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Yield and Nutrient Uptake of Rice (*Oryza sativa* L.) as Influenced by Interventions in Nutrient Management under the System of Rice Intensification

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ABSTRACT

Field experiment conducted at the Agricultural College Farm, Bapatla on sandy clay soils showed significant variations in grain yield, straw yield and harvest index with the interventions in nutrient management for rice under the System of Rice Intensification. Better grain yield, straw yield and harvest index were recorded with the application of 125% Recommended Dose of Fertilizer (RDF) for Conventional Rice (CR) along with 10 t or 5 t FYM ha^{-1}. Uptake of nutrients (NPK) measured at all the sampling intervals significantly affected by interventions in nutrient management and followed the trend shown by dry matter accumulation and yield. At all the stages, higher uptake was recorded by the application of 125% RDF for CR along with 10 t FYM ha^{-1}, which was closely followed by that of the same level of RDF with 5 t FYM ha^{-1}.

Key words : Grain Yield,Nutrient Management, Nutrients Uptake, Rice, System of Rice Intensification

Rice (*Oryza sativa* L.), the oldest staple food crop, feeds over half of the world population. Although, the total planted area under rice is smaller than either wheat or maize, it plays a pivotal role in providing 700 calories day^{-1} $person^{-1}$ for about 3000 million people, most of whom live in developing countries (www.fao.org). Though India ranks first in area but next only to China in productivity of rice. High population, growth rate in India compared to that of China necessitates development of improved management practices to increase rice productivity in India. Among the management practices, nutrient management deserves special attention for both economic as well as environmental concerns in rice cultivation (www.fao.org). Therefore, the present study was carried out with an objective to study the influence of integrated nutrient management on rice under the System of Rice Intensification (SRI) has any influence on the yield and nutrient uptake of rice.

MATERIAL AND METHODS

The field experiment was conducted at the Agricultural College Farm, Bapatla during *rabi* 2005-06. The soil was sandy clay loam with 7.6 pH; 0.24 dS m^{-1} E. C. ; 0.32% organic carbon ; 160 kg ha^{-1} available N; 16 kg P_2O_5 ha^{-1} available P and 320 kg K_2O ha^{-1} available K. The study comprised ten treatments *viz.,* T_1: 10 t FYM ha^{-1} alone; T_2: 100% recommended dose of fertilizer for conventional rice ; T_3 : 50% RDF for CR + 10 t FYM ha^{-1}; T_4 : 75% RDF for CR + 10 t FYM ha^{-1}; T_5 : 100% RDF for CR + 5 t FYM ha^{-1}; T_6 : 100% RDF for CR + 10 t FYM ha^{-1}; T_7 : 125% RDF for CR; T_8 : 125% RDF for CR + 5 t FYM ha^{-1}; T_9 : 125% RDF for CR + 10 t FYM ha^{-1} and T_{10} : Control (no FYM or fertilizer). Recommended dose of fertilizer to conventional rice was 120-60-40 N-P_2O_5-K_2O ha^{-1}. All the ten treatments were arranged in a randomized block design with three replications. All the P and K fertilizers were applied as basal and N was applied in three splits as per treatments *i.e.,* ½ basal and remaining half in two equal splits at maximum tillering and panicle initiation stages. Nursery was raised in zinc trays and 8-day old seedlings were transplanted. Soil was kept saturated but not inundated. Weeding was done with rotary weeder with 10 days interval for 4 times starting from 10days after planting (DAP). The whole FYM applied as basal as per treatments. All the other cultural practices recommended for SRI were followed

RESULTS AND DISCUSSION

Large variation in grain yields *i.e.,* from 1774 kg ha^{-1} to 7173 kg $ha^{-1}$was noticed across the treatments imposed showing the scope for increase in yields with the supply of nutrients from both fertilizer and FYM even under the SRI like that of conventional cultivation. Further, the results indicated that higher productivity comes from adequate supply of nutrients even under SRI. As a result, the treatments which received 125% RDF

Table 1. Yield of rice as influenced by integrated nutrient management.

