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Characterisation and Classification of Soils of Nasik District, Maharashtra

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Abstract : *Three typical pedons on different altitude, climate and parent material were studied in Nasik district of Maharashtra. Soils developed from basalt on spur of Western Ghat under hot-humid climate are dark reddish brown colour with argillic horizon and qualified for Typic Rhodustalfs . The other group of soils those developed on interfluves under subhumid zone are very deep, dark reddish brown , clayey and qualify for Typic Ustropepts. Soils on piedmont plain experiencing semiarid climate are very deep, moderately well drained, clayey and are placed in subgroup Chromic Haplusterts.*

In Nasik district, red soils are mainly occurring in north-western portion and black soils in south-eastern parts. The red soils are mostly under forest and/or marginally cultivated to millets, whereas, the black soils are cultivated to sorghum and pulses (rainfed), and grape (irrigated). An attempt has been made in the present investigation to study the morphology and some physicochemical properties and classification of these soils developed over different elevation, climate and parent material.

MATERIAL AND METHODS

The study area covers three distinct ecoregions (i) sahyadri edge of the Western Ghat characterised by high hill ridges (> 1000m above MSL), high rainfall more than 2000 mm and hot humid climate (ii) interfluves (905 m above MSL) characterised by 850 mm rainfall and sub-humid climate, and iii) piedmont plain (700 m above MSL) characterised by 700 mm rainfall and semi-arid climate. Three pedons representing dominant soils of the different zones were selected in the villages Koswan, Devargaon and Gangapur. Horizon-wise soils samples were collected and analysed for their mechanical composition (pipette method), pH, organic carbon, CEC etc. using standard procedures.

RESULTS AND DISCUSSION

Morphology : The salient morphological properties of the soils are described in Table 1. Koswan soils have dark reddish brown colour in 2.5 YR hue, value 3 and chroma 4 throughout the profile. The soil is developed over iron rich basalt which might have imparted red colour to the soil as the rock is exposed to weathering and leaching under hot-humid climate. Sahu *et al.* (1990) also reported similar findings in northern plateau zone of Orissa. The pedon is well drained with moderate, medium sub angular blocky structure. Vegetation comprising of tropical moist forest mostly *Tectona grandis, Anogeissus latifolia, Terminalia tomentosa, Madhuca indica,* etc., allow good amount of organic matter on surface and thus clay rich in organic matter showed a high degree of aggregation (Visser & Caullier 1988). Ragi and black gram are cultivated in patches. Elevation, erosion, P-fixation and moisture stress appear to be the constraints to farming. Progressive increase of clay down the solum indicates clay illuviation which is confirmed by the presence of patchy, moderately thick clay cutans.

Devergaon soils are developed over alluvium in interfluves of Kashyapi (Kas) and Alandi rivers. Soils have dark reddish brown colour with hue 5 YR, value 2 to 3 and chroma 3. The pedon is well drained with moderate, medium sub-angular blocky structure. Bushy vegetation with *Acacia spp.* as its major component and tall grasses constitute the natural vegetation of the area. Groundnut and minor millets

TABLE 1. Morphological characteristics of the pedons

Horizon with depth (cm)	Colour	Text-ture	Structure	Cons-istence moist	Efferves-cence	Ramarks
Pedon 1: (Fine, mixed, isohyperthermic Typic Rhodustalfs)						
Ap (0-12)	2.5 YR 3/4	c	m 2 sbk	fr	—	3-15% stones on surface
Bt2 (12-37)	——do——	c	m 2 sbk	fr	—	
B3 (37-72)	——do——	c	m 2 sbk	fr	—	15-20% coarse fragments
Cr (72-85)	——————————Weathered basalt——————————					
Pedon 2: (Fine, mixed, isohyperthermic Typic Ustropepts)						
Ap (0-11)	5 YR 3/2	c	m 2 sbk	fr	—	
Bw1 (11-36)	5 YR 3/3	c	m 2 sbk	fr	—	
Bw2 (36-53)	——do——	c	m 2 sbk	fr	—	
Bw3 (53-75)	——do——	c	m 2 sbk	fr	—	
Bw4 (75-98)	——do——	c	m 2 sbk	fr	—	
Bw5 (98-121)	——do——	c	m 2 sbk	fr	—	
BC (121-150)	——do——	c	m 2 sbk	fr	—	
Pedon 3 : (Fine, montmorillonitic, isohyperthermic Chromic Haplusterts)						
Ap (0-8)	10 YR 4/3	c	m 2 sbk	fi	ev	1 cm wide crack, many fine, $CaCO_3$ nodules
Bw1 (8-36)	——do——	c	m 2 sbk	fi	ev	——do——
Bw2 (36-60)	——do——	c	m 2 sbk	fi	ev	——do——
Bw3 (60-81)	——do——	c	m 2 sbk	fi	ev	pressure faces, many fine, $CaCO_3$ nodules
Bss4 (81-102)	——do——	c	c 3 abk	fi	ev	slickensides, many fine $CaCO_3$ nodules
Bss5 (102-127)	——do——	c	c 3 abk	fi	ev	——do——

are cultivated in patches. Textural B horizon is evident because of clay enrichment in sub-horizons. Erosion and P-fixation are the major constraints in farming.

The Gangapur soil is situated on very gently sloping piedmont plain of alluvium brought down by Godavari river. *Acacia spp.* and neem (*Azadirachta indica*) are the dominant vegetation in this tract. The soils are moderately well drained and have brown to dark brown colour with hue 10 YR, value 4 and chroma 3. Soil structure is moderate, medium subangular blocky in the upper 81 cm and thereafter changes to strong coarse angular blocky. Consistency is firm under moist condition. Grape is cultivated in this soil. Micronutrients deficiency is the problem in these soils which reduces the yield of grape considerably. Development of salinity can not be overlooked.

