substances as well as added urea - N released more of NH_4 - N in gypsum alone treatment.

NO_3 - N

The NO_3 - N recorded the peak in the ninth week and thereafter a decline was observed. Similar trend of results as in NH_4 - N was observed in all the main plot treatments (Fig. 2). The NO_3 - N concentration was significantly higher in GM+gypsum treatment followed by GLM + gypsum treatment. The reduction in NO_3 - N concentration in all the treatments after ninth week of rice transplantation was due to the crop removal or immobilisation and denitrification by general soil microflora and denitrifiers, respectively (Alexander, 1961).

The NH_4 - N and NO_3 - N concentrations increased significantly as the N levels increased at all the main plot treatments, and it was comparatively higher in GM/GLM + gypsum treatment than in GM/GLM/gypsum alone treatments. The NH_4 - N supplemented through GM/GLM over and above the liberated N from added urea would have caused significant increase in NH_4 - N, whereas the efficient microbial activity as well as the enhanced rate of nitrification would have resulted in higher NO_3 - N at all N levels. The reduction in NH_4 - N in later period and reduction in NO_3 - N at all N levels in gypsum alone treatment was due to the absence of contribution of N from organic source. In GM/GLM alone treatment the reduction was due to slower rate of decomposition and mineralisation of applied GM/GLM and urea - N.

The study reveals that the higher N content and succulent nature of GM - *Sesbania aculeata* produced significantly higher N fraction than GLM - *Pongamia glabra* which is of hardy nature with lesser N content.

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EFFECT OF PHOSPHORUS AND FARMYARD MANURE ON CHANGES IN PHOSPHORUS FRACTIONS IN A RICE SOIL

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ABSTRACT

Application of phosphorus alone and in combination with FYM increased contents of total P and different P-fractions. An increase in available P content was recorded at higher levels of P in association with FYM. The content of different P fractions as per cent of the total P followed the order : Occluded P > Fe-P > Ca-P > Al-P.

KEY WORDS : Effect of P, FYM. P Fractions, Rice Soil

Phosphorus utilization in crops is generally low. Nad and Goswamy (1984) suggested that for sustainable agriculture production, application of higher levels of P alone or in association with organic matter can enhance the contents of total P, available P and different P fractions. These

fractions have been reported to supply P throughout the growth period of crops (Dhillon and Dev. 1990).

An attempt was made to study the effect of P and FYM on the changes in available P content at different growth stages of rice (PC-19) vis-vis different P fractions and total P at harvest.

MATERIALS AND METHODS

A field experiment was conducted during the kharif season of 1993 at the Research Farm of RARS, R.S. Pura (Jammu). The soil was of clay loam type (inceptisol) with pH value 6.8 and electrical conductivity 0.10 dS m^{-1}. The soil had 0.60 per cent organic carbon and 287.26,12.88 and 112.0 kg/ha of available N,P and K. The experiment was laid out in a randomised block design with four replications and comprised of 10 treatment combinations viz., five levels of P_2O_5 (0,25,50,75 and 100 kg/ha) and two levels of FYM (o and 10 t/ ha). Farm yard manure (0.46% N, 0.34% P, 0.78% K) was applied 15 days before transplanting of crop. Full dose of P and K and half of N was applied by broadcast method. All the plots received a uniform dose of 100 kg N and 25 kg K_2O/ha. Besides, N, P and K, zinc sulphate at the rate of 20 kg/ha was also applied to all plots. Paddy (var. PC-19) was transplanted in rows 20 cm apart on 13th July and harvested on 22nd October, 1993. Soil samples were collected before transplanting and at different stages of crop viz, tillering, panicle initiation, flowering and at harvest stage to monitor the changes in available P content and other P fractions (Al-P, Fe-P, Ca-P and occluded P). Total P content was also estimated at harvest to assess the per cent contribution of P vis-a-vis available and total P were estimated by standard methods as described in Jackson, (1957).

RESULTS AND DISCUSSION

Effect of P and FYM on different P fractions

The data in respect of the content of different inorganic P fractions viz, Al-P, Fe-P, Ca-P and occluded, P after harvest of crop are presented in Table-1. Application of different P and FYM treatments appreciably increased the contents of different P fractions when compared to control. The percent increase over control in Al-P, Fe-P, Ca-P and occluded - P ranged from 9.83 to 110.61, 2.55 to 26.20, 1.43 to 44.88 and o.57 to 13.75 respectively. Subramanian and Gopalswamy (1991) and Jashpal et al. (1993) have reported an increase in different P fractions with an increase in the P levels. Such an increase can be explained by the fact that such soils contain appreciable amount o clay (53.4 percent) and silt (21.6 percent) vis-vis amorphous and crystalline forms of Fe and Al which are the potential sites for P fixation and some of added P could be converted to Al-P, Fe-P, Ca-P fractions due to presence of such sites (Sharma et. al., (1980).

