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Research Article

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Effect of urban compost, sewage sludge, poultry manure and fertilizers on soil fertility improvement and fruit yield of brinjal (*Solanum melongena* L.)

■ R. SAIKUMAR AND K. JEEVAN RAO

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MEMBERS OF RESEARCH FORUM:

Corresponding author :
R.SAIKUMAR, Department of Soil Science, College of Agriculture, Prof. Jayashankar Telangana State Agricultural University, Rajendranagar, HYDERABAD (TELANGANA) INDIA
Email: saikumaragrico@gmail.com

Co-authors :
K. JEEVAN RAO, Department of Soil Science, College of Agriculture, Prof. Jayashankar Telangana State Agricultural University, Rajendranagar, HYDERABAD (TELANGANA) INDIA

Summary

Field experiment was carried out at College Farm, College of Agriculture, Rajendranagar, Hyderabad to determine the effect of sewage sludge, urban compost, poultry manure and fertilizers on the soil fertility improvement and fruit yield of brinjal in 2013 *Kharif* season. The three organic manures were applied each at 2.5and 5.0 t/ha, 100%RDF and combination of fertilizer levels (75% RDF) with manures at different levels and a control treatment, arranged in a Randomized Block Design (RBD) with three replicates. The results showed significant increase in the fruit yield of brinjal crop under integrated treatments compared to control treatment. The application of poultry manure @ 5.0 t/ ha along with 75% RDF resulted in the highest fruit yield of brinjal (33.6) followed by sewage sludge @ 5.0 t/ ha along with 75% RDF (32.5). The highest values of organic carbon, available nitrogen, phosphorus and potassium were obtained under poultry manure @ 5.0 t/ ha along with 75% RDF.

Key words : Brinal, Fruit yield, Organic manures, Fertilizers, Soil fertility

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Introduction

Brinjal is one of the most commonly grown vegetable crop of the country belonging to the family Solanaceae. Brinjal has ayurvedic medicinal properties and white brinjal is good for diabetic patients. It is also a source of vitamins A, C and minerals.

Sewage sludge, urban compost and poultry manure are the three sustainable manures, but it is not possible to meet the nutritional requirements from the organic sources only. The potentialities of organic source are very limited to afford higher crop production due to slow release of plant nutrients from organic matter. To overcome this problem application of organic manures in combination with inorganic fertilizers, called integrated nutrient management can play important role in brinjal cultivation. Integrated nutrient use has assumed great significance in vegetable production. This practice sustains the productivity of soils under highly intensive cropping system. 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 and Kumar *et al*., 2012). The supplementary and

complementary use of organic manures and inorganic fertilizers augment the efficiency of both substances to sustain soil productivity. Considering the above facts, the present study was undertaken to investigate the effect of organic manures and inorganic fertilizers alone or in combination on fruit yield of brinjal and on soil fertility.

Resource and Research Methods

A field experiment was conducted at college farm, Rajendranagar. Data pertaining to the properties of experimental soil are presented in Table A. The soil was sandy loam in texture and slightly alkaline in reaction. It was low in available nitrogen, medium in available phosphorus, potassium and low in organic carbon. The experiment was laid out in a Randomized Block Design with the 14 treatments, 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 per cent 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 theses manures were analyzed for their chemical composition *viz.*, N,P,K, OC, pH, EC and available micronutrients etc. (Table B). All these manure were applied as per the treatments. Nitrogen, phosphorus and potassium were applied through urea, SSP and muriate of potash, 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. Soil samples collected after harvest of brinjal were analyzed for their soil organic carbon, available nitrogen, phosphorus and potassium by following standard procedures outlined by Walkley and Black (1934) for organic carbon, Subbiah and Asija (1956) method for nitrogen, Olsen *et al.* (1954) method for available phosphorus and Jackson (1973) method for available potassium in soil. The data recorded on various parameters during the course of investigation

Table A : Salient characteristics of experimental soil

Sr. No.	Characteristics of soil	Value
Physical properties		
1.	Bulk density (Mg m^{-3})	1.40
2.	Mechanical composition (%)	
	Sand	74.80
	Silt	5.85
	Clay	19.35
	Textural class	Sandy loam
	Water holding capacity (%)	21.40
Physico-chemical properties		
1.	Soil reaction (pH)	7.50
2.	Electrical conductivity (EC) (dSm^{-1})	0.35
3.	Cation exchange capacity (CEC) [cmol (p^+) kg^{-1}]	19.20
Chemical properties		
1.	Organic carbon (%)	0.44
2.	Available nitrogen (kg N ha^{-1})	203.8
3.	Available phosphorus (kg P_2O_5 ha^{-1})	24.0
4.	Available potassium (kg K_2O ha^{-1})	234
Enzymatic activity		
1.	Urease (µg of NH_4^+-N released g^{-1} soil h^{-1})	3.30
2.	Dehydrogenase (µg of TPF produced g^{-1} soil d^{-1})	1.80
3.	Acid phosphatase (µg of p-nitrophenol released g^{-1} soil h^{-1})	60.0
4.	Alkaline phosphatase (µg of p-nitrophenol released g^{-1} soil h^{-1})	63.0

Table B : Characteristics of urban compost, sewage sludge and poultry manure

Sr. 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

and the summed up data were statistically analyzed following the analysis of variance for Randomized Block Design as suggested by Panse and Sukhatme (1978).

