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RESEARCH ARTICLE :

Effect of different levels of potassium and green manure on grain yield and soil properties of rice (*Oryza sativa* L.)

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SUMMARY : A field experiment was carried out at Agricultural College Farm, Mahanandi in Kurnool district of Andhra Pradesh to study the effect of different levels of potassium and green manure on grain yield and soil properties of rice during *Kharif*, 2015. The results revealed that EC and pH at harvest of the crop were not significantly influenced by various treatments. The grain yield, organic carbon, available N, P_2O_5 and K_2O were significantly increased with increase in K fertilizer application and also due to green manure incorporation. Application of green manure in combination with K fertilizer recorded higher in above mentioned parameters than when applied alone. Among all the treatments, the highest grain yield, organic carbon, available N, P_2O_5 and K_2O status of soil were obtained with incorporation of green manure (*Dhaincha)* (GM)+120 kg K_2O ha^{-1} which was on par with GM+80 kg K_2O ha^{-1} and GM+40 kg K_2O ha^{-1}.

KEY WORDS :
Rice, Potassium, Green manure, Grain yield, Soil physico-chemical properties, Available N, P_2O_5, K_2O status

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BACKGROUND AND OBJECTIVES

The advent of high yielding varieties and increased area under assured irrigation led to a major shift from organic based nutrient application to chemical fertilizers. Consequently, there was not only a reduction in the consumption of organic manures but also excess use of high analysis fertilizer in an unbalanced manner and imposed additional problems of soil fertility, such as acidity, alkalinity, multiple nutrient deficiencies and loss of soil health. In view of the escalating prices and high demand supply gap of chemical fertilizer, there is a strong need to adopt integrated nutrient supply system by judicious combinations of organic manures, inorganic fertilizers to improve soil health and productivity. 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 soils of Agricultural college farm, Mahanandi are high in available K and K supplying power of rice growing soils of canal ayacut in Kurnool district is low as indicated by PBC^K. 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. Hence, the present study was under taken to know the influences of different levels of K alone and combination with green manure on grain yield, soil physico chemical properties and available nutrient status in rice crop.

RESOURCES AND METHODS

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. The treatment details are given in Table 1, 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*) was grown in the treatments T_5, T_6, T_7 and T_8 ploughed *in situ* at flowering before transplanting. The content of N, P and K in green manure is 3.5 %, 0.3 % and 1%, respectively.

Soils samples were collected from each treatment plots at five spots and representative samples were dried and sieved through 2 mm sieve. The samples were analyzed for pH, EC, OC and available nutrient status using standard procedures as outlined by Jackson (1973). Grain yield was recorded as per the treatments and express in kg ha^{-1}.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Yield:

All the treatments recorded significantly higher grain yield than control except T_2 (40 kg K_2O ha^{-1}) (Table 1). Grain yield increased with increasing levels of K upto120 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 yield. Swamanna (2015) also reported increase in yield of rice crop with increasing K level upto 120 kg K_2O ha^{-1} under pot culture studies. The increased grain yield by the application of K fertilizer was due to the continuous supply of K to the crop during crop growth period which was more beneficial and increased total no of tillers, dry mater accumulation, effective tillers, number and weight of filled grains and fertilizer use efficiency resulted higher yields of rice. These findings are in close conformity with those of Meena *et al.* (2003) and Surekha *et al.* (2003).

Table 1 : Grain yield and soil properties as influenced by different levels of potassium and green manure in rice crop at harvest stage

Treatments	Grain yield (kg ha^{-1})	pH	EC (dSm^{-1})	Organic Carbon (%)	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})
T_1: 0% RDK (Control)	5008	8.01	0.22	0.56	158	76	562
T_2: 50% RDK (40 kg K_2O ha^{-1})	5281	8.02	0.22	0.60	174	81	591
T_3: 100% RDK (80 kg K_2O ha^{-1})	5433	8.03	0.24	0.62	166	99	614
T_4: 150% RDK (120 kg K_2O ha^{-1})	5517	8.03	0.25	0.62	181	110	636
T_5: GM (*Dhaincha*) *in situ* only	5493	8.06	0.19	0.70	210	149	602
T_6: GM + 40 kg K_2O ha^{-1}	555	8.06	0.21	0.68	219	156	667
T_7: GM + 80 kg K_2O ha^{-1}	5671	8.07	0.21	0.68	221	152	688
T_8: GM + 120 kg K_2O ha^{-1}	5748	8.07	0.19	0.68	238	158	713
S.E.±	95	0.02	0.02	0.01	5.34	6.4	19.4
C.D. (P=0.05)	292	NS	NS	0.02	16.3	19.5	60.1
CV%	3.0	0.36	12.11	1.99	4.8	9.2	5.35

