gross return, the net return was lesser due to higher cost of cultivation. The reduction in cost of cultivation in rice- rice-soybean system by 15 per cent compared to rice-rice-rice system, coupled with remunerative price of soybean seed resulted in the highest net returns from rice-rice-soybean system.

Application of 50 per cent of recommended K to all the three crops in the cropping system resulted in higher gross return as well as net returns than that from K fertilization to anyone crop in the cropping systems. This was primarily due to the increased economic yield of the component crops of the systems.

The BC ratio was the highest in rice-rice-soybean system followed by rice-rice-rice system (Table 4). The results of the study clearly indicated that for high available K soil conditions of Western Tamil Nadu, application of 50 per cent recommended K fertilizer to each of the component crops of rice-rice-soybean system was highly remunerative. In areas with abundant water supply throughout the year, rice-rice-rice system with 50 per cent K fertilizer application to each of the component crops was the best system.

Potassium fertilizer application at 50 per cent recommended dose to each one of the component crops of rice-rice-soybean system in K- rich soils of Western region of Tamil Nadu is highly remunerative. Where abundant water supply throughout the year is available, potash application is recommended at 50 per cent recommended level to each one of the crops of rice-rice-rice system for soils of high available K.

REFERENCES

SWAMINATHAN, M.S. (1981). **FAI National Seminar for Achieving Fertilizer Consumption Targets and Improving Fertilizer Use efficiency.** Fertilizer Association of India, New Delhi, Dec. 3-5, 1981.

(Received: December 1994 Revised: February 1995)

Madras Agric. J., 83(3): 172-176 March 1996
https://doi.org/10.29321/MAJ.10.A00998

POTASSIUM MANAGEMENT IN RICE BASED CROPPING SYSTEMS OF WESTERN ZONE OF TAMIL NADU

G.JAMES MARTIN

Department of Agronomy
Agricultural College and Researches Institute
Tamil Nadu Agricultural University
Coimbatore 641 003

ABSTRACT

Field experiments were conducted consecutively for three seasons at the Tamil Nadu Agricultural University, Coimbatore. Four rice based cropping systems were evaluated. Application of 50 per cent and 100 per cent recommended K fertilizer was included for the respective crops. Skipping of K application to any two of the component crops of the cropping systems and K application to all the three crops were included. The highest biomass production was recorded in rice-rice-rice system followed by rice-rice-soybean system. Half and full dose of potash produced the same biomass. Rice-rice-soybean system produced the highest rice grain equivalent. Potassium fertilizer application to all the three component crops of the cropping systems resulted in higher rice grain equivalent than that from K fertilization to any one of the crops.

KEY WORDS : Rice Based Cropping Systems, Potassium Fertilization, Biomass Production, Rice Grain Equivalent.

Recent research information amply reveals that high crop yields and intensive cropping can be sustained only through optimum use of nutrients in balanced ratios. On a gross basis, crop uptake of potassium exceeds nitrogen uptake by 60 per cent in Indian Agriculture (NCA, 1976). The entire potash requirements are met from imports. It is imperative to make use of the available potash fertilizers to the most productive use so that each unit gives higher yield response. The FAO has conceptualised the idea of System Approach to Plant Nutrition (SPAN) (Roy and Braun, 1984). Tandon (1983), Pillai *et al.* (1985) and Biswas *et al.* (1987) suggested the fertilizer prescription for a system as a whole is economical and efficient with considerable scope of fertilizer economy. Very

little research information is available on potash management in rice based cropping systems. Hence this study was undertaken.

