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Effect of incremental doses of fertilizers on nutrient uptake and quality parameters of Kharif rice, *Oryza sativa* L on deltaic soils of Andhra Pradesh

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ABSTRACT

Field experiments were conducted on rice, *Oryza sativa* L for three consecutive Kharif seasons viz 2006, 2007 and 2008 on Godavari alluvials (Vertic chromusters) at Andhra Pradesh Rice Research Institute, Maruteru with an objective to study the effect of incremental doses of major fertilizers on Kharif rice in Krishna Godavari delta regions of AP. Incremental doses of N, P and K over the recommended doses recorded significant improvement in uptake, post soil nutrient status and grain quality parameters. Increase in N dose by 25 per cent over recommended dose increased the uptake of P and K conspicuously besides increase in uptake of N. Similarly increase in K dose by 25 per cent resulted in marked improvement in N uptake also. The status of available P and K was significantly improved by enhancing P and K levels to 150 per cent from 100 per cent in case of potassium and both the levels of 100 per cent and 125 per cent with regard to phosphorus. There was the buildup of available P and K in soil by increasing P and K dose by 50 per cent and above over present recommendation. Grain quality in terms of grain protein content increased progressively with the incremental doses of N and P. The milling characters were significantly influenced by incremental doses of N, P and K. Hulling (%) was significantly improved up to first incremental dose of N (125%). The milling (%) and per cent head rice recovery increased N up to 50 per cent though the differences were conspicuous up to 25 per cent N increase.

Keywords: Rice; incremental doses; nutrient uptake; grain

INTRODUCTION

With the advent of modern production technology the usage of higher doses of fertilizers in balanced manner is inevitable to exploit their full potential particularly under irrigated conditions. Modern high yielding varieties of rice producing around 5 tonne/ha of grain can remove about 110 kg N, 15 kg P 129 kg K, 5 kg S, 2 kg Fe, 2 kg Mn, 200 g Zn and 150 g B per ha from the soil. The depletion of nutrient reserves in the soil is a major but often hidden form of land degradation. Application of inadequate and imbalanced fertilization to crops not only results in low

crop yields but also deteriorates the soil health (Sharma et al 2003). It is worth finding the effect of incremental doses of nutrients on the nutrient uptake by rice crop and the resultant nutrient status of soil besides grain quality parameters. In view of the above a study was conducted to review the effect of incremental nutrient doses on the nutrient uptake by the Kharif rice grown in delta soils of Andhra Pradesh and also the resultant soil nutrient status and grain quality of rice.

MATERIAL AND METHODS

Field experiments were conducted on rice, Oryza sativa L for three consecutive Kharif seasons of 2006, 2007 and 2008 on Godavari alluvials (Vertic chromusters) at Andhra Pradesh Rice Research Institute, Maruteru, Andhra Pradesh, India (26.38^0 N, $84. 44^0$ E and 5 m above mean sea level). The soil was clay loam having pH 7.1, CEC of 42 meq/100g of soil, organic carbon 0.9 per cent, available nitrogen 297 kg/ha, available P 16.3 kg/ha and K 227 kg/ha. The trial was conducted in randomized block design with three replications and ten treatments consisting of different levels of NPK (kg/ha) viz 60-40-40, 75-40-40, 90-40-40, 105-40-40, 60-50-40, 60-60-40, 60-70- 40, 60-40-50, 60-40-60 and 60-40-70. The 26 days old seedlings of variety MTU 1061 (145 days duration) were planted at a spacing of 20 x 15 cm with 2-3 seedlings per hill. Weeds were controlled by application of pre-emergence herbicide Pretilachlore @ 0.75 kg ai per hectare followed by one hand weeding at 40 days after transplanting. Water was maintained at a depth of 2 cm up to panicle initiation and 5 cm thereafter up to one week before harvest. The field was drained before application of fertilizers and one week before harvest. Fertilizers were applied as per the requirement treatment through urea, SSP and MOP. Entire doses of P and K and 1/3 recommended dose of N were applied as basal dose and remaining N was applied in two splits at active tillering and panicle initiation. The experiments received uniform plant protection and cultural management practices throughout the period of crop growth. Data on N, P and K uptake by the crop and grain quality were collected following standard procedures from 10 randomly marked hills. The surface soil samples from 0 to 15 cm depth before and after the harvest of the crop were collected and analyzed for the postharvest nutrient status. Data were analyzed using ANOVA and the significance was tested by Fisher's least significance difference ($p= 0.05$) by pooling three years data.

