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Studies on foliar sprays of Micronutrients with Chemicals on Yield and Quality of Banana Cv. Ardhapuri

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Abstract
The experiment was carried out at Banana Research Station, Nanded to study the effect of micronutrients with chemicals on yield and quality of banana. The experiment was laid out in Randomized Block Design with three replications and thirteen treatments. The observations on yield and quality attributes were recorded during investigation. The yield and quality parameters such as weight of bunch (21.77 kg), average yield (94.12 Mt/ha), acidity (0.18%), reducing sugar (17.21%), non-reducing sugar (3.81%) and total sugars (21.02%) were found maximum in the treatment *i.e* T_6 $ZnSO_4$ (0.5%) + B_2 $(SO_4)_3$ (0.1%) + KH_2PO_4 (0.5%) which were 75.28, 70.50, 43.75, 23.36, 88.61 and 31.62 per cent, respectively more as compared to control. Maximum pulp to peel ratio (3.25) was found in treatment *i.e* T_6 $ZnSO_4$ (0.5%) + B_2 $(SO_4)_3$ (0.1%) + KH_2PO_4 (0.5%) which was comparatively more (30.00%) than the control. It is inferenced that Benifit:Cost ratio was found significant due to foliar application of $ZnSO_4$(0.1%) +$B_2(SO_4)_3$(0.1%) +KH_2PO_4(0.5%) for better yield and quality attributes in banana.

Keywords: Banana, yield, quality, micronutrients

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. The fruit is considered as a good source of vitamins A, B_1, B_2, and C. Banana is also a good source of carbohydrates, proteins and minerals. Pulp of ripen banana is rich in sugars and easy to digest. Eating several bananas provides a readily available supply of calories, for this reason, banana is recommended to people who need large amounts of glucose in their blood and to maintain adequate level of muscles. Therefore, due to the good nutritional value and easy availability, banana is major staple food for many millions of people (Sharrock and Lusty 1999) [15].

Adequate amount of micronutrients is also required to obtain plays a key role in nutrition of the plants. It plays a key role in nutrition of the plants. As a matter of fact, the plant life would not good yield in fruit crops. Plant growth regulators such as gibberellic acid and benzyl adenine plays most important role in case of growth, yield and quality. Various quality attributes such as colour, size, weight of fruits and weight of bunch, which simultaneously increases overall yield. Some of the chemicals such as potassium dihydrogen phosphate also plays an important role in enhancing these characters. Potassium is a general metabolic activator, increasing the rate of respiration and rate of photosynthesis. Yield is the function of weight of banana and number of bunches per hectare (Apshra and Sathiamoorthy, 2003) [2] which is ultimately determined by finger growth.

Thus, additional potassium containing compounds when applied as foliar spays, induces faster development of bunches (Evans, 1971) [6]. Higher fruit quality especially higher sugar contents can be explained by the role of potassium which is involved in carbohydrate synthesis, breakdown, translocation and synthesis of proteins and neutralization of physiologically important organic acids (Tisdale and Nelson, 1966) [16]. Therefore, the investigation was undertaken to know the effect of micronutrients, chemicals and plant growth regulators on yield and quality in banana.