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Soil chemical analysis after harvest of brinjal :

The organic carbon (OC) content of the soil was not significantly influenced by the type and level of manure application in conjunction with fertilizers in brinjal (Table 1). Application of sewage sludge, poultry manure and urban compost increased the OC status of soil over RDF (100%NPK) and control. The increase in organic carbon status of soil in organic manures applied plots could be due to stimulation of growth and activity of microorganisms and also due to better root growth. The results were in concurrence with the findings of Madhavi (1992) with PM. Application of poultry manure @ 8 t ha^{-1} recorded the highest OC at all the stages of maize crop growth, Hema *et al*. (2005).

The available N significantly increased in both fertilizer and manure applied plots. Among the treatments, a higher value of available N was obtained in T_{14} (PM @ 5.0 t ha^{-1} + 75% RDF) (302.3) and T_{12} (SS @ 5.0 t ha^{-1} + 75% RDF) (285.7), While the soil available N was least with untreated control (183.0) (Table 1). Among all the treatments, significantly superior result was found in T_{14} (PM @ 5 t ha^{-1}+75% RDF) than all other rest of treatments. Among the manures, PM increased the availability of N in soil. This effect might be due to higher amount of N present in PM and its

subsequent mineralization increased available form. Similar kind of result also reported by Agbede *et al.* (2008); Onwu *et al.* (2014) and Sohu *et al.* (2015).

The highest available P was noticed in T_{14} (PM @ 5 t ha^{-1}+75% RDF) 34.2 kg ha^{-1}, which was at par with T_{12} (SS @ 5 t ha^{-1}+75% RDF) recorded 33.4 kg ha^{-1} treatment (Table 1). The RDF (100% NPK) applied plots also significantly increased the available P over control but inferior to integrated treated plots. Among the manures increased P content was higher in PM that

Table 1: Effect of different organic manures and fertilizers on the soil chemical composition after harvesting brinjal

Treatments	Organic carbon (%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
T_1- Control	0.40	183.0	23.0	213.3
T_2- RDF	0.43	215.7	25.3	259.7
T_3- UC @ 2.5 t ha^{-1}	0.45	201.7	26.5	232.3
T_4- UC @ 5 t ha^{-1}	0.48	212.3	28.8	246.0
T_5- SS @ 2.5 t ha^{-1}	0.49	225.0	28.6	256.0
T_6- SS @ 5 t ha^{-1}	0.51	240.7	31.0	266.0
T_7- PM @ 2 .5 t ha^{-1}	0.49	236.3	29.8	259.0
T_8- PM @ 5 t ha^{-1}	0.52	250.0	33.0	272.3
T_9- UC @ 2.5 t ha^{-1}+ 75% RDF	0.47	234.0	28.5	264.0
T_{10}- UC @ 5 t ha^{-1}+75% RDF	0.49	249.7	31.2	272.0
T_{11}- SS @ 2.5 t ha^{-1}+75% RDF	0.51	259.0	30.6	266.0
T_{12}- SS @ 5 t ha^{-1}+75% RDF	0.52	285.7	33.4	276.0
T_{13}- PM @ 2 .5 t ha^{-1}+75% RDF	0.51	272.7	31.0	269.0
T_{14}- PM @ 5 t ha^{-1}+75% RDF	0.54	302.3	34.2	293.3
Mean	0.49	240.6	29.7	260.4
S.E. ±	0.07	1.28	2.00	1.01
C.D.(P=0.05)	NS	3.71	5.81	2.95

Note: RDF: Recommended dose of fertilizer UC: Urban compost SS: Sewage sludge PM: Poultry manure NS= Non-significant

Table 2: Effect of different organic manures and fertilizers on Brinjal fresh fruit yield

