

Original Research Article

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Effect of Urban Compost, Sewage Sludge and Poultry Manure with Chemical Fertilizers on Yield, Nutrient Content and Uptake in Brinjal-Cauliflower Cropping System

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ABSTRACT

An experiment was conducted during kharif 2013 and rabi 2013-14 to evaluate the best combination of organic and inorganic sources of nutrients for maximizing yield. Combined application of poultry manure 5 t ha⁻¹ and 75% recommended dose of NPK recorded higher fruit yield (33.6 t ha⁻¹) and curd yield (29.3 t ha⁻¹) followed by combined application of sewage sludge 5 t ha⁻¹ and 75% recommended dose of NPK. Experimental results revealed that the concentration and uptake of major nutrients by brinjal and cauliflower plant parts were significantly influenced by the application of organic manures along with inorganic fertilizers. In both the seasons highest values for net income noted for treatment involving combined use of poultry manure 5 t ha⁻¹ + 75% RDF (Rs.301369 ha⁻¹), whereas the highest benefit: cost ratio (2.27) were noted for sewage sludge 5 t ha⁻¹ + 75% RDF.

Keywords

Brinjal,
Cauliflower,
Organic manures,
Nutrient uptake,
Yield.

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Introduction

The imbalanced and skewed application of NPK accompanied by restricted use of organic manures and micronutrients have made soils not only deficient in the nutrients, but also deteriorated the soil health, resulting in declining of the crop response to the application of fertilizers. On the other hand, Organic manures alone may not be able to meet the nutrient requirement of high yielding crops to produce the required food grains for the burgeoning human population due to their low nutrient contents and slow rates of nutrient release. Under this circumstance, integration of chemical and organic sources

and their management have shown promising results not only in sustaining the productivity but have also proved to be effective in maintaining soil health and enhancing nutrient use efficiency (Laxminarayana *et al.*, 2011; Kumar Mukesh *et al.*, 2012). The supplementary and complementary use of organic manures and inorganic fertilizers augment the efficiency of both substances to sustain soil productivity. Keeping in view the significance of organic manures in maintaining the soil health and importance of brinjal and cauliflower in human nutrition an attempt was made to critically examine the

use of poultry manure, sewage sludge and urban compost along with chemical fertilizers to obtain better yields and to maintain better soil health in brinjal-cauliflower cropping system under integrated nutrient management.

Materials and Methods

A field experiment was conducted at College farm, Rajendranagar, during kharif 2013 and rabi 2013-14. The soil was sandy loam in texture and slightly alkaline in reaction. It was low in available N, medium in available P, K and low in organic carbon (Table 1). The experiment was laid out in a randomized block design with 14 treatment combinations, each being replicated thrice consisting of two levels of each of sewage sludge, urban compost and poultry manure 2.5, 5.0 t ha⁻¹ and combination of 75 percent RDF. The organic manures *i.e.*, poultry manure (PM), urban compost (UC) and sewage sludge (SS) procured from poultry station, Rajendranagar, Hyderabad, SELICO private company gandemguda, Rangareddy and Amberpet sewage treatment plant, respectively. All these manures were analyzed for their chemical composition viz., N, P, K, OC, pH, EC and available micronutrients (Table 2). All these manure were applied as per the treatments. N, P and K were applied through Urea, SSP and MOP, respectively while the total quantity of phosphorus and potassium were applied as basal and nitrogen was applied in three equal splits viz. 1/3 as basal, 1/3 at flowering and the remaining 1/3 at fruit formation to brinjal. Thirty days old seedlings of brinjal (hybrid) were transplanted on ridges at a spacing of 60 cm x 60 cm. During rabi season cauliflower was grown to know the manures and fertilizers effect on soil to assay the cumulative and residual effects on cauliflower from earlier brinjal crop. Each earlier treatments plot was divided into two; among them, one plot was used to get cumulative effect on cauliflower, other one

