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Uptake of major nutrients by rice (*Oryza sativa* L.) as influenced by different levels of potassium and green manure at harvest stage

DV Sujatha*, P Kavitha, MVS Naidu and P Uma Maheswari

Agricultural College, Mahanandi, Kurnool, ANGRAU, Andhra Pradesh, India

**Corresponding author e-mail: sujathadwaram42@gmail.com*

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ABSTRACT

A field experiment was conducted during kharif, 2015 at Agricultural college farm, Mahanandi to study the concentration and uptake of major nutrients by rice as influenced by green manure and different levels of potasium at harvest stage. The results revealed that yield, concentration and uptake of major nutrients by rice were increased with increasing levels of potassium up to 120 kg K_2O ha^{-1}. However, there were no statistical differences between three levels of K 40, 80 and 120 kg K_2O ha^{-1} in increasing yield, concentration and uptake of major nutrients. Application of green manure in situ (G.M) in combination with K recorded higher values of above mentioned parameters than when applied alone. The higher concentration and uptake of major nutrients were obtained with GM+120 kg K_20 ha^{-1} which was on par with GM+80 kg K_20 ha^{-1} and GM+40 kg K_20 ha^{-1}.

Key words: *Rice, green manure, yield, uptake of major nutrients*

Rice is an important food crop in the world. It is the staple food in South-East Asia and at present more than half of the world population depends on this crop. It is also one of the most important cereals in India and occupies second position in cultivation after wheat. Rice is one of the major field crops in Kurnool district and the crop is cultivated in an area of 91,568 ha (Department of Agriculture 2014). Incorporation of dhaincha at flowering stage before transplanting of rice was followed by most of the farmers in major rice growing areas of Kurnool district. The available potassium content was increased by the incorporation of dhaincha (Singh *et al*. 2009 and Singh *et al*. 2006). Hence judicious application of potassic fertilizer is required for better crop production were reported by Prasad (2014) and Swamanna (2015). Though much work has been reported on green manure in combination with N and P in rice crop but no investigation have been carried out in green manure along with K fertilizer of rice crop. Hence, present investigation will be carried out to know the yield, dry matter production, concentration, uptake of major nutrients and economics of rice as influenced by the different levels of potassium and green manure.

A field experiment was conducted at Agricultural College Farm, Mahanandi in Kurnool district of Andhra Pradesh during Kharif, 2015. The soils of experimental field was sandy loam with soil pH 7.97, EC 0.33 dSm^{-1}, organic carbon 0.55%, low in available N (239 kg ha^{-1}), high in P_2O_5 (82 kg ha^{-1}) and K_2O (1075 kg ha^{-1}) respectively. The eight treatments consisted of 0, 40, 80 and 120 kg K_2O ha^{-1} alone and in combinations with green manure, which were laid out in randomized block design and replicated thrice. Nitrogen in the form of urea was applied in three equal splits as basal, at tillering and at panicle initiation stages. Phosphorus in the form of single super phosphate was applied basally. Potassium in the form of muriate of potash was applied in two equal splits as basal and at panicle initiation stage as per the treatments. Green manure (dhaincha @ 5t ha^{-1}) was grown in the treatments T_5, T_6, T_7 and T_8 ploughed *in situ* at flowering one week before transplanting. The content of N, P and K in green manure was 3.5 %, 0.3 % and 1 % respectively. Plants samples were collected by

destructive sampling at tillering and panicle initiation stage in m^{-2} area in each plot. At harvest stage the grains from each net plot was cleaned and sun dried until constant weight was recorded and expressed in kg ha^{-1} and the straw in each plot was allowed to dry in the field until a constant weight obatained and the field weight was recorded and expressed in kg ha^{-1}. The collected plants were dried in oven at 65^0C till constant weights recorded and expressed in kg ha^{-1}. After recording the dry weights, the straw and grain samples were grounded in a willey mill and were analyzed for the concentrations of major nutrients as per the procedures out lined by Tandon (1993). The uptakes of major nutrients were computed with using the formula:

$$\text{Uptake of nutrients (kg ha}^{-1}) = \frac{\text{Nutrient concentration (\%) x wt. of dry matter (kgha}^{-1})}{100}$$

Yield

All the treatments recorded significantly higher grain and straw yield than control except T_2 (40 kg K_2O ha^{-1}) (Table 1). Grain and straw yield increased with increasing levels of K up to 120 kg K_2O ha^{-1}. However, there was no statistical difference between the three levels of K (40, 80 and 120 kg K_2O ha^{-1}) in increasing grain and straw yield. The increased grain and straw yield by the application of K fertilizer was due to the continuous supply of K during crop growth period which might be due to increased number of total tillers, dry mater accumulation, effective tillers, number and weight of filled grains. These findings are in close conformity with those of Meena *et al*. (2003).