Treatments	fresh fruit yield (t ha^{-1})
T_1- Control	16.0
T_2- RDF	27.0
T_3- UC @ 2.5 t ha^{-1}	21.0
T_4- UC @ 5 t ha^{-1}	24.0
T_5- SS @ 2.5 t ha^{-1}	23.0
T_6- SS @ 5 t ha^{-1}	25.6
T_7- PM @ 2 .5 t ha^{-1}	24.3
T_8- PM @ 5 t ha^{-1}	26.5
T_9- UC @ 2.5 t ha^{-1}+ 75% RDF	27.7
T_{10}- UC @ 5 t ha^{-1}+75% RDF	29.0
T_{11}- SS @ 2.5 t ha^{-1}+75% RDF	28.8
T_{12}- SS @ 5 t ha^{-1}+75% RDF	32.5
T_{13}- PM @ 2 .5 t ha^{-1}+75% RDF	30.0
T_{14}- PM @ 5 t ha^{-1}+75% RDF	33.6
Mean	26.4
S.E.±	1.12
C.D.(P=0.05)	3.24

Note: RDF: Recommended dose of fertilizer, UC: Urban compost, SS: Sewage sludge, PM: Poultry manure

improved available P content in these plots. Ewulo *et al.* (2008) found that the poultry manure increased the available P than other manures. The increase in availability of P with the application of PM and other organics was attributed to release of appreciable quantities of CO_2 during decomposition of organic matter which might have formed the carbonic acid, leading to increased solubility of phosphorus resulting in higher phosphate availability. Similar kind of results found by Agbede *et al.* (2008) and Onwu *et al.* (2014).

During the brinjal, among the treatments T_{14} and T_{12} were found superior with available K status of 293.3 and 276.0 kg ha^{-1}, respectively (Table 1). All the manure and fertilizer combination treatments had the capacity to enhance the available K status of the soil over control. Recommended dose of fertilizer applied plot also significantly increased available K (259.7 kg ha^{-1}) over the control (213.3 kg ha^{-1}). This result indicated that the poultry manure, sewage sludge and urban compost available K content was highest in PM treated plots. This effect might be due to higher amount of K present in PM, which was easily converted to available form. Similarly Agbede *et al.* (2008) observed that recommended application of NPK fertilizers + poultry manure to improve the soil fertility status. Similar results were also found by Shelke *et al.* (2001) and Kavitha and Rao (2010).

Effect of organic manures and fertilizers on brinjal fruit yield :

The fruit yield of brinjal was significantly influenced by different levels of organic manures and inorganic fertilizers (Table 2 and Fig.1). The lowest and highest yields were recorded at T_1 (control) and T_{14} (PM @ 5 t ha^{-1} +75% RDF), respectively. The fruit yield varied from 16.0 to 33.6 t ha^{-1}. However, the yield recorded at T_{14} was at par with that recorded at T_{12} (32.5 t ha^{-1}), T_{10} (29.0 t ha^{-1}) and T_{13} (30.0 t ha^{-1}) and significantly superior over all other treatments. Conjunctive use of different levels of chemical fertilizers with any one of the organics produced higher yields as compared to their individual applications. This was due to the direct availability of nutrients from inorganic fertilizers and also the manures containing higher available N, P and K contents. The maximum yield in treatment T_{14} was due to more number and large sized fruits as well as increased the synthesis of carbohydrates which ultimately promoted greater yield (Mohan Kumar and Narse Gowda, 2010). The above results corroborates with Rakhonde *et al*. (2015); Ayeni *et al*. (2009) and Ilodibia and Chukwuma (2015).

The present study shows that sewage sludge, poultry manure and urban compost can be used as a source of plant nutrients. Its application to soil alone or in combination with inorganic fertilizer brought an increase in the yield of brinjal and improved the soil organic carbon content, available N, available P and available K in soil over control.

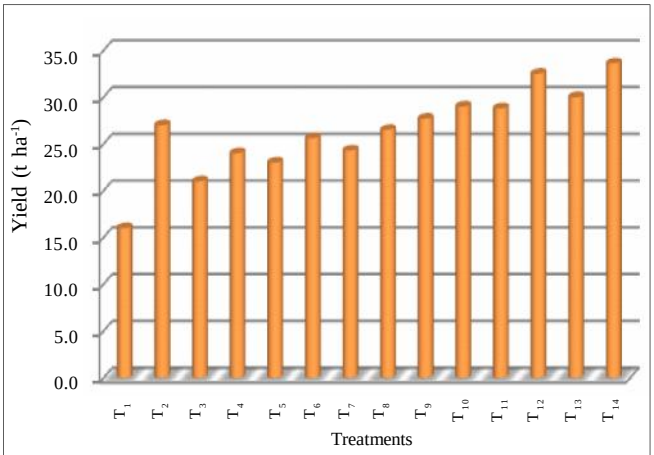

Fig. 1 : Yield of brinjal as influenced by different organic manures and fertilizer treatments

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