was used to get residual effect on cauliflower. However, the crop was grown without addition of any manure and fertilizer for residual sub plot. Cumulative sub plot was applied with fertilizers and manures as per the crop recommendation and treatments. In both seasons Plants samples were collected at harvest stage; yields of fruit/ head and plant were recorded separately after thoroughly sun drying. These samples were air dried and later oven dried at 60°C and ground to fine power using stainless steel willy mill and analyzed for N, P and K content by adopting standard methods as micro kjeldahl method, Vanado molybdate phosphoric method and flame photometry, respectively. After determination of nutrient concentration in edible part and plant separately, these values were multiplied by corresponding dry matter yield to obtain nutrient uptake (Table 3). Data was analyzed statistically to test significances and the treatments are tested at five percent level of significance. The analysis was carried out by the methodology as described by Panse and Sukhatme (1976).

Results and Discussion

Brinjal fruit yield (kharif, 2013)

Brinjal performance was significantly increased by the application of sewage sludge, urban compost, poultry manure along with 75 percent recommended dose of fertilizers as compared to control. Combined application of organic manures and inorganic fertilizers proved better in increasing brinjal fruit size and yield. Significantly higher fruit yield were recorded for treatment supplying poultry manure 5.0 t ha⁻¹ in combination with 75 percent recommended dose of NPK (33.6 t ha⁻¹) followed by treatment supplying sewage sludge 5.0 t ha⁻¹ in combination with 75 percent recommended dose of NPK (32.5 t ha⁻¹) (Table 4). Higher fruit yield was observed with combined application of inorganic and

organic sources of nutrients may be attributed to adequate and continuous supply of essential elements at initial stage by inorganic fertilizers and organic manures at later stage, improved soil properties, development of proliferous root system, increased metabolic activity, greater synthesis, translocation and accumulation of carbohydrates. Similar results were also reported by Narayan *et al.*, (2004); Rakhonde *et al.*, (2015) and Singh Rana Veer *et al.*, (2015).

5.0 t ha⁻¹ + 75% RDF), followed by SS 5.0 t ha⁻¹ +75% RDF 28.7 t ha⁻¹ and 21.8 t ha⁻¹ (Table 4). Integrated manures and fertilizer applied plots showed good response to yield and individually manure treated plots showed significantly lesser yield than combined applications. The relative increase in yield by combined application of poultry manure and fertilizers of could be attributed to improvement in soil structure, nutrient retention and water for plant use.

Cauliflower fresh head yield (rabi, 2013-14)

In the second season of cumulative and residual effect on rabi 2014 cauliflower, significantly increase yield of 29.3 t ha⁻¹ and 22.0 t ha⁻¹ was recorded with poultry manure

Nutrient concentrations and uptake

In both the seasons, the highest N concentration and uptake were recorded with the poultry manure 5.0 t ha⁻¹ along with 75% recommended dose of fertilizers.

Table.1 Salient Characteristics of experimental Soil

S.No	Characteristics of soil	Value
I	Physical properties	
a.	Bulk density (Mg m ⁻³)	1.40
b.	Mechanical composition (%)	
	Sand	74.80
	Silt	5.85
	Clay	19.35
	Textural class	Sandy loam
c.	Water holding capacity (%)	21.40
II.	Physico-chemical properties	
a.	Soil reaction (pH)	7.50
b.	Electrical conductivity (EC) (dSm ⁻¹)	0.35
c.	Cation exchange capacity (CEC) [cmol (p ⁺) kg ⁻¹]	19.20
III.	Chemical properties	
a.	Organic carbon (%)	0.44
b.	Available nitrogen (kg ha ⁻¹)	203.8
c.	Available phosphorus (kg ha ⁻¹)	24.0
d	Available potassium (kg ha ⁻¹)	234
III	Enzymatic activity	
a.	Urease (µg of NH ₄ ⁺ -N released g ⁻¹ soil h ⁻¹)	3.30
b.	Dehydrogenase (µg of TPF produced g ⁻¹ soil d ⁻¹)	1.80
c.	Acid phosphatase (µg of p-nitrophenol released g ⁻¹ soil h ⁻¹)	60.0
d	Alkaline phosphatase (µg of p-nitrophenol released g ⁻¹ soil h ⁻¹)	63.0