Material and Methods

The research programme was undertaken at Banana Research Station, Nanded, during the year 2017-2018. The experiment design was Randomized Block Design with two replications and thirteen treatments. Each treatment having twelve numbers of plants with a spacing of 1.5m x 1.5m. The observations were recorded on yield and quality of banana fruit. The treatments *Viz*. T_1 *i.e* $ZnSO_4$ (0.5%) + B_2 $(SO_4)_3$ (0.1%) + GA_3 (80 ppm), T_2 *i.e* $ZnSO_4$ (0.5%)+$FeSO_4$ (0.2%) + GA_3 (80 ppm), T_3 *i.e* $ZnSO_4$ (0.5%)+ $CuSO_4$ (0.2%) + GA_3 (80 ppm), T_4 *i.e* $B_2(SO_4)_3$ (0.1%) + $FeSO_4$ (0.2%) + GA_3 (80 ppm), T_5 *i.e* $B_2(SO_4)_3$ (0.1%) + $CuSO_4$ (0.2%) + GA_3 (80 ppm), T_6 *i.e* $ZnSO_4$ (0.5%) + B_2 $(SO_4)_3$ (0.1%)+ KH_2PO_4 (0.5%),T_7 *i.e* $ZnSO_4$(0.5%) + $FeSO_4$ (0.2%) + KH_2PO_4 (0.5%), T_8 *i.e* $ZnSO_4$ (0.5%) +$CuSO_4$ (0.2%) + KH_2PO_4 (0.5%), T_9 *i.e* $B_2(SO_4)_3$ (0.1%) + $FeSO_4$ (0.2%) + KH_2PO_4 (0.5%), T_{10} *i.e* $B_2(SO_4)_3$ (0.1%) + $CuSO_4$ (0.2%) + KH_2PO_4 (0.5%), T_{11} *i.e* $ZnSO_4$ (0.5%) + B_2 $(SO_4)_3$(0.1%) + $FeSO_4$(0.2%) + $CuSO_4$(0.2%) GA_3 (80 ppm), T_{12} *i.e* $ZnSO_4$ (0.5%) + $B_2(SO_4)_3$(0.1%) + $FeSO_4$(0.2%) + $CuSO_4$(0.2%)+ KH_2PO_4 (0.5%), T_{13} (Control). with two replications. The micronutrient sprays on 5th, 6th & 7th month after planting and chemical sprays were given at leaf flag stage. Recommended cultivation and cultural practices like weeding, irrigation and protection measures were followed as and when required. The data obtained was analyzed statistically and test of significance was done by following the statistical method, as described by (Panse and Sukhatme, 1985) [10].

Results and Discussion

Yield parameter

The data as influenced by micronutrient, chemicals and plant growth regulators on yield and quality parameters as given in Table 1.

The significantly maximum number of hands per bunch (9.14), fingers per bunch (131.32) and weight of bunch (21.17 kg) were recorded in treatment T_6 *i.e.* spraying of $ZnSO_4$ (0.1%) + $B_2(SO_4)_3$ (0.1%) + KH_2PO_4 (0.5%) which were 39.06, 58.08,75.28 per cent, more as compared to control. However, those are at par with the treatment T_9 *i.e.* spraying of $B_2(SO_4)_3$ (0.1%) + $FeSO_4$ (0.2%)+ KH_2PO_4 (0.5%) (9.03), T_{12} *i.e.* $ZnSO_4$ (0.1%) + B_2 $(SO_4)_3$ (0.1%) + $FeSO_4$ (0.2%) + $CuSO_4$ (0.2%)+ KH_2PO_4 (0.5%) (8.81), T_{11} *i.e*.$ZnSO_4$ (0.1%) + $B_2(O_4)_3$ (0.1%) + $FeSO_4$ (0.2%) + $CuSO_4$ (0.2%) + GA_3 (80 ppm) (8.69), T_7 *i.e* $ZnSO_4$ (0.1%) + $FeSO_4$ (0.2%) + KH_2PO_4 (0.5%) (8.57). The minimum number of hands per bunch (6.53), fingers per bunch (83.07) and weight of bunch (12.42 kg) were recorded in treatment T_{13} (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 which helped the increasing the number of fruits per hand and bunch (Adams *et al.*, 1975 and Kamijima, 1981) [1]. The research on similar line was done by Pathak *et al.* (2011) [12]. 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 and fingers per bunch. The research on similar line was done by Barman and Baruah (2003) [3], Yadlod and Kadam (2008) [18], Dixit *et al.* (1997) [5]. Micronutrients play an important role in photosynthesis, development of reproductive stage, aids in regulating plant growth hormones and reaction involving cell division and growth of banana, which helps increasing in the yield of banana in term of increasing the weight of bunch. Similar type of study was done by Pathak *et al.* (2011) [12] and Vijaykumar and Shanmugavelu (1983) [17].

