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EXCHANGEABLE CATIONS OF SOME IMPORTANT SOIL PROFILES OF KERALA*

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Since the discovery of cation exchange in soils, efforts by various workers have thrown much light on this phenomenon. It is a well established fact that the content and nature of the exchangeable bases have a profound bearing on crop growth. In view of the dominant role played by cation exchange reactions and exchangeable bases in soil productivity and plant nutrition, it is desirable that detailed investigation of soils on the nature and content of exchangeable cations be taken up, as such studies will be of considerable help in evolving suitable management practices. The present study was Undertaken with the object of studying the content and ntaure of exchangeable bases in typical soil profiles of Kerala and to trace their downward variation.

Materials and Methods

Fourteen soil profiles representing the major soil groups of Kerala were collected from different parts of the State. The samples were collected in each case from fixed depths 0-30 cm, 30-60 cm and 60-90 cm. In all 40 soil samples were collected for the study. The samples were air dried for a period of one week, gently ground with a wooden mallet and passed through a 2 mm sieve. The material passing through the sieve was stored in labelled bottles and used for analysis. The exchangeable cations of the samples were determined by adopting standard methods as outlined by Piper (1950).

Results and Discussion

The results of analysis are presented in Table 1. In sandy soils (No. 1 to 6) it was found that calcium formed the predominent exchangeable base followed by magnesium, potassium and sodium. Profile It showed only traces of exchangeable calcium, magnesium and potassium, while exchangeable sodium was present in small quantities. Because of the low clay content the nutrients added to the soils are immediately leached down as evidenced by the increase in total exchangeable base with depth. Because of the low cation exchange capacity and exchangeable base content, the fertility status of these soils is poor, Donahue (1958) considered cation exchange capacity as the single index of fertility so that soils with low exchange capacities had correspondingly low fertility.

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Table 1

Cation exchange capacity & exchangeable cations

Sample No.	Profile No.	Location & Soil type	Depth (Cm)	Exchangeable cations m. e/100g oven dry soil: Ca	Mg	K	Na	H (By difference)	Cation exchange capacity	pH
1	2	3	4	5	6	7	8	9	10	11
1	Profile I	Kayamkulam Sandy	0-30	0.77	0.66	0.22	0.16	0.31	2.12	5.1
2			30-60	1.43	0.50	0.08	0.17	0.06	2.[illegible]4	5.4
3			60-90	0.77	0.33	0.20	0.09	0.58	1.27	5.2
4	Profile II	Kayamkulam Sandy	0-30	Trace	Trace	Trace	0.19	1.33	1.[illegible]2	5.0
5			30-60	,,	,,	,,	0.28	1.60	1.[illegible]8	5.3
6			60-90	,,	,,	,,	0.33	1.75	2.[illegible]8	5.2
7	Profile III	Trichur Kole land	0-30	2.09	1.76	1.24	0.27	4.48	9.84	5.0
8			30-60	1.10	1.65	1.27	0.25	0.61	4.88	4.5
9			60-90	1.21	2.88	1.38	0.16	0.07	5.68	4.8
10	Profile IV	Alwaye Alluvial	0-30	1.32	3.74	0.67	0.21	12.[illegible]0	18.84	4.1
11			30-60	0.39	2.05	1.40	Trace	19.[illegible]6	13.40	4.[illegible]
12			60-90	0.88	1.44	1.29		10.[illegible]3	13.84	4.3
13	Profile V	Chirayinkil Alluvial	0-30	0.44	Trace	[illegible]		[illegible]	4.40	6.[illegible]
14			30-60	1.21	0.22	[illegible]		[illegible]	2.40	5.0
15			60-90	0.[illegible]	0.55	[illegible]		[illegible]	2.00	5.1
16	Profile VI	Perinthalmanna Laterite	0-30	1.[illegible]	1.60	0.79	0.18	1.[illegible]1	5.40	4.6
17			30-60	[illegible]24	1.61	0.[illegible]8	Trace	3.[illegible]	6.84	4.7
18			60-90	[illegible]65	0.50	0.[illegible]8	0.12	1.[illegible]7	3.82	4.7

