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Effect of different levels of fertigation on growth and maturity attributes of banana (*Musa paradisiaca* L.) Cv. grand Naine

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Abstract
An investigation on "Effect of different levels of fertigation on growth and maturity of banana (*Musa paradisiaca* L.) Cv. Grand Naine" was conducted at Banana Research Station, Nanded, Taluka and District Nanded, Maharashtra, during year 2018-2019. The field experiment was laid out in Randomized Block Design with seven treatments and three replications. The experiment consist of seven treatment combinations *viz.,* T_1 - 50% RDF through fertigation, T_2 - 60% RDF through fertigation, T_3 - 70% RDF through fertigation, T_4 - 80% RDF through fertigation, T_5 - 90% RDF through fertigation, T_6 - 100% RDF through fertigation, T_7 (control) - 100% RDF through Soil application. An investigation showed that the maximum growth attributes *viz.* plant height, plant girth, number of leaves per plant and leaf area was recorded by treatment T_6 *i.e.,* 100% RDF through fertigation at 3 Months after planting, 5 Months after planting, 7 Months after planting, and at shooting stage. The treatment T_6 *i.e.,* 100% RDF through fertigation was also found better with respect to maturity attributes *viz.,* number of days required for flowering after planting, the number of days required for harvesting after flowering and days for total crop duration. However treatment T_7 (control) - 100% RDF through Soil application were recorded minimum values for growth attributes as well as crop duration attributes.

Keywords: Fertigation, growth, banana

Introduction
Banana (*Musa spp*.) is one of the oldest fruit known to mankind and it's the distant past traced back from its point out in Ramayana (2029 BC, Kautilyas Arthashatra 300-400 BC). Banana belongs to the family Musaceae of the order Scitaminae. Today it is a leading tropical fruit in world market with a high scale of export potentiality. Banana is cultivated in the world in the vicinity of 4.83 million ha with worldwide production 99.99 million Metric tonnes, having 20.8 Metric tonnes production. In which India donate 29% and ranked first in area and production of banana in the globe. Next to India, China ranked second, whereas, Philippines ranked third country in the production, contributing 10% and 9%, respectively. (Anon. 2017) [2]. Fertigation is a new inventive intellectual method, by which not only fertilizers, soil amendments or other water soluble products are applied through an irrigation system to get higher fertilizer use efficiency but also increases the crop yield. It increases the fertilizer use efficiency through small and controlled quantity of fertilizers that are applied throughout the crop growing season in as compaired to large quantity of fertilizers located on the soil at the commencement of the season, as in straight practice (Dangler and Locascio, 1990) [5]. In Marathwada area there is very less precipitation and also water resources are limited, so that the utilization of fertigation system in banana plays vital function in growth and development of crop. Hence, present investigation was carried out during 2018- 2019.

Materials and Methods
A field experiment was carried out during 2018-2019 at Banana Research Station, Nanded, Maharashtra. The experiment was laid out in randomized block design. The randomization was in seven treatments with three replications. The treatments were undertaken during five different stages of crop growth. The time of application fertilizer (fertigation) to banana is, 1) 30 – 45 DAP, 2) 46 – 70 DAP, 3) 71 – 146 DAP, 4)147 – DAP, 5)273 – 300 DAP. The recommended dose of fertilizer to banana is 200:160:200 g NPK per plant. In control treatment fertilizers were applied through urea, single super phosphate and muriate of potash, respectively.

In water soluble fertilizer treatments, different grades of fertilizer *viz*., urea (46:0:0), monoammonium phosphate (12:61:00), potassium sulphate (0:0:50) were used for fertigation. Five plants from all treatment were arbitrarily selected and labeled. These plants were used for measuring growth and crop duration attributes. Growth attributes *viz,* height of plant (cm), girth of stem (cm), number of leaves per plant, and leaf area (m^2) were recorded at 3 Months after planting, 5 Months after planting, 7 Months after planting, and at shooting stage. The leaf area was determined per plant using following formula and it was expressed in square meter (Murray, 1960).

Leaf area (m^2) = Leaf length (cm) x Leaf width (cm) x 0.8
Where, 0.8 is leaf area constant

The number of days required for flowering after planting was recorded and average days required for flowering were calculated. The physiological maturity of the fruit was judged by observing the change in color of the skin from green to light green and fading of the triangular ridges of the fruits and counted number of days required to harvest after flowering and mean was calculated. Total crop duration(days) was calculated by adding days required for flowering after planting and days required to harvest after flowering and mean was determined.

