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Short Communications

FRACTIONS OF SOIL PHOSPHORUS UNDER DIFFERENT CROPPING PATTERNS

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The contents of different phosphorus (P) fractions in soil depend upon various factors such as texture, organic carbon, calcium carbonate, water regimes, soil pH and type and amount of phosphatic fertilizers given to the crop plants. Besides these factors, distribution and content of P fractions is also affected by different cropping patterns followed in a particular area.Duration of crop also affects the forms of soil phosphorus to a considerable extent (Aggarwal *et al.*, 1987). Knowledge of active forms of soil P is very useful in evaluation of available P status and also computation of fertilizer requirement of different crops. Although sufficient information is available on the depthwise distribution of soil phosphorus forms but such informations under various cropping patterns, specially in soils of Lucknow district is very meager. Therefore, present investigation was carried out to study the effect of various cropping patterns on fractions of soil phosphorus in Lucknow district. Ten popular cropping systems (rice-wheat, maize-wheat, rice-potato, maize-potato, rice-pea, maize-pea, rice-cauliflower, maize-cauliflower, okra-potato and okra-tomato) existing in Bakshi Ka Talab Block development area are taken under study. These cropping patterns are being followed by farmers since last 8-10 years. The soil samples were collected from surface (0.0-0.15m) and subsurface (0.15-0.30m) from five fields of each pattern and mixed depth wise to obtain as representative sample from each pattern of both depths. All the samples were collected in the month of June, 2011 and processed accordingly. Soils were analyzed for organic carbon, calcium carbonate and P fractions by standard procedures (Jackson, 1973) and available P was determined by adopting method of Olsen *et al.* (1954).

Table 1: Distribution of Soil P fractions under different cropping patterns

Crop pattern	Depth of soil (m)	Organic C (g kg^{-1})	Calcium carbonate (g kg^{-1})	Organic P (mg kg^{-1})	Inorganic P fractions (mg-kg^{-1})				Available P (kg ha^{-1})
					Saloid- P	Ca-P	Fe-P	Al-P	
Rice-wheat	0.00-0.15	3.4	4.5	78	20	182	72	40	8.9
	0.15-0.30	2.8	4.8	63	15	201	80	38	7.6
Maize-wheat	0.00-0.15	3.8	4.8	92	29	190	92	44	9.0
	0.15-0.30	3.0	5.3	66	18	210	83	42	7.5
Rice-potato	0.00-0.15	3.8	4.7	98	34	177	78	41	10.8
	0.15-0.30	2.6	5.2	60	13	200	85	36	7.8
Maize-potato	0.00-0.15	3.6	3.9	92	25	180	83	42	11.0
	0.15-0.30	2.8	4.5	62	18	205	88	35	8.0
Rice-pea	0.00-0.15	3.2	3.9	76	24	175	88	34	10.0
	0.15-0.30	2.6	4.6	58	15	198	96	40	8.2
Maize-pea	0.00-0.15	3.4	4.9	94	23	180	93	46	10.4
	0.15-0.30	2.7	5.3	60	15	196	90	43	8.4
Rice-cauliflower	0.00-0.15	4.0	4.5	96	38	195	80	35	9.6
	0.15-0.30	3.1	5.6	66	20	212	86	34	8.0
Maize-cauliflower	0.00-0.15	3.9	4.9	90	40	190	85	42	10.0
	0.15-0.30	3.0	5.7	72	21	214	78	38	8.6
Okra-potato	0.00-0.15	3.5	5.0	80	25	175	90	36	11.0
	0.15-0.30	2.7	5.7	62	17	117	86	30	9.0
Okra-tomato	0.00-0.15	3.6	4.9	87	24	180	82	33	10.0
	0.15-0.30	2.4	5.1	56	17	200	78	30	8.3

Perusal of data (Table 1) clearly revealed that organic carbon content decreased while calcium carbonate content increased with soil depth under each cropping pattern. Further, it is evident that organic carbon content ranged between 3.2 and 4.0 g kg^{-1} and 2.4 and 3.1 g kg^{-1} in surface and subsurface layers, respectively. Calcium carbonate content varied from 3.90 to 5.00 mg kg^{-1} in respective layers. Over all, soils under all cropping patterns falls under poor organic carbon status and noncalcareous. Further, it is apparent that organic P fraction was found to be higher in surface layer as compared to subsurface

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soils under each cropping pattern and this is certainly because of higher organic matter content in surface layer. These findings corroborate with the results obtained by Bahl and Singh (1997). Organic P ranged from 55 to 68 mg kg^{-1} in surface and 37 to 48 mg kg^{-1} in subsoil. Among inorganic P fractions, Ca-P was found most abundant fraction followed by Fe-P, Al-P and Saloid- P under all cropping patterns. Saloid- P varied from 20 to 40 mg kg^{-1} in surface layer and 13 to 21 mg kg^{-1} in subsurface layer; however, values of this fraction were noted higher in surface soils. The highest saloid-P was observed in maize-cauliflower pattern followed by rice-cauliflower pattern. It is interesting to note that Ca-P increased with depth of soil profile under all patterns but maximum Ca-P content was observed with okra-potato while minimum with rice-pea and maize-pea cropping patterns.

Table 2: Correlation coefficient values (r) between soil properties (Organic C and $CaCO_3$) and various P fractions

Soil- P fractions	Correlation coefficient values “r” in between	
	Organic C	$CaCO_3$
Ca-P	0.236	0.395*
Fe-P	0.375*	0.255
Al-P	0.356*	0.209
Saloid-P	0.398*	0.218
Organic-P	0.635**	0.192
Olsen’s-P	0.396*	0.256

** Significant at 5% and ** Significant at 1% levels*

This might be because of higher absorption of Ca-P by pea crop. Similar findings were also reported by Tarafdar *et al.* (2006). Fe-P ranged from 72 to 93 mg kg^{-1} in surface and 82 to 96 mg kg^{-1} in lower depth. However, it is obvious that the content of Fe-P was found to be lower in surface soils of rice based cropping pattern over rest of the cropping systems. This may be probably due to the fact that rice absorbed more Fe-P as compared to other crops. These findings are in conformity with Verma et al. (2009) who reported higher absorption of Fe-P in rice based cropping systems.

Al-P fraction ranged from 33 to 46 mg kg^{-1} and 30 to 43 mg kg^{-1} in surface and subsurface soils, respectively. Surface soils were found to be little bit rich in Al-P over subsurface soils and this tendency was noticed under all cropping patterns. The lowest Al-P fraction was observed in okra based cropping system owing to more uptake of this fraction by okra. Available P (Olsen’s- P) ranged between 8.9 and 11.0 mg kg^{-1} in upper layers while 7.5 and 8.6 mg kg^{-1} in surface layer. The top soils of maize-potato and okra-potato cropping patterns were higher in available P content as compared to rest of the patterns. However, soils of rice-wheat, maize-wheat, rice-cauliflower cropping patterns were found to be poor as compared to rest of the cropping systems. These results corroborates with the findings of Verma *et al.* (2009). Table -2 clearly indicated that Ca-P was correlated with calcium carbonate while Fe-P, Al-P, Saloid-P and Olsens’s-P with organic carbon at 5% level of significance, however relationship between organic P and organic C were significant at 1% level. All these relationships were noticed positive.

On the basis of results obtained in this study, it may be concluded that lower values of Fe-P were observed under rice based cropping pattern while Al-P values were lowest under okra based cropping system. The Ca-P content of soil was less in pea based cropping pattern. Available P was relatively higher in potato based cropping patterns.

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