to tropical South and Southeast Asia. In India banana is known for it's antiquity and are interwoven with Indian heritage and culture. The plants are considered as the symbol of prosperity and fertility. Owing to its greater socio-economic significance and multifaceted uses, banana is popularly known as *Kalpataru* (A plant with virtues). It is the tree having all parts of the plant including leaves, pseudostem, flower bud and corn can be used in one or another way (Chaddha, 1974) [1].

Hence, the usefulness of post shooting sprays of various micronutrients during fruit development in influencing the fruit yield, shelf life and quality of banana. Banana has been found to report well to the sprays of micronutrient mixture supplied through (Zn + Fe + Cu +B) in proper concentration.

Malik (1999) [8] suggested that growth and development of plant can be modified by manipulating levels of hormones and stage of application in different organs. Hence, the present investigation to overcome the production constraints, chemical manipulation could be tried to improve the root system in proportion to shoot growth. Apart from this, any attempt on improving the physiological efficiency of the crop will also have significant impact one of the biological approach to overcome these bottlenecks and to make the stupendous contribution in increasing productivity by the use of plant growth regulators. Very small contribution of these substances produce major growth changes. Plant growth regulators have witnessed a substantial upsurge in synthesis and utilization in the last decade and have emerged as magic chemicals which could not profitability exploited to overcome physiological constraints

leading to enhanced production. Plant growth regulators plays most important role in growth, yield and quality. In a view of above informataion this investigation was undertaken in banana.

Material and Methods

The experiment entitled effect of micronutrients, chemical and plant growth regulators on growth and yield of banana Cv. Grand Naine" was conducted at Mahmadapurwadi, Tal-Basmat, Dist-Hingoli. Banana was planted at spacing of 1.5 x 1.5 m distance. The experiment was laid out in Randomized Block Design with three replications and eight treatments *viz.* T_1 (control), T_2 *i.e* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%), T_3 *i.e* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + GA_3 (200 ppm), T_4 *i.e* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B GA_3 (300 ppm), T_5 *i.e* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + BA (10 ppm), T_6 *i.e* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + BA (20 ppm), T_7 *i.e* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + KH_2PO_4 (0.5%), T_8 *i.e* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + KH_2PO_4 (1%). There were three sprays were taken in an experiment 5th and 7th months after planting and third spray after emergence of last hand. The recomended package and practices of fertilizer management and plant protection were adopted during investigaton. Quality and biochemical analysis of banana pulp was carried out at Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The observations on growth and yield attributes were recorded and genarated data subjected for analysis vide procedure given by Panse and Sukhatme (1985).

Results and Discussion

The data on growth and yield attributes as influenced by application of micronutrients, chemical and plant growth regulators is given in Table 1.

Table 1: Effect of micronutrients, chemical and plant growth regulators on growth and yield parameters of banana Cv. Grand Naine.

