Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-6: 452-458

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-6 pp. 452-458**
Journal homepage: http://www.ijcmas.com

Original Research Article

Effect of Different Micro-Nutrients on Flowering and Fruiting Characters and Crop Duration of Banana (*Musa paradisiaca* L.) cv. Grand Naine

Hemant Kumar Panigrahi*, Tikeshwar Kumar, S. N. Dikshit and Prabhakar Singh

Department of Fruit Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur - 492012, Chhattisgarh, India
**Corresponding author*

A B S T R A C T

A field experiment on the "Effect of different micro-nutrients on growth parameters of banana (*Musa paradisiaca* L.) cv. Grand Naine" was carried out at instructional farm Pt. Kishori Lal Shukla College of Horticulture and Research Station (IGKV) Rajnandgaon, Chhattisgarh during the year 2015-16 employing randomized block design having eleven treatments replicates thrice. The treatment consisted eleven different combination of micronutrients along with recommended dose of fertilizers *viz.* RDF + $FeSO_4$ (0.5%), RDF +$ZnSO_4$(0.5%), RDF + $CuSO_4$ (0.2%), RDF +Borax (0.1%), RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %), RDF + $ZnSO_4$ (0.5%) + $CuSO_4$ (0.2 %), RDF + $ZnSO_4$ (0.5%) + Borax (0.1%), RDF + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %), RDF + $FeSO_4$ (0.5 %) + Borax (0.1%), RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %) + Borax (0.1%) and water spray (control). The experiment was conducted on banana crop cv. Grand Naine with foliar application of micro-nutrients singly and in combinations along with fertigation of recommend dose of fertilizers applied at 3rd, 5th and 7th month after planting. As far as the flowering and fruiting characters and crop duration is concerned, RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%) treated plants comes early to flowering and fruiting as compared to other treatments. Similarly, the same treatment (F5) took lowest time from flowering to maturity. The shortest crop duration (333.73 days) was recorded under the treatment F5, which was 60.16 days earlier as compared to control. The treatment F5 [RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%)] was found best in respect to flowering and fruiting characters and crop duration in Grand Naine cultivar of banana.

Keywords

Micro-nutrients, Banana, Grand Naine, Foliar spray, Crop duration etc.

Introduction

Banana (*Musa paradisiaca* L.) is the most important fruit in the world. It belongs to family Musaceae. Banana is native to tropical South and South East Asia. It has nutritional, medicinal, industrial as well as aesthetic value in Hindu region. Owing to its greater socio-economic significance and multifaceted uses banana is popularly known as *Kalpataru* (A plant with virtues). All parts of the plant including leaves, pseudostem, flower bud and corn can be used in one or another way (Chaddha, 1974). In India, banana is fourth important food crop in terms of gross value exceeded only by paddy, wheat and milk products. It is also a dessert fruit for millions apart from a staple food owing to its rich and easily digestible carbohydrates with a calorific value of 67-137/100 g edible fruit. It is a good source of vitamin ''A'' (190 IU per

100 g of edible portion) and vitamin ‘‘C’’ (100 mg/ 100g) and fair source of vitamin B and B_2.

Banana is one of the most important commercial crops in the world. It is estimated that 87% of banana production is for local food consumption. According to 2012 statistics, India leads the world in banana production by producing around 18% of the world wise crop of 139 million metric tonnes.

Banana is cultivated in the world in an area of 4.80 million ha with global production of 99.99 million tonnes having productivity of 20.80 Mt/ha. India contributes 29 per cent in total world production of banana and ranked first in area and production in the world. In India, banana occupies 20 per cent area (776000 ha) among the total area under fruit crops and produces 25.51 million tonnes with a productivity of 34.20 Mt/ha (Anon., 2013). Chhattisgarh is one of the State in which banana is produced in an area of 20792 ha having annual production of 498814 metric tonnes with the average productivity of 23.99 Mt/ha (Anon., 2014). Climate of Chhattisgarh is well-suited for cultivation of banana; therefore it is being grown almost in all districts of Chhattisgarh. Banana cv. Grand Naine is a dominant cultivar in Chhattisgarh State.