Treatments		Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
T_1 :	10 t FYM ha^{-1} alone	2332	3551	39.5
T_2:	100% RDF for CR	2860	4289	40.1
T_3 :	50% RDF for CR +10 t FYM ha^{-1}	3228	4844	40.0
T_4:	75% RDF for CR +10 t FYM ha^{-1}	3703	5373	40.8
T_5 :	100% RDF for CR + 5 t FYM ha^{-1}	4427	6180	41.7
T_6:	100% RDF for CR + 10 t FYM ha^{-1}	4968	6440	43.5
T_7 :	125% RDF for CR	5496	7523	42.2
T_8:	125% RDF for CR + 5 t FYM ha^{-1}	6680	7786	46.1
T_9 :	125% RDF for CR +10 t FYM ha^{-1}	7173	8098	47.9
T_{10}:	Control (no FYM or fertilizer)	1774	3053	37.3
	SEm ±	223.73	369.16	0.77
	C D (P-0.05)	665	1097	2.3
	CV (%)	9.1	11.2	3.2

RDF: Recommended dose of fertilizer FYM: Farm yard manure
CR : Conventional rice

for CR along with 5 t (T_8) or 10 t (T_9) FYM ha^{-1} recorded the highest grain and straw yields .The better plant growth and dry matter accumulation supported for higher yield attributes and hence, recorded with those treatments increased yields of those (T_8 and T_9) treatments. Harvest index harmonized the same trend that was observed in grain and straw yields (Table 1). The results obtained in the study are in conformity with Mathew (1996); Dahiphale *et al.* (1999) in conventional rice cultivation and Robert Randriamibarisoa (2001), Joeli Barison (2002) in SRI method of cultivation.

Nitrogen uptake (kg ha^{-1}) recorded at various intervals during rice crop growth was significantly influenced by the nutrient management treatments (Table 2). At 30 DAP, though the highest N uptake was recorded by the treatment (T_9) that received 125% RDF for CR along with 10 t FYM ha^{-1}, it was on a par with that recorded by those treatments which received 125% RDF for CR with 5 t FYM ha^{-1} (T_8), 125% RDF for CR (T_7) and 100% RDF for CR with 10 t FYM ha^{-1} (T_6). Rest of the treatments behaved alike in recording N uptake. The lowest N uptake, however, was registered in control treatment (T_{10}) which received neither FYM nor fertilizer and remained comparable with that registered by the treatments, which received 10 t FYM ha^{-1} alone (T_1) and 100% RDF for CR alone (T_2). At 60 DAP; the highest N uptake was recorded with the application of 125% RDF for CR along with 10 t (T_9) or 5 t FYM ha^{-1} (T_8) among all the treatment in the study. The rest of the treatments were found almost equally effective increasing N uptake by rice. The lowest N uptake was recorded by the control treatment (T_{10}), which received neither FYM nor fertilizer. At 90 DAP, the N uptake followed the similar trend as that observed at 60 DAP.

Phosphorus uptake (kg ha^{-1}), measured at various growth intervals, was significantly influenced by various treatments imposed (Table 2) . At 30 DAP, the highest P uptake was recorded by the treatment that received 125% RDF for CR along with 10 t FYM ha^{-1} (T_9), which was found on a par with that treatments, which received 125% RDF for CR with 5 t FYM ha^{-1} (T_8), 100% RDF for CR (T_7), 100% RDF for CR with 5 t (T_5) or 10 t (T_6) FYM ha^{-1} and 75% RDF for CR with 10 t FYM ha^{-1} (T_4). The lowest P uptake was recorded by the control treatment (T_{10}) that received neither FYM nor fertilizer, which was closely followed by that of the treatment (T_1) received 10 t FYM ha^{-1}.At 60 DAP, the highest P uptake was noticed in treatment (T_9) that received 125% RDF for CR together with 10 t FYM ha^{-1}, which was comparable with that of the treatment (T_8) that received same level of RDF for CR with 5 t FYM ha^{-1}. Similarly, the P uptake in T_7 and T_6 treatments was also statistically equal. These treatments, T_9, T_8, T_7 and T_6, were significantly superior to rest of the treatments in increasing P uptake. Significantly the lowest P uptake was recorded in treatment (T_{10}) that

Table 2. Nitrogen, phosphorus and potassium uptake(kg ha^{-1}) by rice as influenced by nutrient management practices under the SRI