Treatment No.	Height of plant (cm)	Girth of stem (cm)	No. of leaves/plant	Days required from flowering to maturity	Days required from maturity to ripening	Crop duration (Days)	No. of fingers per hand	Length of finger (cm)	Weight of finger (g)	No. of hands per bunch	No. of fingers per bunch	Weight of bunch (kg)	Yield (Mt/ha)
T_1	159.64	52.52	11.61	143.21	8.74	364.67	16.26	14.75	128.23	7.14	122.85	17.38	79.83
T_2	170.41 (6.74)	56.29 (7.17)	12.24 (5.42)	118.24 (17.43)	9.72 (11.21)	362.89 (0.48)	16.91 (3.99)	15.24 (3.32)	131.30 (2.39)	7.54 (5.60)	130.72 (6.40)	19.88 (14.38)	87.43 (9.52)
T_3	176.38 (10.48)	61.94 (17.93)	12.98 (11.80)	120.12 (16.12)	13.50 (54.46)	359.34 (1.46)	17.62 (8.36)	17.21 (16.67)	133.74 (4.29)	7.96 (11.48)	140.25 (14.16)	21.01 (20.88)	95.11 (19.14)
T_4	189.48 (18.69)	65.38 (24.48)	13.85 (19.29)	123.52 (13.14)	13.25 (51.77)	354.46 (2.79)	19.09 (17.40)	17.99 (21.96)	136.44 (6.40)	9.08 (27.17)	173.31 (41.07)	24.09 (38.60)	106.77 (33.74)
T_5	171.43 (7.38)	60.59 (15.36)	13.78 (18.69)	129.56 (9.53)	11.25 (28.71)	356.86 (2.14)	18.35 (12.85)	16.90 (14.57)	140.23 (9.35)	8.31 (16.38)	154.48 (25.74)	23.32 (34.17)	103.04 (29.07)
T_6	186.86 (17.05)	63.13 (20.20)	14.89 (28.25)	133.20 (6.98)	12.87 (47.25)	344.65 (5.48)	19.43 (19.49)	17.60 (19.32)	141.49 (10.34)	8.94 (25.21)	173.78 (41.45)	26.04 (49.82)	116.38 (45.78)
T_7	174.56 (9.34)	61.02 (16.18)	13.47 (16.02)	139.28 (2.74)	11.22 (28.37)	348.98 (4.30)	18.71 (15.06)	16.78 (13.76)	144.93 (13.02)	8.78 (22.96)	164.34 (33.77)	25.82 (48.56)	112.63 (41.08)
T_8	181.23 (13.52)	59.68 (13.73)	13.02 (12.14)	137.32 (4.11)	10.97 (25.51)	357.98 (1.83)	17.99 (10.43)	15.83 (7.32)	138.64 (8.11)	8.16 (14.28)	147.12 (19.75)	22.79 (31.12)	99.76 (24.96)
S.E.±	5.71	2.26	0.40	3.92	0.43	10.75	0.55	0.71	3.45	0.26	4.87	0.81	3.45
C.D.at 5%	**17.25**	**6.84**	**1.22**	**11.84**	**1.31**	**NS**	**1.69**	**2.14**	**10.37**	**0.80**	**14.71**	**2.47**	**10.42**

Effect on growth parameters

Effect on height of plant (cm)

The results obtained for height of plant had significant influence due to foliar application of micronutrients, chemical and plant growth regulators. The significant maximum height of plant (189.48 cm) was recorded in treatment T_4, which was 18.69 per cent increase over the control. However, it was at par with treatment T_6 (186.86 cm) which was 17.05 per cent increase over control. It was followed by treatment T_8 (181.23 cm), T_3 (176.38 cm) and T_7 (174.56 cm). The lowest height of plant (159.64 cm) was noted in treatment T_1 (control).

GA_3 had influence on cell enlargement which was enhanced by given micronutrient mixture. This helps in metabolic process in cell which resulted in increment of height. Increase in height by GA_3 spray at 100 ppm may be attributed to the fact that GA_3 is known to the cause of cell enlargement by synthesis of enzymes that weaken the cell wall and thus offer scope for cell elongation (Van Overbeck, 1966) [15]. These result are in conformed with result reported by Jeya Kumar and Balamohan (1997) [7].

Effect on girth of stem (cm)

The significant maximum girth of stem (65.38 cm) was recorded in treatment T_4. Which was 24.48 per cent increase over control. However, it was at par with treatment T_6 (63.13 cm), *i.e.* 20.20 per cent increase over control, treatment T_3 (17.92%) increase over control. It was followed by T_7 (61.02 cm), T_5 (60.59 cm) and T_8 (59.68cm). The lowest girth of stem (52.52 cm) was recorded in treatment T_1 (control).

The increase in girth of stem was the result of extensibility of cell wall. The wall pressure along with cell decreases and pressure caused by osmotic forces in the vascular sap makes water to enter the cell, resulting cell enlargement (Thimann, 1969) [13]. This type of study was done by Ghanta and Mitra (1993) [5]

Effect on number leaves per plant

The number of leaves per plant had significant influence due to application foliar sprays. The significant maximum number of leaves per plant (14.89) was recorded in treatment T_6, which was 28.25 per cent increase over control, however, it

was at par with treatment T_4 (13.85) which was 19.29 per cent increase over control and T_5 (13.78) which was 18.69 per cent increase in number of leaves over control. The lowest numbers of leaves (11.61) were recorded in treatment T_1 (control).