1	2	3	4	5	6	7	8	9	10	11
19	Pr[illegible] V I	Angadip[illegible]	0-30	[illegible]	[illegible]ce	[illegible]	0.12	[illegible]	5 10	4.4
20		Laterite	0 60	1.76	0.50	[illegible]	0.13	[illegible]	[illegible] 24	4.8
21			[illegible]	2[illegible]	0 [illegible]	[illegible]	0 25	1.47	5 42	4.6
22	Profile VIII	Vellay[illegible]i	0 30	1 [illegible]	0.44	[illegible]22	0.25	0 10	2.50	4.3
23		Lateri[illegible]e	30 60	0 66	Trace	0.12	Trace	1.[illegible]	1.84	4.[illegible]
24			[illegible]	0.85	[illegible]33	0.12	,,	0 14	1 [illegible]2	4.4
25	Profile IX	[illegible]hoor	0-30	4 50	2 90	0.75	2.22	13 [illegible]5	24.32	3.0
26		K[illegible]ri	3 -60	5 18	4 1[illegible]	[illegible]-1	3 22	12 91	26 12	3.9
27	ro[illegible]le X	[illegible]ch[illegible]r	0 3	4 [illegible]0	2 [illegible]0	Trace	2[illegible]4	13 90	23.[illegible]4	3.7
28		Kari	30 60	3 [illegible]	2 20	[illegible]74	1.7[illegible]	15.03	23.36	3.0
2[illegible]	Profile X	Koz[illegible]inj[illegible]	0-30	28 05	17 60	0.45	1.04	[illegible]86	48.[illegible]	7.8
30		Black	[illegible]0-60	23.65	1[illegible]80	0[illegible]	2.7[illegible]	0 07	47.30	7.5
31			[illegible]0-90	17 05	20 90	0.74	6.04	2.19	46.9[illegible]	7.8
32	Profile XII	[illegible] injam[illegible]	0-30	[illegible]95	17.[illegible]	0 47	0.12	1.57	47.16	[illegible]
[illegible]		[illegible]ack	30 60	25 [illegible]	[illegible] 70	[illegible]47	3 52	1 57	49.56	7.6
[illegible]4	I		60 [illegible]	20.55	[illegible]	0.51	4.4[illegible]	1.61	46.[illegible]6	7 [illegible]
[illegible]5	Profil[illegible] X I.I	Palode	0 [illegible]	0 83	[illegible]	0.2[illegible]	0 33	4.1[illegible]	5.[illegible]	4 6
[illegible]		Forest	30-60	1.05	T[illegible]	[illegible]16	[illegible]13	[illegible].26	3 60	4 [illegible]
[illegible]7			[illegible]90	1 27	0 9	[illegible]41	[illegible]46	47	3 [illegible]	4.9
3[illegible]	[illegible] XIV	Pachalloor	0 [illegible]	1.8[illegible]	[illegible]e	[illegible]16	[illegible]16	[illegible]48	2 12	4.7
[illegible]9		Red	30 [illegible]	0 [illegible]4	0.39	[illegible]	Tr[illegible]	0 [illegible]8	2.54	4.[illegible]
40			[illegible]-90	[illegible]	0.79	0.75	,,	0 28	2.40	4.[illegible]

The soils of Kole area are submerged under water during the major part of the year. Calcium formed the predominant exchangeable base in the surface layer. Musierowiez *et al* (1956) working with Warsaw soils observed an increase in the content of exchangeable calcium with increase in humus and clay. So the higher content of calcium in these soils can be attributed to the presence of relatively higher amounts of humus and clay. The higher magnesium content of the soils may be attributed to the presence of magnesium bearing minerals which release magnesium on weathering. The increase in magnesium down the profile is obviously due to leaching. In the case of calcium it is not washed down to the same extent as magnesium especially in soils containing sufficient organic matter, where calcium forms calcium humate which is relatively insoluble. This was observed by Stephenson (1926) working on Oregon soils.

In alluvial soils (Nos. 13 to 15) calcium and magnesium showed an increase in the sub-surface layers clearly indicating that eluviations of these ions has taken place. Profile V which is also an alluvial deposit has shown a low content of exchangeable bases. Lower down the profile it was sand and this is clearly the reason for the poor content of bases in these soils.

In the laterite profile Nos. VI to VIII calcium formed the predominent, exchangeable base followed by magnesium. Sodium and potassium were found only in traces. These observations agree with the results of Menon *et al* (1957). In the laterite soils they observed more than 50% of the bases to the calcium followed by megnesium. Potassium and sodium were found only in traces. In the present study, of the three profiles examined, profile VII showed accumulation of the bases in the sub-surface layer which may be due to the inten.se leaching to which these soils are subjected. The increased amounts of magnesium in profile VI suggests the presence of ferro-magnesium minerals which liberate magnesium on weathering.

