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Study of Profile of a Gypsiferous Soil (Dasarapatti Series) in Coimbatore District*

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In a study of Profile of the gypsiferous Dasarapatti soil series (Dpt), two typical soil profiles were examined for morphological, physical, chemical and biological properties. The Dpt soil has vertisol characteristics with gypsum crystals in A_{1s} and C_1 horizons. High lime content, base status, CEC and montmorillonitic clay are characteristics of the soil Internal drainage is the main problem in this soil.

In the dry areas of Coimbatore district, the characteristics of Dasarapatti series (Dpt) were established tentatively by the All India Soil Survey and Land use Organization. Morphology, physical and chemical properties and bilogical characteristics of this series were examined in this study with a view to evaluate the fertility of the soil and to suggest management practices.

MATERIAL AND METHODS

In a rapid survey of Coimbatore district, the well cuttings, road-sides, river sides, deep gullies and auger borings were examined in all areas of suspected Dpt series characteristics. Two typical sites were selected, profiles dug up, examined and described in detail as per the proforma in the USDA Soil Survey Manual. For the horizonwise samples collected, mechanical analysis and physical constants were done as per the procedure of Piper (1966) and chemical and biological properties by AOAC's (1962) method.

RESULTS AND DISCUSSION

Morphological characteristics :

The description of a typifying pedon is given below.

Site description

Location - 0.8 KM East of Anupatti village, Palladam Taluk, Coimbatore District; mapping unit $\frac{\text{Dpt - CL d5}}{\text{A - el}}$; Relief-normal; Surface drainage-moderate; physiographic position - low terrace; Depth of water table - 15m; Slope - A; stoniness and rockiness - nil; Parent material - weathered basic igneous rocks and micaceous schists; present crop - cotton; Natural Vegetation - annual. grasses and forbes; Salt and alkali - slightly alkaline.

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Pedon description

Horizon	*Depth in cm*	*Description*
Ap	0-25	very dark grayish brown (10 YR 3/2) dry, very dark brown (10 YR 2/2) moist; clayey; medium, well developed, Sub-angular blocky, hard, firm, sticky and plastic; no mottles; many irregular dirty white lime nodules, many thin grass roots; slightly alkaline; strong effervescence with dilute HCl; many 5-10 cm wide cracks; moderately slow permeability; clear wavy boundary.
A_{12}	25-68	Very dark grayish brown (10 YR 3/2) moist; clayey, coarse moderately developed angular blocky; medium sized distinct mottles; very hard; very firm, very sticky and plastic; many dirty white lime nodules; slightly permeable; many thin grass roots; many intersecting slicken-sides; strong effervescence with dilute HCl; many 5-10 cm wide cracks; clear smooth horizon boundary.
A_{13}	68-102	Dark brown (10 YR 3/3), moist; clayey; coarse moderately developed angular blocky; extremely hard, extremely firm; very sticky and very plastic; coarse, clear mottles of pale yellow colour; (10 YR 6/4) violent effervescence with dilute HCl; slightly alkaline; very slow permeability; many dirty white lime nodules and gypsum crystals of varying size; few thick roots; many slicken sides (intersecting); diffused horizon boundary.
C_1cs	102-127	Very dark grayish brown (10 YR 3/2) moist; clayey; coarse, little developed angular blocky; plenty of gypsum crystals of varying size; many intersecting slicken sides on ped faces; the other features are same as the above horizon.

This highly gypsiferous-cum-calcareous series is occuring in areas of low rainfall and high temperature. The mean annual soil temperature at a depth of 50

cm from surface is above 22°C in this tract and hence it is grouped as hyperthermic. The difference between mean summer temperature and mean winter temperature is less then 5°C. Therefore, the soil temperature class for these soils is fixed as isohyperthermic. It has self-mulching quality, deep cracks; slickensides, heavy clayey texture, very sticky and very plastic consistency and high shrink-swell properties as revealed from morphology suggesting montmorillonitic qulaity of clay. Very slow permeability is the result of heavy and fine texture. Insufficiency of rainfall has led to accumulation of gypsum crystallised in lower layers, confirming the conclusions of Sinha (1957). Possibly weathering of basic igneous rocks with dark coloured minerals has led to this dark coloured soil with morphological features detailed in pedon description under dry arid conditions of the tract. It is observed that crops like cotton, sugarcane etc perform well in this tract when irrigation facility is available.

