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Studies on the Distribution of Different Forms of Potassium in Red Soil

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ABSTRACT

A study was made with the object of finding out the nature of distribution of different forms of K in the two major soil series of Coimbatore district, Tamil Nadu. Two profiles in each soil series *viz.*, Irugur (red non-calcareous) and Palathurai (red calcareous) were studied for water soluble, exchangeable non-exchangeable and total K. The study revealed that in general, water soluble and exchangeable K content decreased with increase in depth of soil. The non-exchangeable and total K varied with soil series and both were found to increase with depth in the profiles studied.

INTRODUCTION

Potassium is known to exist in soil as the water soluble, exchangeable non-exchangeable and mineral forms as reported by Mortland (1960) and Wiklander (1960) and an attempt is made to evaluate the different forms of K present in the soils of Tamil Nadu. The nature of K bearing minerals and the different forms of K present in Indian soils have been studies by Karim and Khan (1956), Menon and Mariakulandai (1957), Dhanapalan Mosi (1960) Ayyathurai (1965) Tiwari *et al.* (1967), Subrahmanyam (1968) Kadrekar and Kibe (1972). However a knowledge of the profile distribution of the different forms of K in the soils of Tamil Nadu is scanty and hence the present investigation was undertaken in two major soil series of Coimbatore district, Tamil Nadu.

MATERIALS AND METHODS

Two profiles in each soil series *viz.*, Irugur and Palathurai representing the red non-calcareous and calcareous soils were studied. The Irugur series consists of moderately deep dark red non-calcareous soils derived form gneissic rock. The Palathurai series consists of deep to very deep red soils of calcareous nature. Profile soil samples were collected at Irugur, Akkadavur, Palathurai and Pothanur of Coimbatore district. The soil samples thus collected were powdered gently to pass through 2 mm sieve and the sieved samples were analysed for physico-chemical properties and various forms of K. Mechanical analysis were done by the International pipettee method. Moisture, loss of ignition, sequioxides, lime and magnesia were determined in the HCl extract as described in Association of official Agricultural Chemists (1955).

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Water soluble and exchangeable K were estimated by shaking 5 g of soil each 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 as per the procedures of Toth and Prince (1949) and Stanford and English (1949). Non-exchangeable K was estimated thus. Ten grams of soil was boiled with 50 ml of N HNO_3 for 10 minutes and it was made upto 100 ml and the K was estimated in the flame photometer. The K obtained minus exchangeable K was recorded 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 profile samples for chemical constituents and different forms of K are given in Table 1 and 2. The distribution of different forms of K is given in Fig. 1. These soils belonged to the group sandy loam to sandy clay. The pH of the soils