MATERIALS AND METHODS

Field experiments were conducted consecutively for three seasons *viz.*, South West Monsoon (SWM) season of 1984 (Jun-Sep., 1984), North East Monsoon (NEM) season of 1984-85 (Oct. 1984-Feb.1985) and summer season of 1985 (Feb.-May 1985) at the Central Farm Wetlands, Tamil Nadu Agricultural University, Coimbatore to develop potash management strategy for rice based cropping systems for Western Tamil Nadu. The soil of the experimental field was moderately drained and deep clay loam classified as Typic Ustochrept. The soil belonged to Noyyal series. The soil was low in available N (264 kg/ha), medium in available P (17.2 kg/ha) and high in available K (453 kg/ha). Initial soil sample was analysed for water soluble K (18.5 ppm), exchangeable K (219.0 ppm), non- exchangeable K (717.0ppm) and total K (0.82%). The soil contained 0.82% organic carbon. The soil pH was 8.1 and the EC was 0.19 dSm-1. The irrigation water contained 3.00 ppm of K.

Field experiments were laid out in split plot design with three replications. The details of the three season experiment are:

Table 1. Dry matter production (t ha^{-1}) in the cropping systems, Coimbatore

Cropping system	K level	S_1	S_2	S_3	S_4	Mean
Rice-Rice-Rice	K_1	40.42	40.13	39.49	41.72	40.44
(C_1)	K_2	40.70	39.01	40.52	41.94	40.54
	Mean	40.56	39.57	40.01	41.83	40.49
	K_0					37.72
Rice-Rice-Soybean	K_1	33.79	33.47	32.94	33.61	33.43
(C_2)	K_2	33.30	33.86	32.57	34.76	33.62
	Mean	33.55	33.67	32.76	34.19	33.54
	K_0					32.33
Rice-Rice-Finger millet	K_1	36.30	37.90	36.65	37.99	37.21
(C_3)	K_2	37.24	36.75	37.63	38.20	37.46
	Mean	36.77	37.33	37.14	38.10	37.34
	K_0					36.28
Rice-Rice-Cotton	K_1	28.82	29.64	28.91	30.43	29.45
(C_4)	K_2	30.36	30.50	29.70	30.64	30.30
	Mean	29.59	30.07	29.31	30.54	29.88
	K_0					29.36
	Mean	35.12	35.16	34.81	36.17	

	SE_D	CD (P = 0.05)
Cropping systems	0.707	1.729
K levels	0.196	NS
Season of application	0.277	0.553
K levels x Season	0.392	NS
C at K	0.799	NS
K at C	0.392	NS
C at S	0.890	NS
S at C	0.554	NS
Control vs Rest	0.294	0.587
Control vs Rest at C	0.588	1.175
C at control vs Rest	1.199	2.868

S_1 - K applied during SWM season, 1984
S_2 - K applied during NEM season, 1984
S_3 - K applied during Summer, 1985
S_4 - K applied during all the three seasons

Main plot treatments : Cropping Systems

I Crop SWM season	II Crop NEM season	III Crop Summer
JUN-SEP. 1984	OCT.1984-JAN.1985	FEB-MAY 1985
C_1 Rice (IR 50)	Rice (Co 43)	Rice (IR 50)
C_2 Rice (IR 50)	Rice (Co 43)	Soybean (Co1)
C_3: Rice(IR 50)	Rice (Co 43)	Finger millet (Co 11)
C_4: Rice (IR 50)	Rice (Co 43)	Cotton (MCU 7)

Sub-plot treatments : Levels (K) and season of application of K (S)

K_0 : Control(No K application)

K_1S_1 : 50% recommended K to the first (SWM) crop alone

K_1S_2 : 50% recommended K to the second (NEM) crop alone

K_1S_3 : 50% recommended K to the third (Summer) crop alone

K_1S_4 : 50% recommended K to all the three crops

K_2S_1 : 100% recommended K to the first (SWM) crop alone

K_2S_2 : 100% recommended K to the second (NEM) crop alone

K_2S_3 : 100% recommended K to the third (Summer) crop alone

K_2S_4 : 100% recommended K to all the three crops

The field was initially ploughed well and two puddlings were given with iron plough. Each plot was enclosed by bunds to safeguard against the entry of water and to minimise the movement of nutrients from one plot to another.

