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Effect of Different Organic Manures on Growth, Yield, Nutrient Uptake and Soil Properties of Banana cv Grand Nain

Key words : Banana,Organic Manure, Organic Farming, Soil Health

Organic farming is being practiced in 140 countries of the world. The ill effect of chemicals used in agriculture have changed the mindset of consumers of different countries who are now buying organic with high premium for health.

Banana being an exhaustive crop require higher amount of nutrients to obtain the good yield. It is estimated that expenditure for manures and fertilizers accounts 20 to 30 per cent of the total cost of crop production. Due to the escalating cost of fertilizers and their hazardous effects on environment, the awareness has been increased in the farming community for the alternate agriculture system known as biological farming or organic farming. Hence, the study was planned to see the effect of different organic manures on growth, yield and quality of banana cv. Grand Nain under South Gujarat condition.

The field experiment was conducted at Organic Farm, Navsari Agricultural University, Navsari during *kharif* season of 2005-06 with a popular variety of banana in Gujarat, namely "Grand Nain". The experiment, laid down with sixteen treatments comprising the different organic manures and inorganic fertilizers was replicated thrice in randomized block design. The treatments *viz.,* T_1: Vermi compost (6 kg plant^{-1}), T_2: Neem cake (6 kg plant^{-1}), T_3: Poultry manure (15 kg plant^{-1}), T_4: Castor cake (6 kg plant^{-1}), T_5: Vermi compost (3 kg plant^{-1}) + Neem cake (3 kg plant^{-1}) , T_6: Vermi compost (3 kg plant^{-1}) + Poultry manure (7.5 kg plant^{-1}), T_7: Vermi compost (3 kg plant^{-1}) + Castor cake (3 kg plant^{-1}), T_8: Neem cake (3 kg plant^{-1}) + Poultry manure (7.5 kg plant^{-1}), T_9: Neem cake (3 kg plant^{-1}) + Castor cake (3 kg plant^{-1}), T_{10} :Poultry manure (7.5 kg plant^{-1}) + Castor cake (3 kg plant^{-1}), T_{11}:Vermi compost (2 kg plant^{-1}) + Neem cake (2 kg plant-1) + Poultry manure (5 kg plant^{-1}), T_{12}: Vermi compost (2 kg plant^{-1}) + Neem cake (2 kg plant^{-1}) + Castor cake (2 kg plant^{-1}), T_{13}:Vermi compost (2 kg plant^{-1}) + Poultry manure (5 kg plant^{-1}) + Castor cake (2 kg plant^{-1}), T_{14}: Neem cake (2 kg plant^{-1}) + Poultry manure (5 kg plant^{-1}) + Castor cake (2 kg plant^{-1}), T_{15}: Vermi compost (1.5 kg plant^{-1}) + Neem cake (1.5 kg plant^{-1}) Poultry manure (3.75 kg plant^{-1}) + Castor cake (1.5 kg plant^{-1}), T_{16}: 100 % Recommended Dose of Fertilizers (200g N :90g P_2O_5 :200g K_2O). The soil of the experimental site was clay in texture, medium in available N (268 kg ha^{-1}), medium in available P_2O_5 (41 kg ha^{-1}) and high in available K_2O (354 kg ha-$^{-1}$) and medium to high in cationic micronutrients. All the organics and chemical fertilizers (nitrogen, phosphorus and potassium) were applied in the shallow ring made around the plant according to the root zone of the plant and immediately covered by the soil subsequently irrigation was given.

At harvest, yield data of crop was recorded and soil and plant samples were collected and analysed for different parameters by standard procedure (Jackson 1967).

Growth parameters:

The data presented in Table 2 indicated that the plant height and plant girth did not show any variation due to different treatments at harvest. However, the total leaf area (24.81 cm2) was significantly altered at flowering time due to application of 100 per cent RDF (T_{16}), which was at par with vermi compost (3 kg plant^{-1}) + castor cake (3 kg plant^{-1}), vermi compost (2 kg plant^{-1}) + neem cake (2 kg plant^{-1}) + castor cake (2 kg plant^{-1}), vermi compost (3 kg plant^{-1}) + neem cake (3 kg plant^{-1}) and poultry manure (7.5 kg plant^{-1}) + castor cake (3 kg plant^{-1}).

Yield:

Application of 100 per cent RDF (T16) increased the banana yield as compared to different organic manure treatments Table 2. But, it was at par with T_7 and T_{12}. The probable reason for lower yield might be due to slow release of nutrient in initial stage which did not convert into vegetative phase effectively. Another reason might be due to lack of translocation of these nutrients from vegetative parts to yield contributors or short supply of nutrients. Although, it has been reported the beneficial effect of organic farming starts after certain time lapse.

