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Substitution of inorganic potassium by organic sources in rice

A. VELAYUTHAM, V.VEERABADRAN AND B.J. PANDIAN

Department of Agronomy, Agricultural College and Research Institute, Killikulam - 628 252, Tamil Nadu.

Abstract : Experiments were conducted during kharif seasons of 194-1996 to evaluate the efficacy of different organic sources to substitute inorganic potassium in rice. Application of 25 percent K as rice husk ash and 75 per cent as muriate to potash produced higher mean rice grain yield of 5666 kg ha^{-1} which was 7.32 per cent higher over 100 per cent K through inorganic fertilizer alone. Hundred percent substitution of inorganic potassic fertilizer with organics did not prove to be advantageous. Higher net return per rupee was associated with 25 per cent K as rice husk ash and 75 per cent as MOP. *(Key words :* Rice husk ask, Inorganic potassium, Organic sources, Rice, Yield)

Intensive cropping with high yielding varieties and use of high doses of nitrogen resulted in heavy depletion of soil reserves of potassium (Khere *et al.*, 1990). Recent hike in price of inorganic potassic fertilizer has given rise to a situation where farmers are skipping the application of potassic fertilizers. To overcome the nutrient imbalance caused by this tendency, there is need to find alternative sources of potassium which are cheap and easily available in larger quantities. Rice husk ash is one such organic waste which is rich in potassium (2.5 to 4.0 per cent) and offers good scope to substitute inorganic potassium in rice nutrition. Comprehensive information on the role of rice husk ash in rice nutrition is very limited. Hence an experiment was conducted to evaluate the comparative performance of rice husk ash, coir waste and green manure, *Sesbania aculeata* in substituting the inorganic K fertilizers in rice.

Materials and methods

The experiment was conducted at Agricultural College and Research Institute, Killikulam (40 m altitude, 8° 46' N and 77° 42' E) during *kharif* seasons of 1994-96 for three years. The soil was clay loam. It was low in available nitrogen (275 kg/ha^{-1}), medium in available phosphorus (21 kg/ha^{-1}) and potassium (230 kg/ha^{-1}). The treatment consisted of three organic sources, viz., rice husk ash, coir waste and *Sesbania aculeata* added at different levels of 25, 50, 75 and 100 per cent substitution of inorganic potassium. These were compared with recommended level of k (50 kg K_2O as muriate of potash) and no K fertilizer as control. The fertilizer dose recommended for short duration rice is 120:38:38 kg/ha^{-1}. The recommended quantity of phosphorus was applied as a basal dose. While potassium was applied as per the treatment schedule basally. The experimental design was RBD and the test variety was ADT 36. The nutrients content of organic sources used are as follows.

Organic source		Nutrient content in per cent		
		N	P	K
1.	Composted coirpith	1.21	0.056	1.10
2.	*Sesbania aculeata*	1.20	0.200	0.36
3.	Rice husk ash	-	-	2.50

Results and Discussion

Effect on growth characters

Potassium substitution at 25 per cent as organics and 75 per cent as inorganics produced taller plants as compared to the application of inorganics alone (Table. 1). Application of 25 per cent K as rice husk ash and 75 per cent as muriate of potash registered significantly higher plant height of 102.10 cm at harvest. The control plots with no K fertilizer was associated with shorter plants (90.06 cm). With regard to tiller population, higher mean tillers $hill^{-1}$ of 17.20, 17.30 and 16.0 were observed with the application of 25 per cent K as rice husk ash, *Sesbania aculeata* and coirwaste respectively. One hundred per cent K as muriate of potash produced only a mean tiller $hill^{-1}$ of 13.00 (Table 1).

Effect on productive tillers

More number of productive tillers of 388.67 m^{-2} (Table. 2) was observed under application of 25 per cent K as rice husk ash and 75 per cent as inorganics due to its higher K content. The effect of judicious combination of organics and fertilizer potassium improving the yield attributes of rice has been reported by Thakur (1990) and Vijayaragavan *et al.* (1992).