Rice nursery was raised separately. During SWM season, rice seedlings were planted at a spacing of 15 x 10 cm. After the harvest of SWM rice, water was le[illegible] and by digging with mummutty with manual labour without disturbing the bunds so as to keep the plots intact without the soil of adjacent plots getting mixed up. The plots were then levelled with hand levelling board. In all the cropping systems during NEM season, rice seedlings were planted at a spacing of 20 x10 cm and during summer in C_1 system, rice was planted at 15 x 10 cm spacing.

After the harvest of NEM rice crop, one irrigation was given to all the plots in C_2, C_3 and C_4 systems. Mummutty digging was given without disturbing the bunds. The NEM rice crop stubbles were also incorporated into the soil. A vertical trench of 5 cm width and 45 cm depth was dug up in the buffer channel separating the summer rice crop plots with other gardenland crop plots and thick polythene sheet was inserted into the trench and compacted with soil so as to prevent water entering into the adjacent gardenland crop plots by seepage from the flooded rice crop plots.

In C_2 system, soybean was sown with a spacingof 30 cm between rows and 10 cm between plants. Finger millet nursery was raised separately in a well ploughed, levelled field. Twenty day old seedlings were transplanted in C_3 system with a spacing of 15 x 15 cm. Acid delinted cotton seeds were dibbled in dried banana leaf cups filled with red earth and farm yard manure. Twenty five day old seedlings were planted in the main field at 60 x 30 an spacing.

Recommended doses of fertilizers to the different crops in the various systems were as follows:

	Fertilizer nutrient		
Crop	N	P_2O_5	K_2O (kg ha^{-1})
Rice	100.0	50.0	50.0
Soybean	20.0	80.0	40.0
Finger millet	60.0	30.0	30.0
Cotton	60.0	30.0	30.0

The fertilizers were applied as urea, superphosphate and muriate of potash as detailed below :

	N	P	K
	(of the total dose)		
Rice - Basal dressing	Half	Full	-
Top dressing I (25 DAP)	Quarter	-	Half
Top dressing II (45 DAP)	Quarter	-	Half
Other crops - Basal dressing	Half	Full	Half
Top dressing I (25 DAS/DAP)	Quarter	-	Quarter

In rice, fertilizers were broadcast and incorporated into the soil. For other crops, fertilizers were placed in 5 cm lines away from the seed rows and covered with soil.

Biological production potential of each cropping system was determined by adding the above ground biomass produced by the componer crops. Rice grain equivalent was worked out b converting, the economic yield of crops other tha rice into rice grain yield based on market price c the produce. All inputs used and labour employe were recorded for all the crops. In working out th gross returns, the by-products were also considere

Table 2. Rice grain equivalent yield (kg ha^{-1}) in the cropping systems, Coimbatore

Cropping system	K level	S_1	S_2	S_3	S_4	Mean
Rice-Rice-Rice	K_1	15809	15496	15405	16113	15708
(C_1)	K_2	15794	13216	15435	16216	15165
	Mean	15802	14356	15420	16165	15437
	K_0					14643
Rice-Rice-Soybean	K_1	15987	15180	15813	15918	15725
(C_2)	K_2	15626	16285	15395	16980	16072
	Mean	15807	15733	15604	16449	15899
	K_0					14820
Rice-Rice-Finger millet	K_1	11785	11348	11343	11862	11585
(C_3)	K_2	12000	11616	11741	12252	11902
	Mean	11893	11482	11542	12057	11744
	K_0					11329
Rice-Rice-Cotton	K_1	11498	11396	11240	12235	11592
(C_4)	K_2	11994	11817	11570	12312	11923
	Mean	11746	11607	11405	12274	11758
	K_0					11201
	Mean	13812	13294	13493	14236	