RESULTS AND DISCUSSION

N, P and K uptake

The uptake studies of N, P and K at harvest showed that incremental doses of N, P and K recorded significantly progressive improvement in uptake of respective nutrients (Table 1). Increased

Table 1. Effect of incremental doses of N, P and K on N, P and K uptake by rice and postharvest available soil nutrient status (pooled data of three years)

Treatment N, P, K (kg/ha)	Organic carbon (%)	Available status (kg/ha)			Uptake at harvest (kg/ha)		
		N	P	K	N	P	K
60-40-40	0.90	265	16.20	234	70.26	26.04	114
75-40-40	0.90	268	16.16	224	81.65	30.01	133
90-40-40	0.91	273	15.92	220	88.62	32.43	142
105-40-40	0.93	282	15.82	214	93.52	34.13	149
60-50-40	0.90	265	16.73	229	72.51	32.32	113
60-60-40	0.91	266	17.75	223	76.97	35.90	124
60-70-40	0.91	262	18.09	222	78.87	37.85	131
60-40-50	0.91	263	16.29	244	75.15	27.48	144
60-40-60	0.91	262	15.56	255	79.06	28.82	170
60-40-70	0.91	263	15.28	263	82.23	29.63	191
SEm ±	0.01	5.31	0.68	11	1.14	0.62	3.92
$CD_{0.05}$	0.02	16	2.01	32	3.38	1.83	12

nutrient absorption by rice with increased fertilizer doses has also been reported by Singh and Namdeo (2004). Increase in N dose by 25 per cent over recommended dose increased the uptake of P and K conspicuously besides increase in uptake of N. Similarly increase in K dose by 25 per cent resulted in marked improvement in N uptake also. Similar results of increase in K content and uptake due to increase in N level, increase in N content and uptake with increase in P and K levels were reported by Singh et al (2005). Application of additional doses of fertilizers enriches the available nutrient status and consequently results in higher nutrient uptake.

Postharvest N, P, K and organic carbon status

Incremental doses of N, P and K did not alter the status of available N except at 75 per cent increase of N. The status of available P and K was significantly improved by enhancing P and K levels to 150 per cent from 100 per cent in case of potassium and both the levels of 100 per cent and 125 per cent with regard to phosphorus. There was the buildup of available P and K in soil by increasing P and K dose by 50 per cent and above over present recommendation. This might be due to the fact that higher doses of fertilizers only can satisfy the sorption sites of clay surfaces and are able to build up the status of potassium.

Grain quality

Grain quality in terms of grain protein content increased progressively with the incremental doses of N and P. However this increase was measurable at increase in N and P dose by 50 per cent (Table 2). This might be due to higher availability of N and P in plant and in grain for more assimilation of nitrogen and protein synthesis. Though the differences were not conspicuous the grain protein content decreased progressively with incremental doses of K which probably was due to dilution effect of potash. The milling characters were significantly influenced by incremental doses of N, P and K (Table 2). Hulling (%) was significantly improved up to first incremental dose of N (125%) and further increase in N reduced the hulling percentage to a little extent. Though incremental doses of P and K progressively increased the hulling yet the differences were measurable up to first increment only. The milling (%) and per cent head rice recovery increased N up to 50 per cent though the differences were conspicuous up to 25 per cent N increase. It is known that protein content imparts strength to the grain. Higher protein content thus resulted in higher head rice recovery. Significant increase in hulling percentage and head rice recovery due to increase of N dose from 40 to 80 kg/ha was also reported by Adhikari et al (2005). Incremental doses of P and K progressively

Table 2. Effect of incremental doses of N, P and K on protein content and milling characters of rice (pooled data of three years)

Treatment N,P, K (kg/ha)	Protein content (%)	Hulling (%)	Milling (%)	Head rice recovery (%)
60-40-40	7.81	77.2	66.5	53.9
75-40-40	8.11	80.0	68.8	57.4
90-40-40	8.32	79.2	69.1	58.5
105-40-40	8.64	76.9	68.0	57.1
60-50-40	8.00	80.5	69.3	57.1
60-60-40	8.37	81.8	70.1	58.7
60-70-40	8.75	82.0	71.6	59.2
60-40-50	7.80	81.0	72.2	59.5
60-40-60	7.71	82.2	73.7	61.8
60-40-70	7.54	82.7	75.2	63.0
SEm ±	0.14	0.86	0.68	0.98
$CD_{0.05}$	0.41	2.5	2.0	2.9

enhanced the milling (%) and per cent head rice recovery up to third increment (75% increase) though the improvement was noticeable up to first increment.

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