Environment and Ecology 40 (2C) : 827—832, April—June 2022
ISSN 0970-0420

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

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Received 28 April 2022, Accepted 21 May 2022, Published on 23 June 2022

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+15kg FYM per plant, T3 100 RDN +15 kg FYM+Azosprillum 100g per plant, T4 100 RDN+ 8 kg Vermicompost, T5 100 RDN+8 kg Vermicompost +100g Azotobacter, T6 100 RDN+15kg FYM + 8kg Vermicompost + 100g Azotobacter, T7 75 RDN+20 kg FYM/ per plant, T8 75 RDN + 20 kg 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+100g Azotobacter, T12 50 RDN+25 kg FYM, T13 50 RDN+25kg FYM+50 g Azosprillum +100g PSB+100g Azotobacter, T14 50 RDN+8 kg Vermicompost, T15 50 RDN+8 kg Vermicompost +100g PSB+100g Azotobacter+50 Azosprillum, T16 50 RDN+20 kg FYM+8 kg Vermicompost +50 Azosprillum+100g PSB+100g Azotobacter. On the basis of result it is observed that the treatment T11 75 RDN+20kg FYM+10 kg Vermicompost +100g PSB+100g Azotobacter was found the best treatment combination in terms of yield and economics parameters of banana cv Grand Naine.

Keywords Fym, Vermicompost, Biofertilizer, economics, Yield .

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 favorite 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 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

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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 300 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 and Maiti (2013). Bio fertilizers are inputs containing microorganism 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 nain which is grown commercially

MATERIALS AND METHODS

The present investigation was laid out on the experiment of 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 treatments i.e. mentioned under Table 1, followed during the course of the investigation are mentioned below

Experimental site

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

Table 1. Treatment details.

Treatments symbols	Treatments
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+8 kg Vermicompost +100g Azotobacter
T6	100 RDN+15 kg FYM + 8kg Vermicompost + 100g Azotobacter
T7	75 RDN+20 kg FYM/ per plant
T8	75 RDN + 20 kg FYM+100 g Azosprillum+100 g Azototobacter
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 PS B+100g Azotobacter
T14	50 RDN+8kg Vermicompost
T15	50 RDN+8kg Vermicompost +100g PSB+100g Azotobacter+50 Azosprillum
T16	50 RDN+20kg FYM+8 kg Vermicompost +50 Azosprillum+100g PSB+100g Azotobacter

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

Treatment	Bunch weight (g)		No. of hands/ Bunch		No. of fingers/ Hand		No. of fingers/ Bunch	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T1	10.76	12.01	6.04	7.03	11.35	12.43	68.71	87.53
T2	13.55	14.88	8.74	9.62	12.62	13.77	110.28	132.45
T3	12.51	13.65	9.32	10.07	13.66	14.76	127.28	148.60
T4	14.63	16.15	8.50	9.16	15.76	16.88	134.01	154.68
T5	13.44	15.09	8.39	9.14	15.49	16.59	130.09	151.77
T6	16.37	17.52	9.38	10.01	17.79	18.84	166.94	188.67
T7	15.80	16.98	7.60	8.05	16.46	17.57	125.04	141.38
T8	14.82	16.07	9.34	9.89	16.78	17.87	156.78	176.80
T9	16.70	18.32	8.45	9.10	14.69	15.80	124.16	143.81
T10	18.51	19.95	10.79	11.45	16.17	17.22	174.48	197.17
T11	19.59	21.11	11.65	12.53	17.48	18.62	203.67	233.33
T12	17.53	19.18	8.59	8.74	15.39	16.51	132.29	144.38
T13	16.49	17.82	9.38	9.60	17.05	18.06	160.02	173.47
T14	16.36	17.61	9.51	10.06	14.13	15.21	134.44	153.08
T15	15.80	16.94	10.30	10.96	15.24	16.34	157.04	179.15
T16	14.70	15.92	8.69	9.14	12.58	13.59	109.25	124.13
F-test	S	S	S	S	S	S	S	S
CD at 0.5%	0.432	0.898	0.450	0.574	0.690	0.827	10.573	11.298
SEd. (±)	0.211	0.440	0.220	0.281	0.338	0.405	5.177	5.532

RESULTS AND DISCUSSION

Yield parameters

Bunch weight

Significant differences were registered among the different treatments in respect to bunch weight per plant in banana cv Grand Naine.

