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Effect of Organic Manure and Bio-Fertilizer on Growth and Quality of Banana (*Musa paradisiaca*) cv- Grand Naine

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ABSTRACT

The present experiment carried out during (2015-2016) and (2016-2017) in the Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj. The experiment was conducted in Randomized Block Design (RBD) with 16 Treatments and 3 Replications they are as follows : T1 100 RND, T2 100 RND+15 kg FYM per plant, T3 100 RDN +15 kg FYM+Azosprillum 100g per plant, T4 100 RDN+ 8 kg Vermicompost, T5 100 RDN+8kg Vermicompost +100g Azotobacter, T6 100 RDN+15kg FYM + 8kg Vermicompost + 100g Azotobacter, 7 75 RDN+20 kg FYM/ per plant, T8 75 RDN + 20kg FYM+100g Azosprillum+100 g Azotobacter, 9 75RDN 10kg + Vermicompost, T10 75 RDN+10 kg Vermicompost +100g PSB+100g Azotobacter, 11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter, T12 50RDN+25kg FYM, T13 50RDN+25kg FYM+50g Azosprillum +100g PSB+100g Azotobacter, T14 50RDN+8kg Vermicompost, T15 50RDN+8 kg Vermicompost +100g PSB+100g Azotobacter+50 Azosprillum T16 50RDN+20 kg FYM+8kg Vermicompost +50 Azosprillum+100gPSB+100g Azotobacter. On the basis of result it is observed that the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter was found the best treatment combination in terms of growth, yield and quality parameters of Banana cv Grand Naine.

Keywords Organic manure, Azotobacter, PSB, azosprillum , Growth and quality.

INTRODUCTION

Banana (*Musa* sp.) is the second most important fruit crop in India next to mango. Its year round availability, affordability, varietal range, taste, nutritive and medicinal value makes it the favourite fruit among all classes of people. It has also good export potential. (NHB) Banana is one of the oldest and most popular fruit. Banana otherwise called 'Apple of Paradise'. The Indo-Malayan region is believed to be the place

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of origin. It is widely used as a fresh fruit. The central core of the pseudostem is used as a vegetable. The banana pseudostem is also used for manufacturing paper and boards.(Expert System of Banana, TNAU Agritech Portal). India ranks first in terms of area and production, growing in about 4,90,700 ha with an annual production of 168,13,500 mt, sharing about 17% of global production. Among the various states in India, Tamil Nadu, Karnataka and Maharashtra account for major share in area and production (NHB).

Banana is a rich source of carbohydrate and is rich in vitamins particularly vitamin B. It is also a good source of potassium, phosphorus, calcium and magnesium. The fruit is easy to digest, free from fat and cholesterol. Banana powder is used as the first baby food. It helps in reducing risk of heart diseases when used regularly and is recommended for patients suffering from high blood pressure, arthritis, ulcer, gastroenteritis and kidney disorders (NHB). Banana evolved in the humid tropical regions of SE. Asia with India as one of its centers of origin. Modern edible varieties have evolved from the two species – *Musa acuminata* and *Musa balbisiana* and their natural hybrids, originally found in the rain forests of SE. Asia. During the seventh century AD its cultivation spread to Egypt and Africa. At present banana is being cultivated throughout the warm tropical regions of the world between 30^0 N and 30^0 S of the equator

Use of bio fertilizers for crop production is gaining momentum, as they are environmentally safe when compared to chemical fertilizers. The availability and uptake of inorganic nutrients like nitrogen, phosphorus and potassium by plant influenced by micro-organisms that are involved in the uptake of essential plant nutrients Kumar *et al.* (2013). Bio fertilizers are inputs containing micro-organism which is capable of fix atmospheric nitrogen and mobilizing nutritive elements from non usable form to usable form through biological process (Tien *et al.* 1979).

Banana appears to have the maximum capability to recover by proper application of fertilizers. Some workers have reported favorable response of banana and other fruit crops to micronutrients application (Ghanta and Mitra 1993, Das and Mohan, 1993). Keeping above facts in mind, a field trial was conducted to study the (i) effect of various fertilizer doses with vermicomposting and (ii) recommended dose of fertilizer (RDF) with micronutrients on growth, crop duration and yield of Banana cv Grand Naine which is grown commercially.

