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EFFECT OF CONTINUOUS MANURING AND FERTILISATION ON SOIL PHOSPHORUS FRACTIONS IN AN ALFISOL UNDER RICE-RICE CROPPING SYSTEM

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ABSTRACT

Continuous manuring and fertilization in an intensinve cropping on an Alfisol resulted in less depletion of inorganic P fractions viz., Saloid-P (16.6%), Fe-P (14.1%), Al-P (14.4%), Ca-P (16.5%) and more of organic-P (40.6%) in surface soil. Regular addition of green leaf manure (GLM) enhanced saloid-P, Al-P and Fe-P and Fe-P whereas farm yard manure (FYM) addition influenced Ca-P and organic-P. Continuous P addition either alone or in combination with N and K enhanced both inorganic and organic-P fractions than the treatments having no P.

Key words: Continuous manuring, Phosphorus fractions.

Continuous use of heavy doses of organic manures and fertilizers requires careful and detailed monitoring of changes in the fertility status of soil. Results from some long term trails in India showed that chemical fertilizers increased inorganic form of P and farm yard manure built up the organic form of P in different cropping systems (Anjaneyulu and Omanuwar, 1979, Zahate et al., 1979; subbarao and Ghose, 1981). Information about the changes in soil P fractions under intensive cropping of rice in rice-rice cropping system over a period of time is inadequate in Alfusol soils. In view of this, an attempt has been made to evalate the changes in the P fractions of soil of Madurai Agricultural College farm due to continuous manuring and cropping.

MATERIALS AND METHODS

The experiment conducted during 1975-83 had four main plot treatments with three organic sources viz., FYM At 25 t/ha, Green Leaf Manure (GLM) at 12.5 t/ha and compost at 25 t/ha and control. The sub-plot treatments were 100, 60 and 60 kg/ha N, P2O5 and K2O individually and in all combinations with no manure treatment urea, superphosphate and muriate of potash were the sources of N, P and K respectively. The GLM was applied a fortnight before transplanting while half the N and entire P2O5 and K2O were added basally. The remaining N was applied equally at tillering and panicle initiation stages.

The surface (0-15 cm) and sub-surface (15-30 cm) soil samples collected after harvest of 13th crop of rice (IR 50) raised during smmer 1983 were loamy sand and sandy clay loam in texture with a pH of 8.1 and 8.3 and EC of 0.57 and 0.52 m.mhos/cm respectively. The available N, P and K contents were 190, 3.5 and 100 kg/ha respectively in surface soil and 100, 4.0 and 48 kg/ha in sub surface soil. It was a typical Alfisol. The organic carbon content was 1.19 and 0.49 per cent respectively in surface and subsurface soil.

The total P was estimated by percholric acid extract method (Jackson, 1973). The inorganic P fractions were estimated by the method outlined by Hensse (1971). The difference between total P and inorganic P was taken as organic P.

RESULTS AND DISCUSSION

All the P fractions declined due to nine years of intensive cropping without any P addition (Table 1). The extent of reduction was more in organic P fractions (36.6 to 40.6%) when compared to inorganic fractions in both surface and

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Table 1. Effect of continuous manuring and fertilization on soil P fractions (ppm)

