P MANAGEMENT IN RICE-RICE-GREENGRAM CROPPING SYSTEM

LEKHA SREEKANTAN and SP. PALANIAPPAN*

ABSTRACT

The productivity and economics of rice-rice-greengram cropping system under different P management practices were studied. The optimal P management schedules for the highest total productivity and profit were green manuring combined with superphosphate application in the first crop rice and long stubble (25 cm) incorporation with superphosphate application in the second crop of rice, short stubble (10 cm) incorporation with superphosphate application in the second crop or short stubble incorporation with rock-phosphate application in the second crop.

Efficient fertilizer management is possible with greater understanding of direct, residual and cumulative effects on different crops grown in a sequence (Reddy, 1985). Phosphorus, when applied as superphosphate, is a costly input. For the manufacture of this fertilizer, the raw materials, high grade rockphosphate and sulphuric acid, are being entirely imported in our country. Large quantities of low grade rockphosphate have been located in some parts of India. These materials cannot be used for the manufacture of superphosphate due to their low P content. In order to make economic use of these materials, they have to be directly used as fertilizer. Due to the low solubility of P present in these rock-phosphates, their contribution of P to a single crop would be little, especially in neutral and alkaline soils. However, in a cropping system involving three or four crops, there may be gradual dissolution and release of P which can be made use of by the crops in the system. This may be especially a practical proposition in lowland rice soils favouring P dissolution under low redox potential when rockphosphate is applied with greenmanure or organic residues, dissolution of P is likely to be hastened by the organic acids released from decomposition. Application of mussoorie rock-phosphate with greenmanure has been found to increase P availability in rice under lowland conditions (Ranjan and Kothandaraman, 1986). Hence organic manuring in conjunction with mussoorie rockphosphate application and superphosphate application was tested in a rice based cropping system to develop an economic and viable P management practice for high productivity in the much popular cropping system of rice-rice-greengram.

MATERIALS AND METHODS

The first crop of short duration rice (IR.50) was raised in a factorial randomised block design with three replications. The second crop of medium duration rice (Co-43) and third crop of greengram (CO4) were raised in split plot design sole. The treatments comprised of greenmanuring with 12 t/ha of Sunnhemp (G1) and no greenmanuring (G0) in combination with no P (P0) and 50 kg/ha of P_2O_5 as superphosphate (Ps) and as rockphosphate (Pr) for the first crop of rice. These were the main plot treatments for the second crop, the subplot treatments being long stubble (25 cm) incorporation (S1) and short stubble (10 cm) incorporation (S0) in combination with no P (Po), 60 kg/ha P_2O_5 as super-phosphate (Ps) and recommended P as rockphosphate (Pr). No treatments were given to the third crop of greengram which was raised as a residual crop. The total productivity in the system

Table 1. Total grain production in the system (t/ha)

Treatment	G_0P_0	G_0P_s	G_0P_r	G_1P_0	G_1P_s	G_1P_r	Mean
S_0P_0	8.689	0.965	9.098	9.904	11.646	9.758	9.843
S_0P_s	8.922	10.462	9.676	10.140	12.335	10.369	10.317
S_0P_r	8.554	10.274	9.500	9.930	12.001	10.129	10.065
S_1P_0	8.803	10.354	9.038	9.872	11.439	9.955	9.910
S_1P_s	9.147	11.193	9.875	10.676	12.645	10.826	10.727
S_1P_r	8.841	10.559	9.600	10.134	11.830	10.680	10.274
Mean	8.826	10.468	9.465	10.110	11.983	10.286	

	GP	SP	GA at SP	SP at GP
SED	0.4669	0.2724	0.3455	0.1112
CD	1.0404	0.5449	0.7629	0.2224

under various treatments and the net returns and benefit cost ratios were worked out.

RESULTS AND DISCUSSION

The total grain production of the system as a whole from various treatments green-manuring along with superphosphate application gave the highest productivity among the treatments given to the first crop (Table-1) Green manuring along with rock-phosphate application was statistically on par to the next best treatment of superphosphate applied alone. Organic acids produced by the decomposition of green-manure could have increased the uptake of P by reducing fixation in the case of superphosphate and increasing the P availability from rockphosphate through the organic acids formed (chhonkar, 1979). Superphosphate with long and short stubble incorporation was on par with the rockphosphate combinations among the second crop

treatments. Interaction was also significant with G1PsS1Ps, G1PsSoPs and G1PsSoPr giving the highest productivities in that order. Superphosphate being a more readily available source of P than rockphosphate, its better uptake and better performance is understandable. Thus the best three treatments were green manuring combined with super-phosphate application in the first crop followed by long stubble incorporation and super-phosphate application in the second crop; green manuring combined with super-phosphate application in the first crop followed by normal short stubble incorporation with superphosphate application in the second crop and green manuring combined with superphosphate application in the first crop of rice followed by short stubble incorporation with rockphosphate application in the second crop of rice. A soluble P source like superphosphate is preferable for

Table 2. Net returns (Rs./ha) in rice-rice-greengram cropping system.