MATERIALS AND METHODS

The present investigation entitled was laid out on the experiment site of Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad during the year 2015-2016 and 2016-2017. The details of the experimental site and treatment details i.e., mentioned in Table 1, followed during the course of the investigation are mentioned below.

Experimental site

Allahabad is approximately 98 meters above the mean sea level and is situated at 25.78 ºN latitude and 81.5 ºE longitudes in the southern part of Uttar Pradesh with both extremes of temperature of less than 5ºC during December – January and 45ºC in summer.

Table 1. Treatment details.

Treatments symbols	Treatments
T1	100 RND
T2	100 RND+15kg FYM per plant
T3	100 RDN +15kg FYM+Azosprillum 100g per plant
T4	100 RDN+ 8 kg Vermicompost
T5	100 RDN+8kg Vermicompost +100g Azotobacter
T6	100 RDN+15kg FYM + 8kg Vermicompost + 100g Azotobacter
T7	75 RDN+20 kg FYM/ per plant
T8	75 RDN + 20kg FYM+100g Azosprillum+100 g Azotobacter
T9	75 RDN 10kg + Vermicompost
T10	75 RDN+10kg Vermicompost +100g PSB+100g Azotobacter
T11	75 RDN+20kg FYM+10kg Vermicompost +100g PSB +100gAzotobacter
T12	50 RDN+25kg FYM
T13	50 RDN+25kg FYM+50g Azosprillum +100g PSB + 100g Azotobacter
T14	50 RDN+8kg Vermicompost
T15	50 RDN+8kg Vermicompost +100g PSB+100g Azotobacter+50 Azosprillum
T16	50 RDN+20kg FYM+8kg Vermicompost +50 Azosprillum+100g PSB+100g Azotobacter

The city receives an annual rainfall of 1014 mm with maximum downpour during July –September.

RESULTS AND DISCUSSION

Growth parameters

Plant height (in cm)

From the given result in Table 2. It is observed that at 240 days after transplanting the treatment T11 75 RDN+20 kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter recorded maximum plant height (201.65 cm) followed by the treatment T15 (197.75 cm) and T10 (197.51 cm), which were at par with other treatments, while the minimum plant height (159.54 cm) was reported in the treatment T1(100 % RND) during first year (2015-16). During second year (2016-17), the treatment T11 75 RDN+20kg FYM+10 kg Vermicompost +100 g PSB+100g Azotobacter obtained maximum plant height (205.60 cm) followed by T10 (200.11) and T12 (198.43 cm) and the least plant height (161.00 cm) was recorded in the treatment T1 (100 % RDN). Pooled analyzed data revealed that, treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter obtained maximum plant height (203.63 cm) and was on par with each other. Whereas, T1 (100 % RDN) revealed minimum plant height 160.27 cm). Similar report has been given by Athani *et al.* (2009), Bhutani *et al.* (2012).

No. of leaves

From the given result in Table 2. It is observed that at 240 days after transplanting the maximum no of leaves (32.67) was recorded in treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter followed by T2 (31.23) and T10 (30.60). The minimum number of leaves was recorded in T1 (22.98) during first year. In second year, experiment, the treatment T11 75 RDN+20 kg FYM+10 kg Vermicompost +100g PSB+100g Azotobacter found to be superior in term of no of leaves (34.69) followed by T2 (32.37) and T10 (31.79). The minimum number of leaves (24.190 observed under T1 (100 % RDN). The computed value for pooled data showed differences among the treatments. The treatment T11 75 RDN+20 kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter reported the maximum leaves (33.68) followed by T2 (32.37), while lowest leaves (23.58) were observed in T1 (100 % RDN). Similar report has been given by Athani *et al.* (2009), Bhutani *et al.* (2012).

Table 2. Effect of organic manure and bio-fertilizer on growth parameters of banana (*Musa paradisiaca)* cv- Grand Naine.

