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Characterization of some typical pedons in lower Vellar basin of Pudukottai district, Tamil Nadu

J. SOMASUNDARAM, S. NATARAJAN, K. K. MATHAN, V. ARUN KUMAR AND R. SIVASAMY

Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore - 641 003, India

Abstract : IRS-1B LISS II Geocoded false colour composite imagery on 1:50,000 scale was interpreted in conjunction with SOI toposheets for delineation of physiographic units in the Vellar Basin of Pudukottai district, Tamil Nadu. Based on the pre-field map, ground truth investigation was carried out. Some of the interpreted physiographic units were found to have similar soil composition, and hence, re-grouped under similar mapping unit. There were 24 map units. The soils were associated with 10YR/7.5YR/2.5YR hue and classified as Entisols, Inceptisols and/or Alfisols.

Additional key words : *Remote Sensing, IRS-1B, soil classification*

Introduction

Soil is recognized as one of the most valuable natural resources on whose proper use depend the life supporting systems and social and economic development. Remote sensing has proved to be the most efficient, economical and reliable technique to prepare a comprehensive inventory of soil resources and land use pattern of an area (Venkataraman 1980; Patel *et al.* 2001) and detection of special and temporal changes in these resources (Manchanda *et al.* 2002; Mini *et al.* 2007). The present study was carried out to characterise and classify the soils of lower Vellar Basin of Pudukottai district, Tamil Nadu state using remote sensing techniques.

Materials and Methods

Study area

The study area (30,075 hectares) is distributed in Alangudy, Thirumayam, Pudukottai and Aranthangi talukas of Pudukottai district, Tamil Nadu. It lies between 10°7'33" and 10°25'13"N latitude and 78°47'13" and 78°58'32"E longitude. The soil moisture regime of the area is 'ustic' and the temperature regime is 'isohyperthermic'. The physiography is undulating to level. Many tributaries, ephemeral streams and network of channels of the study area are draining in to the Vellar river basin. The study area is dry and rainfall is scanty with mean annual precipitation of 539 mm.

Field studies

The field survey was preceded by interpretation of images for the preparation of base maps. The basic data used in the present investigation is IRS 1B LISS II Geocoded false colour composite with spectral bands 2,3 and 4 on 1:50,000 scale imageries corresponding to the Survey of India (SOI) toposheets 58 J/15 and 58 J/16 which was visually interpreted based on image characteristics such as tone, texture, size, pattern, association and mottles. Mapping units were prepared on pre-field maps and were checked during ground truth verification. Image interpretation units (IIUs) having similar soil characteristics were grouped into one mapping unit. Morphological characteristics of these profiles were studied in the field (Soil Survey Division Staff 1999). Horizon-wise soil samples were collected from 13 typical profiles for physical, chemical, and exchangeable properties.

Laboratory investigations

The soils were analysed for the relevant properties by adopting standard procedures and soils were classified up to family level as per USDA Soil Taxonomy (Soil Survey Staff 1999).

Results and Discussion

Physiography, land use and soils

Physiogrpahy and land use map was prepared after interpretation of satellite imagery in conjunction with field checks. Image interpretation units having similar characteristics were grouped into one mapping unit (Table 1).

Thirteen pedons were studied representing different physiographies *viz.* nearly level (P1, P3, P4 and P5); very gentle to gentlly sloping (P6, P7, P8, P9 and P11) and undulating land (P2, P10, P12, and P13). Soils of the study area have wide variations in texture (sandy clay to clay loam) and drainage conditions (poor to well drained).

