

* Study of the Forms of Soil Phosphorus in Tamil Nadu

by

V. BALASUBRAMANIAN¹ and D. RAJ²

Introduction: Knowledge of the Chemistry of soil P is indispensable for following its utilisation by plants, and accounts of soil-plant relationship will be clear only when the forms and properties of soil P are known. Therefore, attempts to fractionate soil P and to learn the chemical nature of the fractions have been and will continue to be subjects of fruitful research. The main objective of this study is to examine in detail the distribution pattern of soil P in the major soil groups of the Tamil Nadu. Forty soil samples representing the four soil groups of the State, viz., alluvial, red, black and laterite, were collected from various parts and analysed for the different fractions of soil P in addition to those physical and chemical properties which have a bearing on the problem taken up for the present study.

Experimental details: The air dried soil samples were analysed for moisture, pH, total P and P fractions. The fractionation of soil P was done according to Jackson's fractionation procedure (1962). Only three fractions, viz., aluminium phosphate, iron phosphate and calcium phosphate, principally concerned with the available P were determined. The estimation of P from different fractions was done by the colorimetric method.

Results and Discussion: The relative proportions of various P fractions present in the soils studied are given in Table 1. A perusal of the data indicated that in general the calcium phosphate fraction was the largest of the various fractions of P studied in black, alluvial and red soils. On an average 51.2% of the total P content of these soils was present as calcium phosphate. Truog (1936), Kanwar and Grewall (1959) and Larsen *et al.* (1965) observed a similar distribution pattern where the calcium phosphates were abundant in soils with high pH. Ghani and Aleem (1943) observed traces of calcium phosphate in acid soils. Chai Moo Cho and Caldwell (1959), Kanwar and Grewall (1959) and Dunbar and Baker (1965) noted mostly iron and aluminium phosphates in acid soils. Similar results were obtained in the present study also. In laterite soils, iron and aluminium phosphates were present as the dominant ones among the three phosphate fractions determined. Calcium phosphate was found only in traces in these soils. In the soils having a pH between 6.5 and 7.5 all the three forms of inorganic P were equally distributed, though more of Fe and Al than Ca phosphates were present in acid soils and more of Ca than Fe and Al phosphates in alkaline, calcareous soils.

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1. Assistant Lecturer in Chemistry, Agricultural College, Madurai; 2. Professor of Soil Science, Agricultural College and Research Institute, Coimbatore-3.

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TABLE I. Total P and fractions of soil phosphorus (ppm. P. moisture free basis)

Total P in ppm	Fractions of soil P in ppm		
	P in Al PO ₄	P in FePO ₄	P in (Ca ₁₀ (P ₄ O ₁₃) ₂)
<i>Alluvial</i>			
232.8	13.2	45.7	108.6
800.4	73.3	25.8	676.4
284.2	13.8	10.2	117.4
473.7	19.5	6.5	258.3
275.1	4.6	11.3	195.5
166.8	Nil	8.4	93.7
229.0	8.7	30.7	92.7
269.0	11.6	33.2	110.6
463.4	10.7	8.2	312.0
327.7	19.2	1.5	208.7
131.3	3.5	4.0	53.1
402.7	5.8	12.7	278.3
<i>Red soil</i>			
190.4	23.6	30.8	69.8
144.4	Nil	3.1	43.8
131.8	3.0	7.0	47.3
188.3	Nil	12.2	13.2
204.3	2.0	15.7	10.1
94.2	0.5	11.2	40.6
166.3	1.5	12.7	13.2
85.9	12.0	12.5	28.0
150.8	Nil	5.1	107.4
191.2	1.6	8.4	118.0
<i>Black soil</i>			
323.7	37.7	Nil	318.0
562.8	47.4	Nil	138.0
825.2	47.6	14.8	578.0
163.3	18.7	18.7	80.2
161.1	4.4	1.6	138.8
186.6	17.7	4.4	83.8
123.2	2.2	5.4	45.2
194.8	1.1	Nil	65.0
279.3	14.0	Nil	195.0
123.8	12.4	0.8	109.0
<i>Laterite soil</i>			
109.3	21.0	11.2	Nil
105.0	Nil	20.1	8.1
443.0	24.0	113.2	32.0
256.4	18.8	13.6	6.3
496.8	49.8	134.0	32.1
146.6	23.2	15.0	4.6
1389.0	138.8	72.7	0.4
812.8	70.7	195.7	20.0

In 1958, Chang and Jackson indicated that the distribution of soil inorganic P in Miami silt loam was found to measure the degree of chemical weathering the chemical sequence being, phosphates of Ca, Al, Fe and occluded phosphates. Adopting this point of view to the study of the soils examined in the present work, it appeared that both red and laterite soils were matures containing higher amounts of Fe than aluminium phosphates, whereas alluvial and black soils were young and immature with Ca^{++} and Al^{+++} ions being more active in fixation than Fe^{+++} ions. Similar views were held by Kanwar and Grewallt (1959) and Dahnke *et al.* (1964) for soils of India and El Salvador respectively. Though there were indications for the change of distribution pattern of fractions of P with pH, the relations were not statistically significant, except the one between calcium phosphate content of soils increased with decreasing hydrogen ion concentration. This is in line with the work of Larsen *et al.* (1965) who showed that the rate of formation of a crystalline basic calcium phosphate increased with soil pH. Total P did not influence the inorganic P fraction. Dean (1938) observed no relationship between total P and aluminium phosphate or iron phosphate.

Conclusions: In general, the calcium phosphate fraction dominated the black, alluvial and red soils. On an average 51.3% of the total P content of these soils were present as calcium phosphate.

In laterite soils, Fe and Al phosphates occupied the major portion among the three fractions determined. Calcium phosphate was found in traces in these soils. When the P fractions were used as chemical weathering indices it appeared that both red and laterite soils in the above study were mature containing higher amounts of iron phosphate than aluminium phosphate, whereas alluvial and black soil were young and immature with Ca^{++} and Al^{+++} ions being more active in fixation than Fe^{+++} ions.

Soil reaction and total P content did not correlate with any of the fractions significantly although there was some relationship between calcium phosphate and hydrogen-ion concentration.

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Cation Exchange Capacity of Roots and its Relationships with the Mineral Nutrition of Plants

by

K. V. PALIWAL

Introduction: Voluminous literature on ion uptake by plants has been reported, but mostly it is interpreted in terms of soil factors, the contribution of plant root characteristics, if any, is neglected. Since Devaux (1916) reported cation exchange properties in plant roots and suggested that it may play an important role in explaining the uptake of cations from soil colloids or nutrient solutions, voluminous work on different aspects of cation exchange capacity (CEC) of roots has been reported. Significance of ion exchange properties of roots has been emphasised by Mattson *et al.* (1948, 1949) while others (Epstein, 1956; Epstein and Lagget, 1954; Laties, 1959) do not consider cation exchange capacity of much significance in formulating ion uptake theories. Some of these points have been reviewed and discussed from time to time (Epstein, 1955; Heintze, 1961; Frejat *et al.* 1967). The objective of the present paper is to evaluate and discuss the literature available on the origin, methods of determination, variation due to different crops or their varieties, fertilizer application and absorption of nutrients in relation to CEC of plant roots.