From the result presented in Table 2. It is observed among the different treatments the treatment T11 75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter recorded the highest bunch weight (19.59 and 21.11 kg) followed by the treatment T10 (18.51 and 19.95 kg) during both the crop cycle and the lowest bunch weight (10.76 kg and 12.01 kg) was registered in the treatment T1(100 RND) and was on par with each treatments during both the trail year. Pooled analysis data indicated that among the different treatments, the treatment T11 (75 RDN+20 kg FYM+10 kg Vermicompost +100 g PSB+100g Azotobacter) registered the highest bunch weight (20.35 kg) and was on par with each other and the lowest bunch weight (11.39 kg) was registered in the treatment T1 and was on par with the each treatment. Similar report has been given by Athani *et al.* (2009), Bhutani *et al*. (2012).

Number of hands per bunch

From the result presented in Table 2. It is observed among the different treatments, the treatment T11 (75 RDN+20kg FYM+10 kg Vermicompost +100g PSB+100g Azotobacter) registered the highest number of hands per bunch (11.65 hands) followed by T10 (10.79 hands), T15 (10.31hands) and was on par with each other and T1 (100% RDN) recorded lowest number of hands per bunch (6.04 hands). During second trail year, among the different treatments, T11 (75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter) registered the highest number of hands per bunch (12.53 hands) followed by T10 (10.79 hands), T15 (10.96 hands) and was on par with each other and T1 (100% RDN) recorded lowest number of hands per bunch (7.03 hands). Pooled analysis data indicated that the treatment T11 (75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter) recorded the highest number of hands per bunch (12.09 hands) and which was at par with amons the treatments and the lowest number of hands per bunch (6.53 hands) was recorded in the treatment T1 (100% RDN). Similar report has been given by Athani *et al.* (2009), Bhutani *et al.* (2012).

Number of fingers per hand

From the result presented in Table 2. It is observed among the different treatments, the treatment T6 (100 RDN+15kg FYM + 8kg Vermicompost + 100g Azotobacter) observed the highest number of fingers per hand (17.79 and 18.84 fingers) during both the trail year followed by the treatment T11 (17.48 and 18.62 fingers), T13 (17.05 and 18.06 fingers) and T8 (16.78 and 17.87 fingers) which was at par with each treatment. The lowest number of fingers per hand (11.35 fingers) was registered in the treatments T1 (100% RDN) during first year and the treatment T1 (12.43 fingers) registered the lowest number of fingers per hand in second year. Similar report has been given by Gaikwad *et al*.(2010).

Number of fingers per bunch

From the result presented in Table 2. It is observed among the different treatments, the treatment T11 (75 RDN+20kg FYM+10kg Vermicompost +100gPSB+100gAzotobacter) observed the highest number of fingers per bunch (203.67 and 233.33 fingers) during both the trail year followed by the treatment T10 (174.48 and 197.17 fingers) and T6 (166.94 and 188.67 fingers) and the lowest number of fingers per bunch (68.71 and 87.53 fingers) was registered in the treatments T1 (100% RDN) during first year and second year. Pooled analysis data indicated that the treatment (75 RDN+20 kg FYM+10 kg Vermicompost +100gPSB+100gAzotobacter) recorded the highest number of fingers per bunch (218.50 fingers) followed by the treatments T10 (185.83 fingers) and T6 (177.80 fingers) and the lowest number of fingers per hand (78.12 fingers) was found in the treatment T1 (100 % RDN). Similar report also given by Suhasini *et al.* (2018).

Finger weight

Data pertaining to fruit weight (g) are presented in Table no.3. Significant differences among the treatments were recorded in both years trail.

From the results presented in Table 3, it is evident that the fruit weight of banana cultivar Grand Naine under the treatment T11 (75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter) was found to be maximum (134.82 and 135.55 g) during both the research year followed by T12 (132.96 and 133.41 g), T10 (131.27 and 132.25 g) T8 (123 and 123.88 g), whereas T1 (100 %RDN) recorded minimum fruit weight (99.68 and 99.56 g) during first and second year. Similar report has been given by

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

Treatment	Finger/Fruit weight (g)		Fruit yield/plant (kg)		Fruit yield/ha (q)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T1	98.68	99.56	6.78	8.71	20.91	26.88
T2	106.51	107.46	11.75	14.23	36.25	43.92
T3	110.44	111.19	14.06	16.52	43.38	50.99
T4	112.48	113.14	15.07	17.50	46.51	54.00
T5	108.85	109.30	14.16	16.59	43.70	51.20
T6	110.20	110.64	18.40	20.87	56.77	64.42
T7	117.92	118.58	14.74	16.76	45.50	51.73
T8	123.00	123.88	19.28	21.90	59.51	67.59
T9	121.16	122.04	15.04	17.55	46.42	54.16
T10	131.27	132.25	22.90	26.07	70.68	80.47
T11	134.82	135.55	27.46	31.63	84.73	97.60
T12	132.96	133.41	17.59	19.26	54.28	59.44
T13	120.87	121.32	19.35	21.05	59.70	64.96
T14	117.64	118.08	15.81	18.07	48.80	55.78
T15	120.99	121.62	19.00	21.78	58.62	67.22
T16	129.10	129.76	14.10	16.11	43.52	49.70
F-test	S	S	S	S	S	S
CD at 0.5%	1.452	1.496	1.278	1.708	3.943	4.219
SEd (±)	0.711	0.732	0.626	0.837	1.931	2.066