Although, production of banana in the country as well as in State is very high, but export quality production is very low. There are number of constraints for export quality production of banana such as lack of exportable varieties, lack of consistency of supply, large tracts of low and unproductive plantation, poor crop management, lack of awareness about essential micro-nutrients, heavy post-harvest losses and all these factors also results for high cost of production. Among management practices, balanced dose of nutrition including micronutrients plays an important role in quality improvement in banana. The role of micro-nutrients for production of quality traits have been already reported by many scientists. Zinc aids in regulating plant growth hormone and enzyme system, necessary for carbohydrate and starch formation, iron (Fe) promotes formation of chlorophyll pigment, which acts as an oxygen carrier involving cell division and growth. Copper (Cu) catalyzes several plant processes like photosynthesis, development of reproductive stage, indirect role in chlorophyll production, increase sugar content, intensifies colour and improves flavour of fruit on ripening and Boron (B) is necessary for translocation of sugars and promotes fruit maturity.

Application of essential nutrients in appropriate quantity is fundamental for various physiological processes in plants. Nutrients like nitrogen, phosphorus and potash play a vital role in promoting the plant vigour and productivity, where micro-nutrients like zinc, boron, copper and molybdenum perform a specific role in the growth and development of plant, flowering and fruiting characters, quality produce and uptake of major nutrients. The fertilizers applied through soil are also needed in higher quantities because some portion leaches down and some does not become available to the plants due to complex chemical reaction. However, a nutrient management schedule especially for micro-nutrient *i.e.,* Zn, B, Cu and Fe etc. has to be developed, which maintains productivity and quality of banana. Flowering and fruiting parameters and crop duration of banana is believed to be influenced by foliar application of micro-nutrients. A significant goal of foliar fertilizer studies is to develop cultural practices by which crop nutrient requirements are satisfied through maximum

uptake of nutrients from a minimum quantity of applied nutrients. In general foliar application of micro-nutrients gives a better crop response than either band or broadcast application. Foliar application gives flexibility of fertilization, which enables the specific nutritional requirements of the crop to be met at different stages of its growth.

Materials and Methods

The present investigation entitled ‘‘Effect of different micro-nutrients on flowering and fruiting characters and crop duration of banana (*Musa paradisiaca* L.) cv. Grand Naine “was carried out during the year 2015-2016 at Instructional Farm, Pt. Kishori Lal Shukla College of Horticulture and Research Station (IGKV) Rajnandgaon Chhattisgarh during the year 2015-16 employing randomized block design having eleven treatments replicates thrice. The treatment consisted eleven different combination of micronutrients along with recommended dose of fertilizers *viz.* RDF + $FeSO_4$ (0.5%), RDF +$ZnSO_4$ (0.5%), RDF + $CuSO_4$ (0.2%), RDF +Borax (0.1%), RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %), RDF + $ZnSO_4$ (0.5%) + $CuSO_4$ (0.2 %), RDF + $ZnSO_4$ (0.5%) + Borax (0.1%), RDF + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %), RDF + $FeSO_4$ (0.5 %) + Borax (0.1%), RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %) + Borax (0.1%) and water spray (control).

The soil of experimental field is sandy-loam, which is locally known as “Matasi““ in the region. For analysis of nutrient status of experimental soil, the soil sample were collected randomly from 4-5 places up to a depth of 20 cm in the field and mixed up thoroughly to make a composite sample. The composite sample was analyzed for Physico-chemical characters and the results are presented as under: Chhattisgarh is reputed for producing the best quality of Grand Naine (G-9) banana. Therefore it was selected for the present investigation. The planting materials were healthy tissue culture banana plants of cv. Grand Naine and were procured from tissue culture laboratory Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The desired concentrations of micro-nutrients were prepared and sprayed at the interval of 3rd, 5th and 7th month after the planting of banana plants.

All the experimental plants were uniformly maintained and were provided same cultured practices *i.e.* fertilization irrigation and plant protection measures during whole period of investigation. Irrigation and fertilizers has been provided to the plants through the drip system of irrigation.

