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EFFECT OF RATE AND FREQUENCY OF MICRONUTRIENT ON GROWTH ATTRIBUTES AND DRY MATTER YIELD OF BANANA CV. GRAND NAINE UNDER SOUTH GUJARAT CONDITION

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ABSTRACT
The field experiment was carried out using banana as a plant crop and ratoon crop at Soil and Water Management Research Unit, NAU, Navsari. The different rate of multi-micronutrients mixture grade-V (M_1 = 25g/plant, M_2 = 50g/plant, M_3 = 75g/plant) and the frequency of application (S_1 = Basal and S_2 = 50 per cent each as basal and 50 per cent two month after planting) was used in different treatment. The treatments *viz*., PFDC(T_1), PFDC + M_1S_1(T_2), PFDC + M_1S_2(T_3), PFDC + M_2S_1(T_4), PFDC + M_2S_2(T_5), PFDC + M_3S_1(T_6), PFDC + M_3S_2(T_7) and 100% RDF only (T_8) for both years were tested using RBD with four replications. The dry matter yield (t ha^1) of different banana plant part (leaves, pseudostem and fruits) was significantly more (2.18, 10.43 and 10.70 t ha^{-1} respectively) in treatment T_7 *i.e.* (M_3S_2) compared to rest of the treatments. Whereas the growth parameters (plant height, pseudostem girth and number of functional leaves) were non-significantly influenced. Similar result was observed in ratoon crop. Application of treatment T_6 (T_1 + M_3S_1) and T_7 (T_1 + M_3S_2) can be beneficial under south Gujarat condition to achieve a good growth attributes and dry matter yield different plant parts.

INTRODUCTION

India is the largest producer of banana in the world contributing 25.60 per cent to the global production, with 26.51 million tonnes from an area of 0.77 million ha. Among the fruit crops, banana enjoys a special status in India with a major share of 11.11 per cent in the area and 32.6 per cent of the production (Anonymous, 2013).

Banana (*Musa paradisiaca* L.), which belongs to the family Musaceae in the order Scitamineae, have been considered as one of the most important fruit crops of the world. It is also known as "Apple of Paradise". The banana fruit has nutritional, medicinal and industrial values. Banana is cultivated in about 120 countries. The total annual world production is estimated at 86 million tones of fruits. In Gujarat, banana covers an area of 0.70 lakh hectares with production of 45.23 lakh tonnes (Anon, 2007).

Banana requires high amount of nutrients for maximum bulky vegetative growth and fertilization management is also very important for sustaining banana yield and soil health. Crops are generally sensitive to micronutrients stress therefore, correction of hidden hungers or deficiencies of micronutrients are very important for balanced nutrition.

The multi micronutrients fertilizers mixture grades prepared on the basis of micronutrients deficiency status of Gujarat soils proved beneficial in increasing yield of different crops under varied agro-climatic conditions and different types of soils. Drip irrigation is a promising system for economizing on the available irrigation water. Among the different micronutrient grades, the multi micronutrients mixture (Grade-V) having Fe 2.0, Mn 0.5, Zn 5.0, Cu 0.2 and B 0.5 per cent is recommended for soil application@20 kg/ha. Improvement of micronutrient in food parts will help to correct malnutrition problems of Fe and Zn in human beings (Patel and Singh, 2010). Zinc and manganese functions in many enzyme systems as bridges to connect the enzyme with the substrate upon which it is meant to act (Das, 2003). Keeping this in view, the present experiment was conducted to study the effect of rate and frequency of micronutrient application on growth attributes and dry matter yield of banana cv.Grand Naine.

MATERIALS AND METHODS

The field experiment was carried out at Soil and Water Management Research unit NAU, Navsari. The experimental field belongs to AES-III of South Gujarat with the predominant deep black soil and clay in texture. The initial pH, EC and OC of experimental soil were 7.95, 0.23 dS/m and 0.52 % respectively. The experimental plot was prepared by deep ploughing and harrowing and well decomposed fine textured farm yard manure @ 10 kg pit^{-1} was applied at the time of planting.

