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Influence of Sewage Sludge Urban Compost and Fym with Inorganic Fertilizers on Drymatteraccumulation Uptake and Yield of Rice Crop.

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Abstract: *The experiment was conducted at college farm , Rajendranagar to study the influence of sewage sludge, urban compost and FYM along with inorganic fertilizers on dry mater accumulation, uptake of major nutrients and yield of rice variety cv. Tellahamsa (oryja sativa L.) in Hyderabad , Andhrapradesh.Experimental results revealed that the concentration and uptake of major nutrients by paddy grain, straw intern yield were significantly influenced by the application of organic manures along with inorganic fertilizers.*

Continuous addition of chemical fertilizers leads to detoriation of soil health in the long run and the soil will be unable to sustain the productivity. In order to achieve sustainable production of food grains and to maintain soil health conjunctive use of fertilizers and organic manures is essential. Keeping these above facts under consideration, an experiment was carried out to study the influence of sewage sludge, urban compost and FYM along with inorganic fertilizers on dry matter accumulation, uptake of major nutrients and yield by rice crop in college farm, college of agriculture, Rajendranagar, Hyderabad.

Keywords: *Inorganic fertilizers , NPK uptake, Organic manures, Yield of rice.*

MATERIALS AND METHODS

A field experiment was conducted at college farm, Rajendranagar.Data partaning to the physico-chemical properties of experimental soil are presented in Table 1. The soil was sandy loam in texture and slightly alkaline in reaction. It was low in available nitrogen, medium in available phosphorus, potassium and organic carbon. The experiment was laid out in a split plot design with the 28 treatments, each being replicated thrice consisting of two levels of each of sewage sludge , urban compost and FYM @ 10, 20 t ha^{-1} and combination of four levels of fertilizers 0, 50, 75 and 100 percent RDF(120:60:40 N:P_2O_5:K_2O kg ha^{-1}).

The organic manures *i.e.*, farmyard manure, urbancompost and sewage sludge procured from dairy farm, Rajendranagar, Hyderabad, SELICO private company gandemguda, Rangareddy and Amberpet sweage treatment plant, respectively. All theses manures were analyzed for their chemical composition *viz.*, N, P, K, OC, pH, EC and available micronutrients etc. 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 two equal splits *viz.*, half as basal and half at maximum tillering stage. Twenty eight days old seedlings of rice were transplanted at the rate of two seedlings per hill by adopting a spacing of 20 cm × 15 cm in well puddle and leveled plots. Plants samples such as grain and straw were collected at harvest stage, yields of grain and straw were recorded separately after thoroughly sun drying. These samples were air dried and later oven

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dried at 60°C and ground to fine power using stainless steel willy mill and analysed for N, P and K content by adopting standard procedures as A.O.A.C (1980) [1] Jackson (1973)[4] and Muhr et al (1965)., [10] respectively. After determination of nutrient concentration in grain and straw separately, these values were multiplied by corresponding dry matter yield to obtain nutrient uptake .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 Panse and Sukahtme (1976)[13] for split plot technique.

RESULTS AND DISCUSSION

Characteristics of sewage sludge obtained from the municipal sewage treatment plant, Amberpet at Hyderabad, urban compost procured from SELCO International Composting Unit, Gangemguda, Ranga Reddy district and FYM obtained from Department of Dairy Science, College of Agriculture, Rajendranagar, ANGRAU, Hyderabad were given in Table 1.