The morphological properties of thirteen pedons are listed in table 2. The colour of the surface soils varied from greyish brown to yellowish red. The colour variation in all these soils were mainly due to the differences in relief and consequent transportation of products of weathering (or) reduction of Fe and Mn (Diwakar and Singh 1994; Bhasker and Subbaiah 1995). Among the 13 pedon, Vamban (P7) had typical dark red colour throughout profile. It is evident that reddish colour is mainly due to presence of Fe oxides or wider ratio of Fe oxide to clay ratio. Wider the ratio,

Table 1. Map symbols and their details

Map symbol	Soil series	Area (ha)	Per cent
1	Pudhuarimalam, Adappankarachatram	400.00	1.33
2	Aliyanilai	387.50	1.28
3	Purakudikadu	1437.50	4.77
4	Kamakshipuram	962.50	3.20
5	Nayakarpatti, Kamakshipuram	2231.25	7.41
6	Adappankarachatram , Vamban	1987.50	6.60
7	Arimalam, Nayakarpatti	568.75	1.89
8	Aliyanilai,Adappankarachatram	200.00	0.66
9	Arimalam, Tanjur	3025.00	10.00
10	Periyanayagipuram	62.50	0.20
11	Vengalangadu	231.25	0.76
12	Purakudikadu, Pudhuarimalam	562.50	1.87
13	Vamban, Aliyanilai	5293.75	17.6
14	Adappankarachatram	381.25	1.26
15	Adappankarachatram, Nayakarpatti	700.00	2.32
16	Kamakshipuram, Nayakarpatti	581.25	1.93
17	Kamakshipuram, Aliyanilai	562.50	1.87
18	Adappankarachatram, Aliyanilai	1768.75	5.88
19	Madathupatti	862.50	2.86
20	Mettupatti	112.50	0.37
21	Tanjur, Madathupatti	1112.50	3.69
22	Mettupatti, Vengalangadu	2450.00	8.10
23	Aliyanilai,Vengalangadu	3837.50	12.7
24	Vengalangadu	356.25	1.18
	Total	30,075.00	100.00

brighter is the colour and *vice- versa* (Singh *et al.* 1995).

Soil structure varied from granular to strong coarse sub-angular blocky. Pedons of Vamban (P7), Purakudikadu (P10) and Pudhuarimalam (P11) indicated better development of soil structure. Laterites occur below the soil cover which are brittle and shatter when cut and crumble to irregular masses of iron gravels. The succeeding layers had vesicular or honey-comb structure. Similar results have been reported by Bhasker and Subbaiah (1995) and Suresh kumar *et al.* (2001). In sub-surface horizons of Mettupatti (P8), Tanjur (P5) and Arimalam (P6) common medium prominent dusky red (2.5 YR 2.5/2) mottles were present. Most of the pedons had strong brown and dark brown mottles/iron and manganese concretions. The occurrence of these oxidized mottles might be due to fluctuating water table (Nirmalya Bala and Sahu 1993).

Based on morphological, physical and chemical characteristics, the soils of , Aliyanilai (P1), Mettupatti (P8) and Vengalangadu (P13) were classified under Entisols; Madathupatti (P3), Arimalam (P6), Periyagipuram (P9), Purakudikadu (P10) and Pudhuarimalam (P11) were grouped under Inceptisols and Nayakarpatti (P2), Kamakshipuram (P4), Tanjur (P5), Vamban (P7) and Adappankarachatram (P12) were classified as Alfisols

Physical properties

Nayakarpatti (P2) had the highest clay followed by Madathupatti (P3), Vamban (P7) and Periyanagi-puram (P9) pedons. The clay content of the pedons showed a gradual increase with depth indicating illuviation of clay as evidenced from presence of argillic horizon (Jagdish Prasad *et al.* 1995). Sand fractions constituted the bulk of mechanical compositions in most of the pedons (Table 2). Maduthupatti (P3) pedon had the highest silt content followed by Arimalam (P6). This was attributed mainly to weathering and advanced pedogenesis (Singh *et al.* 1995). In general, in most of the pedons, silt content increased with depth.

Chemical properties

These soils are slightly acidic to alkaline in reaction (pH 4.70 to 8.30). The alkaline pH was observed in Purakudikadu (P10) pedon (Table 3). The electrical conductivity varied from 0.003 to 0.57 dS m^{-1}. The free calcium carbonate varied from 0.12 to 2.72 per cent. In all pedons, small amounts of free $CaCO_3$ were recorded which was distributed throughout the profiles apparently due to existing hydrological situations (Singh and Mishra 1994). Lime nodules were observed in the sub-surface horizon of Vamban (P7) pedon, which could be attributed to accumulation of free carbonates, because of moderate to slow permeability and subsequent precipitation of calcium. Similar trend was observed by Sahu and Mishra (1997). The organic carbon of the pedons varied from 0.3 to 7.6 g kg^{-1}. The higher organic carbon content of surface soil is mainly due to fresh accumulation or organic matter and crop residues.