Treatment	Plant height (cm)		No. of leaves		Plant girth (cm)		Shooting stage	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T1	159.54	161.00	22.98	24.19	39.33	40.31	327.46	322.91
T2	166.39	168.06	31.23	32.37	40.17	41.14	321.00	316.85
T3	173.86	175.66	29.57	30.40	40.93	40.87	326.34	321.71
T4	175.78	177.21	28.43	29.38	42.26	43.75	292.59	288.04
T5	181.60	182.76	30.17	31.35	41.00	43.47	295.21	290.69
T6	191.24	193.40	29.37	30.19	42.38	42.23	296.51	291.36
T7	175.38	177.58	28.53	29.44	48.28	49.23	318.82	313.60
T8	179.00	180.41	29.72	30.87	49.78	50.80	315.27	310.27
T9	170.67	172.17	29.28	30.51	48.88	49.90	316.54	308.89
T10	197.51	200.11	30.60	31.79	56.17	57.94	290.81	282.18
T11	201.65	205.60	32.67	34.69	58.96	59.54	284.18	273.93
T12	191.13	198.43	29.37	30.39	44.58	45.34	311.19	304.67
T13	196.26	197.71	28.60	29.54	41.79	43.41	305.27	300.91
T14	166.16	167.84	28.93	30.18	41.66	42.87	295.88	291.23
T15	197.75	199.61	28.72	29.44	43.56	44.43	291.20	286.65
T16	195.53	196.49	28.55	29.84	43.13	44.14	291.45	286.79
F-test	S	S	S	S	S	S	S	S
CD at 0.5%	2.665	1.783	2.409	0.855	0.428	1.130	25.173	26.670
SEd (±)	1.305	0.873	1.179	0.419	0.210	0.553	12.326	13.059

Plant girth

From the given result in Table 2. It is observed that the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter recorded significantly maximum plant girth (58.96 and 59.54 cm) at 240 days after transplanting followed by T10 (56.17 and 57.94 cm) and T8 (49.78 and 50.80 cm) during both the trail year (2015-16 and 2016-17) and the treatment T1 (100 % RDN) showed minimum plant girth (39.33 and 40.31 cm) during both the trail year. Pooled analysis data showed that Treatment T11 recorded more plant girth (59.25 cm) in banana cv Grand Naine which were at par with each other. whereas less plant girth (39.82 cm) was recorded in T1 (100 % RDN) which was significantly minimum over all other treatments. Similar report also given by Suhasini *et al*. (2018).

Shooting stage

From the given data in the Table 2. It is found that T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB +100g Azotobacter take minimum days (284.18 and 273.93 days) for shooting followed by T10 (290.81 and 282.18 days), T15 (291.20 and 286.65 days) and T16 (291.45 and 286.79 days) during both the trial years. It is clear from the results that T1 (100 % RDN) takes maximum days (327.46 and 322.91 days) for shooting during both the trial years. Pooled analysis data exhibited that among the different treatments, the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100 g PSB+100 g Azotobacter registered the minimum days (279.05 days) for shooting stage followed by the treatment T10 (286 days) and the treatment T1 (100 % RDN) recorded maximum days (325.19 days) for shooting. Similar report has been given by Gaikwad *et al*. (2010).

Quality parameters

TSS (Brix^{o})

The total Soluable Solid of banana showed significant variation among different treatment. From the results presented in Table 3. It is clear that the total soluble solids contentof fruits in banana cultivar Grand Naine under the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter was found to be increased (16.69 and 16.75 oB) during first and second year of trial followed by T13 (15.96 and 16.01 ^{o}B), T16 (15.85 and 15.88 ^{o}B) and T10 (15.58 and 15.63 ^{o}B). It was interesting to note that the treatment T1 (100 % RDN) found to be showed lowest total soluble solids content (12.30 and 12.33 0 OB) during first and second year of experiment.

In pooled analyzed data, the total soluble solids content of treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter was found to be highest (16.72 ^{o}Brix), while the minimum TSS content (12.32 oB) was recorded in T1 (100 % RDN).

Acidity

From the results presented in Table 3. Among the different treatments, the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100gAzotobacter registered the lowest acidity percentage (0.17 %) followed by T10 (0.19 %) and T15 (0.20 %) which was not showed significant variation. The highest acidity percentage (0.35 %) was recorded in the treatments T1 (100 % RDN) during first year. In second year, among the different treatments, the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100gPSB+100gAzotobacter recorded the lowest acidity percentage (0.19 %) followed by T10 (0.21 %) and T15 (0.22 %) and the highest acidity percentage (0.36 %) was recorded in the treatment T1 (100 % RDN).

Pooled analysis data revealed that among the different treatments, the treatment T11 (0.18 %) registered the lowest acidity percentage and the highest acidity percentage (0.36 %) was recorded in the treatment T1 (100 % RDN).

