The Andhra Agric. J 58(2):170-173, 2011

Effect of Different Organic Manures on Nutrient Uptake of Rice Grown in Saline Soils with Sub-Surface Drainage System

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ABSTRACT

A field experiment was carried out during *kharif*, 2005 to study the effect of different organic manures (FYM, Poultry manure, Pressmud, Green manure (dhaincha) and Green leaf manure (*Calotropis* sp.) on nutrient uptake of rice grown in saline soil with sub-surface drainage system using rice (var: BPT 1768) as test crop. The experiment was laid out in randomized block design (RBD) with four replications. The results revealed that the highest concentration and uptake of major nutrients viz. N, P and K were recorded with the application of FYM followed by green leaf manure, green manure, pressmud and poultry manure while the highest concentration and uptake of micronutrients viz. Zn, Fe, Mn and Cu were recorded with the application of FYM followed by green leaf manure, green manure, pressmud, poultry manure and control.

Key words : Nutrient uptake, Organic manures, Rice, Saline soils.

The problem of soil salinity is one of the most serious factors restricting crop production, especially in command areas subjected to frequent water logging. In Andhra Pradesh, the command area affected by water logging and salinity are 0.34 and 0.24 m.ha, respectively. The irrigation induced salinity is relatively a recent feature in most of the commands. The impact of irrigation in many areas has caused the ground water table to rise into crop root zone leading to reduction in crop yield.

Apart from reclamation of the saline soils, judicious management of nutrients through inorganic and organic fertilizers is extremely important for improving and maintaining fertility of these soils.

MATERIAL AND METHODS

A field experiment was conducted to study the effect of different organic manures on nutrient uptake of rice grown in saline soils with sub-surface drainage system during *kharif,* 2005. The system, installed with an average drain depth of 1.0 m and drain spacing of 60 m was used as an experimental site. Corrugated PVC pipes enveloped with synthetic geotextile material having pore sizes of 400 microns were used as horizontal collector lines. Soil reaction was 8.8, EC was 5.3 d Sm^{-1} and Organic carbon was 4.4 g kg^{-1}, Available N, P and K were 260.5 27.5 and 450.2 kg ha^{-1}, respectively. The texture of the soil is clay loam with 34.5, 48.0 and 17.5 % of clay, silt and sand, respectively. The hydraulic conductivity of the soil before conducting the experiment was 0.132 m/day.

The experiment was laid out in randomized block design (RBD) with four replications, and it consisted of the following six treatments *viz*., control (T_1), FYM @ 10 t ha^{-1} + RDF (T_2), Poultry manure @ 5 t ha^{-1} (T_3), Press mud @ 5 t ha^{-1} + RDF (T_4), Green manure (dhaincha) @ 40 kg seed ha^{-1} + RDF (T_5) and Green leaf manure (*Calotropis* sp.) @ 5 t ha^{-1} + RDF (T_6). Each treatment was imposed in one acre area and samples were drawn at four places randomly.

Recommended dose of fertilizer (RDF) consisted of 120-60-30 N, P_2O_5 and K_2O kg ha^{-1}, respectively. Half of N and the entire dose of P and K were applied as basal dressing, the rest of N was applied in two split doses at maximum tillering and boot leaf stages of the crop. Nutrients were applied in the form of urea, single super phosphate and muriate of potash to supply N, P and K, respectively. Dhaincha was grown and incorporated into the soil one week before transplanting. Calotropis, FYM, press mud and poultry manure were applied before puddling. The experimental data were analyzed statistically.

RESULTS AND DISCUSSION

N, P and K concentration and uptake

The concentration and uptake of N, P and K, both in grain and straw of rice grown in saline soils increased significantly with the application of organic manures (Table 1& 2).

Nitrogen concentration and uptake in rice grain and straw with the application of organic

Table 1. Effect of different organic manures on N, P & K concentrations (%) at harvest of rice