Results and Discussion

Days taken to first flowering

Amongst the different treatments, minimum days taken to first flowering (235.18) was observed under the treatments F5 [RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %)], which showed non-significant differences with treatments F7 [RDF + $ZnSO_4$ (0.5%) + Borax (0.1%)], F10 [RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %) + Borax (0.1%)], F9 [RDF + $FeSO_4$ (0.5 %) + Borax (0.1%)] and F6 [RDF + $ZnSO_4$ (0.5%) + $CuSO_4$ (0.2 %)] having days taken to first flowering 241.37, 244.21, 249.23 and 251.20 days, respectively. Similarly the treatments F10, F9, F6, F4, F2 and F8 having days taken to first flowering of 244.21, 249.23, 251.20, 254.11, 259.57 and 260.11, respectively. Maximum days taken to first flowering (273.37) was observed under the treatment F0 (RDF + Control), which showed statistically at par with

treatments F3 [RDF + Borax (0.1%)], F1 (RDF + $FeSO_4$ (0.5 %)], F8 [RDF + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %)] and F2 [(RDF + $ZnSO_4$ (0.5%)] having respective days taken to first flowering 267.25, 264.44, 260.11 and 259.57.

There were significant differences among different treatments with regarding to days taken to first flowering. Early inflorescence emergence was significantly altered by the micro-nutrients (Table 2). This might be due to reduced flowering duration, which could be attributed to enhancing effect of zinc in enzymatic reaction, cell division as well as in growth. The present finding is corroborates with the finding of Supriya and Bhattacharyya (1993), Ghanta and Mitra (1993) in banana and Babu *et al.,* (2007) in Mandarin orange.

Days taken to first fruiting

Different micro-nutrients showed significant differences under the present investigation. The minimum days taken to first fruiting (250.65 days) was noted under the treatment F5 [RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %)], which was found statistically at par with the treatments F7 [RDF + $ZnSO_4$ (0.5%) + Borax (0.1%)], F10 [RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %) + Borax (0.1%)] and F9 [RDF + $FeSO_4$ (0.5 %) + Borax (0.1%)] having days taken to first fruiting 257.39, 261.52 and 267.29, respectively. Similarly the treatments F1, F8, F2, F4, F6 & F9 and F3, F1, F8, F2, F4, F6 & F9 having respective days taken to first fruiting 285.33, 280.48, 279.25, 273.37, 269.47 & 267.29 and 288.51, 285.33, 280.48, 279.25, 273.37, 269.47 & 267.29 showed non-significant differences with each other. Maximum days taken to first fruiting (296.70) were observed under the treatment F0 (RDF+Control).

It may be due to the effect of micro-nutrients specially zinc and Fe helps the absorption of other macro-nutrients from the soil (Table 1). It also involves in cell division and cell enlargement as well as in growth of banana crop. These findings are close agreement with the findings of Babu and Singh (2002), Das and Mohan (1993), Ghanta and Mitra (1993), Haque *et al.,* (2000) and Singh and Rajput (1997).

Days taken from flowering to maturity

As per the Table 2, the minimum days taken from flowering to maturity (98.22) was observed under the treatments F5 [RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5%)], which was found to be non- significant difference with the treatments F7 [RDF + $ZnSO_4$ (0.5%) + Borax (0.1%)], F10 [RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %) + Borax (0.1%)], F9 [RDF + $FeSO_4$ (0.5 %) + Borax (0.1%)] and F2 [RDF + $ZnSO_4$ (0.5%)] having 99.15, 102.45, 105.19 and 105.38, days taken from flowering to maturity. Similarly the treatments F8, F4, F6, F3 and F1 having respective days taken from flowering to maturity 110.24, 110.20, 108.28, 107.30 and 105.42 days showed non-significant differences with each other. The Maximum days taken from flowering to maturity (120.52) was recorded under the treatment F0 (RDF + Control). Shortened the number of days taken from flowering to maturity might be due to the better source sink relationship of translocation of carbohydrates efficiency to the developing bunch. The present results are in conformity with the findings of Das and Mohan (1993) in banana and other fruit crops.