P Fractions	Saloid-P		Al-P		Fe-P		Ca-P		Organic-P		Total inorganic-P		Total-P	
Depth Treatments	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
ORGANIC MANURES														
Control (Without manure)	12.5	6.9	25.3	21.3	29.0	44.4	42.3	61.1	38.4	102	125	164	164	164
FYM	18.2	9.0	34.5	54.9	32.5	33.5	55.1	51.1	75.8	46.2	140	148	216	197
GLM	19.2	8.9	35.9	58.2	33.1	33.9	54.1	48.8	68.9	42.8	141	149	210	192
SEd	0.3	0.2	0.3	0.1	0.5	0.5	1.3	0.7	0.5	0.6	0.4	0.4	2.0	0.4
CD at 5%	0.8	0.5	0.8	0.2	1.5	1.5	4.0	2.2	1.6	2.0	1.4	1.3	6.5	1.4
FERTILIZER COMBINATIONS														
Control (Without fertilizer)	12.2	5.9	25.5	40.1	20.0	24.0	42.5	51.3	27.2	102	112	152	139	
N	15.9	7.9	29.8	56.9	24.2	30.3	47.1	44.1	59.2	23.6	121	138	180	162
P	16.9	9.5	31.1	59.6	32.0	36.2	61.1	54.1	94.7	58.1	141	159	236	217
K	14.1	6.6	29.7	48.9	27.1	29.5	45.1	43.4	55.7	33.0	114	128	170	161
NP	20.5	10.1	31.9	59.4	34.9	34.1	52.7	51.9	80.1	53.2	144	159	225	212
NK	15.1	7.6	39.6	43.7	29.7	31.9	47.6	42.2	58.1	48.8	124	125	183	179
PK	16.7	8.4	35.4	58.1	34.6	36.8	63.7	53.2	67.2	41.9	150	156	217	198
NPK	16.9	8.3	39.7	62.5	36.0	37.6	55.7	53.4	79.3	51.6	148	161	227	213
SEd	0.3	0.3	0.5	0.7	0.6	0.5	1.5	0.7	0.6	0.6	0.6	1.4	2.4	2.8
CD at 5%	0.6	0.6	0.9	1.5	1.2	1.1	3.1	1.4	1.2	1.2	1.3	2.8	4.8	5.7
1982-Absolute control (Without manure & fertilizer)	(16.6)	(16.1)	(14.1)	(9.3)	(14.4)	(16.0)	(16.5)	(6.6)	(40.6)	(36.6)	(14.9)	(9.7)	(9.4)	(16.9)
1975-Initial sample	12.6	6.2	23.4	38.6	14.6	23.8	36.4	34.8	40.6	38.3	87	103	128	142

Figures in parenthesis represent per cent change over 1975 initial sample)

sub-surface soil. this could be due to greater mineralisation of organic-P and subsequent uptake by crops. The above findings are in accordance with the earlier work of Williams and Lipsett (1961) and Greb and Olsen (1967).

Continuous addition of organic manure significantly enhanced the different fractions of P over no manure plot. The extent of increase was 48.0, 53.1, 37.2, 22.5 and 15.4 per cent in saloid-P, Fe-P, Al-P, Ca-P and organic-P respectively in surface soil and 30.4, 16.2, 17.0m 18.2 and 13.0 per cent in sub-surface soil. This could be due to continuous addition of P through organic manures and continuous addition of biomass by the crops due to intensive cropping.

Among the organic manures GLM contributed significantly to the saloid-P, Al-P and Fe-P. This could be due to reduction of soil pH by the release of organic acids during decomposition which could have enhanced the availability of the above fractions. Continuous addition of FYM enhanced Ca-P and organic-P fractions. Similar observation was made by Zahate *et al.* (1979). Subbarao and Ghose (1981) recorded 22.4 per cent increase in organic-P fraction due to continuous addition of FYM. The sub-surface samples of manureed plots contained slightly higher Fe-P and Al-P than surface soil. This could be due to the movement of Fe-P under submited condition to lower depths. However, saloid-P, Ca-P and organic-P accumulations were more in surface soil.

In all the cases, the P treatment either alone or in combination with other N and K fertilizers (NP, PK, NPK) gave higher saloid-P, Al-P, Fe-P, Ca-P and organic-P than the treatment having no P (N,K,NK). This could be attributed to the continuous addition of P through fertilizers. Similar results have been reported by Mahapatra and Partrick (1969) and Ivanov (1975).

The total organic P content was higher in P alone treated Plots when compared to other P coimbinations, possibly due to lower rate of conversion of organic-P in the absence of N and K. Higher organic-P content recorded in the surface soil could possibly be due to the less mobile nature of organic-P to the sub-surface soil. Higher Ca-P recorded in the surface soil could possibly be due to conversion of added soluble P into insoluble forms of Ca-P. Debnath and Hajra (1972) have also reported an increase in Ca-P content on the addition of water soluble P to the soil which corroborates with the present findings.

The results of the correlation coefficients between crop yield and soil P fractions revealed that the crop yield exhibited significant positive correlation with saloid-P (0.48) Al-P (0.70), Fe-P (0.61) and Ca-P (0.45) fractions.

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