Vanilarasu *et al.* (2019).

Fruit yield (kg/plant)

The data on yield per plant (kg) influenced by organic manure and bio-fertilizer were recorded and presented in Table 3. Yield per plant (kg) varied significantly due to the effect of different treatments. During first year , the maximum 'yield per plant' (27.46 kg) was recorded in treatment T11 (75 RDN+20kg FYM+10 kg Vermicompost +100g PSB+100g Azotobacter) followed by T10 (22.90 kg) and T13 (19.35 kg), which were on par with each other. The minimum 'yield per plant' was recorded in T1 (6.78 kg). In second year experiment , the treatment T11 (75 RDN+20 kg FYM+10kg Vermicompost +100g PSB+100g Azotobacter) found to be superior in term of yield per plant (31.63 kg) followed by T10 (26.07 kg) and T8 (21.90 kg) which was significantly superior over rest of the treatments. The minimum yield per plant was recorded in T1 (8.71 kg).

Fruit yield (t ha^{-1})

The data on yield (t ha^{-1}) influenced by organic manure and bio-fertilizer were recorded and presented in Table 3. Yield (t ha^{-1}) varied significantly due to the effect of different treatments.

During first year, the maximum yield in t ha^{-1} (84.73 t) was recorded in treatment T11 (75 RDN+20kg FYM+10kg Vermicompost +100gPS-B+100gAzotobacter) followed by T10 (70.68 t) and T13 (59.70), which were on par with each other. The minimum yield (t ha^{-1}) was recorded in T1 (20.91 t).

In second year experiment, the treatment T11 (75 RDN+20kg FYM+10kg Vermicompost +100gPS-B+100gAzotobacter) found to be superior in term of yield-t ha^{-1} (97.60 t) followed by T10 (80.47 t) and T8 (67.59 t) which was significantly superior over rest of the treatments. The minimum yield was recorded in T1 (26.88 t.).

Economic parameters

The data of economic parameters influenced by organic manure and bio-fertilizer were recorded in Table 4. The maximum yield t ha^{-1} (91.17) was found to be in T11 (75 RDN+20kg FYM+10kg Vermicompost +100g PSB+100 g Azotobacter). Similarly, maximum gross return rs/ha get in T11 is (1823400). Total expenditure spend was 424015 rs/ ha and the benefit cost ratio obtained was 4.30032 .

Table 4. Effect of organic manure and bio-fertilizer on economic parameters of banana (*Musa paradisiaca*) cv- Grand Naine.

Tr. No.	Yield (t/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Expdt. on the treatment (Rs/ha)	Total expenditure (Rs/ha^{-1})	Net income (Rs/ha^{-1})	B:C ratio
T1	23.89	477800	86140	6500	92640	385160	5.157599
T2	40.09	801800	86140	51500	137640	664160	5.825341
T3	47.18	943600	86140	186500	272640	670960	3.460974
T4	50.26	1005200	86140	78500	164640	840560	6.105442
T5	47.45	949000	86140	213500	299640	649360	3.167134
T6	60.59	1211800	86140	258500	344640	867160	3.516133
T7	48.62	972400	86140	64875	151015	821385	6.439095
T8	63.55	1271000	86140	334875	421015	849985	3.018895
T9	50.29	1005800	86140	94875	181015	824785	5.556446
T10	75.57	1511400	86140	277875	364015	1147385	4.152027
T11	91.17	1823400	86140	337875	424015	1399385	4.30032
T12	56.86	1137200	86140	78250	164390	972810	6.917696
T13	62.33	1246600	86140	328750	414890	831710	3.004652
T14	52.29	1045800	86140	75250	161390	884410	6.479955
T15	62.92	1258400	86140	325750	411890	846510	3.055185
T16	46.61	932200	86140	385750	471890	460310	1.97546

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+10kg Vermicompost +100gPSB+100g Azotobacter was found the best treatment combination in terms of yield and economics parameters of banana cv Grand Naine.

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