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Characterization and Classification of Soils on Valley Plains of Middle Andaman Island

G.C. SAHU AND NIRMALYA BALA
Department of Agricultural Chemistry, Soil Science and Biochemistry; Orissa University of Agriculture and Technology, Bhubaneswar, Orissa, 751 003

Abstract: *Five pedons of valley plains of Middle Andaman Islands were characterized and classified. Three pedons situated in valley flat plains had mottles, loam to sandy clay texture with slow permeability and were moderately acidic to neutral. Two pedons just adjacent to the valley plains on slightly sloping land and in brackish water marshes were sandy loam to loam in texture with moderate permeability and strongly to mildly acidic. In all these soils organic carbon content was generally high in the surface (0.37-0.06 g kg^{-1}) and gradually decreased with depth. Exchange acidity was mostly due to exchangeable H^+. The CEC varied from 23.0 to 8.4 cmol$^-$ (p^+) kg^{-1} and Ca^{2+} dominated the exchange complex. Soils of valley plains were classified as Fluventic Entropepts, Aquic Eutropepts and Aeric Tropaquepts. The other two soils were classified as Typic Udifluvents.* (**Key words:** Valley plain soils, morphology, physical and chemical characteristics, taxonomic classification)

Narrow strips of flat valley lands are the main soils for cultivation of coconut and rice in the middle Andaman islands. Previous studies on the soils of Andaman and Nicobar Islands (Singh *et al.* 1988; Ganeshamurthy & Mongia 1989) provided information regarding soil characteristics, fertility status and management, mostly from south Andaman. Hillslope soils of middle Andaman were studied by Bala and Sahu (1993). At attempt has been made in the present investigation to study the morphological, physical and chemical characteristics of the soils developed in the valley plains of middle Andaman and to classify them as per Soil Taxonomy (Soil Survey Staff 1975, 1987).

Materials and Methods

Five representative pedons situated on both the sides of Andaman Trunk Road from Govindapur, Chitrakut, Nimbudera, Santipur and Uttara (referred to as Pedon 1 to 5, respectively) were morphologically examined in the field. Soil samples collected from different horizons were analysed for particle size distribution, pH, EC, organic carbon and CEC following standard procedures. Exchange acidity and exchangeable Al^{3+} were determined by the methods of McLean (1965). Free oxides were determined by the method of Jackson (1956). Fine sand fractions of the soils from the control sections were separated (Jackson 1956) and studied under petrological microscope.

Results and Discussion

Morphology

Salient morphological features of the pedons are presented in table 1. The pedon 1 represented a valley flat, fallow land, under shrubs and grasses, nearly level, well drained with water table at 1.5 m depth. These soils were pale brown to olive grey, loam to sandy loam, fine granular to subangular blocky with no mottles. Irregular to rounded Fe and Mn concretions constituted 2-10 per cent in this pedon.

Pedon 2 represented soils from the valley

Table 1. *Morphology of the pedons*

Horizon	Depth (m)	Soil colour		Textural class	Structure	Consistence
		Matrix	Mottles			
Pedon 1 (Fluventic Eutropept)						
A11	0 - 0.17	10YR 6/3	-	l	f 1 gr	dl, mvfr, wss
B21w	0.17 - 0.25	2.5YR 6/2	-	l	m 2 sbk	dvh, mfr, ws
B22w	0.25 - 0.75	2.5Y 5/1	-	ls	m 1 sbk	dl, mvfr, wss
B23w	0.75 - 1.05	5Y 5/2	-	sl	m 1 sbk	dl, mfr, wss
B3	1.05 - 1.45	5Y 5/2	-	cl	m 2 sbk	dsh, mfr, ws
Pedon 2 (Aquic Eutropept)						
Ap	0 - 0.15	10YR 7/2	-	sl	m to sgr	dsh, ml, wso
B21w	0.15 - 0.65	10YR 6/3	10YR 5/3 m	l	m 3 sbk	dvh, mfi, ws
B22w	0.65 - 1.55	2.5Y 5/4	2.5Y 6/0 m	l	m 3 sbk	dh, mfi, wss
Pedon 3 (Aeric Tropaquept)						
Ap	0 - 0.25	2.5Y 5/4	7.5YR 7/8 m	sil	m 2 gr	dsh, mvfr, wss
B21w	0.15 - 0.70	10YR 5/2	10YR 5/1 m	sil	m 2 sbk	dh, mfr, wss
B22w	0.70 - 1.50	10YR 6/3	10YR 6/6 m	sc	c 2 cr	dh, mfr, wss
B3	1.15 - 1.50	10YR 6/3	-	ls	sg to m	dsh, mfi, wso
Pedon 4 (Typic Udifluvent)						
Ap	0 - 0.15	10YR 7/2	-	ls	m to sgr	dsh, mfr, wso
A11	0.15 - 0.70	10YR 6/3	-	ls	sg to m	dsh, mfr, wso
A12	0.70 - 0.95	10YR 7/2	-	l	m 2 sbk	dsh, mfr, ws
C1	0.95 - 1.30	10YR 6/2	-	sl	m 1 sbk	dsh, mfr, ws
C2	1.30 - 1.45	10YR 5/2	-	sl	m 1 sbk	dsh, mfr, wss
Pedon 5 (Typic Udifluvent)						
A11	0 - 0.20	10YR 5/2 m	-	sil	m 1 sbk to gr	dsh, mfr, wss
A12	0.20 - 0.55	2.5Y 6/4 m	10YR 6/8 m	l	m 2 sbk to gr	dsh, mfr, mvs
A13	0.55 - 1.00	2.5Y 5/4 m	10YR 8/6 m	sicl	m 2 sbk to m	dsh, mfi, wvs
C	1.00 - 1.45	2.5Y 6/0 m		si	m 2 sbk	dh, mfi, wvs