Physical properties :

The data on physical properties (Table 1) show that texture is silty clay loam to clayey in surface and clayey in sub-surface. In both profiles analysed, clay content in Ap horizen ranges from 38.9 to 54.6% increasing with depth reaching a maximum in A_{1s} and C_1 cs horizons ranging from 70.3 to 76.5%. Sand fractions are maximum in Ap horizon decreasing with depth reaching the maximum in C_1cs horizon. The maximum water holding capacity, volume expansion and hygroscopic moisture follow the same trend as clay content in different horizons revealing their general dependence on clay. The analytical data on fractional separates and physical properties are in good agreement wirh morphological features like consistency under dry, moist and wet conditions and cracks observed in field, The Dpt soils have high water retentive ability (53-63% in surface soil) in all horizons indicating montmorillonitic clay mineralogy.

Chemical properties :

Among chemical properties(Table II) Al_2O_3 content is uniformly higher than Fe_2O_3 content indicating the finer texture and clay mineral components present in it. High lime content is explained by calcareous nature. Because of washings collected from high terrace lands in the vicinity of Dpt series locations, it has high lime status, The Dpt series is rated as poor in organic carbon, adequate in totalN and excellent in total K_2O and Cao contents as per Sharma (1956). The CEC is high enough to predict montmorillonitic clay mineralogy, Extractable cations indicate high base status and fertility.The distribution of chemical constituents does not follow any regular pattern because of the self mixing characteristics. Soil reaction ranges from slightly alkaline to moderately alkaline owing to high base and soluble salt contents. The surface soil registers a slightly high pH (8.6) than lower horizons (pH 8.2) probably because of efflorescence of dissolved salts through capillary action, under high temperature conditions here. The E.C., total water-soluble salts and soluble cations and anions increase with depth reaching a maximum in A_{1s} and C_1cs horizons indi-

cating insufficiency of rainfall to leach down the salts any further. Very high water-soluble $So_4^{=}$ and $Ca++$ ions in A_{13} and C_1cs horizons confirm the field observations of many gypsum crystals in these horizons again due to insufficiency of water available to dissovle even these relatively easily soluble salts.

Biological properties:

The CO_2 evolution, ammonifying and nitrifying power (Table II) generally decrease with depth due to progressively less and less aeration in lower horizons for microbial population to be active.

The maximum value of Co_2 evolution, ammonifying and nitrifying power in surface soil implies the most conducive conditions like high organic matter and good aeration for favouring good microbial activity indicating that the top soil is more productive.

Based on morphological details, physical and chemical properties, this soil can be classified according to the USDA comprehensive soil classification system as Dasarapatti series of fine, montmorillonitic, isohyperthermic family of Typic chromusterts.

This soil could be improved with respect to permeability and internal drainage by addition of organic matter like compost and light textured materials like sand. This soil is fertile and productive provided drainage is taken care of. This soil material can be efficiently used as a good substitute for tank silt in soils having poor water retentive capacity, light texture and slightly acidic in reaction. Light textured soil materials such as sand can be mixed with Dpt soils to improve its permeability and ease of workability with cultural implements. Gypsum can be quarried from these soils to some extent for use as amendments to alkali soils.