Rice crop performance was significantly improved by the application of sewage sludge, urban compost, FYM along with different levels of recommended dose of fertilizers as compared to control. The grain and straw yields were increased by the application of recommended dose of fertilizers (120:60:40 N:P_2O_5:K_2O kg ha^{-1}), grain and straw yields increased in 100 per cent RDF treatment over control were under 70 per cent and 29 per cent under field conditions. The increase in the yields of rice was mainly due to the availability of major nutrients (N, P and K) that were essential to the crop during the critical growth stages of life cycle. Sharma *et al.*, (2001)[15] also reported increased grain yields of rice was due to the applied nitrogenous fertilizers

Application of nitrogen through urea, phosphorus through single superphosphate and potassium through muriate of potash resulted in increase in the content and uptake of N, P and K by rice crop during *kharif* season (Tables 4-9). Grain content and uptake of N in 100 per cent RDF treatment were 2.65 per cent and 144 kg ha^{-1} as against 2.52 per cent and 80 kg ha^{-1} observed in control, respectively. Straw content and uptake of

Table 1
Initial characteristics of experimental soil

Sl. No.	*Characteristics of soil*	*Value*
I	*Physical properties*	
	(a) Bulk density (Mg m^{-3})	1.47
	(b) Mechanical composition (%)	
	Sand	64.5
	Silt	22.8
	Clay	12.7
	Textural class	Sandy loam
	(d) Hydraulic conductivity (cm h^{-1})	0.35
	(e) Porosity (%)	38.20
	(f) Water holding capacity (%)	15.69
II.	*Physico–chemical properties*	
	(a) Soil reaction (pH)	7.64
	(b) Electrical conductivity (EC) (d Sm^{-1})	0.24
	(c) Cation exchange capacity (CEC) (c mol $(p)^+$ kg^{-1})	24
	(d) Exchangeable sodium percentage (ESP)	12.85
	Chemical properties	
	(a) Organic carbon (%)	0.51
III.	*Chemical properties*	
	(a) Nitrogen (kg N ha^{-1})	215.7
	(b) Phosphorus (kg P_2O_5 ha^{-1})	28.3
	(c) Potassium (kg K_2O ha^{-1})	252.6
	Total major nutrients (mg kg^{-1})	
	(a) Nitrogen	1304
	(b) Phosphorus	412
	(c) Potassium	1842
	DTPA extractable micronutrients (mg kg^{-1})	
	(a) Iron	6.50
	(b) Manganese	18.8
	(c) Zinc	0.98
	(d) Copper	0.62

Table 2
Initial Characteristics of organic manures

Characteristics	*Sewage sludge*	*Urban compost*	*FYM*
Physico-chemical properties			
pH	6.47	7.42	7.72
EC (dSm^{-1})	1.72	1.08	0.94
CEC (c mol (p^+) kg^{-1})	26.41	19.32	15.65
OC (%)	36.20	4.57	13.58
Nutrient status			
Available N (mg kg^{-1})	1.54	0.32	0.53
Available P (mg kg^{-1})	1.22	0.67	0.34
Available K (mg kg^{-1})	0.50	0.16	0.45

N in 100 per cent RDF treatment were 2.59 per cent and 155 kg ha^{-1} as against 2.36 per cent and 112 kg ha^{-1} noticed in control treatment. A significant increase in content uptake of P and K by grain and straw were seen in 100% RDF over control. Content and uptake of P and K by straw showed significant increase with entire dose of fertilizers as compared to control. The increase in nutrient uptake (N, P and K) may be attributed to the increase in dry matter production due to application of N, P and K in required quantities. The data on yield (Table 3) and uptake of major nutrients showed that the rice crop was benefited by the application of organic manures such as sewage sludge, urban compost and FYM.

Application of organic materials was found to influence the growth of rice crop directly by supplying nutrients (Palaniappan and Balasubramanian, 1991)[12] and by stimulating the microbial activity (Kukreja *et al.*, 1991)[8]. The rice grain yield was highest with sewage sludge (20 t ha^{-1}) treatment when compared to urban compost and FYM (@ 20 t ha^{-1}). The values were 51.13, 44.38 and 47.20 q ha^{-1} at highest level of SS, UC and FYM. The increase in grain and straw yields in SS (20 t ha^{-1}) treatment was 27 per cent, 39 per cent as compared to control. The results showed that sewage sludge is a better source of nutrients to rice than urban compost. The increase in grain and straw yields with sewage sludge application to rice field might be increased microbial activity and enzymatic activity which plays an important role in mobilization of nutrients facilitating uptake by plants that might be resulted in better growth and yields of crop.