Note: m denotes soil colour in moist condition

plain medium land with 1 to 3 per cent slope. These soils were moderately eroded and moderately well drained. The colour of these soils varied from light grey to light olive brown with greyish mottles in the lower layers. The texture was sandy loam to loam and structure was granular to sub-angular blocky from surface downwards.

Pedon 3 represented imperfectly drained valley bottom levelled flat land. The land was used for rice cultivation. These soils were light olive brown to dark brown with reddish yellow to yellowish brown mottles. Soil texture was silty loam to sandy clay down the depth with granular to blocky structure.

Pedon 4 represented soils from valley flat land with 1 to 3 per cent slope. Boulders and rock fragments were present on the soil surface. These soils are well drained, light grey to pale brown with no mottles. Soil texture was loamy sand to loam and structure was slightly granular to sub-angular blocky. Stones of 1 to 3 cm size constituted more than 10 per cent by volume.

Pedon 5 was representative of degraded forest land along the brackish water marshes in Rangat *tehsil*. These soils had 1 to 3 per cent slope and were moderately eroded with rounded rocks and boulders on the surface. The soils were greyish brown to grey with brownish yellow to straw yellow jarosite mottles and Fe-Mn concretions. Soil texture varied from silty loam to silty clay and with granular to sub-angular blocky structure.

Soil Characteristics

All the soils except of pedon 1 (Table 2, 3) exhibited gradual increase in clay content from surface downwards up to about 1 m depth. In pedons 3, 4 and 5, the clay content decreased in lower layers. The surface texture varied from loam through sandy loam and loamy sand to silty loam. The soils were strongly to moderately acidic ex-

Table 2. *Physical and chemical characteristics of the soils*

Depth (m)	Mechanical composition			pH_w	EC (dS m^{-1})	Org. C (g kg^{-1})
	Sand (%)	Silt (%)	Clay (%)			
Pedon 1						
0 - 0.17	73.9	15.7	10.4	6.3	0.097	0.17
0.17 - 0.25	55.9	21.7	22.4	6.2	0.104	0.06
0.25 - 0.75	77.9	13.7	8.4	6.3	0.080	0.05
0.75 - 1.05	77.9	10.7	11.4	6.8	0.484	0.04
1.05 - 1.45	51.9	19.7	28.4	7.6	0.409	0.03
Pedon 2						
0 - 0.15	74.2	12.0	13.8	5.4	0.047	0.06
0.15 - 0.65	58.2	24.0	17.8	5.2	0.039	0.05
0.65 - 1.55	58.2	20.0	21.8	6.3	0.047	0.02
Pedon 3						
0 - 0.25	62.2	28.0	9.0	5.4	0.050	0.12
0.25 - 0.70	37.3	39.7	23.0	5.5	0.026	0.09
0.70 - 1.15	69.3	3.7	27.0	5.4	0.034	0.07
1.15 - 1.50	72.2	18.0	9.8	5.5	0.036	0.04
Pedon 4						
0 - 0.15	76.2	18.0	5.8	5.7	0.052	0.13
0.15 - 0.70	80.2	14.0	5.8	5.6	0.026	0.05
0.70 - 0.95	62.2	20.0	17.8	5.5	0.040	0.06
0.95 - 1.30	74.2	6.0	19.8	5.4	0.031	0.04
1.30 - 1.45	82.2	4.0	13.8	5.3	0.030	0.04
Pedon 5						
0 - 0.20	64.2	26.0	9.8	5.4	0.152	0.37
0.20 - 0.55	50.2	24.0	25.8	4.8	0.043	0.09
0.55 - 1.00	38.2	28.0	33.8	5.5	0.091	0.05
1.00 - 1.45	42.2	32.0	25.8	8.1	4.460	0.05