Table.2 Characteristics of urban compost, sewage sludge and poultry manure

S.No	Character	Urban compost	Sewage sludge	Poultry manure
Physico- chemical properties				
1	pH	7.13	6.80	7.10
2	EC (dS m ⁻¹)	1.52	1.60	1.20
3	OC (%)	23.00	29.00	33.10
Total major nutrient status (%)				
4	N	0.90	1.60	2.80
5	P	0.32	0.93	1.38
6	K	0.54	0.60	1.46
DTPA extractable micronutrients and heavy metals (mg kg⁻¹)				
7	Fe	189.0	260.0	324.0
8	Mn	30.0	55.0	76.5
9	Zn	19.0	28.8	59.0
10	Cu	14.0	19.4	16.2
11	Cd	1.30	1.56	0.56
12	Ni	1.42	5.30	2.69
13	Cr	5.29	6.24	2.13
14	Pb	4.23	5.60	2.04
Total micronutrients and heavy metals (mg kg⁻¹)				
15	Fe	3250.0	6290.0	1270.0
16	Mn	210.0	758.0	298.0
17	Zn	81.0	423.4	80.0
18	Cu	87.9	345.6	64.2
19	Cd	19.5	60.8	18.0
20	Ni	12.2	61.5	15.0
21	Cr	58.2	99.4	10.2
22	Pb	54.0	120.0	73.2

Table.3 Effect of urban compost, sewage sludge and poultry manure with fertilizers on dry matter (kg ha⁻¹) yield in brinjal-Cauliflower cropping system

Treatments	Brinjal		Cumulative cauliflower		residual cauliflower	
	plant dry matter	fruit dry matter	plant dry matter	head dry matter	plant dry matter	head dry matter
T1-Control	1450	1280	920	851	890	770
T2-RDF	1690	1550	1256	2100	780	1090
T3- UC @ 2.5 t ha ⁻¹	1310	1120	1060	1800	860	1400
T4- UC @ 5 t ha ⁻¹	1550	1390	1350	1950	1050	1625
T5- SS @ 2.5 t ha ⁻¹	1598	1440	1410	2060	1080	1660
T6- SS @ 5 t ha ⁻¹	1918	1742	1530	2255	1210	1880
T7- PM @ 2.5 t ha ⁻¹	1620	1580	1486	2170	1160	1700
T8- PM @ 5 t ha ⁻¹	2000	1910	1680	2460	1290	2000
T9- UC @ 2.5 t ha ⁻¹ + 75% RDF	1990	1860	1500	2200	1020	1710
T10- UC @ 5 t ha ⁻¹ +75% RDF	2430	2210	1656	2324	1100	1800
T11- SS @ 2.5 t ha ⁻¹ +75% RDF	2528	2413	1830	2455	1280	1910
T12- SS @ 5 t ha ⁻¹ +75% RDF	2720	2640	1968	2649	1410	2130
T13- PM @ 2.5 t ha ⁻¹ +75% RDF	2620	2458	1750	2580	1315	1980
T14- PM @ 5 t ha ⁻¹ +75% RDF	2930	2790	2100	2810	1640	2280
Mean	2025	1885	1536	2190	1149	1710
S.E m(±)	42	44	33	72	31	58
CD(0.05)	122	128	97	208	89	168

Note: RDF: recommended dose of fertilizer UC: urban compost SS: sewage sludge PM: poultry manure

Table.4 Effect of urban compost, sewage sludge and poultry manure with fertilizers on yield in brinjal-cauliflower cropping system

