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Distribution of Different Forms of Calcium in Certain Soil Profiles of Tamil Nadu

S. LOGANATHAN[1] and K. K. KRISHNAMOORTHY[2]

To study the depth distribution of different forms of calcium, eight soil profiles were chosen representing eight established soil series in Tamil Nadu at the rate of two series under each of black, red, alluvial and laterite soil groups. The contents of different forms of calcium such as total, exchangeable, water soluble and free calcium carbonate were estimated. Total calcium varied with the types of soil and it was of the following order; black, alluvial, red and laterite soils. In general, it increased with depth. Exchangeable calcium also followed a trend similar to total calcium and it increasad with depth of the profile. Water soluble calcium was highest in black soil and least in laterite soil. There was no regular trend of changes in the content of water soluble calcium with depth. Free calcium carbonate was found to be present only in black, red and alluvial soils. Soil topography was observed to influence the calcium carbonate content of the soil.

The concentration of calcium in differing proportions at varying depths of the soil profile is largely affected by the veritical and lateral movement of water in soil profile. The other contributing factors are topography and local climatic factors. Thus investigations of the depthwise distribution of different forms of calcium in soil profiles assume considerable importance.

MATERALS AND METHODS

Two profiles under each of black, red, alluvial and laterite soil groups in Tamil Nadu were studied. The soil samples in the profiles were collected horizonwise up to the depth of parent material or water table whichever occured first. Each profile represented a particular established soil series. Various forms of calcium were estimated in the soil by standard methods of analysis.

RESULTS AND DISCUSSIONS

The data on the depthwise distribution of various forms of calcium are furnished in Table I. The data on other soil properties are given in Table II.

1. **Total calcium :** It could be observed that in five out of eight profiles, the content of total calcium increased with depth, but in the rest of three profiles, which consisted of one black soil(Pusaripatti), one red soil (Palladam) and one alluvial soil (Ilupuli), there were no regular trends. Occurrence of calcium salts in soil profile was mainly decided by water movement in the soil profile and depth up to which the percolating water was accessible and the soil was wet. Absence of sufficient rainfall in the places like Pusaripatti, Palladam and Ilupuli might have contributed to the accumulation of calcium in surface layers.

1-2. Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-641003.

TABLE I. Content of different forms of calcium in soil profile

Soil sample number	Soil group	Location	Depth in cm	Total calcium (Ca) %	Exchangeable calcium (me/100 g soil)	Calcium carbonate ($CaCO_3$) %	Water soluble calcium Ca (ppm)
1	Black	Peelamedu	0-25	3.32	27.0	8.0	128
2	,,	,,	25-50	4.25	42.5	8.0	2760
3	,,	,,	50-115	3.60	52.0	6.0	2552
4	,,	Pusaripatti	0-40	3.50	49.5	4.0	2384
5	,,	,,	40-100	2.98	54.5	4.0	2520
6	,,	,,	109-150	2.73	50.3	4.0	2200
7	,,	,,	150-200	2.24	32.6	4.0	1832
8	Red	Palathurai	0-25	1.08	10.0	1.0	128
9	,,	,,	25-65	0.75	17.5	—	104
10	,,	,,	65-110	3.20	20.5	5.0	120
11	,,	Palladam	0-15	2.30	16.0	9.0	104
12	,,	,,	15-40	0.75	15.0	—	136
13	Alluvial	Aduthurai	0-30	0.68	21.0	—	80
14	,,	,,	30-60	0.95	17.5	—	56
15	,,	,,	60-90	3.83	17.5	2.0	72
16	,,	Ilupuli	0-20	2.10	3.5	5.0	80
17	,,	,,	20-65	1.25	7.5	2.0	56
18	,,	,,	65-105	1.25	4.5	3.0	72
19	Laterite	Ooty	0-20	0.40	2.5	—	64
20	,,	,,	20-55	0.25	4.0	—	80
21	,,	,,	55-150	0.30	4.0	—	112
22	,,	Vallam	0-15	0.23	2.0	—	64
23	,,	,,	15-40	0.18	1.0	—	24
24	,,	,,	40-75	0.20	3.5	—	24
25	,,	,,	75-115	0.30	3.0	—	48

It could be observed that the high level laterite soil profile of Ooty and low level laterite profile of Vallam have shown regular trend of increases of total calcium with increase in depth. These places received very high, well distributed rainfall as well as surface flow of water respectively.

2. Exchangeable calcium: This form of calcium also showed a tendency of differential accumulation with depth similar to total calcium. Black soil profiles contained higher amount of exchangeable calcium, the range being 32 to 54 me per 100 g soil. On the other hand, laterite soil profiles contained very small proportion of exchangeable calcium (1.0 to 4.0 me).