Silica content in most of the pedons showed decreasing trend with depth, whereas Arimalam and Mettupatti (P8) pedons showed reverse trend (Table 3). Increased silica content with depth was also reported by Diwarkar and Singh (1994). The parent material could be prime factor contributing to variation in the silica and the presence of higher coarse fraction which also could have contributed to higher silica content in soil. The silica may be derived from *in-situ* weathering (or) from rocks in higher sites. Coarse sand had positive correlation with acid insolubles (r=0.72**)

The sesquioxide (R_2O_3) content of pedons varied considerably. These variations in R_2O_3 might be also from the type of parent material, physiography, soil drainage and overall pedo-chemical environments (Table 3). The SiO_2/R_2O_3 ratio of the pedons ranged from 3.16 to 14.07. The ratio was wider in all the pedons. The highest ratio was observed in Adapankaranchatram (P12) pedon. The low molar SiO_2/R_2O_3 ratio indicated moderate weathering in soil whereas high molar ratio indicated *vice-versa*. (Table 3).

Table 2. Physical properties of soils

Pedon No/ Seies name	Horizon	Depth (cm)	Colour (M)	Clay (%)	Silt (%)	Coarse sand (%)	Fine sand (%)	Gravel (%)
P1 (Aliyanilai)	Ap	0 - 24	7.5 YR 4/6	13.2	15.6	31.1	40.1	7.3
	AC	24 - 70	7.5 YR 4/6	15.9	12.4	33.2	38.5	17.4
P2 (Nayakarpatti)	Ap	0 - 17	10 YR 3/3	4.9	6.2	42.2	46.7	3.3
	Bt1	17 - 34	10 YR 5/6	21.2	8.3	31.4	39.1	6.5
	Bt2	34 - 68	10 YR 5/6	20.2	7.6	30.8	41.4	1.4
	Bt3	68 - 85	10 YR 5/3	48.3	13.1	15.2	23.4	7.3
P3 (Madathupatti)	Ap	0 - 14	10 YR 4/3	6.1	15.1	31.9	46.9	1.8
	A12	14 - 23	10 YR 3/4	8.9	16.2	31.5	43.4	3.1
	Bw1	23 - 51	10 YR 5/8	38.0	25.0	13.2	23.8	8.5
	Bw2	51 - 80	10 YR 5/6	47.1	12.6	28.0	12.3	12.4
	Bw3	80 - 110	10 YR 5/8	47.8	13.1	26.1	13.0	14.6