Physico-chemical properties : The physico-chemical properties of the soils (Table 2) indicate the clay content is found to increase downwards in Koswan profile. It is due to the illuviation of clay as evidenced from the presence of argillic horizon. The organic carbon content was found to decrease from the surface downwards, indicating the maturity of the profile developed on very stable landform (Sahu *et al.* 1990)

Devargaon soil have fairly high amount of organic carbon (surface horizon) and gradual increase in clay content. Gangapur soil have 1 cm wide

Table 2. Physico-chemical characteristics of soils

Horizon with depth (cm)	OC (%)	pH	CEC	Exch. bases				Base sat. (%)	$CaCO_3$	Sand	Silt	Clay
				Ca	Mg	Na	K			(%)		
			Cmol (+) kg^{-1}									
Pedon 1: Koswan ($20^0$37', $73^0$51')												
Ap (0-12)	0.83	5.9	28.8	12	10	0.6	0.5	80	-	29.7	16.4	53.9
Bt2 (12-35)	0.61	6.2	31.8	13	12	0.5	0.5	82	-	23.1	12.2	64.7
B3 (35-71)	0.30	6.0	31.2	13	11	0.5	0.5	80	-	34.1	13.7	52.2
Cr (71-85)	Weathered basalt											
Pedon 2: Devargaon ($20^0$04', $73^0$33')												
Ap (0-11)	1.50	6.2	23.3	9	7	0.6	0.9	75	-	30.2	22.5	47.3
Bw1 (11-34)	0.61	5.4	28.7	10	9	0.5	0.9	70	-	24.1	25.7	50.2
Bw2 (34-52)	0.43	5.4	28.0	11	8	0.6	0.6	72	-	20.3	28.2	51.5
Bw3 (52-73)	0.34	5.9	34.7	11	13	0.4	0.6	72	-	18.4	29.6	52.0
Bw4 (73-78)	0.21	5.9	30.7	13	12	0.5	0.6	85	-	21.3	27.9	50.8
Bw5 (98-122)	0.20	5.8	36.5	15	13	0.6	0.6	80	-	23.7	25.7	50.6
BC (122-150)	0.12	5.9	31.2	14	12	1.0	0.5	88	-	34.8	20.5	44.7
Pedon 3: Gangapur ($19^0$58', $73^0$48')												
Ap (0-8)	1.10	7.7	57.2	32	11	1.0	1.9	80	11.5	24.6	28.2	47.2
Bw1 (8-36)	0.82	7.9	55.6	26	12	1.0	1.1	72	12.0	23.8	24.7	51.5
Bw2 (36-60)	0.32	8.0	54.2	28	14	1.1	0.9	81	12.9	22.7	23.3	54.0
Bw3 (60-81)	0.32	8.0	55.7	28	14	2.1	0.9	80	12.9	20.2	24.2	55.6
Bw4ss (81-102)	0.29	7.9	57.2	27	16	2.1	0.9	80	13.5	18.7	22.8	58.5
Bw5ss (102-127)	0.28	8.0	54.9	26	17	1.9	0.1	81	13.7	19.6	21.8	58.6

cracks extending upto 60 cm and intersecting slickensides (after 81 cm) which make this profile different from others. Under the prevailing high rainfall condition Koswan and Devargaon soils are depleted of free calcium, magnesium and other bases which resulted in soil acidity and lowering of bases in the exchange complex. But Gangapur soil has fairly high amount of free calcium carbonate (>10 %) and pH values are more than 7. Higher values of cation exchange capacity of Clay/CEC ratio >1 points the dominance of smectite group of clay minerals. Increase in CEC values down the profile in Koswan and Devargaon soils can be attributed to gradual increases in clay upto a certain depth.

Soil Classification : Based on morphological and physico-chemical properties, the soils of the study area have been classified as per the criteria given in the Keys to Soil Taxonomy (Soil Survey Staff 1992). The surface horizons of Koswan, Devargaon and Gangapur soils qualify for Ochric epipedon. Due to the presence of argillic horizon and base saturation more than 35 per cent, Koswan soil qualify for the Alfisoils order. The prevailing Ustic moisture regime in the area, justifies its placement in the suborder Ustalfs. As the argillic horizon in Koswan soils have hue of 2.5 YR throughout its thickness, it qualifies for the great group Rhodustalfs. Devargaon soils meet the requirements of cambic B horizon and presence of isohyperthermic temperature regime justify its placement in suborder Ustropepts. Both Koswan and Devargaon soils meet the central concept of their respective great group, hence they are classified as Typic Rhodustalfs and Typic Ustropepts,

respectively. Koswan adn Devargaon (both fine) soils possess mixed, isohyperthermic family properties.

On the other hand Gangapur soils with more than 30% clay, wide cracks extending to more than 50 cm depth and slickensides about to intersect in sub-surface horizons, qualify for Vertisol and suborder Usterts. The alkaline pH, absence of salic, gypsic and calcic horizon in Gangapur pedon allows its placement in Haplustets at great group level and colour value 4 justifies its placement in Chromic Haplusterts subgroup. Gangapur soils possess fine, montmorillonitic, isohyperthermic family properties.

REFERENCES

Sahu, G.C., Patnaik, S.N. & Das, P.K. (1990) Morphology, genesis, mineralogy and classification of soils of northern plateau zone of Orissa. *J. Indian Soc. Soil Sci.* **38**:116-121.

Soil Survey Staff (1992) Keys to Soil Taxonomy, Sixth Edition, 1994.

Visser, S.A. & Caullier, M. (1988) Observation on the dispersion and aggregation of clays by humic substances, I. Dispersive effects of humic acids. *Geoderma*, **42**:331-337.