The foliar application of micronutrients enhanced the cell differentiation which laterally supported by the application of BA compounds, which helps in maximizing the number of leaves. These results are in conformed with result reported by Yadlod and Kadam (2003) [18].

Effect on maturity parameters

Effect on days required from flowering to maturity.

The significant results on minimum number of days required from flowering to maturity (118.24 days) was recorded in treatment T_2 *i.e.* micronutrient mixture in which 17.43 per cent least as compared to control. However, it was at par with treatment T_3 (120.12 days), T_4 (123.52 days) and T_5 (129.56 days). The maximum days required for maturity (146.21 days) were recorded in the treatment T_1 (control).

With respect to retarding the maturation of fruit through the use of growth substances, the response is associated with chemical changes which first cause the fruit to absorb more water than they normally contain (Mitchell, 1949) [9]. The research on similar line was done by Deshmukh and Chakrawar (1980) [4].

Effect on days required from maturity to ripening

The significant maximum days required from maturity to ripening (13.50 days) was observed in treatment T_3 *i.e.* Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + GA_3 (200 ppm) in which 54.46 per cent augmentation found in number of days required for maturity to ripening over the control treatment, however, it was at par with treatment T_4 (13.25 days) and treatment T_6 (12.87 days). The lowest days required from maturity to ripening (9.72 days) were recorded in the treatment T_1 (control).

The delay in ripening was accompanied by a slowdown in the rate of change during ripening such as de-greening, decreasing acidity, increasing the level of ascorbic acid and sugars as well as loss of firmness, starch, cellulose and hemicelluloses (Desai and Deshpande, 1979) [3].

Effect on crop duration (days)

The Minimum crop duration (344.65 days) was observed in treatment T_6 *i.e.* micronutrient mixture + BA (20 ppm), such crop duration was 5.48 per cent minimum as compared to control. The subsequent results were found in treatment T_7 (348.98 days), T_4 (300 ppm) (354.46 days), T_5 (356.86 days), T_8 (357.98 days), T_3 (359.34 days) and T_2 (362.89 days). The maximum crop duration (364.67 days) were recorded in treatment T_1 (control).

Comparatively all the foliar sprays made effect on maturity attributes, by enhancing the ripening in a treatment while minimizing the period of maturity from flowering by another one. Such was the fact that gave the non-significant results regarding the crop duration. These result are in conformed with result reported by Yadav (2010) [17].

Effect on finger Parameter

Effect on number of fingers per hand

The significantly maximum number of fingers per hand (19.43) wetre recorded in treatment T_6, which was 19.49 per cent more as compared to control treatment. However, it was at par with treatment T_4 (19.09), T_7 (18.71), T_5 (18.35), and T_8 (17.99). The minimum number of fingers per hand (16.26) was recorded in T_1 (control).

BA compounds play the role properties of cell initiation, cell differentiation and cell multiplication which were rapidly enhanced by the previously applied and stored micronutrients. The research on similar line was done by Barman and Baruah (2003) [2] in banana.

Effect on length of finger (cm)

The significantly maximum length of finger (17.99 cm) was noticed in the treatment T_4, which was 21.96 per cent more as compared to control. However, it was at par with treatment T_6 (17.60 cm), T_3 *i.e.* micronutrient mixture + GA_3 (200 ppm) (17.21 cm), T_5 (16.90 cm) and T_7 (16.78 cm). The minimum length of finger (14.75 cm) was observed in treatment T_1 (control).

This difference in length of finger might be due to cell enlargement by synthesis of enzymes that weaken the cell wall and thus offer scope for cell. Zn and Fe are played an important role in the synthesising of several enzymes and the growth hormones. Zn may also help in increasing auxin content and they may get transported to the site of action in plant (Jeya Kumar and Balamohan 1997) [7]. Similar, results are stated by Haripriya (1996) [6] in banana.

Effect on weight of finger (g)

The significantly maximum weight of finger (144.99 g) was recorded in treatment T_7, which was 13.02 per cent more as compared to control. However, it was at par with treatment T_6 (141.49), T_5 (140.23g), T_8 (138.64 g) and T_4 (136.44 g). The minimum weight of finger (128.23 g) was recorded in treatment T_1 (control.