P4 (Kamakshipuram)	Ap	0 - 18	10 YR 4/1	5.2	5.0	54.2	35.6	10.2
	Bw	18 - 74	10 YR 5/6	8.3	9.3	45.3	37.1	8.4
	Bt	74 - 101	10 YR 4/6	21.3	7.3	32.2	39.2	12.8
P5 (Tanjur)	Ap	0 - 21	10 YR 5/2	15.3	10.0	33.1	41.6	3.2
	A11	21 - 44	10 YR 4/4	8.3	5.1	48.2	38.4	4.1
	A12	44 - 48	10 YR 4/4	9.1	6.2	47.1	37.6	4.3
	2Bt1	48 - 83	10 YR 4/6	22.3	8.3	36.3	33.1	11.4
	2Bt2	83 - 115	10 YR 5/4	36.0	6.2	33.1	24.7	13.5
P6 (Arimalam)	Ap	0 - 13	10 YR 4/4	33.9	20.5	30.8	14.8	3.1
	Bw1	13 - 38	2.5 YR 3/6	33.9	11.5	37.0	17.6	11.1
	Bw2	38 - 96	7.5 YR 4/6	35.3	12.6	33.9	18.2	17.8
P7 (Vamban)	Ap	0 - 13	2.5 YR 3/6	19.5	20.3	20.2	40.0	1.2
	Bw	13 - 38	2.5 YR 3/6	33.3	4.1	23.4	39.2	1.0
	Bt1	38 - 59	2.5 YR 3/6	35.9	5.2	20.3	38.6	1.8
	Bt2	59 - 86	2.5 YR 3/6	36.1	4.0	24.2	35.7	1.6
	Bt3	86 - 103	2.5 YR 3/6	36.2	4.2	26.1	33.5	3.1
	Bt4	103 - 119	2.5 YR 3/6	38.2	5.5	23.1	33.2	3.4
P8 (Mettupati)	Ap	0 - 15	10 YR 4/4	31.3	4.2	21.8	42.7	22.7
	2B1	15 - 34	10 YR 4/6	12.3	13.1	32.2	42.4	22.2
	2B2	34 - 62	10 YR 4/6	16.2	14.2	29.8	39.8	23.1
	3BC	62 - 84	10 YR 4/6	8.3	11.3	37.3	43.1	22.4
P9 (Periyanayagipuram)	Ap	0 - 20	10 YR 3/4	13.2	16.1	32.3	38.4	2.5
	Bw1	20 - 46	10 YR 4/6	33.4	6.2	22.5	37.9	8.2
	Bw2	46 - 79	10 YR 5/8	33.5	5.2	24.1	37.2	5.2
	Bw3	79 - 109	10 YR 4/6	40.3	4.2	25.0	30.5	4.7
P10 (Purakudikadu)	Ap	0 - 28	2.5 YR 3/6	33.2	7.2	26.2	33.4	24.1
	Bw	28 - 109	7.5 YR 4/6	34.1	6.6	27.3	32.0	23.8
P11 (Pudhuarimalam)	Ap	0 - 12	7.5 YR 4/6	35.1	6.2	25.5	33.2	11.4
	Bw2	12 - 39	7.5 YR 4/6	34.2	5.5	27.3	33.0	7.8
	Bw2	39 - 97	7.5 YR 4/6	35.0	6.1	23.2	35.7	10.2
P12 (Adappankarachatram)	Ap	0 - 10	10 YR 4/4	6.2	8.2	37.1	48.5	6.2
	Bt1	10 - 39	7.5 YR 4/6	13.1	9.1	35.2	42.6	7.9
	Bt2	39 - 87	7.5 YR 4/6	13.3	8.6	33.2	44.9	23.2
P13 (Vengalangadu)	Ap	0 -20	7.5 YR 4/6	4.9	8.5	38.2	48.4	6.4
	AC1	20 - 43	10 YR 4/6	6.1	20.1	32.4	41.4	21.3
	AC2	43-69	10 YR 4/6	7.2	19.3	30.2	43.3	13.2