NS= Non-significant

Application of green manure in combination with K recorded higher grain yield than when applied alone. The highest grain yield (5748 kg ha^{-1}) was obtained with T_8 (GM + 120 kg K_2O ha^{-1}), it was on par with T_7 (GM + 80 kg K_2O ha^{-1}) and T_6 (GM + 40 kg K_2O ha^{-1}) and T_4 (150% RDK). 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 and decomposition of succulent green manure crop, which favoured for release of nutrients and their continuous availability in soil for sustaining higher grain and straw yield of rice. Highest grain yield with green manure along with NPK fertilizers in rice was also reported by Sharma *et al.* (2001) and Singh *et al*. (2002).

Physico-chemical properties:

The pH of soil was not significantly influenced by K fertilizer or green manure either alone or in combinations at harvest of rice crop. There was a slight increase in pH in all plots after harvest of rice crop when compared with initial soil (7.97). It might be due to flooding condition of field during crop growth**.** Application of potassic fertilizer levels and green manure did not show any significant influence on EC at harvest of rice crop**.** (Table 1). There was slight decrease in all treatments when compared with initial soil EC (0.33). It might be due to flooding condition during crop growth which may caused movement of salts to deeper layers. Similar results were reported by Chaudary *et al.* (1981) and Jyothi (2012).

The organic carbon content of soil was significantly increased in green manure and K fertilized plots when compared with control (0.56) and initial soil (0.55) might be due to better root growth and more plant residues, left out in fertilized and manured plots. Higher organic carbon was observed in green manure plots due to direct addition of organic material through green manures. These findings are in conformity with findings of Kavitha *et al.* (2012).

Available nutrient status :

A significant increase was observed in the available nitrogen with K fertilizer application or green manure incorporation either alone or in combinations at harvest stage (Table 1). Among all the treatments, higher available nitrogen was observed with T_8 (G.M+ 120 kg K_2O ha^{-1}) which was on par with T_6 (G.M + 40 kg K_2O ha^{-1}) and T_7 (G.M +80 kg K_2O ha^{-1}). Higher build up of available nitrogen was observed in green manuring either alone or in combination with potassium fertilizer might be due to the favourable soil conditions under green manuring helped the mineralization of soil nitrogen leading to build up of higher avilalable nitrogen. These results were in confirmity with findings of Sharma *et al.*(2000).

Similar to available nitrogen, the available P_2O_5 and K_2O also significantly increased with potassium fertilizer or green manuring either alone or in combination at harvest stage (Table 1). Among all the treatments, higher available P_2O_5 and K_2O were observed with T_8 (green manure+120 kg K_2O ha^{-1}), which was on par with T_6 (G.M + 40 kg K_2O ha^{-1}) and T_7 (G.M +80 kg K_2O ha^{-1}). Higher build up of available phosphorus was observed in green manuring either alone or in combination with potassium fertilizer and is due to release of organic acids, produced during microbial decomposition of organic matter might solubilized native phosphates besides this appreciable quantity of carbon dioxide released during decomposition of organic matter might have formed carbonic acids, which enhanced the solubility the phosphates resulting in higher phosphorus availability in plots treated with green manure. The results are in conformity with findings of Dixit and Gupta (2000) and Singh *et al*. (2006). Higher buildup of available K was observed in application of green manure along with K fertilizers due to additional K applied through it and also solubilizing action on certain organic acids produced during the decomposition and greater capacity to hold K in available form. The results are in confirmation with findings of and Yaduvanshi *et al.* (2013).

The results further showed that depletion of available N and K in all the treatments in comparison with initial soil .However the buildup of phosphorus was high in all plots except control and 40 kg K_2O ha^{-1}, but high in green manure treated plots when compared to fertilizer plots alone. The depletion of available K_2O might be due to higher removal by crop, inadequate addition of K through fertilizer and green manure and leaching losses. However, the depletion of available K is higher in control when compared with fertilizer or green manure either alone or combined treatments. Whereas significant depletion of available N is due to removal of crop and leaching losses. Kavitha *et al.* (2012) also observed the significant depletion of major nutrients in control plots as compared with fertilizer and manure treated plots in tomato- cabbage

cropping sequence.

Conclusion :

The results were concluded that the higher grain yield, organic carbon and major nutrient status 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 trails in farmers fields on long term basis.

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