Kari soils are peculiar in that they are submerged and hence show variation in the content and behaviour of exchangeable bases. In the profiles studied (IX and X) calcium constituted the predominent divalent cation. The range of exchangeable calcium observed in these soils (3.6 to 4.5 m.e/100g) is comparable to the results (1.52 to 7.7 m.e/lOOg) obtained by Kurup (1967). The low pH of these soils reflect the presence of a high content of hydrogen in the exchange complex. Magnesium formed the next predominent divalent cation, the range observed being (2.2 to 4.18 m.e/lOOg) which is in agreement with the figures (1.95 — 6.63 m.e/lOOg) reported by Kurup (1967) for Kari soils. Exchangeable potassium was found only in relatively small quantities ranging from a trace to 0.75 m.e/lOOg. Manilla (1955) working with Finnish soils observed only traces of potassium and sodium in organic soils. In the present investigations the exchangeable sodium content of the Kari soil was comparatively higher. The periodical inundations of these soils with sea water which contains sodium and magnesium salts explains the presence of these elements in exchangeable form in these soils. This again is in agreement with the findings of Nambiar (1947) in rice soils of Kerala.

The dominant cation in the case of black soil is calcium followed by magnesium, sodium and potassium. The dominance of calcium and magnesium in calcareous soils have been observed by Das *et al.* (1946) working with Indian soils and also Menon *et al.* (1957) working with the black soils of Tirunelveli District. In both the profiles in the present study calcium was maximum in the surface layers, whereas magnesium tended to increase down the profile. This is in agreement with the findings of Das *et al.* (1946) in some Indian soils. The clay content of these soils increases with depth showing thereby that eluviation has occurred. The variations in the bases especially sodium with depth as seen from the present study indicate that bases were also leached down the profile.

As in the cases of most of the soils studied, the forest soils showed a predominance of calcium and magnesium. The nature and distribution of the exchangeable base in these soils as revealed by the present study reflects the intense leaching to which these soils have been subjected to.

The red soils are poor in bases. The occurence of bases decreased in the order calcium > magnesium > potassium > sodium. This is the same order as observed by Menon and Mariakulandai (1957) working with red soils of Tamil Nadu. They observed only traces of exchangeable sodium in these soils. The present study also gives a low value for exchangeable sodium. The total bases increase with depth showing the effect of rainfall and resultant leaching of bases.

Summary

A study was made of the exchangeable cations of forty soil samples representing fourteen soil profiles of Kerala.

The exchangeable base content of the different soils was generally in the order calcium > magnesium > potassium > sodium. In the case of kari and black soils the exchangeable sodium showed a higher content over potassium. The maximum amounts of exchangeable calcium, magnesium and potassium was observed in the black soil.

The heighest value of exchangeable hydrogen was observed in the case of *kari* soil which also recorded very low values of pH.

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സംഗ്രഹം

കേരളത്തിലെ പതിനാലു മണ്ണ് പ്രൊഫൈലുകളെ പ്രതിനിധാനം ചെയ്യുന്ന നാൽപ്പത് സാമ്പിളുകളുടെ എക്സ്ചേഞ്ചബിൾ കാററയോണിനെക്കുറിച്ച് പഠനം നടത്തി.

കാൽസിയം > മഗ്നീഷ്യം > പൊട്ടാഷ്യം > സോഡിയം എന്നീ ക്രമത്തിലാണ് ഈ മണ്ണുകളുടെ എക്സ്ചേഞ്ചബിൾ ബെയിസിന്റെ അംശം വെളിപ്പെട്ടത്. 'കരി', 'ബ്ലാക്ക്' മണ്ണുകളെ സംബന്ധിച്ചിടത്തോളം പൊട്ടാഷ്യത്തെക്കാളേറെ വെളിപ്പെട്ടത് സോഡിയത്തിന്റെ അംശമാണ്. കാൽസിയം, മഗ്നീഷ്യം, പൊട്ടാഷ്യം എന്നിവയുടെ എക്സ്ചേഞ്ചബിൾ അംശം ഏററവുമധികം കണ്ടത് 'ബ്ലാക്ക്' മണ്ണിലാണ്.

'കരി' മണ്ണിലാണ് ഹൈഡ്രജന്റെ എക്സ്ചേഞ്ചബിൾ അംശം ഏററവും അധികമുള്ളത് എന്നു കണ്ടു. പി. എച്ച് ഏററവും കുറവുള്ളതും 'കരി' മണ്ണിൽത്തന്നെ.

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