Effect on yield and economics

Potassium substitution at 25 per cent as rice husk ash and 75 per cent as inorganic potassic fertilizer produced significantly higher rice grain yield than other treatments. The mean rice grain yield over 3 seasons was 5666 kg ha^{-1}, where as 25 per cent substitution with coir waste and *Sesbania aculeata* resulted in a rice grain yield of 5474 and 5381 kg ha^{-1} respectively

(Table 2). Application of K as inorganics alone produced only 5251 kg ha $^{-1}$ of grain yield. Lower rice grain yield of 4525 kg ha $^{-1}$ was observed with control (K at 0 kg ha $^{-1}$). Rice husk ash application increased the silica content of leaves, culms and hulls of rice and resulted in an increased rice grain yield (T schen *et al.*, 1983).

Treatments that received 25 per cent of K as rice husk ash improved the net return per rupee invested (3.17) due to the production of additional grain and straw yield. The results indicate that the rice husk ash has the potential to substitute a portion of inorganic K required by the rice crop without any loss of yield, leading to higher net returns.

Table 1. Effect of K Substitution through organic sources on growth characters of rice

		Plant height at harvest (cm)				Number of tillers hill $^{-1}$ at tillering stage			
	Treatment	1994	1995	1996	Mean	1994	1995	1996	Mean
T1	Recommended dose of K (50 kg K_2O ha $^{-1}$) as MOP	95.00	95.70	96.60	95.43	13	13	13	13.00
T2	No K (control)	93.00	93.10	93.10	93.06	11	11	12	11.20
T3	25 per cent K through rice husk ash + 75 per cent K through MOP	101.00	103.40	101.90	102.10	17	18	17	17.30
T4	50 per cent K through rice husk ash + 50 per cent K through MOP	100.50	101.90	100.60	101.00	16	16	16	16.00
T5	75 per cent K through rice husk ash + 25 per cent K through MOP	94.10	100.70	94.70	96.50	15	14	14	14.30
T6	100 per cent K through rice husk ash	93.90	98.50	93.80	95.40	12	13	12	12.30
T7	25 per cent K through coir pith + 75 per cent K through MOP	99.60	102.60	99.10	100.43	16	16	16	16.00
T8	50 per cent K through coir pith + 50 per cent K through MOP	97.90	99.70	91.00	96.20	15	15	15	15.00
T9	75 per cent K through coir pith + 25 per cent K through MOP	95.10	98.40	96.20	96.56	14	14	13	13.67
T10	100 per cent K through coir pith	94.00	96.70	94.60	95.10	11	12	12	11.67
T11	25 per cent K through GM + 75 per cent K through MOP	97.60	102.70	98.00	99.43	17	18	17	17.30
T12	50 per cent K through GM + 50 K through MOP	96.97	100.10	96.50	97.83	15	16	15	15.30
T13	75 per cent K through GM + 25 per cent K through MOP	95.70	96.40	95.83	95.83	14	14	14	14.00
T14	100 per cent K through GM	93.50	92.90	93.40	93.27	12	12	12	12.00
	CD (P = 0.05)	2.39	2.59	2.79		1.34	0.29	1.144	

GM : *Sesbania aculeata*

Table 1. Effect of K Substitution through organic sources on growth characters of rice