Out of eight profiles studied five profiles showed distinct increase in exchangeable calcium with depth but the trend in other profiles was observed to be irregular. Exchangeable calcium being a property more associated with

TABLE II. Mechanical composition, pH and organic carbon content of profile soils

Soil sample number	Soil group	Location	Depth in cm	Mechanical composition (per cent)				pH	Organic carbon (per cent)
				Coarse sand	Fine sand	Silt	Clay		
1	Black	Peelamedu	0-25	20.35	19.60	29.50	19.00	8.0	0.38
2	,,	,,	25-50	14.85	25.70	32.40	24.20	8.1	0.41
3	,,	,,	50-115	15.60	26.70	31.30	23.13	8.3	0.40
4	,,	Pusaripatti	0-40	16.50	22.60	6.61	54.12	8.2	1.22
5	,,	,,	40-100	27.21	20.11	9.02	41.70	8.1	1.11
6	,,	,,	100-150	19.25	18.28	12.16	50.26	8.1	1.19
7	,,	,,	150-200	16.44	24.17	10.13	48.50	8.3	1 22
8	Red	Palathurai	0-25	54.56	18.25	12.27	13.38	8.5	0.38
9	,,	,,	25-65	52.65	34.16	6.16	6.77	7.6	0.26
10	,,	,,	65-100	35.60	26.30	9.66	23.10	7.4	0.47
11	,,	Palladam	0-15	39.85	21.25	20.15	10.98	8.2	0.21
12	,,	,,	15-40	52.90	10.13	13.96	15.70	8.1	01.2
13	Alluvial	Aduthurai	0-30	21.80	40.14	15.91	21.32	6.8	0.58
14	,,	,,	30-60	19.31	30.34	19.82	29.76	6.5	0.93
15	,,	,,	60-90	10.66	22.97	18.89	46.15	7.4	1.21
16	,,	Ilupuli	0-20	12.00	55.16	16.54	12.87	8.8	0.13
17	,,	,,	20-65	23.85	52.55	8.14	15.36	8.2	0.12
18	,,	,,	65-105	26.23	54.36	10.33	8.75	8.2	0.12
19	Laterite	Ooty	0-20	19.33	20.76	33.58	24.10	5.0	2.37
20	,,	,,	20-65	18.46	20.54	28.71	29.43	5.2	3.41
21	,,	,,	55-150	19.39	18.27	33.94	28.15	5.1	0.32
22	,,	Vallam	0-15	25.10	23.16	24.63	23.10	5.1	2.23
23	,,	,,	15-40	26.25	23.37	17.45	32.33	5.8	1.16
24	,,	,,	40-75	28.19	22.51	17.35	28.11	5.4	0.44
25	,,	,,	75-115	32.43	24.76	16.32	22.65	5.5	0.30

clay content had shown a marked variation in clay percentage. Wenner *et al.* (1961) analysed 42 samples of soil profiles and found that clay content was the deciding factor for exchangeable calcium and they were closely interrelated.

The order of presence of exchangeable calcium in soil profiles was black > alluvial > red > laterite and the amounts were 40, 18, 16 and 3 me/100 g soil respectively. The higher amount of exchangeable calcium in black soil profiles might be attributed to the greater proportion of montmorillonitic clay. Red soils possessed less of exchangeable calcium in soil profile which is evidently due to content of kaolinitic clay mineral which has low cation exchange capacity. In the present study it was found that laterite soils contained the least amount of exchangeable calcium in soil profiles though the clay content in high level (Ooty) and

laterite soils in the plains (Vallam) equalled the clay percentage of black soil profiles. This corroborates the fact that more than the quantity, the quality of clay mineral accounts for exchangeable calcium. The mortmorillonitic clay mineral in black soil showed greater resistance to leaching losses of this form of calcium than the kaolinitic clay mineral of laterite soils.

3. **Water soluble calcium**: The content of water soluble calcium in soil profiles varied vastly (from 24 to 2760 ppm). The highest amount of water soluble calcium was observed in black soil profiles followed by red, alluvial and laterite soil profiles. Among the eight profiles studied there was increase in this form of calcium with depth in four profiles, whereas in the rest of them there was a decrease with the depth of the profile. In the higher rainfall areas like Ooty, water soluble calcium showed a tendency to be leached, translocated and accumulated in lower layers of the profiles.

4 **Carbonate form of calcium**: Calcium carbonate occurred throughout the depth only in black soil profiles of Peelamadu and Pusaripatti and in the alluvial soil profile of Ilupuli. It was present in localised depths in red soil profiles of Palathurai and Palladam. This form of calcium was totally absent from the two laterite soil profiles. The calcium carbonate content of the soils was in the order, black > alluvial > red soils. The values ranged from 1.0 to 8.0 per cent.

Calcium carbonate occurred in most of the profiles in the form of powdery deposits in pockets and crevices and as kankar nodules. In each of the black soil profiles, the content of calcium carbonate remained almost constant from top to bottom, with slight reduction along depth. In Palathurai red soil profile, it was present at surface and deep layers but absent in intermediate layers. In Palladam red soil, which is also a calcareous type, this form of calcium was found to occur in top horizon only but in Aduthurai alluvial soil profile it occurred only at very deep layer.

Topography also greatly accounts for the differential accumulation of calcium carbonate in soil profiles. As a matter of fact black soil profiles of Peelamedu and Pusaripatti localities were observed to have been located in an undulating terrain. Consequently the water, rich in calcium salts, would not have percolated down slowly and this failure to percolate slowly and vertically has brought about a uniform distribution of calcium carbonate in the profiles of these two localities.

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