Table 1. Chemical composition of different organic manures

Organic Manures	N	P	K	Fe	Mn	Zn	Cu
	%			mg/kg			
FYM	0.69	0.38	0.62	3650	310	99	22
Vermi compost	0.80	0.55	1.00	1050	96	18	12
Neem cake	2.00	0.60	1.20	955	55	49	28
Poultry manure	1.30	0.70	0.60	890	46	39	21
Castor cake	3.50	1.40	1.30	1022	42	54	30

Table 2. Effect of different treatments on growth, yield and economics of banana cv. Grand Nain

Treatments	Plant height (cm)	Plant girth (cm)	Total leaf area (cm^2)	Yield ($t\ ha^{-1}$)	Net benefit ($Rs.\ ha^{-1}$)	CBR
T_1	167.93	62.30	22.04	67.40	232258	2.22
T_2	164.60	59.93	21.55	64.02	166224	1.08
T_3	160.43	60.83	20.95	62.85	245216	3.55
T_4	166.47	61.33	21.68	65.82	200934	1.57
T_5	172.13	62.03	22.26	69.52	218291	1.69
T_6	167.33	59.10	19.75	60.00	213112	2.45
T_7	174.25	63.00	23.43	71.11	267662	3.05
T_8	164.47	58.47	18.91	58.41	180595	1.62
T_9	155.93	60.27	20.64	62.01	169029	1.20
T_{10}	171.00	61.93	22.15	68.46	243700	2.47
T_{11}	166.33	58.93	19.49	59.47	188133	1.72
T_{12}	173.27	62.77	22.59	70.37	222922	1.73
T_{13}	167.13	61.13	21.24	63.49	216802	2.15
T_{14}	164.20	60.60	21.81	65.71	211525	1.81
T_{15}	166.48	60.93	21.65	64.97	210905	1.85
T_{16}	187.24	64.30	24.81	78.10	247358	3.80
S.Em.±	**7.93**	**2.58**	**0.95**	**2.71**	**-**	**-**
C.D. at 5 %	**NS**	**NS**	**2.74**	**7.82**	**-**	**-**
C.V. %	**8.17**	**7.31**	**7.62**	**7.14**	**-**	**-**

Table 3. Effect of different treatments on nutrient content and uptake by banana leaves

Treatments	N		P		K		Fe		Mn		Zn		Cu	
	Content	Uptake	Content	Uptake	Content	Uptake	Content	Uptake	Content	Uptake	Content	Uptake	Content	Uptake
T_1	2.60	229.12	0.220	19.44	2.57	227.25	131.70	1160.85	81.60	718.32	31.60	276.66	12.93	113.40
T_2	2.52	215.80	0.211	18.08	2.22	190.30	130.60	1124.08	80.50	692.01	28.65	245.93	12.60	107.54
T_3	2.33	195.69	0.205	17.30	2.17	183.31	125.37	1053.92	75.27	632.31	25.27	211.55	11.07	93.04
T_4	2.68	224.52	0.215	18.05	2.36	197.90	126.80	1063.26	76.70	643.15	26.70	223.88	11.37	95.38
T_5	2.86	265.86	0.230	21.27	2.66	245.86	130.88	1212.08	87.13	804.39	29.57	273.78	12.87	118.86
T_6	2.09	172.04	0.202	16.62	2.08	170.75	125.37	1032.41	75.27	619.77	27.12	223.56	10.97	90.42
T_7	3.07	291.63	0.254	24.14	2.75	262.08	138.93	1324.97	90.47	862.03	29.86	290.72	13.87	131.91
T_8	2.53	206.59	0.197	16.25	1.99	162.35	123.03	1013.90	72.93	602.76	24.17	199.94	10.50	86.87
T_9	2.35	189.98	0.203	16.56	2.12	172.46	123.07	999.81	72.97	593.16	24.97	202.72	10.73	87.29
T_{10}	2.76	247.79	0.226	20.30	2.65	238.09	136.57	1225.02	86.47	775.76	32.47	284.17	13.13	117.74
T_{11}	2.55	214.85	0.200	16.95	1.99	168.93	120.00	1014.76	69.90	591.67	24.23	204.60	10.67	90.00
T_{12}	2.98	276.42	0.233	21.59	2.69	250.00	135.33	1255.05	84.83	787.40	29.34	271.72	13.03	120.55
T_{13}	2.57	214.47	0.208	17.40	2.21	184.37	127.40	1065.80	77.30	647.19	27.30	227.61	11.30	94.65
T_{14}	2.55	222.88	0.220	19.24	2.53	222.71	132.60	1158.48	82.50	720.43	30.50	266.60	12.20	106.55
T_{15}	2.62	225.46	0.214	18.37	2.26	194.24	129.93	1115.71	79.83	685.14	32.84	282.10	12.23	104.87
T_{16}	3.29	316.69	0.264	25.58	2.97	289.16	123.73	1204.42	72.09	702.12	24.58	241.23	10.30	99.14
S. Em. ±	**0.16**	**12.90**	**0.012**	**1.40**	**0.19**	**19.87**	**3.84**	**63.05**	**3.36**	**42.36**	**2.09**	**19.83**	**0.80**	**6.65**
C.D. at 5 %	**0.45**	**37.25**	**0.04**	**4.06**	**0.54**	**57.40**	**NS**	**182.09**	**9.70**	**122.34**	**NS**	**57.28**	**NS**	**19.22**
C.V. %	**10.19**	**9.63**	**9.86**	**12.64**	**13.46**	**16.39**	**5.16**	**9.69**	**7.36**	**10.60**	**12.89**	**14.00**	**11.66**	**11.12**