	Treatment	Plant height at harvest (cm)				Grain yield (kg ha^{-1})				Net return per rupee invested			
		1994	1995	1996	Mean	1994	1995	1996	Mean	1994	1995	1996	Mean
T1	Recommended dose of K (50 kg K_2O ha^{-1}) as MOP	372	370	375	372.33	5501	4997	5225	5251	3.15	2.76	2.96	2.96
T2	No K (control)	340	348	350	346.00	4752	4302	4522	4525	2.68	2.36	2.50	2.51
T3	25 per cent K through rice husk ash + 75 per cent K through MOP	390	387	389	388.67	5918	5458	5622	5666	3.37	3.01	3.14	3.17
T4	50 per cent K through rice husk ash + 50 per cent K through MOP	384	382	385	383.67	5562	5099	5488	5383	3.04	2.69	2.98	2.90
T5	75 per cent K through rice husk ash + 25 per cent K through MOP	380	376	380	378.67	5390	4990	5144	5174	2.89	2.60	2.71	2.73
T6	100 per cent K through rice husk ash	379	387	384	383.33	4905	4625	5255	4928	2.58	2.36	2.83	2.59
T7	25 per cent K through coir pith + 75 per cent K through MOP	36	384	380	383.3	5708	5249	5466	5474	3.20	2.87	3.02	3.03
T8	50 per cent K through coir pith + 50 per cent K through MOP	385	383	385	384.33	5377	4991	5131	5166	2.87	2.58	2.68	2.72
T9	75 per cent K through coir pith + 25 per cent K through MOP	384	384	385	384.33	5260	4824	5444	5109	2.68	2.38	2.68	2.58
T10	100 per cent K through coir pith	380	379	380	379.67	4815	4501	5071	4795	2.31	2.09	2.47	2.29
T11	25 per cent K through GM + 75 per cent K through MOP	382	380	383	381.67	5562	5160	5422	5381	3.08	2.79	2.68	2.95
T12	50 per cent K through GM + 50 K through MOP	379	376	329	361.33	5222	4804	5224	5083	3.84	2.55	2.83	2.74
T13	75 per cent K through GM + 25 per cent K through MOP	365	369	370	368.00	5068	4616	4891	4858	2.88	2.63	2.56	2.59
T14	100 per cent K through GM	350	346	350	348.67	4802	4422	4644	4622	2.43	2.19	2.31	2.32
	CD (P = 0.05)		1.26	6.50	2.47		183	167	103				

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Estimation of runoff and soil loss for a hilly watershed

M. MUTHAMIL SELVAN, K. SUBRAMANIAN V. RAJENDRAN AND K. RANGASAMY
College of Agricultural Engineering, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu

Abstract : Estimation and analysis of rainfall-runoff-discharge data for a watershed would be of great use for optimum planning and managing the watershed. Universal Soil Loss Equation (USLE) was used to estimate the annual soil loss from a hilly watershed in the Nilgiris. A set of linear regression models were developed by relating (1) rainfall and runoff, (2) rainfall and soil loss and they can be used for prediction of the runoff and soil loss for the watershed. Packages of soil and water conservation measures were recommendd for the watershed as the present runoff and soil loss wre found to be enormous.
(*Key words* : Runoff and Soil loss and watershed)

Runoff and soil loss estimation in any watershed is the important criteria to adopt suitable soil and water conservation practices. For a hilly watershed the rainfall-runoff and rainfall-soil loss can be conveniently described by treating them as a deterministic lumped linear system. Several methods have been developed during recent years for runoff and soil loss estimation. Vinodkumar and Rastogi (1989) developed a mathematical model of instantaneous unit hydrograph for a small watershed. A linear time invariant model was developed by Sharma *et al* (1992) for predicting sediment transport in th arid zone drainage basin. Shrivastava and Bhatia (1992) used soil conservation services (SCS) model for runoff prediction. A few other models were also developed in India. Most of them need very detailed input data, which are not available. Hence, an effort was made to predict runoff and soil loss by developing simple liner regression models.

Material and Methods

Study Area

Ebbanad watershed near Ooty town in the Nilgiri hills is a part of the Moyar subcatchment of the Bhavani river basin. The watershed starts from Dottabetta peak in Ooty town and ends at about 14 km near the silt monitoring station of Ebbanad. The watershed area is located between the Dottabetta peak and the Bikkepattimud reserved forest ranges at an average altitude of 2155 m above MSL. The watershed lies between 11°24'N and 11°2a'N latitudes and between 76°46'E and 76°50'E longitudes covering an area of 28.1 sq km. It includes Kendorai, Adashola, Tuneri, Tummanatti, Kuppachi, Kottamad, Muruttala and Thiruchukudi Ebbanad hamlets of Ebbanad and Kakkuchi villages.

Computation of soil loss

For computation of soil loss potential of the watershed, the relevant data such as watershed boundary map, land use map, rainfall, drinage network soil map and contour map were collected from various sources.

The actual runoff and soil loss were observed over the different periods of five year (1990-1995). The soil loss assessment is also done theoretically by using the universal soil loss equation and this theoretical soil loss is compared with th actual soil loss determined in the river valley project scheme.

The universal soil loss equation (USLE) given by Wishmeier and Smith (1965) was used to estimate the soil loss from the watershed. The ULSE computes the soil loss for a given site as the product of six major factors whose most likely value at a particular location can be expressed numerically. Th soil loss equation is given by