Results and Discussion

Effect of Different Levels of Fertigation on Growth Attributes

The maximum height of plant (102.20 cm, 140.15 cm, 172.04 cm, and 212.63 cm), girth of stem (32.16 cm, 51.70 cm, 64.44 cm, and 70.77 cm), number of leaves (13.60, 15.66, 17.18, and 16.91), and leaf area (8.10 m^2, 11.63 m^2, 14.00 m^2, and 15.95 m^2) were recorded by treatment T_6 *i.e.*, 100% RDF through fertigation and increased gradually with the period of growth i.e., at 3rd, 5th, 7th MAP and at shooting stage, respectively as compared to others levels of fertigation (Table 1, 2, 3, and 4). The significant difference was observed among all the treatments because of the different levels of fertigation but 100% RDF through fertigation enhanced the growth attributes as compared to soil application of fertilizer.

During an investigation it was observed that, there was highly significant response to height of plant and girth of stem at 100% RDF through fertigation (T_6). Growth involves both cell growth and development. Cell growth and development is a method which consists of cell division, cell enlargement and cell differentiation (Wareing and Phillips, 1970) [15]. Height of plant is an essential parameter, which decides further reproductive growth of the plant. Similar results were also reported by, Srinivas *et al.* (2001) [14], Ahmed *et al*. (2011) [1], Mahendran *et al.* (2013) [9], Pawar and Dingre (2013) [11], Sanjit *et al*. (2014) [13], and Gonge *et al.* (2015) [6]. Reddy *et al.* (2002) [12] who reported that increase in girth of stem could be largely due to regular supply of optimum doses of nitrogen and potassium. Similar results were also reported by Gonge *et al.* (2015) [6].

The number of leaves and leaf area were highest in treatment T_6 *i.e.*, 100% RDF through fertigation. The increase in number of leaves is due to fertilizer application through fertigation resulted in the increased growth of plant by the increased nutrients availability particularly of nitrogen as it had very important role in leaf emergence. Similar results were reported Srinivas *et al.* (2001) [14], and Gonge *et al.* (2015) [6]. Increase in leaf area is because of increase in nutrient use efficiency by minimizing the leaching losses coupled with the split application of N and K fertilizers through drip over one time application of fertilizers as soil application. Similar results was reported by, Srinivas *et al.* (2001) [14].

Effect of Different Levels of Fertigation on Maturity Attributes

Regarding the effect of different levels of fertigation on maturity attributes *viz.*, number of days required for flowering after planting, the number of days required for harvesting after flowering and days for total crop duration. Significantly minimum days required for flowering (220.60 days), minimum days required for harvesting after flowering (115.60 days), and minimum number of days (336.20 days) for total crop duration was recorded by treatment T_6 *i.e.* 100% RDF through fertigation (Table 5). Early flowering was achieved by drip fertigation with water soluble fertilizers at regular intervals. The availability of nutrients at sufficient level to roots at proper stages would have improved synthesis of hormones such as cytokinins and better uptake of potassium by fertigation treatment would have also helped transport of cytokinins and metabolites towards the sink developed namely flower buds. This was may be due to the regular availability of the nutrients, which results in early completion of vegetative growth, induced early flowering, consequently bunch development and the quick production of leaves, which could have supplied more photosynthates and increased flowering stimulus. Significant reduction in number of days required for flowering and minimum days required for harvesting with the higher levels of fertigation were observed in banana. (Aruna *et al.*, 2007) [3]. Similar results were also obtained by Mahalakshmi *et al.* (2001) [8], Srinivas *et al*, (2001) [14], Ashok Kumar *et al.*, (2009) [4], Kumar *et al.* (2012) [12], Pawar and Dingre (2013) [11], and Gonge *et al.* (2015) [6].