FYM application alone as well as in association with P also increased the content of different P fractions. Nad and Goswamy (1984) also obtained significant increase in different P fractions by application of FYM and opined that such an effect of FYM may be due to mineralisation

Table 1. Effect of various levels of P and FYM on different P fractions (ppm) at harvest in rice, 1993

Level of P (P_2O_5 kg/ha)	with FYM				without FYM			
	Fe-P	Al-P	Ca-P	Occl-P	Fe-P	Al-P	Ca-P	Occl-P
0	84.71	22.35	29.06	127.52	82.60	20.35	28.65	126.80
25	90.15	27.86	32.61	131.00	89.26	24.90	31.42	129.80
50	91.71	32.55	35.41	134.47	90.16	29.85	34.05	131.00
75	97.52	37.07	39.41	137.00	93.40	33.15	37.62	135.07
100	104.25	42.86	41.51	144.25	99.05	38.09	39.41	139.25
SEm	4.03	1.71	0.55	0.95				
CD (0.05)	11.69	4.98	1.60	2.75				

Table 2. Effect of various levels of P and FYM on Olsen's P content (Kg/ha) at different growth stages in rice - 1993

Level of P added (P_2O_5 kg/ha)	with FYM				without FYM			
	T	PI	F	Harvest	T	PI	F	Harvest
0	13.90	13.42	13.38	12.75	13.10	12.90	12.90	11.56
25	13.99	13.90	13.70	13.40	13.70	13.62	13.46	13.10
50	16.10	16.10	16.25	16.25	14.04	14.50	15.40	15.25
75	19.18	18.10	17.96	17.25	18.75	17.90	16.75	16.00
100	23.32	22.40	23.10	21.85	22.26	22.10	22.75	21.05
SEM	0.28	0.26	0.36	0.28				
CD (0.05)	0.84	0.75	1.03	0.81				

Note : T. PI and F denote tillering, panicle initiation and flowering stages of crop.

of P and subsequently formation of complex metal ions with P fixing cations like Fe and Al and thus increasing the concentration of P in the soil.

Effect of P and FYM on available P content

The available P content of soil increased with the increasing levels of P application at all the growth stages of the crop (Table 2). The average range of available content of P with 0,25.50,75 and 100 kg P_2O_5/ha varied from 13.10 to 23.32 kg/ha at first stage, 12.90 to 22.40 kg/ha at second stage, 12.90 to 23.10 kg/ha at third stage and 11.56 to 21.85 kg/ha at fourth stage. The content of P decreased with stages which may be ascribed to removal of P by the crop (Gupta and Sharma, 1987). The trend of increase of available P content due to different levels of P is in line with the findings of Das et, al., (1991). The increase in P status of these soils is expected because such soils contain considerable amount of finer fractions (clay and silt) which are the potential sites for P fixation. These fixed fractions serve as a source of extractable P because the Olsen's extractant has been reported to remove P from such fractions (Sharma and Tripathi, 1984).

FYM application also increased the available P content of the soil at all the stages of crop growth. The beneficial effects of FYM on the increase in available P have also earlier been reported by Biswas et, al., (1977) and Gill and Meelu (1980).

The build up of available P in soils in the presence of FYM may be attributed to the solvent action of organic acids produced in the soil after decomposition of FYM besides the additional content of P in FYM (Vyas, 1964).

Effect of P and FYM on total P content of soil

The total P content increased from 800 to 842 ppm, the per cent increase over control ranged from 1.51 to 5.31 per cent (Table 3). The 100 kg P_2O_5 with 10 t/ha FYM recorded the highest total P (842.51 ppm) and the lowest level1 P_2O_5 (25 kg/ ha)with or without FYM.

Table 3. Effect of various levels of P and FYM on total P content at harvest stage in rice

Treatment P_2O_5	Total P content in soils after harvest (mg Kg^{-1})		
	Without FYM	With FYM	Increase over control (%)
0	800.00	800.00	-
25	800.00	800.00	-
50	810.00	812.06	1.51
75	820.45	822.56	2.82
100	838.04	842.51	5.31
SEM ±	3.53		
CD	10.23		

The different P fractions viz., Al-P, Fe-P, Ca-P and occluded P constituted 2.54-25.08, 10.83-12.37,5.01-7.45 and 18.21-19.91 per cent of total P at harvest stage respectively. The available P (Olsen's) formed 3.34 to 6.21 per cent of total P. The content of different P fractions as per cent of total P followed the order: occluded P > Fe-P > Ca-P > Al-P.

Results have revealed that occluded P and Fe-P are the important P fractions contributing to supply of P in these paddy soils.

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HETEROSIS AND INBREEDING DEPRESSION FOR SEED OIL AND PROTEIN CONTENTS IN UPLAND COTTON (*GOSSYPIUM HIRSUTUM* L.)

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ABSTRACT

Inbreeding depression estimated from F_2 data for seed oil and seed protein exhibited significant loss of vigour for these two traits. It is suggested that for achieving lines with high seed oil and seed protein content, recurrent selection may be resorted to.

KEY WORDS: Plant Breeding & Genetics, Inbreeding depression, F_2

Cotton besides providing fibre for manufacture of textiles, is also contributing edible oil and cakes. Cotton seed is the second largest source of edible seed oil in India (Pandey, 1976). Kohel (1978) reported a considerable range in variability for seed oil and protein. The success of commercial cotton hybrids in the seventies and eighties offers fresh properties in their exploitation for oil. However, very little information is available on breeding procedures based on the estimates of the nature