cept the lower layers of pedons 1 and 5. Alkaline reaction in the lower most layer of pedon 5 might be attributed to its physiographic position as it was situated along the brackish water marshes.

Organic carbon content was fairly high in all the horizons. Higher accumulation of organic matter was observed in the surface and it gradually decreased with depth. Exchangeable H^+ content decreased with depth except in A12 horizon of pedon 5. Increase of exchangeable H^+ and presence of exchangeable Al^{3+} in A12 horizon (absent in all other layers) might be due to the presence of jarosite mottles. The extremely acidic condition in this layer (pH 4.8) might have been due to oxidation of FeS_2 present in the jarosite mottles under sampling conditions (Horn *et al.* 1967) and the consequent release of exchangeable H^+ and Al^{3+}. Free iron oxide content varied from 1.8 to 2.9 per cent, the highest (2.9%) being recorded in pedon 3 (Table 4).

The cation exchange capacity (Table 3) varied from 8.4 to 23.0 cmol (p^+) kg^{-1} and did not show any definite trend with depth. Calcium was the dominant exchangeable cation followed by Mg^{2+}, Na^+ and K^+. Per cent base saturation varied widely (47.7 to 94.9%). The value of exchangeable H^+ varied from 0.6 to 0.1 cmol (p^+) kg^{-1} and decreased with depth except the A12 layer of pedon 5. Exchangeable Al^{3+} was present only in A12 horizon of pedon 5 and not in any other horizon. In other layers, the exchange acidity in soils was mainly attributed to exchangeable H^+.

Sand Mineralogy

Mineralogy of the fine sand fractions (100-250 microns) of the control section of different pedons is given in table 4. Quartz was the dominant mineral present in all the pedons, followed by feldspars. Dominance of quartz might be attributed to the parent rock being rich in sandstones (Singh *et al.* 1988). Presence of comparatively higher content of ferro-magensian minerals in pedons 1, 3 and 5 might be due to weathering of serpentine

Table 3. *Exchange characteristics of the soils*

Depth (m)	CEC	Exch. cations						Exch. acidity	Base saturation (%)
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	H^{+}	Al^{3+}		
	←			cmol (p^{+}) kg^{-1}				→	
Pedon 1									
0 - 0.17	23.0	7.90	7.07	0.95	0.16	0.6	-	0.6	69.9
0.17 - 0.25	21.2	6.90	5.72	0.80	0.19	0.2	-	0.2	64.2
0.25 - 0.75	20.3	4.90	7.07	0.71	0.13	0.2	-	0.2	63.1
0.75 - 1.05	16.0	5.56	6.57	0.67	0.20	0.2	-	0.2	81.2
1.05 - 1.45	15.0	5.19	8.13	0.73	0.18	0.1	-	0.1	94.8
Pedon 2									
0 - 0.15	13.5	3.74	3.73	0.98	0.06	0.4	-	0.4	63.1
0.15 - 0.65	17.4	6.82	2.25	1.22	0.16	0.4	-	0.4	60.0
0.65 - 1.55	17.0	7.74	3.07	1.02	0.09	0.2	-	0.2	70.1
Pedon 3									
0 - 0.25	21.7	7.91	4.98	0.89	0.13	0.4	-	0.4	64.1
0.25 - 0.70	16.4	5.32	2.49	0.93	0.19	0.2	-	0.2	54.4
0.70 - 1.15	13.6	3.74	2.48	1.19	0.13	0.2	-	0.2	55.4
1.15 - 1.50	8.4	2.91	0.41	0.93	0.09	0.2	-	0.2	51.7
Pedon 4									
0 - 0.15	16.0	5.57	3.15	0.93	0.13	0.4	-	0.4	61.1
0.15 - 0.70	15.5	3.85	3.05	1.74	0.22	0.2	-	0.2	57.2
0.70 - 0.95	12.4	3.32	2.83	0.79	0.09	0.2	-	0.2	56.6
0.95 - 1.30	12.5	5.57	0.66	0.95	0.09	0.1	-	0.1	58.2
1.30 - 1.45	11.0	3.91	1.24	1.09	0.09	0.4	-	0.4	57.5
Pedon 5									
0 - 0.20	17.7	6.23	3.74	0.87	0.29	0.4	-	0.4	62.8
0.20 - 0.55	13.0	3.15	1.66	1.19	0.19	1.1	1.4	2.5	47.6
0.55 - 1.00	12.3	3.81	4.16	1.09	0.09	0.2	-	0.2	58.1
1.00 - 1.45	14.6	4.39	6.34	2.82	0.09	0.0	-	0.0	93.4