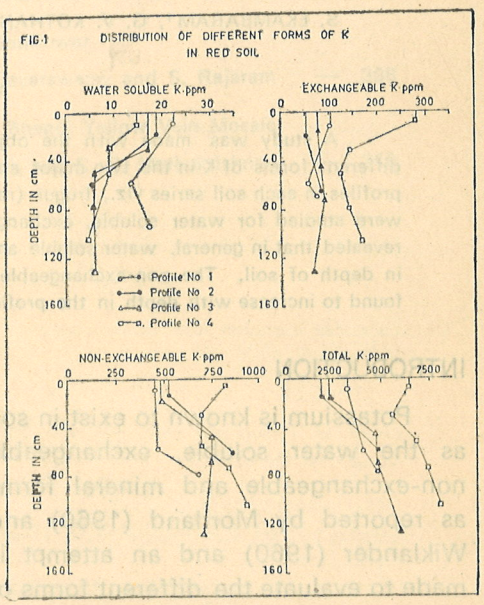

TABLE 1. Chemical constituents and properties

Locality	Profile No.	Depth in cm.	Sesqui-oxide (FE_2O_3) %	Iron oxide (Fe_2O_3) %	Alumina (Al_2O_3) %	Total Calcium CaO %	Total magnesia (MgO) %	pH	C. E. C. me/100 g.
Irugur series (red non-calcareous soil)									
Irugur	1	0-10	4.95	3.95	1.00	0.38	0.60	7.7	17.7
		10-60	15.38	6.29	9.09	0.39	0.23	7.3	23.8
		60-75	15.34	6.08	9.26	0.56	0.25	7.2	23.8
Akkadavur	2	0-18	5.70	2.83	2.87	0.60	0.37	7.5	11.5
		18-60	10.21	5.36	4.85	0.70	0.45	6.9	13.2
Palathurai series (red calcareous soil)									
Palathurai	3	0-15	13.32	2.35	10.97	0.87	0.27	8.1	15.2
		15-45	15.16	4.76	10.40	0.36	0.38	7.6	22.2
		45-75	15.82	4.16	11.72	0.40	0.36	7.2	22.2
		75-100	18.08	4.88	13.20	0.88	0.32	7.1	25.2
Pothanur	4	0-10	9.70	3.63	6.08	1.08	0.25	8.4	24.2
		10-30	13.19	4.51	8.68	0.64	0.71	8.0	30.0
		30-50	15.17	5.19	9.98	0.56	0.83	7.6	29.5
		50-70	15.46	5.55	9.91	0.59	0.83	7.7	35.2
		70-105	17.63	6.33	11.30	1.33	1.10	8.3	32.0

ranged from 6.9 to 8.4. The sesquioxides content of the soils varied from 4.95 to 18.09 per cent. Cation exchange capacity of soils ranged from 8.00 to 27.50 me/100 g of soil with a mean value of 23.50 me/100 g of soil.

Water soluble potassium: The water soluble K varied with the type of soil series. The average content of water soluble K was 11.0 ppm constituting 0.21 per cent of the total K. The water soluble K content of surface layer was 18 ppm in Akkadavur profile and 24 ppm in Irugur profile of Irugur series. The water soluble K content of surface soil did not show much variation in Palathurai series. It was observed that water soluble K was high in the surface soil and decreased with depth in all the four profiles of the two series.

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
Irugur series (red non-calcareous soil)						
Irugur	1	0-10	24	110	480	3300
		10-60	14	60	480	4000
		60-75	17	70	670	4600
Akkadavur	2	0-18	19	55	530	2100
		18-60	6	75	860	4300
Palathurai series (red calcareous soil)						
Palathurai	3	0-15	18	80	500	2300
		15-45	6	80	750	4500
		45-75	5	70	730	4200
		75-130	6	67	710	5800
Pothanur	4	0-10	15	280	810	6400
		10-30	9	130	630	5900
		30-50	9	125	630	6500
		50-70	3	145	810	6800
		70-105	4	160	890	8300

Exchangeable potassium: The exchangeable K content of the surface soil varied from 55 to 110 ppm in the two profiles of Irugur series. It was found that exchangeable K content decreased from 110 ppm to 70 ppm at 60 cm depth in Irugur profile while an increase in exchangeable K content was observed at Akkadavur profile at lower depth. Similar results of increase in exchangeable K was observed in Irugur series by Balaguru (1970). A wide variation was noticed in the content of exchangeable K in the two profiles at Palathurai (80 ppm) and Pothanur (280 ppm). In both the profiles the subsoil was poor in exchangeable K and the K content decreased with depth.

The decrease in exchangeable K varied up to 50 per cent and was not uniform at all depths of the profiles studied. As the clay increases with depth, the exchangeable K is slowly fixed by these clay minerals as a result of which exchangeable K gradually decreases, whereas fixed K increases. Similar decrease of exchangeable K with depth was reported by Wiklander (1960), Weber and Caldwell (1965) and Wild (1971).

Non-exchangeable potassium: The non-exchangeable K content of the soils showed appreciable difference in them. The non-exchangeable K content of Akkadavur profile was slightly higher than that of Irugur profile. The non-exchangeable K content increased with depth in both the profiles of Irugur series. A similar trend was observed in the profiles of Palathurai series. Thus the high content of non-exchangeable K in red soil is attributed to the presence of illite clay mineral. The increase in non-exchangeable K content with depth could be due to the increase in clay content and the consequent increase in the fixing power of the soil. A significant positive correlation was obtained between cation exchange capacity and non-exchangeable K ($r = 0.365$).

Total potassium: The total K content of Irugur soil was comparatively higher than that of Akkadavur soil. The Total K content increased with depth in all the profiles studies (0.33 to 0.46 per cent in Irugur soil, 0.21 to 43 per cent in Akkadavur soil 0.23 to 0.58 per cent in Palathurai soil and 0.64 to 0.83 per cent in Pothanur soil). Such an increase in total K with depth could be attributed to K bearing minerals in colloidal fractions of soils.

The Relationship between different forms of K: Significant positive correlation was obtained between exchangeable K and total K ($r = 0.6133^*$) and non-exchangeable K and total K ($r = 0.7138^{**}$). The significant positive relationship as observed between these different forms of K suggest that there exists an equilibrium between the different forms of K.

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