Increase in yields of rice grain, straw over control due to the application of urban compost was because of supply of more quantities of major nutrients as well as micronutrients through it. Similar results were also reported by Jeevan Rao and Shantaram (1996)[6]. The urban compost contained 0.32, 0.67, 0.16 percentage of N, P and K, respectively. However, the grain yield of rice recorded in urban compost treatment was on par with FYM treatment. Application of organic manures to soil is also beneficial as it helps in release of native nutrients too due to priming action. In addition to this, beneficial effects of application of manures can also be due to fast decomposition of manure in hot and humid climate releasing large amounts of plant nutrients in simple forms. However, unlike the inorganic fertilizers, manures release nutrients slowly over the entire cropping season so that nitrogen is made available for absorption by plant roots gradually against loss by leaching.

The organic matter content of manures helps in fixing the phosphorus due to organo clay complexion and then release into the labile pool for longer time, besides P, application of organic manures maintain nutrients in labile pool for longer time, thus making adequate quantities of nutrients available for absorption by crops.

Rice grain and straw shown increased concentration and uptake of N, P and K with the application of organic manures alone, higher level of sewage sludge applied treatment registered in higher N concentration as well as uptake by grain, and straw The per cent increase in N uptake by grain over control were 37 per cent by grain and 57 per cent by straw. The organic manures have been found to provide favourable physical and chemical conditions in soil that enhance the availability of nutrients, in turn the higher uptake of nutrients (Paulraj and Sreeramulu, 1994)[14]. Geetakumari *et al.* (1993)[2] observed that application of organic manures not only increase the uptake of N through mineralisation but also reduced the losses of nitrogen from the soil. Nyamangara and Mzezewa (1996)[11] reported that higher uptake of P in sewage sludge treatment due to the organic form of sewage sludge P that rendered it free from fixation. Similar to individual manure treatments, sewage sludge treatments were found superior to urban compost treatments and also to FYM in combined treatments. Of all the combined treatments, higher dose of recommended fertilizer alone recorded 48.5 q ha^{-1} of grain yield, but sewage sludge at a dose of 10 t ha^{-1} along with half of recommended fertilizer performed similar to the entire dose of RDF recording the grin yield of 48.5 q ha^{-1} (Table 3).

Sewage sludge at 20 t ha^{-1} in combination with 100 per cent RDF recorded 23 per cent increased yield over full dose of fertilizers applied, this treatment was superior to urban compost and FYM along with 100 per cent RDF which recorded 10 per cent and 13 per cent increased yields respectively

Table 3
Effect of sewage sludge, urban compost, FYM and inorganic fertilizers on yields of grain and straw of rice crop

Treatments	*Grain (q ha^{-1})*					*Straw (q ha^{-1})*				
Main	*Fertilizer levels (%RDF)*					*Fertilizer levels (%RDF)*				
Sub	*0*	*50*	*75*	*100*	*Mean*	*0*	*50*	*75*	*100*	*Mean*
Control	27.50	40.00	44.50	48.50	40.13	33.25	46.54	50.32	52.68	45.70
UC 10 t ha^{-1}	29.00	43.50	47.50	52.30	43.08	36.56	50.31	54.57	56.15	49.40
UC 20 t ha^{-1}	31.00	44.50	48.50	53.50	44.38	40.59	51.17	55.81	57.20	51.19
FYM 10 t ha^{-1}	31.50	47.50	49.50	55.50	46.00	54.18	53.39	56.92	59.54	56.01
FYM 20 t ha^{-1}	33.00	48.30	52.50	55.00	47.20	55.93	57.50	60.00	62.38	58.45
SS 10 t ha^{-1}	34.50	48.50	53.50	56.00	48.13	53.11	60.32	62.25	63.44	59.78
SS 20 t ha^{-1}	37.50	52.50	54.50	60.00	51.13	57.55	63.59	65.14	68.59	63.72
Mean	32.00	46.40	50.07	54.40		47.31	54.69	57.86	60.00	
	S.Em(±)		*C.D. (0.05)*			*S.Em(±)*		*C.D. (0.05)*		
Main	0.19		0.65			0.56		1.93		
Sub	1.36		3.86			1.74		4.94		
Main at same or different level sub	1.12		NS			1.90		NS		