Treatments	Nitrogen				Phosphorus				Potassium			
	30 DAP	60 DAP	90 DAP	Maturity	30 DAP	60 DAP	90 DAP	Maturity	30 DAP	60 DAP	90 DAP	Maturity
T_1 :10 t FYM ha^{-1} alone	12.2	23.7	39.7	46.8	4.4	7.3	12.4	17.9	11.7	32.2	51.3	76.5
T_2 :100% RDF for CR	13.9	32.0	46.2	53.9	5.2	8.2	13.4	19.2	12.3	36.6	55.5	86.4
T_3 :50% RDF for CR + 10 t FYM ha^{-1}	15.4	41.1	57.6	66.6	5.7	9.3	15.4	21.3	14.2	37.4	63.4	95.8
T_4 :75% RDF for CR + 10 t FYM ha^{-1}	16.1	53.0	72.4	85.0	6.1	10.2	16.0	23.6	15.5	38.2	67.5	102.3
T_5 :100% RDF for CR + 5 t FYM ha^{-1}	18.6	63.4	83.0	99.0	6.3	10.7	18.3	25.8	17.3	38.7	72.0	114.7
T_6 :100% RDF for CR + 10 t FYM ha^{-1}	20.7	75.2	100.3	108.4	5.9	12.7	19.7	29.3	18.6	43.5	76.9	120.3
T_7 :125% RDF for CR	21.7	88.6	107.3	120.8	6.4	13.3	20.3	29.9	19.2	46.2	79.6	125.2
T_8 :125% RDF for CR + 5 t FYM ha^{-1}	23.1	102.5	119.1	146.7	6.5	14.7	20.6	30.4	19.8	50.1	82.0	131.1
T_9 :125% RDF for CR + 10 t FYM ha^{-1}	23.7	105.2	130.3	161.8	6.7	16.3	22.2	34.1	22.1	54.9	86.1	139.8
T_{10} :Control (no FYM or fertilizer)	9.0	16.6	29.4	33.9	4.1	6.4	12.0	15.9	10.6	28.1	47.5	68.5
SEm ±	1.51	1.87	2.86	3.53	0.19	0.37	0.42	0.74	0.41	0.87	1.24	2.59
C D (P-0.05)	4.5	5.6	8.5	10.5	0.6	1.1	1.3	2.3	1.2	2.6	3.7	7.7
CV (%)	15.0	5.4	6.3	14.2	5.6	5.8	4.3	10.9	4.4	3.7	3.2	8.8

DAP: Days after planting

received neither FYM nor fertilizer and remained on a par with that of the treatment (T_1) that received 10 t FYM ha^{-1} alone. At 90 DAP and at maturity as well as, the uptake of P by grain and straw followed almost similar trend observed at 60 DAP.

Potassium (kg ha^{-1}) uptake at various stages of crop growth was significantly influenced by the treatments (Table 2). At 30 DAP; significantly the highest K uptake was registered in treatment (T_9) that received 125% RDF for CR together with 10 t FYM ha^{-1}. Uptake of K in T_7 and T_8 treatments was statistically equal. However, these T_9, T_8 and T_7 treatments were significantly superior to the rest of the treatments in increasing K uptake. Significantly the lowest K uptake was recorded in the control (T_{10}), which was comparable with that of the T_1 treatment. At 60 DAP, 90 DAP and at maturity also, uptake of K resulted in different treatments which followed the similar trend observed at 30 DAP with only one exception of recording significantly the lowest K uptake in the control treatment (T_{10}).

Nutrient (NPK) uptake was also significantly affected by interventions in nutrient management. Better uptake of NPK at all stages was found with the application of 125% RDF for CR along with 5 t (T_8) or 10 t FYM ha^{-1} (T_9). The high rate of nutrient application coupled with better root system noticed in these treatments might have supported for better nutrient uptake. Addition of FYM in addition to fertilizer might have reduced the N losses. Further, the FYM might have helped in releasing P from fixed sources (Antil *et al.,* 1995). Higher NPK uptake due to the combined application of organic and inorganic sources was also reported by Ram *et al.* (2000); Sairam and Reddy (2004) in conventional rice cultivation and by Joeli Barison (2002) and Norman Uphoff and Robert Randriamibarisoa (2002) in SRI cultivation which supported the present results. Higher uptake was recorded by the application of 125% RDF for CR along with 10 t FYM ha^{-1}. Addition of FYM, irrespective of the rate of fertilizer application, proved better in acquisition of nutrients.

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