Application of green manure in combination with K recorded higher grain and straw yield than when applied alone. The highest grain and straw yield were obtained with T_8 (GM + 120 kg K_2O ha^{-1}), but which were on par with T_7 (GM + 80 kg K_2O ha^{-1}) and T6 (GM + 40 kg K_2O ha^{-1}). Green manure in combinations with K fertilizers increased the grain yield due to long stature of plants, higher number of tillers m^{-2}, higher dry matter production. Green manure in combinations with K fertilizers increased the straw yield due to the highest plant height and dry matter production were associated with these treatment. This might be due to immediate release of nutrients through inorganic sources and later by mineralization of nutrients through green manure leading to steady supply of nutrients. Similar findings were reported by Sharma *et al*. (2001) .

Nitrogen concentration and uptake

Application of K fertilizers gradually increased the concentration and uptake of nitrogen in both grain and straw up to 120 kg K_2O ha^{-1} (Table 1). However, 80 and 120 kg K_2O ha^{-1} both are equally effective in increasing in concentration and uptake in grain and straw of rice crop. The higher values of concentration and uptake of nitrogen with K addition could be attributed to enhanced vigour of crop growth with

Table 1. Effect of different levels of potassium and green manure on Yields, N, P, K Concentration and Uptake of paddy at harvest stage

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Concentration (% N)		Uptake of N (kg ha^{-1})		Concentration (% P)		Uptake of P (kg ha^{-1})		Concentration (% K)		Uptake of K (kg ha^{-1})	
			Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1 : (Control)	5008	6173	1.28	0.55	64.28	33.85	0.24	0.14	12.01	8.84	0.32	1.31	15.93	80.87
T_2 : 40 kg K_2O ha^{-1}	5281	6716	1.47	0.74	77.75	49.85	0.31	0.17	16.56	11.41	0.33	1.36	17.26	91.34
T_3 : 80 kg K_2O ha^{-1}	5433	7664	1.50	0.92	81.51	70.55	0.34	0.18	17.75	14.05	0.36	1.36	19.56	104.44
T_4 : 120 kg K_2O ha^{-1}	5517	7830	1.61	0.97	88.95	76.69	0.35	0.19	19.30	15.11	0.38	1.40	20.76	112.68
T_5 : GM (dhaincha) in situ only	5473	8979	1.65	1.02	90.14	93.51	0.37	0.24	20.43	21.65	0.39	1.49	21.51	133.41
T_6 : GM+ 40 kg K_2O ha^{-1}	5551	9617	1.73	1.06	96.17	102.19	0.39	0.25	21.81	24.04	0.40	1.56	22.39	149.05
T_7 : GM+ 80 kg K_2O ha^{-1}	5671	10403	1.99	1.09	110.62	113.54	0.40	0.29	23.42	30.45	0.48	1.57	27.03	163.37
T_8 : GM+ 120 kg K_2O ha^{-1}	5748	10931	2.03	1.11	116.87	120.02	0.43	0.31	24.72	33.68	0.49	1.60	28.17	176.83
SE(m)±	95	465	0.05	0.06	3.09	3.88	0.01	0.01	0.49	1.35	0.01	0.01	0.52	6.88
CD(p=0.05)	292	1424	0.14	0.18	9.46	11.87	0.03	0.02	1.50	4.15	0.02	0.04	1.58	21.08
CV %	3.0	7	4.73	10.66	5.89	8.14	8.99	4.76	4.34	11.79	3.17	1.64	4.14	9.42

increased nitrogen utilization and translocation in to the plant resulting in the enhancement of yield similar findings were also reported by Sharma *et al*. (2003) with potassium application in cauliflower and onion.

Green manure either alone or in combination with K fertilizer showed higher values of nitrogen concentration and uptake both in grain and straw than when K fertilizer alone. The highest concentration and uptake of nitrogen in grain and straw was observed with T_8 (G.M +120 kg K_2O ha^{-1}) but it was on par with T_7 (G.M +80 kg K_2O ha^{-1}). This was attributed to the added advantage that green manure application increased soil physical, chemical and biological properties resulting in creation of favorable conditions suitable for better root growth and proliferation lead to higher absorption of water and nutrients. Due to the steady and continuous availability of nitrogen in the rhizosphere coupled with enhanced dry matter production resulted in higher uptake of nitrogen. These results were in conformity with findings of Singh *et al*. (2002).

Phosphorus concentration and uptake

The concentration and uptake of phosphorus also showed the same trend as that of concentration and uptake of nitrogen in grain and straw (Table 1). The phosphorus concentration increased at 150 % RDK (120 kg K_2O ha^{-1}) over control was 45.83 percent and 35.71 percent in grain and straw respectively. Similar increase in P uptake with increasing levels of K application was reported by Surekha *et al*. (2003).

Similar to N, the P concentration and uptake showed higher values with green manure either alone or in combinations with K fertilizer than K fertilizer alone. The highest concentration and uptake of phosphorus in both grain and straw was observed under T_8 (G.M+120 kg K_2O ha^{-1}), but it was at par with T_7 (G.M + 80 kg K_2O ha^{-1}).The concentration and uptake of P increased due to the application of green manure along with inorganic fertilizer were also reported by Singh *et al*. (2006).