Quality parameters

The significantly maximum pulp to peel ratio (3.25), total soluble solid (23.08^0B), reducing sugar (17.21%), non-reducing1 sugar (3.81), total sugar (21.02%), yield (94.12 Mt/ha) and B:C ratio(3.17) were recorded in the treatment T_6 *i.e.* spraying of $ZnSO_4$ (0.1%) + B_2 $(SO_4)_3$ (0.1%) + KH_2PO_4 (0.5%) which were considerably higher than control treatment. However, those are at par with treatment T_9 *i.e.* spraying of $B_2(SO_4)_3$ (0.1%) + $FeSO_4$ (0.2%)+ KH_2PO_4 (0.5%) (3.20), T_{12} *i.e*.$ZnSO_4$ (0.1%) + B_2 $(SO_4)_3$ (0.1%) + $FeSO_4$ (0.2%) + $CuSO_4$ (0.2%)+ KH_2PO_4 (0.5%) (3.18), T_{11} *i.e*.$ZnSO_4$ (0.1%) + $B_2(O_4)_3$ (0.1%) + $FeSO_4$ (0.2%) + $CuSO_4$ (0.2%) + GA_3 (80 ppm) (3.15), T_7 *i.e* $ZnSO_4$ (0.1%) + $FeSO_4$ (0.2%) + KH_2PO_4 (0.5%) (3.10). The treatment T_{13} *i.e*. control was recorded minimum. Whereas, minimum acidity (0.180%) was recorded in treatment T_6 as compared to control (0.320%).

Throughout the fruit development pulp to peel ratio increases regularly. The rise in such ratio is related to the sugar concentration in the tissues. Sugar increases more rapidly in pulp than in peel Stratton and Loesexe (1931) and Kumar and Kumar (2005) [8].

Increase in TSS content of banana fruits during storage and micronutrients and potassium played important role in improving TSS of fruits during storage with pre harvest application of B + Zn + Cu Das (1995) and Dabas and Jindal (1985) [4] significantly recorded the highest TSS (19.87^0B) with foliar spray of Boron (0.3%).

The reduction in acidity might be due to rapid utilization of organic acids during respiration or by the conversion of organic acids into sugars or salts by enzyme or both. These findings are in close conformity with reports of Rao and Chundawat (1984) [13]

The high reducing sugar predominantly glucose recorded to Zn, B and Cu application which probably activate the enzyme (oxidase and source) and it was resulted increase in the sugar content. The research on same line was done by Padashetty *et al*. (2010) [9] and Ramesh Kumar and Kumar (2010) [14]. The highest total sugar contents probably due to reduced rate of catabolic activities like respiration under the influence of plant growth regulators as opined by Vijaykumar and Shanmugavelu (1983) [17]. The B:C ratio remains steady because of the increased cost of cultivation was maintained by yield which increased simultaneously. Similar findings were noted by Patel *et al.* (2010) [11].

Table 1: Effect of foliar sprays of micronutrients with chemicals on yield and quality attributes of banana Cv. Ardhapuri