Recommended dose of fertilizers (RDF) @ 300:90:200 NPK g/plant fertilizers were applied according to treatments in plant crop as well as in ratoon crop. The different rate (M_1 = 25gm/plant, M_2 = 50gm/plant, M_3 = 75gm/plant) of multi-

micronutrients mixture grade-V and the frequency of application (S_1 = Basal and S_2 = 50 per cent each as basal and 50 per cent two month after planting) was used in different treatments for plant as well as ratoon crops were tested using randomized block design with four replications.

The two sets of treatments were tested in sequential manner at fixed site. The treatments details are-

T_1- Control (PFDC), T_2-$T_1 + M_1S_1$, T_3-$T_1 + M_1S_2$, T_4-$T_1 + M_2S_1$, T_5-$T_1 + M_2S_2$, T_6-$T_1 + M_3S_1$, T_7-$T_1 + M_3S_2$, T_8-only RDF

PFDC means Precision farming development centre which is a practice in which 60% nitrogen, 100% phosphorus and 60% potassium of recommend dose of fertilizer (RDF) is applied in banana crop. In this practice 20 % N and 20 % K of total amount was applied as basal and 20% N and 20 % K were applied after two month of planting as split. Remaining 60% amount each of N and K was applied through the drip application at periodical interval of 15 days. P was applied as 50% basal and 50 % 2 MAP.

In case of 100%RDF (T8), the 40% each of N and K was applied as basal and 40% at 2MAP as soil application. Remaining amount was applied through drip application. For micronutrients application Grade V fertilizer (Fe-2.0, Mn-0.5, Zn- 5.0, Cu- 0.2 and B- 0.5 per cent) was uesd. Green manuring was also done at 3MAP and incorporation was done at flowering stage.

For recording the vegetative growth parameters of the leaf, five uniformly growing plants were selected in each replication. The leaf with 3/4 or more photosynthetically active area was considered a functional leaf. The total number of leaves produced by plants during the entire growth period was counted from the first leaf emergence up to the shooting stage.The height of plant (cm) was measured from ground level to the upper most points of contact of petioles of two youngest leaves as suggested by Lahav (1972). The circumference (cm) of pseudostem was measured with help of measuring tape at 20 cm above ground level. The data, collected for all the characters involved under study were subjected to the statistical scrutiny (analysis) for proper interpretation. The standard method of analysis of variance technique appropriate as described by Panse and Sukhatme (1995) was used.

RESULTS AND DISCUSSION

The result on growth attributes and dry matter yield of different plant parts (leaves, pseudostem and fruits) are given as under-

Growth parameters

The results pertaining to growth characters *viz*., plant height (cm), stem girth (cm) and number of leaves were recorded during the growth period of plant banana and ratoon banana are described here.

Plant height (cm)

The periodical plant height at 90, 150 and 210 DAP/ day after rationing (DAR) and at the time of harvesting of plant banana and ratoon banana as influenced by various treatments are presented in table 3.1. The results revealed that different treatment has no significant effect on the plant height. However, maximum plant height was observed under treatment T_7 (T_1 + M_3S_2). This might have been due to the effect of fertilizers that supply the nutrients in readily available form to the plants immediately after application (Upadhyay, 1988). In this treatment, the plant height of banana was observed at 90, 150, 210 DAP and at the time of harvesting were 58.06, 80.67, 129.20 and 174.47 cm, respectively, while

Table 1: Effect of different treatments on periodical plant height (cm) of plant banana and ratoon banana

Treatments	Days after planting (DAP) of banana plant			At harvesting	Days after planting (DAP) of ratoon banana			At harvesting
	90	150	210		90	150	210	
T_1	54.94	77.7	125171.93	52.36	75.36	121.28	168.25	
T_2	55.83	78.03	125.87	172.6	53.26	75.98	122.69	169.78
T_3	55.99	78.47	126.17	172.83	53.85	76.18	123.15	170.18
T_4	56.26	78.87	126.57	173.07	54.12	76.73	124.29	172.39
T_5	57.42	79.74	127.7	173.83	54.85	77.29	125.69	172.89
T_6	57.78	79.83	128.03	174.33	55.28	77.96	126.81	173.48
T_7	58.06	80.67	129.2	174.47	56.85	78.62	127	174.05
T_8	56.92	79.24	127.03	173.25	54.78	77.48	126.14	172.48
S.Em. ±	5.14	5.47	5.29	7.93	4.58	4.78	4.83	7.12
C.D. at 5%	NS	NS	NS NS	NS	NS	NS	NS	
C.V. %	15.01	13.35	7.93	8.17	12.28	11.28	7.23	8.03