Reducing sugar

From the results presented in Table 3. Among the different treatments, the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter registered the highest reducing sugar (11.41 %) followed by the treatment T13 (11.26 %) and was on par with the treatments T10 (10.88 %), T4 (10.64 %), T7 (10.59 %) and T8 (10.36 %), and the lowest

Table 3. Effect of organic manure and Bio-fertilizer on quality parameters of banana (*Musa paradisiaca*) cv Grand Naine.

Treatment	TSS (%)		Acidity (%)		Reducing sugar (%)		Non reducing sugar (%)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T1	12.30	12.33	0.35	0.36	8.45	8.70	3.28	3.46
T2	14.49	14.52	0.26	0.29	9.44	9.68	3.45	3.62
T3	13.74	13.78	0.30	0.33	10.35	10.68	3.71	3.84
T4	14.61	14.63	0.26	0.28	10.64	10.96	3.51	3.66
T5	14.04	14.06	0.26	0.28	10.52	10.85	3.45	3.65
T6	15.52	15.55	0.32	0.34	9.54	9.76	3.64	3.80
T7	14.64	14.67	0.25	0.27	10.59	10.77	3.85	4.07
T8	13.66	13.69	0.21	0.23	10.36	10.61	3.45	3.66
T9	13.34	13.36	0.22	0.23	9.69	10.01	3.64	3.79
T10	15.58	15.63	0.19	0.21	10.88	11.05	4.18	4.36
T11	16.69	16.75	0.17	0.19	11.41	11.60	4.37	4.48
T12	15.31	15.36	0.26	0.28	11.15	11.36	3.79	4.11
T13	15.96	16.01	0.21	0.24	11.26	11.54	3.77	4.10
T14	15.40	15.42	0.25	0.27	10.14	10.37	3.48	3.63
T15	15.19	15.22	0.20	0.22	10.28	10.55	3.73	3.88
T16	15.85	15.88	0.25	0.27	10.35	10.57	3.49	3.60
F-test	S	S	S	S	S	S	S	S
CD at 0.5%	0.402	0.410	0.055	0.093	0.280	0.567	0.257	0.300
SEd (±)	0.197	0.201	0.027	0.045	0.137	0.277	0.126	0.147

reducing sugar content (8.45 %) was recorded in the treatment T1 (100 % RDN) and was on par with the treatments T2 and T9 during first year. In second year, among the different treatments, the treatment T11 (75RDN+20kgFYM+10kg VAM+100g PSB + 100g Azotobacter) recorded the highest reducing sugar content (11.60 %) followed by the treatments T13 (11.54 %), T12 (11.36 %) and T10 (11.05 %) and showed non significant variation except T1 the lowest reducing sugar content (8.70 %) was registered in the treatment T1. Pooled analysis data exhibited that among the different treatments, the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100gPSB+100gAzotobacter reported the highest reducing sugar content (11.50 %) and the lowest reducing sugar content (8.57 %) was registered in the treatment T1 which were significantly greater over control but did not significant when compare with each other. Similar report has been given by Vanilarasu *et al.* (2019).

Non-reducing sugar

From the results presented in Table 3. Among the different treatments, the treatment T11 (75 RDN+20kg FYM+10kg Vermicompost +100gPSB+100gAzotobacter the highest non-reducing sugar (4.37 %) followed by the treatment T10 (4.18 %) and was on par with the each other treatment except T10. The lowest non-reducing sugar content (3.28 %) was recorded in the treatment T1 (100 % RDN) during first year. In second year, among the different treatments, the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100 g PSB+100 g Azotobacter recorded the highest non-reducing sugar content (4.48 %) followed by the treatments T10 (4.36 %), T12 (4.11 %) and T13 (4.10 %) and was on par with other treatment except T10. The lowest non-reducing sugar content (3.46 %) was registered in the treatment T1. Pooled analysis data exhibited that among the different treatments, the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100 g Azotobacter reported the highest non-reducing sugar content (4.43 %) and the lowest reducing sugar content (3.37 %) was registered in the treatment T1(100 % RDN) which were significantly greater over control but did not significant when compare with each other. Similar report has been given by Vanilarasu *et al.* (2019).

CONCLUSION

On the basis of present investigation conducted during the year 2015-16 and 2016-17, it is concluded that

the treatment T11 75 RDN+20kg FYM+10 kg Vermicompost +100 g PSB+100 g Azotobacter was found the best treatment combination in terms of growth and quality parameters of Banana cv Grand Naine.

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