	SE_D	CD (P = 0.05)
Cropping systems	279	683
K levels	122	NS
Season of application	173	346
K levels x Season	244	NS
C at K	342	798
K at C	244	NS
C at S	413	NS
S at C	244	NS
Control vs Rest	183	266
Control vs Rest at C	165	NS
C at control vs Rest	242	NS

S_1 - K applied during SWM season, 1984
S_2 - K applied during NEM season, 1984
S_3 - K applied during Summer, 1985
S_4 - K applied during all the three seasons
K_1 - 50 per cent recommended dose of K

Net returns were arrived at by deducting the cost of cultivation from the gross returns.

RESULTS AND DISCUSSION

Biological production potentials of the cropping systems are given in Table 1. Among the rice based cropping systems, total biomass production was the highest in C_1 (rice-rice-rice) system followed by C_3 (rice-rice-finger millet) system and then by C_2 (rice-rice- soybean) system. Potash application considerably enhanced the biomass production. However, the levels of K (50 and 100 per cent) did not differ in their influence on biomass accumulation. Potassium applied to all the three crops in the cropping systems produced higher quantity of dry matter as compared to K application to any one crop in the cropping systems. In all the cropping systems, K fertilization increased the dry matter compared to control. Greatest difference between K applied treatments and control could be observed in C_1 (rice-rice-rice) system followed by C_2 (rice-rice-soybean) system.

The analysis of biomass accumulation is useful to assess the efficiency of cropping systems to utilise the solar radiation, water and nutrients. The present study indicated that cropping systems involving cereals and millets resulted in higher biomass production. Evidently, crops such as rice and finger millet are profusely tillering crops, contributing substantially to the total biomass production of the systems. Potassium fertilizer applied to all the three crops in the cropping systems (cumulative effect of K) produced higher dry matter production as compared to K application to any one crop in the systems. This indicated the additive effect of K fertilization in increasing the vegetative structures and consequently dry matter.

The data on total rice grain equivalent of the cropping systems are given in Table 2. The highest total rice grain equivalent yield was recorded in C_2 (rice-rice-soybean)system. The total rice grain equivalent from C_1 (rice-rice-rice) system was comparable with that of C_2 system. Both these systems produced grain equivalent yield higher than those from the C_3 and C_4 systems. Application of 50 per cent or 100 per cent recommended dose of K had little difference on the rice grain equivalent from the systems. Potassium fertilizer application to all the three component crops of the cropping systems resulted in higher total grain equivalent yield than that from K fertilisation to any one of the crops.

The increase in rice grain equivalent yield could be attributed to the relatively higher price and higher yield of soybean. The results revealed that rice grain equivalent yield was mostly influenced by the component crops in the system. Similar to total biomass production, K application irrespective of levels to each crop in the systems resulted in greater rice grain equivalent yield.

It is concluded that potassium fertilization at 50 per cent recommended levels to each one of the crops in rice-rice-soybean system for high-K soils of Western Tamil Nadu is the most suitable potassium management strategy.

REFERENCES

BISWAS, B.C., YADAV, D.S. andMAHESWARI, S. (1987). Fertiliser use in the cropping systems. **Fert. News 26**(9): 23-32.

NCA (1976) **National Commission on Agriculture. Report. Vol.X Inputs**. Ministry of Agriculture and Irrigation, New Delhi, 425 pp.

PILLAI, K.G., SUSEELA DEVI and PRABHAKAR SHETTY, T.K. (1985). Research achievements of All India Co-ordinated Agronomic Research Project. **Fert. News** 30(4):26-34.

ROY, R.N. and BRAUN, H. (1984).**Proc. FAI Seminar on Systems Approach to Fertiliser Industry.** Part II. Abs.1-1/pp. 1-23.

TANDON, H.L.S. (1983). Fertilizer use efficiency systems-Components and their status. **Fert. News 28** (12) : 46-53.

(Received: December 1994 Revised: February 1995)