Table 2: Effect of different treatments on pseudostem girth (cm) of plant banana and ratoon banana

Treatments	Days after planting (DAP) of banana plant			At harvesting	Days after planting (DAP) of ratoon banana			At harvesting
	90	150	210		90	150	210	
T_1	16.7	23.79	38.3	61.3	14.36	21.25	35.78	58.96
T_2	17.03	24.6	38.93	61.43	14.89	22.31	36.12	59.18
T_3	17.3	24.73	39.8	61.83	15.28	22.85	37.28	59.98
T_4	17.53	24.83	40.17	61.93	15.83	23.18	38.29	60.19
T_5	17.9	25.4	40.63	62.43	15.97	24.29	38.92	60.87
T_6	18.17	25.27	41.2	62.78	16.58	24.78	39.58	61.36
T_7	18.43	25.77	41.33	63	17.12	25.08	40.57	62.09
T_8	17.87	25.13	40.53	62.07	16.07	24.45	38.47	60.15
S.Em. ±	1.15	1.43	1.75	2.58	1.09	1.29	1.58	2.27
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	10.07	10.28	7.67	7.31	9.28	9.88	6.83	6.76

Table 3: Effect of different treatments on number of functional leaves of plant banana and ratoon banana

Treatments	Days after planting (DAP) of banana plant			At harvesting	Days after planting (DAP) of ratoon banana			At harvesting
	90	150	210		90	150	210	
T_1	6.4	13.6	15.57	20.73	6.23	12.45	14.28	19.28
T_2	6.57	13.67	15.67	20.77	6.35	12.48	14.85	19.88
T_3	6.74	13.74	15.8	20.88	6.68	12.89	14.98	20.06
T_4	6.8	13.83	15.83	21.03	6.72	13.25	15.23	20.36
T_5	6.87	14	16.01	21.17	6.78	13.68	15.87	20.78
T_6	7	14.03	16.05	21.24	6.85	13.78	15.97	21.09
T_7	7.03	14.07	16.14	21.27	6.92	13.9	16.02	21.16
T_8	6.83	13.92	15.9	21.13	6.78	13.08	15.38	20.27
S.Em. ±	NS	NS	NS	NS	NS	NS	NS	NS
C.D. at 5%	14.02	12.77	8.79	7.15	12.28	11.73	8.02	6.85
C.V. %	6.4	13.6	15.57	20.73	6.23	12.45	14.28	19.28

Table 4: Effect of different treatments on dry matter yield (t ha^{-1}) of fruit, leaf and pseudostem of plant banana

Treatments	Fruit dry matter yield (t ha^{-1})	Leaf dry matter yield (t ha^{-1})	Pseudostem dry matter yield (t ha^{-1})
T_1	6.23	1.84	8.73
T_2	6.86	1.89	9.3
T_3	7.13	2	9.59
T_4	8.15	2.02	9.65
T_5	9.14	2.09	10.04
T_6	10.31	2.14	10.24
T_7	10.7	2.18	10.43
T_8	9.59	2.04	9.75
S.Em.±	0.28	0.07	0.28
C.D. at 5 %	0.83	0.2	0.82
C.V. %	6.72	6.69	5.73

Table 5: Effect of different treatments on dry matter yield (t ha^{-1}) of fruit, leaf and pseudostem of ratoon banana