Table 4
Effect of sewage sludge, urban compost, FYM and inorganic fertilizers on N content of grain and straw of rice crop

Treatments	*Grain (%)*					*Straw (%)*				
Main	*Fertilizer levels (%RDF)*					*Fertilizer levels (%RDF)*				
Sub	*0*	*50*	*75*	*100*	*Mean*	*0*	*50*	*75*	*100*	*Mean*
Control	2.42	2.52	2.54	2.55	2.50	2.28	2.33	2.40	2.41	2.35
UC 10 t ha^{-1}	2.50	2.54	2.55	2.57	2.54	2.38	2.40	2.48	2.54	2.45
UC 20 t ha^{-1}	2.53	2.56	2.58	2.63	2.57	2.44	2.45	2.57	2.59	2.50
FYM 10 t ha^{-1}	2.51	2.59	2.62	2.65	2.59	2.40	2.50	2.55	2.56	2.50
FYM 20 t ha^{-1}	2.53	2.66	2.69	2.73	2.65	2.49	2.61	2.64	2.66	2.60
SS 10 t ha^{-1}	2.58	2.63	2.68	2.70	2.64	2.45	2.55	2.60	2.63	2.56
SS 20 t ha^{-1}	2.61	2.67	2.72	2.74	2.68	2.51	2.64	2.70	2.72	2.64
Mean	2.52	2.60	2.62	2.65		2.36	2.50	2.56	2.59	
	S.Em(±)		*C.D. (0.05)*			*S.Em(±)*		*C.D. (0.05)*		
Main	0.003		0.009			0.004		0.012		
Sub	0.005		0.015			0.006		0.018		
Main at same or different level sub	0.005		NS			0.102		NS		

when compared to the treatment received 100 per cent RDF alone. However, the per cent increase was maximum with sewage sludge treatments. Straw also showed the similar increment with sewage sludge treatment along with 100 per cent RDF then the treatments received 100 per cent RDF.

From the results of study it was very clear that the combined application of organic manures and

Table 5
Effect of sewage sludge, urban compost, FYM and inorganic fertilizers on N uptake (kg ha $^{-1}$) by grain and straw of rice crop

Treatments	*Grain*					*Straw*				
Main	*Fertilizer levels (%RDF)*					*Fertilizer levels (%RDF)*				
Sub	*0*	*50*	*75*	*100*	*Mean*	*0*	*50*	*75*	*100*	*Mean*
Control	66	100	113	123	100	75	108	120	126	107
UC 10 t ha^{-1}	72	110	121	124	109	87	120	135	142	121
UC 20 t ha^{-1}	78	113	125	140	114	99	125	141	148	128
FYM 10 t ha^{-1}	79	123	129	147	119	118	133	145	152	137
FYM 20 t ha^{-1}	83	128	141	150	125	131	150	158	167	151
SS 10 t ha^{-1}	89	127	143	151	127	130	153	161	166	152
SS 20 t ha^{-1}	97	140	148	164	137	144	171	175	186	169
Mean	80	120	131	144		112	137	147	155	
		S.Em(±)		*C.D. (0.05)*		*S.Em(±)*			*C.D. (0.05)*	
Main		2.96		7.15		3.41			9.60	
Sub		3.47		9.22		4.21			11.15	
Main at same or different level sub		22.18		NS		24.50			NS	

Table 6
Effect of sewage sludge, urban compost, FYM and inorganic fertilizers on P content of grain and straw of rice crop

