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Studies on the Distribution of Different Forms of Potassium in Alluvial and Black Soils

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ABSTRACT

A study was made with the objects of finding out the nature of distribution of different forms of K in the two major soil series of Tamil Nadu. Two profiles in each soil series *viz.*, Noyyal (alluvial soil) and Peelamedu (black soil) were studied for different forms of K *viz.*, water soluble, exchangeable, non-exchangeable and total K. The results have shown that the different forms of K varied with the type of soil series. Water soluble K decreased with depth in alluvial soil while in black soil no such decrease was observed. In general exchangeable and non-exchangeable K decreased with depth. The total K decreased with depth in alluvial soil and was not so in black soil.

INTRODUCTION

Potassium is a relatively abundant and widely distributed constituent of the surface rocks of earth. It exists in the soil as water soluble, exchangeable, non-exchangeable and mineral forms. The existence of the above forms of K in soil was reported by Mortland (1960) and Wiklander (1960). The nature of K bearing minerals and the different forms of K present in Indian soils have been studied by Karim and Khan (1956), Menon and Mariakulandai (1957), Ayyathurai (1965), Tiwari *et al.* (1967), Subramanyam (1968) and Kadrekar and Kibe (1972), but a knowledge of the profile distribution of the different forms of K in the soils of Tamil Nadu is meagre. Hence a study was undertaken to find out the nature of distribution of different forms of K in two major soil series of Coimbatore district of Tamil Nadu.

MATERIALS AND METHODS

Two profiles in each soil series *viz.*, Noyyal and Peelamedu representing alluvial and black soil respectively were studied. The Noyyal series consists of brown to dark brown, very deep, non-calcareous friable well drained, sandy loam to loamy alluvial soils. The Peelamedu series consits of black soil developed *in situ* and the soils have a fairly thick horizon underlain with a thick moderately alkaline clayey B horizon grading to $CaCO_3$ with hard kankar. Profile soil samples were collected at Chitraichavadi, Chinnathadagam, Peelamedu and Saibaba colony of Coimbatore district. The collected soil samples were powdered gently to pass through a 2 mm sieve and the sieved samples were analysed for physicochemical properties and forms of K. Mechanical analysis was done by the International pipette method. Loss on ignition,

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sesquioxides, lime and magnesia were determined as described in A. O. A. C. (1955).

Water soluble and exchangeable K were estimated by shaking 5g of soil with 25 ml of distilled water and neutral normal ammonium acetate solution respectively for 5 minutes and estimating the K in the filtrates in the flame photometer (Toth and Prince, 1949; Standford and English, 1949). Non-exchangeable K was estimated as described below. Ten grams of soil was boiled with 50 ml of N-HNO_3 for 10 minutes filtered and washed with 0.1 N HNO_3. The filtrate was made up to 100 ml and the K was estimated in the flame photometer. Thus the K obtained minus exchangeable K is regarded as non-exchangeable K (Wood and Deturk, 1940). Total K was estimated flame photometrically after neutralising the HCL extract with ammonia.

RESULTS AND DISCUSSION

The results of analysis of profiles samples for chemical constituents and different forms of K are given in Tables 1 and 2. The distribution of different forms of K is presented in

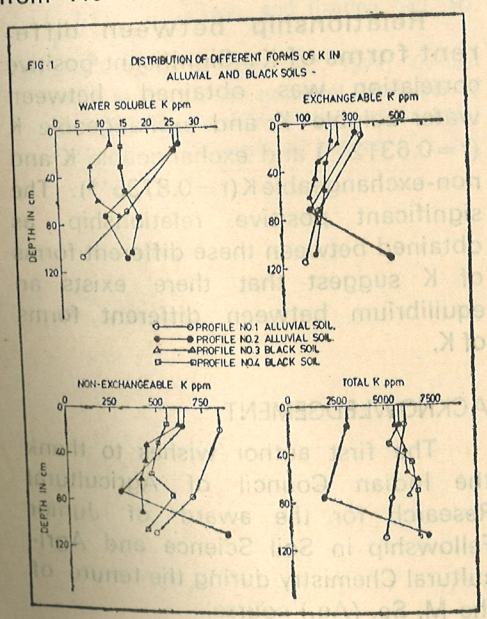
TABLE 1. Chemical constituents and properties of soil series