Crop duration

The average crop duration varied from 333.73 to 393.89 days under the different treatments. It is apparent from the data that

the shortest crop duration 333.73 days were observed under the treatment F5 [RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %)], which was recorded non-significant differences with F7 [RDF + $ZnSO_4$ (0.5%) + Borax (0.1%)], F10 [RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %) + Borax (0.1%)] and F9 [RDF + $FeSO_4$ (0.5 %) + Borax (0.1%)] having crop duration of 340.49, 345.99 and 355.05 days, respectively. The longest crop duration 393.89 days were recorded under the treatment F0 (RDF + Control), which was reported non-significant differences with the treatments F3, F8, F1 and F2. The shortest crop duration of 333.73 days was recorded under the treatment F5 and longest crop duration was observed under F0 (RDF + Control) might be due to the effect of micro-nutrients on higher net assimilation rate on account of better growth leading to the production of endogenous metabolites earlier in optimum level enabling early flower bud initiation and there by early shooting. This results leads support to the findings of Das and Mohan (1993), Yadav *et al.*, (2010) and Ghanta and Mitra (1993) in banana and other fruit crops.

Table.1 Physico-chemical composition of experimental soil

S. No.	Particulars	Analytical Value	Classification	Methods
I Mechanical analysis				
1.	Sand (%)	49.35	Sandy loam (Matasi)	International pipette method (Black, 1965)
2.	Silt (%)	27.36		
3.	Clay (%)	23.29		
II Chemical analysis				
1.	Organic carbon (%)	0.51	Medium	Walkley and Black's method (Black, 1965)
2.	Available N (kg/ha)	331.24	Medium	Modified kjeldahl method (Piper, 1966)
3.	Available P_2O_5 (kg/ha)	23.69	Medium	Olsen method (Olsen, 1954)
4.	Available K_2O (kg/ha)	197.18	Medium	Flame photometer (Jackson, 1973)
5.	Soil pH	7.39	Normal	Carbon electrode pH meter method Piper (1967)
III Micro nutrients				
1.	Zinc (mg/ha)	0.20	Low	DTPA Extract zinc (Lindsay and Norvell, 1978)
2.	Iron (mg/ha)	8.10	Medium	DTPA Extract iron (Lindsay and Norvell, 1978)
3.	Copper (mg/ha)	0.18	Low	DTPA Extract copper (Lindsay and Norvell, 1978)
4.	Boron (mg/ha)	0.40	Low	DTPA Extract copper (Lindsay and Norvell, 1978)

Table.2 Flowering and fruiting characters and crop duration as influenced by foliar application of micro-nutrients in banana (cv. Grand Naine)

Notation	Treatments	Days taken to first flowering	Days taken to first fruiting	Days taken from flowering to maturity	Crop duration (Days)
F_0	RDF + Control (water spray)	273.37	296.70	120.52	393.89
F_1	RDF + $FeSO_4$ (0.5 %)	264.44	285.33	105.42	369.86
F_2	RDF + $ZnSO_4$ (0.5%)	259.57	279.25	105.38	364.95
F_3	RDF + Borax (0.1%)	267.25	288.51	107.30	374.55
F_4	RDF + $CuSO_4$ (0.2 %)	254.11	273.37	110.20	363.64
F_5	RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %)	235.18	250.65	98.22	333.73
F_6	RDF + $ZnSO_4$ (0.5%) + $CuSO_4$ (0.2 %)	251.20	269.47	108.28	359.48
F_7	RDF + $ZnSO_4$ (0.5%) + Borax (0.1%)	241.37	257.39	99.15	340.49
F_8	RDF + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %)	260.11	280.48	110.24	370.35
F_9	RDF + FeSO4 (0.5 %) + Borax (0.1%)	249.23	267.29	105.19	355.05
F_{10}	RDF + $ZnSO_4$ (0.5%) + $FeSO_4$ (0.5 %) + $CuSO_4$ (0.2 %) + Borax (0.1%)	244.21	261.52	102.45	345.99
	SEm ±	7.40	8.41	3.70	10.44
	CD at 5 %	**21.84**	**24.83**	**10.92**	**30.82**

RDF- Recommended Dose of Fertilizers

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