Treatment	N		P		K	
	Grain	Straw	Grain	Straw	Grain	Straw
T_1 : Control (RDF)	0.80	0.45	0.21	0.07	0.17	1.01
T_2: RDF + FYM @ 10t ha^{-1}	1.30	0.64	0.25	0.10	0.27	1.43
T_3: RDF + poultry manure @ 5t ha^{-1}	0.98	0.50	0.23	0.08	0.23	1.13
T_4: RDF + pressmud @ 5t ha^{-1}	1.03	0.53	0.22	0.08	0.23	1.20
T_5: RDF + green manure (Dhaincha) @ 40kg seed ha^{-1}	1.18	0.58	0.23	0.09	0.25	1.32
T_6: RDF + green leaf manure (*Calotropis* spp.) @ 5t ha^{-1}	1.23	0.60	0.25	0.10	0.26	1.38
SEm $\pm$	0.04	0.02	0.01	0.05	0.01	0.04
CD (0.05%)	0.11	0.06	0.02	0.01	0.03	0.13

manure increased significantly over control. The percentage increase of N concentration and uptake in grain and straw over the control ranged from 11.11 to 42.22, 22.50 to 62.50, 12.43 to 61.73 and 31.16 to 92.74, respectively. The highest nitrogen concentration and uptake in rice grain and straw recorded with the addition of FYM followed by green leaf manure and green manure, which were significantly higher than pressmud. Nitrogen concentration and uptake by the addition of poultry manure though significantly higher than control was on a par with the pressmud. The increased nutrient uptake in the treatments receiving organic manures might be due to the higher availability of nutrients from the native as well as mineralization of organic manures which enhanced the concentration of nutrients in readily available form for absorption. These results are in accordance with those reported by Basker, (2003) and Reddy *et al*., (2006).

The percentage increase of P concentration and uptake in grain and straw ranged from 14.29 to 42.86, 4.76 to 19.05, 5.12 to 51.97 and 12.83 to 34.32, respectively (Table 1 and Table 2). Addition of organic manures except pressmud increased P concentration significantly over control, significantly high concentration and uptake of P in straw were recorded the treatments received FYM & green leaf manure compared to green manure, poultry manure and pressmud , which were on par with each other. P uptake by grain recorded by the addition of FYM and green leaf manure was on par with each other and significantly higher than green manure with the addition of pressmud and poultry manure though on par with each other but significantly lower than green manure.

The percentage increase of K concentration and uptake in grain ranged from 11.89 to 41.58 and 13.21 to 60.94, respectively (Table 1 and 2). Addition of organic manures increased the potassium concentration and uptake by grain and significantly superior over control. The highest concentration and uptake was recorded by the addition of FYM followed by green leaf manure and green manure, which were on par with each other. The uptake by grain with the addition of pressmud and poultry manure was on a par with each other, but significantly lower than that of the other three treatments.

Potassium concentration and uptake recorded by straw was higher than grain. The percentage increase of K concentration and uptake by straw ranged from 35.29 to 58.82 and 37.07 to 76.22, respectively. Addition of organic manure increased the K concentration significantly over control except the treatment, which received poultry manure. The highest K content was recorded with the addition of FYM followed by green leaf manure and green manure, which were on a par with each other and significantly higher than pressmud and poultry manure.

Addition of organic manure increased the potassium uptake significantly over control. The highest uptake was recorded by the addition of FYM, which was significantly higher than that of green leaf manure followed by green manure, the later two treatments were on a par with each other. K uptake by the addition of pressmud and poultry manure was

Table 2. Effect of different organic manures on N, P & K uptake (kg ha^{-1}) by straw and grain of rice

Treatment	N uptake		P uptake		K uptake	
	Grain	Straw	Grain	Straw	Grain	Straw
T_1 : Control (RDF)	43.00	29.68	11.77	5.08	9.63	66.62
T_2: RDF + FYM @ 10t ha^{-1}	82.88	48.00	15.81	7.72	16.97	107.22
T_3: RDF + poultry manure @ 5t ha^{-1}	56.40	33.37	13.28	5.34	13.20	75.42
T_4: RDF + pressmud @ 5t ha^{-1}	61.52	36.05	13.62	5.61	13.94	81.62
T_5: RDF + green manure (Dhaincha) @ 40kg seed ha^{-1}	71.10	40.64	14.46	6.12	15.56	92.50
T_6: RDF + green leaf manure (*Calotropis* spp.) @ 5t ha^{-1}	75.28	42.06	15.38	6.86	15.78	96.73
SEm ±	2.38	1.31	0.28	0.14	0.60	2.80
CD (0.05%)	7.18	3.96	0.84	0.42	1.82	8.44

Table 3. Effect of different organic manures on micronutrients concentration (ppm) in grain and straw of rice