GA_3 having the property of cell elongation and cell differentiation which helps in increasing the fruit weight. The reason for increase in weight of finger might be due to increased finger size along with the accumulation of sugar and higher pulp content resulting in increased weight of finger. The research on similar line was done by Satyanarayana (1985) [12] in banana.

Effect on bunch Parameter

Effect on number of hands per bunch

The significantly maximum number of hands per bunch (9.08) was recorded in treatment T_4 (8.87), which was 27.17 per cent more as compared to control treatment. However, it was at par with treatment T_6 (8.94), T_7 (8.78) and T_5 (8.31). The minimum number of hands per bunch (7.14) was recorded in treatment T_1 (control).

The successful fertilization of the ovule was followed by cell division and cell expansion, resulting in the growth of the fruit. Gibberellins are known to influence both cell division and cell enlargement. The research on similar line was done by Pathak *et al.* (2011) [10] in banana. The position action of Zn, Fe, Cu and B on yield might be attributed to banana nutritional status, biosynthesis and translocation of carbohydrates and lead to increase yield in term of number of hands per bunch.

Effect on number of fingers per bunch

The significant highest number of fingers per bunch (173.71) was recorded in treatment T_6 which was 41.45 per cent more as compared to control. However, it was at par with treatment T_4 (173.31) and T_7 (164.34). The minimum number of fingers per bunch (122.85) were recorded in T_1 (control).

The positive action of Zn, Fe, Cu and B on yield might be attributed to banana nutritional status, biosynthesis and

translocation of carbohydrates and lead to increase yield in term of number of fingers per bunch. Similar type of result was found by Yadlod and Kadam (2008).

Effect of weight of bunch (kg)

The significantly maximum weight of bunch (26.04 kg), which was 49.82 per cent more over control treatment recorded in treatment T_6. However, it was at par with treatment T_7 (25.82 kg) and T_4 (21.01 kg). The lowest weight of bunch (17.38 kg) was recorded in treatment T_1 (control).

Micronutrients play an important role in photosynthesis, development of reproductive stage, aids in regulating plant growth hormones and reaction involving cell division. Which helps increasing in the growth and yield of banana in term of increasing the weight of bunch. Similar type of study was done by Haripriya (1996) [6] and Pathak *et al.* (2011) [10] in banana.

Effect on yield parameter

Effect on yield (Mt/ha)

The significantly maximum yield (116.38 Mt/ha) recorded in treatment T_6, which was 45.78 per cent more as compared to control. However, it was at par with treatment T_7 (112.63 Mt/ha) and treatment T_4 (106.77 Mt/ha). It was followed by treatment T_5 (103.04 Mt/ha), T_8 (99.76 Mt/ha), T_3 (96.11 Mt/ha) and T_2 (87.43 Mt/ha). The lowest yield (79.83 Mt/ha) was recorded in treatment T_1 (control).

The increase in yield could be attributed to the change in morphological traits such as reduced pseudostem height, increased pseudostem girth and more number of functional leaves. This is in confirmation with the findings of Shakila (2000) [11]. Micronutrients *viz*. Zn, Fe, Cu, B are play an important role in photosynthesis, development of reproductive stage, aids in regulating plant growth hormones and reaction involving cell division. Which helps increasing in the yield of banana in term of increasing the weight of bunch. The research on similar line was done by Thangaselvabai *et al.* (2009) [14]. BA is neutral to size increase and increased fruit weight by increasing the cell density in the cortex area of the fruit.

Conclusion

The present investigation revealed that the foliar application of micronutrients in the mixture form, alone or in combination with plant growth regulators and chemical *i.e*. Potassium Dihydrogen Phosphate were able to increase the growth and yield characters of banana Cv. Grand Naine. Among the treatments of sprays with Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + GA_3 (300 ppm) and Zn (0.5%) + Fe (0.2%) + Cu (0.2%) + B (0.1%) + BA (20 ppm) was found to be more effective in increasing the growth attributing characters.

In short, micronutrients in combination with GA_3 found the best to improve the growth and with BA and KH_2PO_4 showed the best response in increasing the yield characters of banana.

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