Treatment	G_0P_0	G_0P_s	G_0P_r	G_1P_0	G_1P_s	G_1P_r	Mean
S_0P_0	11605	14326	12569	13852	17559	13612	13920
S_0P_s	11878	15293	13700	14447	18811	14876	14834
S_0P_r	11262	14797	13384	13158	18303	14330	14206
S_1P_0	11736	14789	12233	13364	16872	13789	13797
S_1P_s	12298	16675	13755	15155	19375	15470	15455
S_1P_r	11672	15378	13322	14030	17514	14973	14482
Mean	11742	15210	13160	14001	18072	14508	

	GP	SP	GP at SP	SP at GP
SED	936.8	462.4	986.6	800.9
C.D.	2087.3	924.8	NS	NS

Table 3.   Benefit-cost ratio for the system (Rs.)

Treatment	G_0P_0	G_0P_s	G_0P_r	G_1P_0	G_1P_s	G_1P_r
S_0P_0	2.51	2.81	2.62	2.73	3.12	2.69
S_0P_s	2.49	2.86	2.70	2.74	3.19	2.77
S_0P_r	2.45	2.85	2.70	2.62	3.18	2.74
S_1P_0	2.48	2.81	2.52	2.61	2.97	2.64
S_1P_s	2.49	2.96	2.65	2.76	3.19	2.78
S_1P_r	2.45	2.85	2.63	2.67	3.02	2.76

higher productivity. However, an indigenous source like rockphosphate can also be used without much reduction in total productivity. It can be seen that when a soluble P fertilizer like superphosphate is applied to the first crop of rice with green manuring, rockphosphate may be applied to the second crop of rice with short stubble and if superphosphate without green-manuring is given to the first crop of rice rockphosphate in conjunction with long stubble can be applied to the second crop of rice for fairly good productivity. Among the first crop treatments, greenmanuring and super-phosphate application gave the highest net returns (Table 2). All the other treatments except no green-manuring + no P treatment were on par. The latter in turn was on par with rockphosphate applied without greenmanure. While no green manuring coupled with superphosphate application gave the second highest net profit, it is interesting to note that rockphosphate along with green manure application was on par with this and came next best.

Considering the treatments given to the second crop, long stubble incorporation with superphosphate gave the highest net returns.

This was on par with short stubble incorporation combined with superphosphate. The latter was again statistically similar to long stubble incorporation with rockphosphate application. Rockphosphate applied with short stubble gave the lowest net profit. Although interaction was not significant the relatively high net return giving treatments were greenmanuring with superphosphate application in first crop and long stubble incorporation with super phosphate application in the second crop, greenmanuring with superphosphate application in the first crop and superphosphate with short stubble incorporation in the second crop and greenmanuring with superphosphate application in the first crop and rockphosphate with short stubble incorporation in the second crop. While the former two treatments gave the highest benefit cost ratio (3,19). the treatment G1PsSoPr closely followed giving a B-C ratio of 3.18 (Table 3). Thus these treatments have emerged as the optimal manure/fertilizer schedules for the rice-rice-greengram cropping system from the economic point of view where greengram is raised as a rice fallow pulse without fertilization.

REFERENCES

CHHONKAR, P.K. 1979. Soil micro-organisms in relation to availability of phosphorus to plants. Phosphorus in soils, crops and fertilizers. Bull. Indian Soc. Soil Sci. 12: 30-42.

RANJAN, A.S. and KOTHANDARAMAN, G.V. 1986. Influence of organic matter on rockphosphate and its effect on yield and uptake of nutrients by rice. Rockphosphate in agri-

culture. Proc. of symp. held on August 23-24, 1985 at TNAU, Coimbatore. pp. 161-169.

REDDY, G.V. 1985. Fertilizer management in rice based cropping systems. Paper presented at the University Professors (IFFCO Chair). Agronomists meet at Udaipur on 26th August 1985, organised by the Indian Farmers Fertilizers Co-operative Ltd., New Delhi.