Tr. No	Treatment details		No. of hands /bunch	No. of fingers /bunch	Wt. of bunch (kg)	Yield per plant(kg)	Yield (Mt/ha)	Pulp:peel	TSS(^{0}B)	Acidity (%)	Reducing sugar (%)	Non reducing sugar (%)	Total sugar (%)	B:C Ratio
	Micronutrients	Chemicals												
T_1	$ZnSO_4$ (0.5%) + $B_2(SO_4)_3$(0.1%)	GA_3 (80 ppm)	8.30 (27.10)	111.22 (33.88)	17.19 (38.40)	17.19 (38.40)	76.40 (38.40)	2.84 (13.6)	18.91 (40.07)	0.253 (20.93)	15.15 (8.60)	2.74 (35.64)	17.89 (12.02)	2.57 (35.97)
T_2	$ZnSO_4$ (0.5%) + $FeSO_4$(0.2%)	GA_3 (80 ppm)	7.45 (14.08)	98.41 (18.46)	15.14 (21.90)	15.14 (21.90)	67.50 (22.28)	2.70 (8.00)	17.19 (27.33)	0.273 (14.68)	14.62 (4.80)	2.35 (16.33)	16.97 (6.26)	2.27 (20.10)
T_3	$ZnSO_4$ (0.5%) + $CuSO_4$(0.2%)	GA_3 (80 ppm)	7.41 (13.47)	97.64 (17.53)	14.76 (18.84)	14.76 (18.84)	65.40 (18.47)	2.65 (6.00)	16.19 (19.92)	0.286 (10.62)	14.20 (1.79)	2.22 (9.90)	16.44 (2.94)	2.20 (16.40)
T_4	$B_2(SO_4)_3$(0.1%) + $FeSO_4$(0.2%)	GA_3 (80 ppm)	7.46 (14.24)	100.62 (21.12)	15.36 (23.67)	15.36 (23.67)	68.30 (23.73)	2.77 (10.80)	18.35 (35.92)	0.250 (21.87)	15.10 (8.24)	2.69 (33.16)	17.79 (11.39)	2.30 (21.69)
T_5	$B_2(SO_4)_3$(0.1%) + $CuSO_4$ (0.2%)	GA_3 (80 ppm)	6.55 (0.30)	83.75 (0.81)	12.63 (1.69)	12.63 (1.69)	65.17 (18.06)	2.58 (3.20)	15.95 (18.14)	0.289 (9.68)	14.10 (1.07)	2.15 (6.43)	16.25 (1.75)	2.19 (15.87)
T_6	$ZnSO_4$ (0.5%) + B2 $(SO_4)_3$(0.1%)	KH_2PO_4 (0.5%)	9.14 (39.06)	131.32 (58.08)	21.77 (75.28)	21.17 (75.28)	94.12 (70.50)	3.25 (30.00)	23.08 (70.96)	0.180 (43.75)	17.21 (23.36)	3.81 (88.61)	21.02 (31.62)	3.17 (67.62)
T_7	$ZnSO_4$(0.5%) + $FeSO_4$ (0.2%)	KH_2PO_4 (0.5%)	8.57 (31.24)	119.33 (43.64)	18.76 (51.09)	18.76 (51.09)	83.41 (51.10)	3.10 (24.00)	21.03 (55.77)	0.218 (31.87)	16.30 (16.84)	3.30 (63.36)	19.60 (22.73)	2.81 (48.67)
T_8	$ZnSO_4$ (0.5%) +$CuSO_4$ (0.2%)	KH_2PO_4 (0.5%)	8.47 (29.70)	116.44 (40.17)	18.20 (46.53)	18.20 (46.53)	80.90 (46.55)	2.95 (18.00)	20.95 (55.18)	0.227 (29.06)	16.05 (15.05)	3.24 (60.33)	19.29 (20.78)	2.72 (43.91)
T_9	$B_2(SO_4)_3$(0.1%) + $FeSO_4$ (0.2%)	KH_2PO_4 (0.5%)	9.03 (38.28)	129.19 (55.51)	20.71 (66.74)	20.71 (66.74)	92.05 (66.75)	3.20 (28.00)	22.26 (64.88)	0.196 (38.75)	16.90 (21.14)	3.51 (73.76)	20.41 (27.80)	3.12 (65.07)
T_{10}	$B_2(SO_4)_3$(0.1%) + $CuSO_4$ (0.2%)	KH_2PO_4 (0.5%)	8.43 (29.09)	113.62 (36.77)	17.68 (42.35)	17.68 (42.35)	78.60 (42.39)	2.90 (16.00)	20.81 (54.14)	0.236 (26.25)	15.85 (13.62)	2.82 (39.60)	18.67 (16.50)	2.65 (40.21)
T_{11}	$ZnSO_4$ (0.5%) + $B_2(SO_4)_3$(0.1%) + $FeSO_4$(0.2%) + $CuSO_4$(0.2%)	GA_3 (80 ppm)	8.69 (33.07)	122.22 (46.37)	19.36 (58.29)	19.36 (58.29)	86.03 (55.85)	3.15 (26.00)	21.81 (61.58)	0.210 (34.37)	16.61 (19.06)	3.40 (68.31)	20.01 (25.29)	2.89 (52.91)
T_{12}	$ZnSO_4$ (0.5%) + $B_2(SO_4)_3$(0.1%) + $FeSO_4$(0.2%) +$CuSO_4$(0.2%)	KH_2PO_4 (0.5%)	8.81 (34.91)	125.78 (51.41)	20.05 (61.43)	20.05 (61.43)	89.14 (61.48)	3.18 (27.20)	21.94 (62.51)	0.204 (36.25)	16.72 (19.85)	3.45 (70.79)	20.17 (26.29)	2.99 (58.20)
T_{13}	Control	-	6.53	83.07	12.42	12.42	55.20	2.50	13.50	0.320	13.95	2.02	15.97	1.89
		S.E ±	0.16	4.16	0.84	0.84	3.82	0.06	0.78	1.35	0.29	0.16	0.52	
	C.D at 5%		0.45	12.07	2.46	2.46	11.79	0.17	2.11	3.85	0.93	0.54	1.48	