Potassium concentration and uptake

Application of potassium gradually increased the concentration of rice crop at all the stages of crop growth up to 120 kg K_2O ha^{-1} (Table 1). Similar increase in concentration of K due to the levels of K fertilizer application in rice crop was also reported by Surekha *et al*. (2003) and Swamanna (2015).

Green manure either alone or in combination with K fertilizer showed higher values of concentration than K fertilizer alone. The highest potassium concentration was observed under T_8 (G.M +120 kg K_2O ha^{-1}) which was at par with T_7 (G.M +80 kg K_2O ha^{-1}) at all the stages of crop growth.

Uptake of K increased with increase in rates of application of K and also due to green manure incorporation. Among all treatments the highest K uptake was observed with T_8 (G.M +120 kg K_2O ha^{-1}) which was on par with T_7 (G.M +80 kg K_2O ha^{-1}) at all the stages of crop growth.

The increased uptake of N, P and K due to the application of green manure along with K fertilizer might be due to the role of organic matter in supplying nutrients as well as improvement in the physical properties and water holding capacity of soil, which in turn brings the nutrients in to soluble and available form. The positive effects of organic manures on nutrient availability and their extraction due to increased activity of roots seemed to have improved the nutrient status of the plant roots. The variation in N, P and K uptake among different treatments might be due to their inherent capability to supply nutrients during the crop growth period, which in turn influenced the dry matter production and hence nutrients uptake by plants. These results were in accordance with findings of Kavitha and Rao (2010).

The results concluded that the highest yield, concentration, uptake of major nutrients increased with increasing levels of K up to 120 kg K_2O ha^{-1} but significant difference was observed at 80 and 120 kg K_2O ha^{-1}. Application of green manure in combination with K fertilizers recorded higher yield, concentration and uptake of major nutrients were obtained with incorporation of green manure as dhaincha (GM) + 120 kg K_2O ha^{-1} but which was on par with GM+80 kg K_2O ha^{-1} and GM + 40 kg K_2O ha^{-1}. Hence, the incorporation of green manure (dhaincha) at flowering stage before transplanting along with 40 kg K_2O ha^{-1} may be recommended for rice crop. However, the results will have to be confirmed by conducting extensive field trials in farmers fields on long term basis.

REFERENCES

Department of Agriculture, 2014. Annual Report

Kanthi SM, Ramana AV, Murthy KVR and Uma Mahesh V. 2014. Effect of different crop establishment techniques and nutrient doses on growth, yield and economics of rice (*Oryza sativa* L.). The Andhra Agricultural Journal 61(1): 31-34

Kavitha P and Rao KJ 2010. Comparative studies of sewage, sludge, urban compost and FYM on yield parameters, major nutrients uptake and economics of tomato (*Lycopersicon esculentum* mill). Journal of soils and crops 20(2): 183-188

Meena S, Singh S and Shivay YS 2003. Response of hybrid rice (*Oryza sativa L.*) to nitrogen and potassium application in sandy clay loam soils. Indian Journal of Agricultural Sciences 73(1): 8-11

Prasad PNS 2014. Studies on available potassium in rice (*Oryza sativa* L.) growing soils of canal ayacut in Kurnool district. M.Sc Thesis, submitted to Acharya N.G. Ranga Agricultural University. Hyderabad, India

Shama MP, Bali SV and Gupta DK 2001. Soil fertility and productivity of rice-wheat cropping system in an Inceptisol as influenced by integrated nutrient management. Indian Journal of Agricultural Sciences 71: 82-86

Sharma RP, Datt N and Sharma PK 2003. Combined application of nitrogen, phosphorus, potassium and farm yard manure in onion (*Allium cepa*) under high hills, dry temperature condition of North-Western Himalayas. Indian Journal of Agricultural Sciences 73:22-27

Singh RP, Singh PK and Singh AK 2009. Effect of green manuring on physico- chemical properties of soil and productivity of rice. Oryza 48 (2): 120-123

Singh RN, Prasad J and Kumar B 2002. Effect of green manuring, FYM and bio fertilizers in relation to fertilizer nitrogen and major nutrient uptake by upland rice. Journal of the Indian Society of Soil Science 50(1-4): 313-314

Singh S, Singh RN, Prasad J and Singh BP 2006. Effect of integrated nutrient management on yield and uptake of nutrients by rice and soil fertility rainfed uplands. Journal of the Indian Society of Soil Science 54(3): 327-330

Surekha K, Reddy MN, Rao KV and Sta Cruz PC 2003. Evaluation of crop residue management practices for improving yields, nutrient balance and soil health under intensive rice-rice system. Journal of the Indian Society of Soil Science 52(4): 448-453

Swamanna J 2015. Potassium release characterstics and response to potassium application in rice (*Oryza sativa* L.) growing soils of Kurnool district. M. Sc Thesis submitted to Acharya N.G. Ranga Agricultural University, Hyderabad, India

Tandon HLS 1993. Methods of analysis of soils, plants,water and fertilizers. Fertilizer development and consultation organization. PamPosh Enclave, New Delhi