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TABLE I Physical properties

Profile No.	Horizon	Thickness (cm)	Mechanical analysis					Maximum Water-holding capacity %	Volume expansion %	Hygroscopic moisture %
			Clay %	Silt %	Coarse sand %	Fine sand %	Textural class name			
I*	Ap	0-25	54.5	11.4	7.4	13.2	Clayey	62.8	26.6	2.6
	A_{12}	25-68	67.1	20.9	5.6	9.1	Clayey	66.5	20.0	1.3
	A_{13}	68-102	72.1	15.1	3.9	9.1	Clayey	83.1	35.3	2.3
	C_1cs	102-127	70.3	17.4	4.1	8.9	Clayey	75.7	37.8	8.6
II**	Ap	0-25	38.9	18.2	22.0	11 8	Silty clay loam	53.1	23.6	3.2
	A_{12}	25-64	50.5	15.7	14.8	10.4	Silty clay	58.2	23.4	6.1
	A_{13}	64-107	75.4	12.1	7.9	4 6	Clayey	63.3	38.9	7.0
	C_1cs	107-132	76.5	14.4	5.6	3.6	Clayey	78.1	76.7	6.5

* Location: $\frac{1}{2}$ mile East of Anupatti village, Palladam Taluk, Coimbatore District, Tamil Nadu.

** Location: Northwest of Ragalpavi village, Udumalpet Taluk, Coimbatore District, Tamil Nadu.

TABLE II Chemical Properties

(a) Chemical constitutents

Profile No.	Horizon	Acid insolubles %	Total Fe_2O_3 %	Total Ar_2O_3 %	Total Cao %	Total Mgo %	Total P_2O_5 %	Total K_2O %	Total HCl solubles %	Organic Carbon %	Total N %	$CaCo_3$ %
I	Ap	71.12	8.70	11.18	7.18	0.53	0.046	0.57	28.21	0.30	0.041	16.43
	A_{12}	67.82	11.26	9.58	7.93	0.98	0 068	0.57	30 39	0.37	0.041	10.93
	A_{13}	69·69	6.81	13.57	6.68	0.47	0.435	0.60	28 57	0.38	0.032	10.03
	C_1cs	66.98	11.10	11.94	7.78	0.39	0.079	0 66	31.95	0.26	0.038	10.04
II	Ap	78.17	7.26	8.48	3 80	0.47	0.030	0.48	20.52	0 24	0.047	6.40
	A_{12}	76.17	4.77	11.99	4.52	0.20	0.050	0.51	32.04	0.31	0.092	8.51
	A_{13}	75.03	4.35	12.51	5.21	0.20	0.067	0.42	22.76	0.29	0.043	9.23
	C_1cs	73.15	8 24	10.50	6.34	0.31	0.045	0.48	25·92	0.04	0.017	7.26

TABLE II (b) Exchange properties, Available Nutrients and Water-Solubles

Profile No.	Horizon	CEC (me/ 100g)	pH (soil: water= 1.2.5)	E. C. mmhos/ cm	Water-solubles (ppm)			
					Total soluble salts	$SO_4^=$	Ca	Mg++
I	Ap	49.2	8 6	0.59	950	181	100	24
	A_{12}	50.0	8.1	2.32	2613	172	1280	336
	A_{13}	45.8	8.2	4.68	4662	1567	1320	252
	C_1cs	50.7	8.3	4.79	5110	1553	1400	300
II	Ap	47.5	8.6	0.59	850	267	80	24
	A_{12}	48.5	8.2	1.75	2961	889	1220	95
	A_{13}	47.7	8.2	4.44	3945	1425	840	312
	C_1cs	44.3	8.2	4.44	4390	1761	1280	207

TABLE III Biological Properties

Profile No.	Horizon	Co_2 Evolution mg/100g/day	Mineralising power	
			Ammonifying power (mg/ 100g soil)	Nitrifying power (mg/ 100g soils)
I	Ap	0.98	21.8	20.7
	A_{12}	0.77	18.4	15.9
	A_{13}	0.73	20.9	11.6
	C_1cs	0.69	18.5	9.6
II	Ap	1.41	21.5	21.7
	A_{12}	1.01	20.7	19.2
	A_{13}	0.97	10.4	16.2
	C_1cs	0.93	8.7	10.2