Table 3. Chemical properties of soils

Pedon No	Depth (cm)	EC (dS m^{-1})	pH 1:1	pH 1:2	OC (%)	$CaCO_3$ (%)	R_2O_3 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	SiO_2 (%)	SiO_2/R_2O_3	Al_2O_3/Fe_2O_3	SiO_2/Al_2O_3	SiO_2/Fe_2O_3
P1	0 - 24	0.04	5.0	5.0	0.03	0.24	28.60	10.35	18.25	70.22	4.80	2.75	6.54	7.32
	24 - 70	0.03	6.2	6.3	0.44	0.28	33.28	8.75	24.53	65.21	3.68	4.37	4.52	10.08
P2	0 - 17	0.08	5.8	5.9	0.15	0.12	16.80	8.73	8.07	79.28	9.86	1.44	16.70	5.10
	17 - 34	0.04	4.9	4.7	0.06	0.20	18.12	10.31	7.81	68.52	8.08	1.18	14.91	4.66
	34 - 68	0.07	5.2	5.6	0.09	0.20	26.18	8.90	17.28	69.21	5.12	3.03	6.81	7.80
	68 - 85	0.04	5.2	5.1	0.26	0.16	30.11	9.05	21.06	67.38	4.26	3.63	5.44	8.82
P3	0 - 14	0.15	6.8	7.1	0.55	0.56	21.98	11.59	10.39	76.52	7.30	1.40	12.52	5.03
	14 - 23	0.09	7.7	7.6	0.32	0.28	25.62	8.98	16.64	72.10	5.47	2.89	7.37	7.56
	23 - 51	0.13	7.7	8.0	0.32	0.44	32.98	8.88	24.10	62.58	3.57	4.23	4.41	9.84
	51 - 80	0.19	8.3	8.2	0.26	0.52	35.12	7.59	27.53	60.21	3.16	5.65	3.72	12.26
	80 - 110	0.54	7.8	8.0	0.29	0.60	28.21	9.16	19.05	65.38	4.46	3.24	5.83	8.16
P4	0 - 18	0.05	6.2	6.5	0.29	0.24	13.01	8.88	4.13	86.21	14.91	0.72	35.49	3.88
	18 - 74	0.03	6.1	6.5	0.29	0.24	18.48	8.83	9.65	78.42	8.71	1.70	13.81	5.55
	74 - 101	0.05	6.2	6.5	0.38	0.28	25.41	9.02	16.39	71.41	5.47	2.83	7.41	7.47
P5	0 - 21	0.24	8.2	7.6	0.70	0.48	18.98	7.45	11.53	73.02	7.61	2.41	10.77	6.75
	21 - 44	0.10	8.3	7.7	0.15	0.46	14.29	7.40	6.89	82.28	12.02	1.45	20.30	5.12
	44 - 48	0.11	8.4	7.5	0.26	0.52	19.38	7.26	12.12	74.31	7.53	2.60	10.42	7.07
	48 - 83	0.16	7.2	7.6	0.23	0.51	25.21	8.75	16.46	68.33	5.26	2.93	7.06	7.64
	83 - 115	0.17	7.6	7.7	0.23	0.53	28.31	9.02	19.29	63.10	4.28	3.33	5.56	8.32
P6	0 - 13	0.06	6.4	6.6	0.38	0.68	26.12	9.89	16.23	69.31	5.22	2.56	7.26	7.00
	13 - 38	0.06	7.4	7.4	0.23	0.56	21.46	7.60	13.86	71.41	6.48	2.84	8.76	7.48
	38 - 96	0.07	7.4	7.50	0.23	0.28	18.46	7.83	10.63	75.68	8.22	2.12	12.10	6.25
P7	0 - 13	0.12	6.5	6.60	0.76	0.51	26.28	10.41	15.87	63.14	4.76	2.38	6.76	6.69
	13 - 38	0.08	6.4	5.60	0.58	0.44	24.38	10.59	13.79	68.31	5.64	2.03	8.42	6.10
	38 - 59	0.05	5.3	5.40	0.44	0.37	31.28	11.75	19.53	61.08	3.84	2.59	5.32	7.05
	59 - 86	0.06	5.2	5.10	0.35	0.40	34.14	11.46	22.68	59.02	3.34	3.09	4.42	7.89
	86 - 103	0.06	5.7	5.10	0.29	0.44	32.28	11.28	21.00	61.21	3.69	2.90	4.96	7.58
	103 - 119	0.04	5.4	5.70	0.29	0.46	34.12	12.04	22.08	62.41	3.56	2.86	4.81	7.51

Contd.