Locality	Profile No.	Depth in cm.	Sesqui-oxides (R_2O_3) %	Iron oxide (Fe_2O_3) %	Alumina (Al_2O_3) %	Total calcium (CaO) %	Total magnesia (MgO) %	pH	C. E. C. me/100 g.
Noyyal series (Alluvial soil)									
Chitraichavadi	1	0-20	12.74	4.82	7.92	2.31	0.98	8.3	34.0
		20-75	11.58	4.31	7.29	1.12	0.27	8.8	34.8
		Below 75	10.95	3.55	7.40	1.40	0.71	8.8	34.6
Chinnathadagam	2	0-15	4.43	2.01	2.42	0.34	0.34	7.0	12.3
		15-75	2.21	1.45	0.76	0.21	0.22	7.2	10.4
		Below 75	12.91	5.20	7.71	0.48	1.18	7.3	22.4
Peelamedu series (Black soil)									
Peelamedu	3	0-15	12.52	4.04	8.48	4.41	2.48	8.3	51.4
		15-30	13.95	4.45	9.50	4.70	2.02	8.3	52.2
		30-45	15.16	4.63	10.53	4.76	1.43	8.5	58.8
		45-60	16.12	4.89	11.23	5.14	1.61	8.4	58.5
		60-75	14.37	4.80	9.57	5.36	1.70	8.4	59.0
Saibaba colony	4	0-15	15.97	4.30	11.67	4.28	2.04	8.3	61.1
		15-35	11.29	4.02	7.27	4.29	1.85	8.6	55.9
		35-55	13.66	4.47	9.19	4.38	2.84	8.3	55.7
		55-75	14.73	4.48	10.25	4.28	1.42	8.6	57.2
		75-100	15.15	4.47	11.08	4.70	1.50	8.1	57.2

TABLE 2. Distribution of different forms of potassium (ppm K on moisture free basis)

Locality	Profile No.	Depth in cm	Water soluble K	Exchangeable K	Non-exchangeable K	Total K
Noyyal series (Alluvial soil)						
Chitiraichavadi	1	0-20	26	345	940	6000
		20-75	15	155	690	5400
		Below 75	5	95	500	5000
Chinnathadagam	2	0-15	27	320	640	3400
		15-75	10	120	300	1800
		Below 75	15	445	1000	7200
Peelamedu series (Black soil)						
Peelamedu	3	0-15	12	250	620	5600
		15-30	7	155	450	4800
		30-45	7	140	450	6000
		45-60	9	125	420	6300
		60-75	14	145	420	6200
Saibaba colony	4	0-15	14	215	540	5600
		15-35	15	185	510	5100
		35-55	15	180	430	4700
		55-75	19	165	560	5800
		75-105	14	140	460	5900

Fig. 1. These soils belong to sandy clay to clay. The pH of soils ranged from 7.0 to 8.8. The sesquioxide



content of the soils varied from 2.21 to 16.12 per cent. Cation exchange capacity of alluvial soils ranged from 10.4 to 34.8 me/100 g whereas in black soils it ranged from 51.4 to 61.1 me/100 g.

Water soluble potassium: The results have shown that two alluvial soils were almost equal in the content of water soluble K at the surface and the K content decreased with depth from 27.0 to 5.00 ppm below 75 cm depth. The water soluble K of the two black soils was also equal at the surface. It was observed that the water soluble K content slightly decreased up to 45.60 cm depth and again increased in the last layer in the samples of Peelamedu while in the soils of Saibaba colony it did not show variation.

Exchangeable potassium: The exchangeable K content of the soils varied with the type of soil series and the Noyyal series was high in exchangeable K. It was observed that the two profiles of alluvial soils did not differ much in the exchangeable K content at the surface. In Chitraichavadi profile a sudden decrease in exchangeable K was observed at lower depth i. e. from 345 to 155 ppm at 20-75 cm depth and 95 ppm below 75 cm depth. In the Chinnathadagam profile the exchangeable K decreased at the second layer and an increase was observed at the third layer.

The exchangeable K content of Peelamedu soil was slightly higher than Saibaba colony soil. There was a gradual decrease in exchangeable K with increase in depth in both the profiles. As the clay content increases with depth, the exchangeable K is slowly fixed up by the clay mineral as a result of which the exchangeable K gradually decreases with depth. Similar decrease of exchangeable K with depth were reported by Chang and Feng (1959), Wiklander (1960), Weber and Caldwell (1965) and Wild (1971).

Non-exchangeable potassium: The non-exchangeable K present in these soils showed variation with the type of soil series. The alluvial soils contained higher amount of non-exchangeable K compared to black soil. This difference in the non-exchangeable K is attributed to different clay minerals present in these soils (Manickam, 1961) The non-exchangeable K content decreased with depth in both the profiles except a slight increase at Chinnathadagam profile below 75 cm depth. In the case of black soil, Peelamedu soil contained slightly higher non-exchangeable to than Saibaba colony soil. In both the profiles there was a decrease in K with depth.

Total potassium: The results revealed that the total K varied with nature of soil series. Black soil contained higher amount of K. The total K content decreased with depth in both the profiles of alluvial soils except a slight increase below 75 cm depth in Chinnathadagam profile as in the case of non-exchangeable K. The total K content of black soils did not show much variation in their distribution in the profile. This may be attributed to the similarity of parent material and the soil formation *in situ* as reported by Balaguru (1970), Wild (1971) and Subash Chandra Bose (1971).

Relationship between different forms of K: Significant positive correlation was obtained between water soluble K and exchangeable K ($r = 0.6312^{**}$) and exchangeable K and non-exchangeable K ($r = 0.8735^{**}$). The significant positive relationship as obtained between these different forms of K suggest that there exists an equilibrium between different forms of K.

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