Treatments	fresh fruit/ head yield (t ha ⁻¹)		
	Brinjal (<i>kharif</i> , 2013)	Cauliflower (<i>rabi</i> , 2014)	
		Cumulative	Residual
T ₁ - Control	16.0	13.0	9.4
T ₂ - RDF	27.0	26.1	12.0
T ₃ - UC @ 2.5 t ha ⁻¹	21.0	19.1	15.0
T ₄ - UC @ 5 t ha ⁻¹	24.0	20.0	16.4
T ₅ - SS @ 2.5 t ha ⁻¹	23.0	22.0	17.0
T ₆ - SS @ 5 t ha ⁻¹	25.6	24.6	19.6
T ₇ - PM @ 2.5 t ha ⁻¹	24.3	23.0	18.0
T ₈ - PM @ 5 t ha ⁻¹	26.5	26.0	20.0
T ₉ - UC @ 2.5 t ha ⁻¹ + 75% RDF	27.7	24.0	16.7
T ₁₀ - UC @ 5 t ha ⁻¹ +75% RDF	29.0	25.8	18.0
T ₁₁ - SS @ 2.5 t ha ⁻¹ +75% RDF	28.8	27.1	19.0
T ₁₂ - SS @ 5 t ha ⁻¹ +75% RDF	32.5	28.7	21.8
T ₁₃ - PM @ 2.5 t ha ⁻¹ +75% RDF	30.0	27.4	19.2
T ₁₄ - PM @ 5 t ha ⁻¹ +75% RDF	33.6	29.3	22.0
Mean	26.4	24.0	17.4
S.E m(±)	1.12	0.61	1.10
CD(0.05)	3.24	1.77	3.13

Note: RDF: recom

Table.5 Effect of urban compost, sewage sludge and poultry manure with fertilizers on nutrient concentration and uptake (kg ha⁻¹) in Brinjal-cauliflower cropping system

Treatments	brinjal						cauliflower (cumulative)						residual					
	Nutrient (%)			uptake			Nutrient (%)			uptake			Nutrient (%)			uptake		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
T1-Control	1.4	0.20	1.30	20.3	2.9	18.9	1.20	0.20	1.57	11.0	1.8	14.4	1.23	0.16	1.59	10.9	1.4	14.2
T2-RDF	2.1	0.50	1.60	35.5	8.4	27.0	1.90	0.32	2.54	23.2	4.0	31.9	1.39	0.21	1.78	10.8	1.6	13.9
T3- UC 2.5 t ha ⁻¹	1.5	0.26	1.40	19.7	3.4	18.3	1.50	0.26	2.08	16.3	2.8	22.1	1.43	0.24	1.83	12.3	2.1	15.7
T4- UC 5 t ha ⁻¹	1.7	0.36	1.53	26.4	5.6	23.7	1.70	0.27	2.25	22.3	3.6	30.4	1.49	0.25	2.05	15.6	2.6	21.5
T5- SS 2.5 t ha ⁻¹	1.6	0.42	1.56	25.6	6.7	24.9	1.70	0.27	2.29	23.7	3.8	32.3	1.50	0.25	2.10	16.2	2.7	22.7
T6- SS 5 t ha ⁻¹	1.8	0.53	1.60	34.5	10.1	30.7	1.70	0.28	2.37	26.2	4.3	36.3	1.60	0.26	2.22	19.4	3.1	26.9
T7- PM 2.5 t ha ⁻¹	1.7	0.50	1.58	27.5	8.1	25.6	1.70	0.28	2.37	25.3	4.2	35.2	1.51	0.26	2.15	17.5	3	24.9
T8- PM 5 t ha ⁻¹	1.9	0.56	1.64	38.0	11.2	32.8	1.80	0.29	2.48	29.9	4.9	41.7	1.64	0.27	2.28	21.2	3.5	29.4
T9- UC 2.5 t ha ⁻¹ + 75% RDF	1.8	0.35	1.51	35.8	6.9	30.0	1.80	0.29	2.36	26.7	4.4	35.4	1.51	0.25	2.00	15.4	2.6	20.4
T10- UC 5 t ha ⁻¹ +75% RDF	2.1	0.42	1.58	51.0	10.2	38.4	1.80	0.31	2.45	30.1	5.1	40.6	1.54	0.26	2.18	16.9	2.9	24.0
T11- SS 2.5 t ha ⁻¹ +75% RDF	2	0.45	1.60	50.6	11.3	40.4	1.80	0.31	2.49	32.8	5.7	45.6	1.60	0.26	2.20	20.5	3.3	28.2
T12- SS 5 t ha ⁻¹ +75% RDF	2.2	0.56	1.66	59.8	15.2	45.2	1.90	0.33	2.85	37.4	6.5	56.1	1.66	0.27	2.38	23.4	3.8	33.6
T13- PM 2.5 t ha ⁻¹ +75% RDF	2.1	0.53	1.61	55.0	13.8	42.2	1.90	0.32	2.57	33.1	5.6	45.0	1.60	0.26	2.33	21.0	3.4	30.6
T14- PM 5 t ha ⁻¹ +75% RDF	2.3	0.58	1.68	67.4	16.5	49.2	2.00	0.34	3.00	42.2	7.1	63.0	1.71	0.28	2.63	28.0	4.6	43.1
Mean	1.9	0.44	1.60	38.9	9.3	32.0	1.70	0.29	2.40	27.2	4.6	37.8	1.53	0.25	2.12	17.8	2.9	24.9
S.E m(±)	0.04	0.05	0.08	2.3	0.3	0.4	0.04	0.01	0.04	0.42	0.0	0.4	0.01	0.01	0.07	0.6	0.1	0.4
CD(0.05)	0.11	0.16	0.25	6.6	0.9	1.2	0.13	0.04	0.11	1.21	0.1	1.1	0.04	0.02	0.20	1.7	0.2	1.1