Pedon No	Depth (cm)	EC (dS m^{-1})	pH 1:1	pH 1:2	OC (%)	$CaCO_3$ (%)	R_2O_3 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	SiO_2 (%)	SiO_2/ R_2O_3	Al_2O_3/ Fe_2O_3	SiO_2/ Al_2O_3	SiO_2/ Fe_2O_3
P8	0 - 15	0.09	6.4	6.5	0.73	0.57	32.21	10.31	20.90	63.42	3.92	3.16	5.16	8.02
	15 - 34	0.05	6.9	6.8	0.38	0.49	25.38	9.85	15.53	68.21	5.31	2.46	7.47	6.83
	34 - 62	0.04	7.1	6.7	0.26	0.44	18.92	9.36	9.56	72.42	7.91	1.59	12.88	5.36
	62 - 84	0.04	7.2	6.5	0.12	0.37	13.48	8.88	5.10	79.21	12.47	0.90	26.40	4.17
P9	0 - 20	0.57	8.1	7.7	0.52	0.65	14.28	9.16	5.12	76.11	11.77	0.87	25.27	4.13
	20 - 46	0.26	8.3	8.2	0.44	0.63	29.88	8.60	21.28	63.98	4.06	3.86	5.11	9.21
	46 - 79	0.28	8.1	7.1	0.38	0.65	30.22	8.75	21.47	61.41	3.85	3.82	4.86	9.15
	79 - 109	0.26	8.2	7.9	0.23	0.66	34.01	8.42	25.59	63.48	3.48	4.74	4.22	10.70
P10	0 - 28	0.19	7.3	7.4	0.09	0.66	27.29	9.12	18.17	62.48	4.42	3.11	5.85	7.93
	28 - 109	0.16	8.4	8.3	0.06	2.72	29.21	11.98	17.23	60.98	4.16	2.24	6.02	6.46
P11	0 - 12	0.13	5.5	5.3	0.17	0.41	23.27	12.15	11.12	68.56	6.16	1.43	10.48	5.08
	12 - 39	0.17	7.1	6.9	0.09	0.46	19.81	8.90	10.91	72.41	7.41	1.91	11.28	5.90
	39 - 97	0.10	7.4	7.7	0.09	0.52	25.10	8.75	16.46	68.50	5.28	2.93	7.07	7.64
P12	0 - 10	0.14	6.0	6.1	0.20	0.29	11.98	6.31	5.67	80.41	14.07	1.40	24.11	5.03
	10 - 39	0.10	6.2	5.9	0.12	0.38	18.21	10.02	8.19	75.59	8.79	1.27	15.69	4.82
	39 - 87	0.13	6.2	5.8	0.09	0.52	14.21	9.89	4.32	78.41	12.50	0.68	30.86	3.81
P13	0 -20	0.05	5.2	5.1	0.15	0.23	28.21	14.60	13.61	63.25	4.68	1.45	7.90	5.12
	20 - 43	0.06	4.1	5.1	0.09	0.26	34.00	14.74	19.26	61.00	3.61	2.04	5.38	6.11
	43 - 69	0.05	5.2	5.6	0.06	0.23	28.34	14.90	13.44	63.12	4.67	1.41	7.98	5.04