Table 1: Effect of different levels of fertigation on height of plant (cm) of banana Cv. Grand Naine at different months after planting

Tr. No.	Treatment details	Height of plant			
		3 MAP	5 MAP	7 MAP	At shooting stage
T_1	50% RDF through fertigation	80.45	123.47.	155.15	183.32
T_2	60% RDF through fertigation	84.30	125.88	158.04	184.50
T_3	70% RDF through fertigation	86.39	128.04	161.14	185.50
T_4	80% RDF through fertigation	92.68	132.78	165.27	203.00
T_5	90% RDF through fertigation	95.78	135.44	170.25	207.00
T_6	100% RDF through fertigation	102.20	140.15	172.04	212.63
T_7	100% RDF through soil application (control)	75.77	119.00	148.19	180.36
	S.E. m±	3.67	4.11	3.95	4.34
	CD at 5%	11.33	12.68	12.18	13.38

Table 2: Effect of different levels of fertigation on girth of stem (cm) of banana Cv. Grand Naine at different months after planting.

Tr. No.	Treatment details	Girth of stem			
		3 MAP	5 MAP	7 MAP	At shooting stage
T_1	50% RDF through fertigation	26.06	40.76	54.56	63.52
T_2	60% RDF through fertigation	26.46	42.66	55.26	63.92
T_3	70% RDF through fertigation	27.26	43.66	56.09	64.54
T_4	80% RDF through fertigation	28.13	46.20	58.52	67.79
T_5	90% RDF through fertigation	29.86	47.40	61.48	68.77
T_6	100% RDF through fertigation	32.16	51.70	64.44	70.77
T_7	100% RDF through soil application (control)	23.56	39.86	53.56	61.51
	S.E. m±	1.34	1.73	2.19	1.89
	CD at 5%	4.13	5.35	6.75	5.84

Table 3: Effect of different levels of fertigation on number of leaves per plant of banana Cv. Grand Naine at different months after planting.

Tr. No.	Treatment details	Number of leaves per plant			
		3 MAP	5 MAP	7 MAP	At shooting stage
T_1	50% RDF through fertigation	11.06	13.06	14.60	15.00
T_2	60% RDF through fertigation	11.66	14.00	15.00	15.35
T_3	70% RDF through fertigation	11.76	14.23	15.03	15.97
T_4	80% RDF through fertigation	13.06	14.56	15.43	16.36
T_5	90% RDF through fertigation	13.16	14.60	15.60	16.50
T_6	100% RDF through fertigation	13.60	15.66	17.18	16.91
T_7	100% RDF through soil application (control)	10.30	12.20	13.96	14.40
	S.E. m±	0.49	0.61	0.55	0.48
	CD at 5%	1.53	1.90	1.70	1.48

Table 4: Effect of different levels of fertigation on leaf area (m^2) of banana Cv. Grand Naine at different months after planting.

Tr. No.	Treatment details	Leaf area (m^2)			
		3 Months after planting	5 Months after planting	7 Months after planting	At shooting stage
T_1	50% RDF through fertigation	6.76	10.00	12.55	13.33
T_2	60% RDF through fertigation	7.18	10.30	13.27	14.91
T_3	70% RDF through fertigation	7.24	10.81	13.50	14.95
T_4	80% RDF through fertigation	7.80	11.16	13.64	15.60
T_5	90% RDF through fertigation	8.00	11.52	13.68	15.91
T_6	100% RDF through fertigation	8.10	11.63	14.00	15.95
T_7	100% RDF through soil application (control)	6.69	9.12	11.93	12.75
	S.E. m±	0.33	0.18	0.46	0.46
	CD at 5%	1.01	0.57	1.43	1.44

Table 5: Effect of different levels of fertigation on maturity attributes of banana Cv. Grand Naine.

Tr. No.	Treatment details	Days required for flowering after planting	Days required for harvest after flowering	Total crop duration
T_1	50% RDF through fertigation	223.50	118.00	341.50
T_2	60% RDF through fertigation	222.50	117.50	340.00
T_3	70% RDF through fertigation	222.30	117.30	339.60
T_4	80% RDF through fertigation	221.85	116.85	338.70
T_5	90% RDF through fertigation	221.50	116.50	338.00
T_6	100% RDF through fertigation	220.60	115.60	336.20
T_7	100% RDF through soil application (control)	234.50	124.00	358.50
	S.E. m±	2.71	1.56	2.49
	CD at 5%	8.35	4.82	7.67

Conclusions

The present results have clearly indicated that the application of 100% RDF through fertigation significantly superior for the growth attributes as well as shows the earliness in flowering, harvesting and total crop duration of banana cv. Grand Naine.

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