Treatments	*Grain (%)*					*Straw (%)*				
Main	*Fertilizer levels (%RDF)*					*Fertilizer levels (%RDF)*				
Sub	*0*	*50*	*75*	*100*	*Mean*	*0*	*50*	*75*	*100*	*Mean*
Control	0.150	0.190	0.240	0.250	0.208	0.080	0.100	0.120	0.140	0.110
UC 10 t ha^{-1}	0.160	0.200	0.250	0.260	0.218	0.090	0.110	0.130	0.140	0.118
UC 20 t ha^{-1}	0.170	0.220	0.260	0.270	0.230	0.110	0.120	0.150	0.150	0.133
FYM 10 t ha^{-1}	0.190	0.240	0.250	0.270	0.238	0.120	0.130	0.140	0.150	0.135
FYM 20 t ha^{-1}	0.210	0.253	0.280	0.290	0.258	0.140	0.150	0.153	0.160	0.151
SS 10 t ha^{-1}	0.230	0.240	0.290	0.310	0.268	0.140	0.150	0.160	0.170	0.155
SS 20 t ha^{-1}	0.240	0.250	0.300	0.320	0.278	0.150	0.170	0.180	0.190	0.173
Mean	0.193	0.228	0.267	0.281		0.119	0.133	0.148	0.157	
		S.Em(±)		*C.D. (0.05)*		*S.Em(±)*			*C.D. (0.05)*	
Main		0.009		0.032		0.001			0.005	
Sub		0.008		0.023		0.005			0.014	
Main at same or different level sub		0.023		NS		0.005			NS	

inorganic fertilizers would augment the efficiency of both the substances when compared with their individual application. Similar results also reported by Jayabaskaran and Sreeramulu (1998)[7], Malik *et al.* (2001)[9], and Jeevan Rao (1992)[5].

The nutrient concentrations and uptake data showing higher values supported the beneficial effects of combined application of inorganic and organic sources than with their individual applications. It is evident that the rice crop

Table 7
Effect of sewage sludge, urban compost, FYM and inorganic fertilizers on P uptake (kg ha^{-1}) by grain and straw of rice crop

Treatments	*Grain*					*Straw*				
Main	*Fertilizer levels (%RDF)*					*Fertilizer levels (%RDF)*				
Sub	*0*	*50*	*75*	*100*	*Mean*	*0*	*50*	*75*	*100*	*Mean*
Control	4.13	9.60	11.13	12.13	9.24	2.66	4.65	6.04	7.38	5.18
UC 10 t ha^{-1}	4.35	8.27	11.40	13.13	9.29	3.29	5.53	7.09	7.86	5.94
UC 20 t ha^{-1}	4.96	8.90	12.13	13.91	9.98	4.46	6.14	8.37	8.58	6.89
FYM 10 t ha^{-1}	5.36	10.45	12.87	14.99	10.92	6.50	6.94	7.97	8.93	7.59
FYM 20 t ha^{-1}	6.27	11.40	13.13	14.85	11.41	6.99	8.63	9.00	9.98	8.65
SS 10 t ha^{-1}	7.25	12.43	14.98	16.24	12.73	7.44	9.05	9.96	10.78	9.31
SS 20 t ha^{-1}	8.63	12.60	15.81	18.60	13.91	8.63	10.81	11.73	13.03	11.05
Mean	5.85	10.52	13.06	14.83		5.71	7.39	8.59	9.51	

	S.Em(±)	*C.D. (0.05)*	*S.Em(±)*	*C.D. (0.05)*
Main	0.282	0.976	0.301	1.042
Sub	0.405	1.152	0.256	0.727
Main at same or different level sub	0.756	NS	0.763	NS

Table 8
Effect of sewage sludge, urban compost, FYM and inorganic fertilizers on K content of grain and straw of rice crop

