Response of Rice to Application of K Fertilizer in Low Country Dry and Intermediate Zone of Sri Lanka

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Abstract

Potassium is the most expensive fertilizer but it is the most important plant nutrient in rice production. Therefore, series of experiments were conducted at 11 locations (4 in the Kurunegala district and 7 in Polonnaruwa district) with the objective of investigating yield benefits to addition of K fertilizers. Three potassium fertilizer rates viz. application of half the recommended rate of K (20 kg K_2O ha^{-1}), recommended rate of K (40 kg K_2O ha^{-1}) and no addition of K fertilizer (control treatment) were tested with two replicates in each location during 2011 yala and 2011/2012 maha. Treatments having recommended K was applied 20 kg K_2O ha^{-1} at basal and 20 kg K_2O ha^{-1} at 7-14 days before flowering and treatments having half the recommended K was applied 20 kg K_2O ha^{-1} at 7-14 days before flowering. Exchangeable K contents was below 50 mg kg^{-1} in most of the locations but significant yield response to application of K fertilizer was observed in 1 out of 7 locations in Polonnaruwa and one out of four locations in Kurunegala in two successive seasons. No significant yield difference between applications of half the recommended rate of K and recommended rate of K was observed in any of the 11 locations. Significant declining of exchangeable K contents in soil was not observed even without application of K fertilizer. No clear relationship observed between exchangeable K content and grain yields. A result of this study revealed that no significant yield improvement to application of K fertilizer and as such even if half the recommended levels of K is applied that is enough to obtain the current rice yield levels. Therefore, it can be suggested from this results that studies on long term changes of different form of K in rice fields is timely needed. It will help to identify an indicator other than exchangeable K to decide the K requirement of rice to avoid unnecessary application of K fertilizer.

Key words: Rice, Potassium, Response

Introduction

Rice occupies approximately 33 percent of the total cultivated area in Sri Lanka, which accounts for 0.78 million hectares. Of the above, 75 percent of the rice area is in the Intermediate and Dry zones of Sri Lanka. To get the benefits of high yielding varieties, application of fertilizer has become a must. Potassium is a major nutrient with a critical role in regulating assimilates transportation, so its short supply could affect the productivity of rice (Salisbury and Ross, 1978) Most of the paddy soils in low country of Sri Lanka is considered to be high in K and as a result, a low crop response to applied K is seen (Wickramasnghe et al. 2001). To maximize the use of rice straw and to reduce the use of K fertilizer, K had been removed from the basic rice fertilizer recommendation in Sri Lanka in 1996 but re-introduced in 2001 considering the fact that the removal of K from fertilizer mixtures would lead to a greater risk in rice production (Anon, 1996 and DOA, 2001). In the 2001, K fertilizer at the rate of 40 Kg K_2O ha^{-1} was introduced even with the application of rice straw. Rice production has become a marginal entity at present due to increased costs of inputs, especially labor, fertilizers and pesticides and low farm gate price. Therefore, fertilizer is given at subsidiary rates to rice farmers. However, the farmers continue to remove straw and fertilize the rice crop with K before seeding and flowering stages. This practice ensures that rice yields do not suffer due to K nutrition. Otherwise, the farmers would not adopt such practices and risk their own crop and economy. Since almost all K fertilizer is imported to the country, application of K fertilizer in a judicial manner is important to relief the burden to the government. There has been no information so far available to convince the farmers or the policy makers of the advantages or disadvantages of application of potassium fertilizer in rice cultivation. The objective of this study was to

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determine the effects of application and potassium fertilizer on rice yield and exchangeable K content in the rice-rice cropping systems in low country dry and intermediate zones of Sri Lanka.

Materials and methods

This study was conducted in farmer fields in 11 locations in low country dry and intermediate zones from November, 2010 to mid March, 2012. The experiment sites were situated in a continuous rice producing area where two rice crops are usually grown per year. Three treatments comprised in the experiment were application of half the recommended rate of K (20 kg K_2O ha^{-1}) at basal and half (20 kg K_2O ha^{-1}) at 7-14 days before flowering, half the recommended K (20 kg K_2O ha^{-1}) at 7-14 days before flowering and control plots which received no K fertilizer. Stubble of the preceding rice crop was incorporated into soil in all treatments. Treatments were arranged in a randomized complete block design with two replicates in each location. P was given at the rate of 45 kg P_2O_5 ha^{-1} at basal dressing. Quantity of N was splitted into four and applied as 5 kg, 30 kg , 55 kg and 25 kg at basal, 2, 4 and 6 weeks after planting respectively. Crop management was done uniformly across all treatments. The crop was harvested from 9 m^2 area from each plot. Grains were sun dried after threshing and cleaning, and total grain weight was recorded in each plot. Soil samples were collected at the beginning and after harvesting and analyzed for exchangeable K contents. The analysis of variance was performed for the experimental data using SAS statistical package.

Results and Discussion

It is revealed from the results in Table 1 that there is no significant difference in grain yield among treatments in two seasons in Polonnaruwa. Significant improvement in grain yield to application K over control was observed in Kurunegala in the yala season only but even in this season difference between the treatment receiving half the recommended rate (20 kg at 7-14 days before flowering) and recommended rate (20 kg at basal and 20 kg at 7-14 days before flowering) was not significant. Nine out of 11 locations having exchangeable K contents below 50 mg kg^{-1} but clear relationship between exchangeable K content and grain yield was not observed even when K fertilizer is absent. This is in agreements of the previous findings of the Anon, 1996 that the plant stubble from the preceding rice crop other than straw contributes to a higher fraction of soil organic matter in continuous rice production systems, and hence addition of large quantities of chemical fertilizer would not be essential. Even after two consecutive seasons, significant reduction of exchangeable K contents was observed only in 2 out of 11 locations. As pointed out by De Datta, and Mikkelsen (1985), potassium from non- exchangeable pool provides potassium to soil solution when soil solution K is depleted and as such it may be a reason for exchangeable K content is not a good indicator to decide the K requirement of rice plants.

Table 1: Yield response to application of K fertilizer (average of 4 locations in Kurunegala and 7 locations in Polonnaruwa)

Treatment	Yield (t/ha)			
	Polonnaruwa		Kurunegala	
	Yala	Maha	Yala	Maha
20 + 20 Kg K_2O ha^{-1}	6.37	6.31	4.53	5.82
0 + 20 Kg K_2O ha^{-1}	6.35	6.74	4.25	5.81
Control	6.32	6.35	3.91	5.72
LSD	0.32	0.54	0.57	0.45

Conclusion

It is concluded that irrespective of the exchangeable K contents half the recommended rate of K (20 kg K_2O ha^{-1}) at 7-14 days before flowering is enough to maintain present yield of rice in low country dry and intermediate zones of Sri Lanka. Long term observations on different fractions of K in paddy soils are therefore necessary to ascertain weather application K fertilizer is affect on K fertility in rice soils.

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