Treatment	Zn		Fe		Mn		Cu	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1 : Control (RDF)	7.55	12.87	24.26	33.88	5.00	7.25	12.87	2.14
T_2: RDF + FYM @ 10t ha^{-1}	24.00	30.00	53.62	63.38	8.25	16.13	30.00	5.05
T_3: RDF + poultry manure @ 5t ha^{-1}	12.50	18.37	28.00	36.62	5.63	9.08	18.37	2.90
T_4: RDF + pressmud @ 5t ha^{-1}	17.25	19.50	37.97	40.87	6.25	11.5	19.50	3.50
T_5: RDF + green manure (Dhaincha) @ 40kg seed ha^{-1}	20.00	25.75	45.16	47.52	6.75	13.25	25.75	4.25
T_6: RDF + green leaf manure (*Calotropis* spp.) @ 5t ha^{-1}	22.50	28.00	49.25	59.05	7.25	14.40	28.00	4.75
SEm ±	0.62	0.47	1.51	2.04	0.76	0.46	0.09	0.08
CD (0.05%)	1.86	1.41	4.54	6.16	2.29	1.39	0.27	0.25

on a par with each other, but significantly lower than that of green manure. The higher uptake of potassium registered by the addition of organic manures might be due to solubilising effect besides the decomposition of native K minerals.

Higher uptake of N, P and K with the addition of green leaf manure and green manure might be due to the production of organic acids during the process of decomposition. Similar results were also reported by Bhindra and Thakur, (1996) and Tiwari *et al.*, (2000).

Zn, Fe, Mn and Cu concentration and uptake

The concentration and uptake of Zn, Fe, Mn and Cu in grain and straw of rice in saline soils increased significantly with the addition of organic manures (Table 3 & 4).

The concentration of Zn in straw and grain ranged from 12.87 ppm to 30.00 ppm and 7.55 ppm to 24.00 ppm, Fe concentration from 33.88 ppm to 63.38 ppm and 24.26 ppm to 53.62 ppm, Mn from 7.25 ppm to 16.13 ppm and 5.00 ppm to 8.25 ppm and Cu concentration 2.14 ppm to 5.05 ppm and 12.87 ppm to 30.00 ppm, respectively.

Table 4. Effect of different organic manures on micronutrients uptake (g ha^{-1}) at harvest of rice.

Treatment	Zn		Fe		Mn		Cu	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1 : Control (RDF)	40.59	84.89	130.42	223.47	26.90	47.82	12.10	14.11
T_2: RDF + FYM @ 10t ha^{-1}	153.10	224.97	341.88	475.29	52.60	120.95	23.91	37.87
T_3: RDF + poultry manure @ 5t ha^{-1}	71.60	122.60	160.33	244.40	32.20	60.60	16.03	19.35
T_4: RDF + pressmud @ 5t ha^{-1}	103.10	129.58	226.83	278.00	37.30	78.22	17.62	23.81
T_5: RDF + green manure (Dhaincha) @ 40kg seed ha^{-1}	120.52	180.50	272.13	333.02	40.60	92.86	18.70	29.78
T_6: RDF + green leaf manure (*Calotropis* spp.) @ 5t ha^{-1}	137.80	196.31	301.50	414.00	44.30	100.96	21.43	33.30
SEm $\pm$	2.43	3.73	8.25	14.18	1.63	3.30	0.65	0.97
CD (0.05%)	7.32	11.23	24.84	42.73	4.92	9.95	1.95	2.93

Uptake of Zn, Fe, Mn and Cu significantly increased over control. Uptake of Zn by straw and grain ranged from 84.89 to 224.97 and 40.59 to 153.10, Fe from 223.47 to 475.29 and 130.42 to 341.88, Mn from 47.82 to 120.95 and 26.90 to 52.60 and Cu from 14.11 to 37.87 and 12.10 to 23.91 g ha^{-1}, respectively.

The highest concentration and uptake of Zn, Fe, Mn and Cu were recorded with the application of FYM followed by green leaf manure, green manure, pressmud, poultry manure and control. Higher uptake of micronutrient cations in the treatments receiving organics might be due to the enhanced microbial activity in the soils, which helped in the formation of chelating agents besides preventing micronutrients from precipitation, oxidation and leaching.

Complexing properties of organic manures prevent precipitation and fixiation and keep in soluble forms which enable the plant for more absorption (Suvarna Latha, 2001). The plants grown on saline environment contained higher amounts of Fe, Zn and Mn content in plant due to increased moisture content above some critical limits in heavy textured saline soils and decrease the oxygen diffusion rate and redox potential.

From these results, It could be concluded that the concentration and uptake of N, P, K and micronutrient cations both in grain and straw of rice were improved significantly due to the application of organic manures in saline soils.

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(Received on 17.01.2011 and revised on 11.05.2011)