Table 4. Exchangeable properties of soils

Pedon Number	Depth (cm)	Ex -K	Ex - Na	Ex - Ca	Ex - Mg	CEC	BSP	ESP	Ex - Acid
		c mol (p+)kg^{-1}							c mol (p+)kg^{-1}
P1	0 - 24	0.12	0.86	7.0	4.0	17.1	70.1	5.0	0.2
	24 - 70	0.17	1.02	9.0	5.0	24.1	63.0	4.2	0.3
P2	0 - 17	0.12	0.71	6.5	2.5	14.8	66.4	4.8	0.4
	17 - 34	0.12	0.86	7.5	3.5	17.5	68.5	4.9	0.9
	34 - 68	0.11	0.93	8.0	4.5	17.2	78.7	5.4	0.6
	68 - 85	0.11	0.81	8.0	5.0	15.5	89.8	5.2	0.5
P3	0 - 14	0.16	2.11	6.0	3.0	16.7	67.5	12.6	0.5
	14 - 23	0.10	2.34	4.0	3.0	15.0	59.7	14.8	0.5
	23 - 51	0.10	2.31	8.0	2.5	18.0	71.7	12.8	0.7
	51 - 80	0.10	2.67	7.5	4.0	19.3	73.9	13.8	0.4
	80 - 110	0.12	2.41	8.0	4.0	21.0	69.2	11.5	0.4
P4	0 - 18	0.08	0.74	4.0	2.0	15.1	45.1	4.9	0.5
	18 - 74	0.08	1.12	6.0	4.5	17.3	67.6	6.5	0.7
	74 - 101	0.10	1.30	6.5	3.0	18.6	58.6	7.0	0.7
P5	0 - 21	0.13	2.10	7.0	3.0	16.3	78.3	12.8	0.5
	21 - 44	0.08	2.64	6.0	3.5	18.4	66.4	14.3	0.4
	44 - 48	0.11	2.10	4.5	2.5	14.4	64.0	14.5	0.3
	48 - 83	0.13	2.32	5.5	3.0	15.2	72.0	15.4	0.4
	83 - 115	0.15	2.40	5.5	4.0	15.5	77.7	13.6	0.4
P6	0 - 13	0.21	2.50	8.0	4.5	20.8	73.1	12.0	0.5
	13 - 38	0.17	2.75	7.0	3.5	21.9	61.3	12.6	0.5
	38 - 96	0.13	3.51	8.5	3.5	22.0	69.2	15.5	0.9
P7	0 - 13	0.24	0.52	8.5	4.0	17.1	77.5	3.0	0.4
	13 - 38	0.22	0.42	7.5	3.5	17.4	66.9	2.4	0.4
	38 - 59	0.17	0.53	8.0	4.5	17.5	75.4	3.1	0.4
	59 - 86	0.16	0.53	8.5	4.5	17.6	77.8	3.1	0.9
	86 - 103	0.15	0.41	7.5	3.5	17.6	65.7	2.3	0.9
	103 - 119	0.13	0.48	9.0	5.5	17.7	85.4	2.7	0.7
P8	0 - 15	0.25	1.24	7.0	2.0	18.5	56.7	6.7	0.4
	15 - 34	0.26	1.64	5.0	1.5	16.5	50.9	9.9	0.4
	34 - 62	0.24	1.73	5.5	2.5	15.9	62.7	10.9	0.6
	62 - 84	0.22	1.94	6.0	2.0	15.2	66.8	12.8	0.5
P9	0 - 20	0.12	2.60	6.5	2.5	17.4	69.0	14.9	0.5
	20 - 46	0.10	2.40	5.0	2.0	16.3	58.3	14.7	0.6
	46 - 79	0.12	2.50	5.0	3.5	19.4	61.0	12.8	0.6
	79 - 109	0.14	2.61	5.0	2.0	21.2	47.9	12.3	0.6
P10	0 - 28	0.19	2.55	7.0	3.5	24.4	54.3	10.4	0.7
	28 - 109	0.11	2.18	5.5	3.0	19.8	54.5	11.0	0.5
P11	0 - 12	0.27	1.42	5.0	3.5	20.7	49.2	6.9	0.6
	12 - 39	0.16	1.86	7.0	4.5	19.8	68.3	9.4	0.6
	39 - 97	0.12	1.32	5.5	4.0	19.5	67.6	6.8	0.5
P12	0 - 10	0.14	1.22	5.5	3.5	15.0	64.8	8.1	0.6
	10 - 39	0.12	1.01	5.0	3.0	17.4	51.3	5.8	0.6
	39 - 87	0.09	0.18	6.0	4.0	20.5	53.1	3.9	0.5
P13	0 -20	0.12	0.96	5.5	2.0	16.1	53.3	6.0	1.3
	20 - 43	0.18	0.81	6.5	2.0	16.3	49.7	4.9	1.6
	43 - 69	0.16	0.78	5.5	2.5	16.4	47.6	4.8	1.5

Exchangeable properties

The CEC increased with depth in most of the pedons (Table 4). Higher values of CEC in sub-surface horizons commensurate with amount of clay (r = 0.484**). The CEC decreased with depth in the pedons of Nayakarpatti (P2), Tanjur (P5) and Arimalam (P6) due to variation in clay and organic content (Mishra and Ghosh, 1995)

The exchangeable bases had distinct pattern regarding their sequential dominance. In all the pedons, the order followed was Ca> Mg> Na > K. Similar results were found by Diwakar and Singh (1994). Increase of Ca^{2+} content with depth was noticed in many of these pedons (P1, P2, P3, P4, P6 and P7) which might be due to leaching of bases. The variations observed in base saturation percentage (BSP) indicated the degree of leaching which was used as diagnostic character for classifying the soil orders. High base saturation particularly was due to high Ca^{2+} followed by Mg^{2+}, Na^{+} and K^{+} (Patil and Dasog 1996).

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