*Major-nutrient content (%), Micro-nutrient content (mg kg^{-1}),

*Major-nutrient uptake (kg ha^{-1}) and Micro-nutrient uptake (g ha^{-1})

Economics:

With regard to economics (Table 2), the cost of cultivation was ranging from Rs. 65,042 ha^{-1} in T_{16} to Rs. 153876 ha^{-1} in T_2. With respect to net realization, it was lower with T_2 (Rs. 166224 ha^{-1}) and that of maximum with T_7 (Rs. 267662 ha^{-1}). Looking to the CBR ratio, it was highest in T_{16} followed by T_3 and T_7.

Nutrient content, uptake and soil properties: The content of major nutrient was significantly altered due to application of different treatments (Table 3). The application of 100 per cent RDF significantly increased N (3.29 %), P (0.264 %) and K (2.97 %) in leaves as compared to other treatments. However, the content of micronutrient did not change due to any treatments. Similarly, the uptake of major- and micro-nutrient was significantly increased due to different treatments and reported the higher uptake of major- and micro-nutrient under the treatment 100 per cent RDF, however, it was at par with organic manures treatment in some of the cases.

Different organic treatments were significantly influenced the physico-chemical properties and nutrient availability in soil after harvest of banana (Table 4). The organic carbon content was maximum (0.75 %) under treatment vermi compost (3 kg $plan^{-1}$) + poultry manure (7.5 kg $plant^{-1}$), while in case of available N (311.64 kg ha^{-1}), P_2O_5 (61.49 kg ha^{-1}) and K_2O (352.68 kg ha^{-1}), it was registered higher with application of vermi compost (1.5 kg $plant^{-1}$) + neem cake (1.5 kg $plant^{-1}$) + poultry manure (3.75 kg $plant^{-1}$) + castor cake (1.5 kg $plant^{-1}$) as compared to rest of the treatments in soil after harvest of banana. However, the available Fe, Mn, Zn and Cu in soil at harvest were found maximum under the treatment T_7 than the other treatments. Simply, these could be due to increasing activities of microbes and better root growth releasing higher amount of root exudes to act as solubilizers of different inorganic salts present in the soil (Ohyma, 1989), might have reduced the fixation of nutrients (Gogoi *et al.,* 2004) and addition of nutrients through the decomposition of organic residues (Vasanthi and Kumaraswamy, 1999). The higher availability was registered by castor cake and vermicompost could be attributed to the direct addition and slow release of N, P, and K from manures (Table 1).

The physical properties *viz.,* bulk density (BD), water stable aggregates (WSA) and infiltration rate (IR) were altered significantly due to different treatments. In general, the treatments receiving organic manures recorded significantly lower bulk density and increased WSA (>1.00 mm) and IR as compared to inorganic treatment (100 % RDF). The use of organics might have significantly improved the WSA and thereby decreased bulk density and consequently increased the IR tremendously. In case of clay soil, tremendous improvement in IR seems to be of immense importance for banana crop production.

Based on the present results, it seems that profit and productivity of banana production can be under South Gujarat conditions with the application of vermi compost @ 3 kg $plant^{-1}$ + castor cake @ 3 kg $plant^{-1}$. Although, the organic treatments not only increased the net profit but at the same time it sustains the soil health and productivity.

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