Treatments	Fruit dry matter yield (t ha^{-1})	Leaf dry matter yield (t ha^{-1})	Pseudostem dry matter yield (t ha^{-1})
T_1	5.67	1.72	8.31
T_2	6.49	1.84	8.71
T_3	6.24	1.86	9.01
T_4	8.04	1.88	9.03
T_5	8.31	1.89	9.07
T_6	8.59	2.05	10.05
T_7	9.49	2.09	10.27
T_8	8.92	2.01	9.77
S.Em.±	0.2	0.06	0.24
C.D. at 5 %	0.58	0.16	0.71
C.V. %	5.41	5.78	5.2

in ratoon banana the plant height observed at 90, 150, 210 DAR and at the time of harvesting was 56.85, 78.61, 127.00 and 174.05 cm respectively. Micronutrients activate several enzymes (catalyse, peroxidase, alcohol dehydrogenase, carbonic dehydrogenase, tryptophan synthatase *etc*.) and involved themselves in chlorophyll synthesis and various physiological activities which encouraged plant spread. Zinc is an activator of the enzymes, involves in protein synthesis and has direct effect on the level of IAA in plants. Similar results were observed by Vanilarasu and Balakrishnamurthy (2014), Ghanta and Mitra (1993) and Ram and Bose (2000).

Pseudostem girth (cm)

The periodical pseudostem girth at 90, 150 and 210 DAP/ DAR and at the time of harvesting of plant banana and ratoon banana as influenced by various treatments are showed in table 3.2. The results revealed that different treatment has no significant effect on pseudostem girth. However, maximum pseudostem girth was observed under treatment T_7 (T_1 + M_3S_2). In this treatment, the pseudostem girth was observed at 90, 150, 210 DAP and at the time of harvesting were 18.43, 25.77, 41.33 and 63.00 cm respectively, whereas, lowest pseudostem girth was found under control (T_1) condition. In case of ratoon crop, the pseudostem girth observed at 90, 150, 210 DAR and at the time of harvesting was 17.12, 25.08, 40.57 and 62.09 cm respectively. The improvement in growth and pseudostem girth of banana plant might be due to enhancement of photosynthetic and other metabolic activities by application of micronutrients. These results are also in consonance with the findings of Medhi and Kakati (1994) and Bose and Tripathi (1996).

Number of functional leaves per plant

The periodical data on the number of functional leaves as affected by different treatments are shown in table 3.3. At 90, 150, 210 DAP/DAR and at the time of harvesting, none of the treatments showed no significant effect on the number of functional leaves per plant. However, in banana plant the maximum number of functional leaves was found under T_7 treatment (7.03, 14.07, 16.14 and 21.27) at 90, 150, 210 DAP and at the time of harvesting, respectively and in ratoon crop the maximum number of functional leaves was found under T_7 (6.92, 13.90, 16.02 and 21.16) at 90, 150, 210 DAR and at the time of harvesting respectively. Micronutrients activate several enzymes and various physiological activities which encouraged plant spread. Similar results were observed by Das and Mohan (1993) and Singh and Singh (2002).

Dry matter Yield

The data pertaining to dry matter yield of fruit, leaf and pseudostem presented in table 3.4 (banana plant) and in table 3.5 (ratoon banana) .

The results in table 3.4 revealed that application of micronutrient through treatment T_7 gave significantly the highest dry matter yield of fruit, leaf and pseudostem (10.70, 2.18 and 10.43 t ha^{-1}), respectively but the results remained at par with T6 in fruit dry matter yield, T_3 to T_6 and T_8 in leaf dry matter yield while in pseudostem dry matter yield was at par with T_4 to T_6 and T_8 of banana at harvest.

The results of ratoon banana (table 3.5) revealed that treatment T_7 (T_1 + M_3S_2) gave significantly the highest dry matter yield of

fruit, leaf and pseudostem (9.49, 2.09 and 10.27 t ha^{-1} respectively) in ratoon of banana and the result was at par with T_6 (T_1 + M_3S_1) treatment and T_8 (100 % RDF only) treatment in case of dry matter yield of leaf and pseudostem at harvest. While, the lowest dry matter yield of fruit, leaf and pseudostem (5.67, 1.72 and 8.31 t ha^{-1} respectively) of ratoon was observed under control (T_1). The micronutrient treatments may be attributed to rapidly increase photosynthetic activities and translocation of more photosynthate to growing fruits, which ultimately lead to higher production of dry matter yields.

Similar results were also reported by Patel and Singh (2010) with soil application of micronutrient mixture resulting higher soil available Fe responsible for increasing dry matter yield in black gram. Most of the Fe and Zn are bound with protein, where they catalyses the proteins in the electron transport process of photosynthesis and respiration and catalytic activity of enzymes (Briat *et al*., 2007).

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