Conclusion

The application of $ZnSO_4$ (0.1%) + $B_2(SO_4)_3$ (0.1%) + KH_2PO_4 (0.5%) and $B_2(SO_4)_3$ (0.1%) + $FeSO_4$ (0.2%)+ KH_2PO_4 (0.5%) 5th, 6th,7th and flag leaf stage was revealed best among all in the increase of yield and quality. Micronutrients and Potassium Di -Hydrogen Phosphate found best to improve the yield and quality of Banana. Potassium Di -Hydrogen Phosphate showed best response in increasing the yield and quality characters of banana.

Reference

1. Adams PA, Montague MJ, Tepfer M, Rayle DL, Ikuma H, Kaufman PB. Effect of gibberellic acid on the plasticity and elasticity of Avena stem segments. Plant Physiol. 1975, 751-760.
2. Apshara SE, Sathiamoorthy. Effect of planting more than one sucker per pit on growth and yield of banana Cv. Nendran. Indian J Hort. 2003; 60(4):355-358.
3. Barman P, Baruah K. Effect of plant growth substances on crop yield and quality of banana Cv. Barjahaji (*Musa* AAA group). Assam Agric. Uni. Crop Res. 2003; 26(3):458-461.
4. Dabas AS, Jindal PC. Effect of boron and magnesium spray on fruit bud formation, berry set and berry drop and quality of Thopmson Seedless grape (*Vitis vinifera* L.). Indian J of Agric. Res., 1985; 1:40-44.
5. Dixit CK, Yamdagni R, Jindal R. Effect of foliar application of zinc and iron on chlorosis and yield of Kinnow-A Mandarine hybrid. South Indian Hort. 1997, 3-18
6. Evans LT. Flower Induction and the Floral Concept. Rev. P1. Physiol. 1971; 22:365-394.
7. Kamijima O. Consideration on the mechanism of expression of dwarf genes in rice plants. Jap. J Breed., 1981; 31:302-315.
8. Kumar AR, Kumar N. Sulphate of potash foliar spray effects on yield, quality and post-harvest life of banana. Better Crops. 2005; 91(2):22-24.
9. Padashetty BS, Angadi SG, Sateesh Pattepur. Effect of pre- harvest spray of growth regulators on growth, yield and quality of seedless grape genotypes. The Asian J. Hort. 2010; 5(1):218-221.
10. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers, ICAR, New Delhi, 1985, 145-148.
11. Patel AR, Saravaiya SN, Patel AN, Desai KD, Patel NM, Patel JB. Effect of micronutrients on yield and fruit quality of banana (*Musa paradisica* L.) Cv. Basrai under pair row planting method. The Asian J Hort., 2010; 5(1):245-248.
12. Pathak M, Bauri FK, Misra DK, Bandopadhyay B, Chakraborty K. Application of micronutrients on growth, yield and quality of banana. Journal of Crop and Weed, 2011; 7(1):52-54.
13. Raghava Rao DV, Chundawat BS. Chemical regulation on ripening in Basrai banana at ambient temperature. *Prog. Hort.* 1984; 16(1, 2):58-68.
14. Ramesh Kumar A, Kumar N. Effect of post-shooting sprays of certain nutrients on yield and quality of banana Cv. Neypoovan (AB). Agric. Sci. Digest. 2010; 30(2):125-128.

15. Sharrock S, Lusty C. Nutritive value of banana INIBAP Annual Report, 1999, 28-31
16. Tisdale SL, Nelson WL. Soil Fertility and Fertilizers, Macmillan Co., London. 1966, 81.
17. Vijaykumar C, Shanmugavelu KG. Studies on effect of growth regulators on Kottavazhai. Indian J. Hort. 1983; 40(1):1-7.
18. Yadlod SS, Kadam BA. Effect of plant growth regulators and micronutrients on growth, yield and storage life of banana (*Musa* sp.) Cv. Srimanti. The Asian J Hort., 2008; 3(2):409-411