Treatments	*Grain (%)*					*Straw (%)*				
Main	*Fertilizer levels (%RDF)*					*Fertilizer levels (%RDF)*				
Sub	*0*	*50*	*75*	*100*	*Mean*	*0*	*50*	*75*	*100*	*Mean*
Control	0.28	0.30	0.39	0.43	0.35	1.500	1.520	1.530	1.540	1.523
UC 10 t ha^{-1}	0.29	0.32	0.39	0.44	0.36	1.510	1.520	1.540	1.550	1.530
UC 20 t ha^{-1}	0.31	0.35	0.40	0.46	0.38	1.520	1.530	1.550	1.560	1.540
FYM 10 t ha^{-1}	0.32	0.37	0.40	0.47	0.39	1.530	1.530	1.560	1.560	1.545
FYM 20 t ha^{-1}	0.33	0.39	0.42	0.48	0.41	1.540	1.550	1.570	1.570	1.558
SS 10 t ha^{-1}	0.34	0.39	0.44	0.48	0.41	1.550	1.560	1.570	1.580	1.565
SS 20 t ha^{-1}	0.35	0.41	0.46	0.49	0.43	1.560	1.580	1.580	1.590	1.578
Mean	0.32	0.36	0.41	0.46		1.530	1.541	1.557	1.564	

	S.Em(±)	*C.D. (0.05)*	*S.Em(±)*	*C.D. (0.05)*
Main	0.007	0.025	0.034	NS
Sub	0.012	0.033	0.048	NS
Main at same or different level sub	0.020	NS	0.091	NS

continued to absorb higher proportions of nutrients even at later stages than when the components of integrated nutrient management were supplied individually. The slow release of nutrients from the organic sources is likely to sustain the supply of nutrients to the crop even at later stages as it tends to depend on initial supply from the inorganic sources (Harper, 1974)[3].

Table 9
Effect of sewage sludge, urban compost, FYM and inorganic fertilizers on K uptake (kg ha $^{-1}$) by grain, straw and roots of rice crop

Treatments	*Grain*					*Straw*				
Main	*Fertilizer levels (%RDF)*					*Fertilizer levels (%RDF)*				
Sub	*0*	*50*	*75*	*100*	*Mean*	*0*	*50*	*75*	*100*	*Mean*
Control	7.70	12.00	17.36	20.86	14.48	49.9	70.7	77.0	81.1	69.7
UC 10 t ha^{-1}	8.41	13.92	18.53	23.10	15.99	55.2	76.5	84.0	87.0	75.7
UC 20 t ha^{-1}	9.61	15.58	19.40	24.61	17.30	61.7	78.3	86.5	89.2	78.9
FYM 10 t ha^{-1}	10.08	17.58	19.80	26.09	18.39	82.9	81.7	88.8	92.9	86.6
FYM 20 t ha^{-1}	10.89	18.53	20.05	26.40	18.97	76.9	89.1	94.2	97.4	89.4
SS 10 t ha^{-1}	11.73	18.92	23.54	26.88	20.27	82.3	94.1	97.7	100.2	93.6
SS 20 t ha^{-1}	13.13	21.53	25.07	29.40	22.28	89.8	100.5	102.9	109.1	100.6
Mean	10.22	16.87	20.54	25.33		71.2	84.4	90.2	93.9	

	S.Em(±)	*C.D. (0.05)*	*S.Em(±)*	*C.D. (0.05)*
Main	0.407	1.407	1.469	5.082
Sub	0.668	1.898	2.705	7.688
Main at same or different level sub	1.116	NS	4.137	NS

In summary it can be concluded that higher yields of rice grain and straw were recorded with the application of sewage sludge @ 20 t ha^{-1} along with 100 percent RDF level. Yields of rice grain and straw were followed the order that Sewage sludge > urban compost > FYM, similarly major nutrients uptake (N, P and K) by rice crop was highest at the same treatment in which highest yields were recorded. Since the experimental soil is poor in fertility, combined use of organic and inorganic sources greatly helped the crops through improved nutrition and also by maintaining soil productivity for longer period of time. Hence highest yields of grains and straw, nutrient contents (major) were recorded in the above mentioned treatment.

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