group comprising ultrabasic and basic rocks (Singh *et al.* 1988). Further weathering of these minerals might have been slowed down as the pedons were located in the low lying valley bottom situations. Other minerals occurred in traces in different pedons.

Classification

The pedons 1, 2 and 3 showed the development of a cambic horizon and were classifed as Inceptisols. Pedon 1 was classified as Fluventic Eutropept because of isomesic or warmer temperature, high base saturation (> 50%), organic carbon that decreased regularly with depth and reached a level of more than 0.2 per cent (0.3%) and absence of mottles or lithic contact within 0.5 m.

Pedon 2 was classified as Aquic Eutropept as it satisfied all the requirements of a Typic Eutropept except the mottles, the chroma of which was less than 2 within 1 m depth.

Pedon 3 was classified as Aeric Tropaquept as it had an aquic soil moisture regime and satisfied all the requirements of Typic Tropaquepts except higher value and chroma.

Pedon 4 and 5 lack any diagnostic sub-surface horizon and were classified under Entisols order. These key out as Typic Udifluvents as they did not have lithic or paralithic contact within 25 cm of soil surface, organic carbon content that de-

Table 4. Minerological composition (%) of the fine sand fractions (100-250 microns) and free Fe_2O_3 content of the soils

Pedon	Depth (m)	Q	F	FMS	M	OP	Free Fe_2O_3
1	0.17 - 1.05	41.2	41.1	15.5	1.7	Tr	2.5
2	0.15 - 0.65	59.0	37.4	6.6	2.9	Tr	1.8
3	0.25 - 1.15	56.1	23.0	20.1	Tr	Tr	2.9
4	0.15 - 0.95	88.5	11.0	-	Tr	Tr	2.0
5	0.20 - 1.00	48.5	32.7	17.3	1.5	-	2.8

Q = Quartz, F = Feldspars, FMS = Ferromagnesian minerals, M = Mica, OP = Opaques, Tr = Traces

creased irregularly with depth and remained above 0.2 per cent, did not have a layer in the upper 75 cm that had texture finer than loamy fine sand, had an Ap horizon with moist value of more than 4 and had mottles with chroma of more than 2.

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Characterization and Classification of Coastal Soils of Various pH Groups in Sundarbans, West Bengal

B. MAJI AND B.K. BANDYOPADHYAY
Central Soil Salinity Research Institute, Regional Research Station, Canning Town, South 24-Parganas, West Bengal, 743 329

Abstract: *Thirtyfour pedons of coastal soils representing an area of 15,000 ha of Sundarbans, West Bengal were categorised on the basis of pH variations. Forty per cent of the study area falls in pH range 4-6; 40 per cent in pH range 6-7.5 and the rest 20 per cent in pH range > 7.5. A representative pedon under each pH category was characterized for morphological, physical and chemical properties and classified as per Soil Taxonomy.* (**Key words:** Coastal soils, pH variations, Soil Taxonomy)

An appraisal about the physiography, climate, vegetation and geology of coastal saline soils of eastern India with brief characteristics of the soils found in the coastal tract has been given by Murthy *et al.* (1983). However, detailed study of these soils is lacking. The present investigation aims at providing some basic information on the morphological features and chemical characteristics of the coastal soils of Sundarbans, West Bengal.

Materials and Methods

The study area is a part of Indian Sudarbans and lies between 22°05' and 22°30'N and about 88°30' and 88°55'E. The climate is humid sub-tropical with average annual rainfall of 1750 mm, out of which 80 per cent occurs during June to September. The soils of the area have hyperthermic temperature regime and have developed on deposits laid by river Matla, Bidya and its sub-tributaries.

Thirtyfour soil pedons were examined in different locations of Sundarbans during summer (April-May 1989) using Police Station map (1"= 1 mile or 1: 63, 360) as base map. Based on the soil survey data, the soils of Sundarbans were grouped under three pH categories, *viz.* pH 4-6, pH 6-7.5