Note: RDF: recommended dose of fertilizer UC: urban compost SS: sewage sludge PM: poultry manure

Table.6 Total economics of brinjal –cauliflower cropping sequence during 2013-2014

Treatments	Total cost of cultivation (Rs)	Total net returns (Rs)	B:C ratio
T ₁	124855	75145	0.60
T ₂	129667	241133	1.85
T ₃	125205	153675	1.22
T ₄	125555	178445	1.42
T ₅	125280	188720	1.50
T ₆	125705	224695	1.78
T ₇	127855	201945	1.57
T ₈	130855	236145	1.80
T ₉	128981	229219	1.77
T ₁₀	129331	251069	1.94
T ₁₁	129055	260544	2.01
T ₁₂	129481	295119	2.27
T ₁₃	131631	267569	2.03
T ₁₄	134631	301369	2.23

In brinjal, highest N concentration (2.3 %) and uptake (67.4 kg ha⁻¹) and in cauliflower cumulative and residual, the highest N concentration (2.00 %) and N uptake (42.2 kg ha⁻¹) was obtained with PM 5 t ha⁻¹ + 75% RD (Table 5). Combined application of organic and inorganic sources of nutrients improved nutrient uptake owing to the adequate and continuous supply of nutrients. The results are in line with those of Choudary *et al.*, (2013); Wani *et al.*, (2010) and Narayan *et al.*, (2004). Integrated application of manures and fertilizers showed significant effect on P concentration and uptake, In both the seasons, poultry manure 5.0 t ha⁻¹ + 75% RDF recorded highest P content and P uptake (Table 5).

Poultry manure treated plots recorded the higher P uptake than other sources. The addition of poultry manure might have helped in elongation of root system and ramification of roots in search of nutrients led to increased

uptake of nutrients. Application of organic manures along with fertilizers showed significant effect on K concentration and uptake, among the treatments, the highest K concentration and uptake was obtained in plant with poultry manure 5.0 t ha⁻¹ + 75 % RDF (Table 5). Poultry manure treated plots recorded the higher uptake of K than other treatments; this might be due to increased availability of nutrients from mineralized organic manure, which increased the concentration of K in soil solution in a readily available form for absorption.

Economics of brinjal- cauliflower cropping sequence

Highest values for net income noted for treatment involving combined use of poultry manure 5t ha⁻¹ + 75% RDF (Rs.301369 / ha), whereas the highest benefit: cost ratio (2.27) were recorded with sewage sludge 5 t ha⁻¹ + 75% RDF (Table 6). On an overall view,

integrated treatments performed better than alone manure applications.

It can be concluded that in both the seasons, integrated application of manures and fertilizers recorded superior yields and uptake of nutrients. Among the treatments higher yields, nutrient concentration and uptake were recorded with application of poultry manure 5 t ha⁻¹ along with 75 percent RDF. Since the experimental soil is poor in fertility, combined use of organic and inorganic sources helped the crops through improved nutrition and also by maintaining soil productivity for longer period of time.

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