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Placement of the Black Soils of Tamil Nadu in the Comprehensive System of Soil Classification - Soil Taxonomy

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The black soils of Tamil Nadu were examined in detail with regard to their placement in the comprehensive system of soil classification. They are found to fit in two orders viz., Vertisols and Inceptisols. Even though some black soils have inherited the external characteristics of vertisols, they could be placed under inceptisols. The regurs are placed under typic chromusterts. They exhibit a montorillonite mineralogy and are grouped under fine families.

The black soils of Tamil Nadu are spread over an area of 11,03,625 hectares in the districts of Coimbatore, Tirunelveli, Tiruchirapalli, Ramanathapuram, Dharmapuri, Salem and South Arcot and are suitable for growing cotton and other crops where irrigation facilities are available. These tropical black clayey soils are characterised by dark grayish brown to black colour, high montmorillonite content in organic matter content, high swelling and shrinkage with 2 to 4cm wide, deep cracking during dry season.

In the recent comprehensive system of soil classification Soil Taxonomy by U. S. D. A. Staff (1975), soils with such of the above characteristics are placed in the order 'Vertisols'. So far, no attempt has been made to classify the black soils of Tamil Nadu. Menon and and Mariakulandai (1959) who studied extensively the black soils of Tamil Nadu, however, did not attempt their classification in any system. Raychaudhury (1961) while studying the black soils of India classified them under 'Mazusterts'. Tamhane and Karale (1967) Govindarajan *et al.*, (1968) also attempted the classification of black soils of India placing them in Mazusterts, Chromusters and Pellusterts respectively. Srinivasan *et al.* (1970) while reviewing earlier work, classified black soils and suggested the usage of 'Bv' nomenclature for sub-surface horizons. In conjucation with the published soil classification (1960) and the subsequent supplement to the soil classification (1967), an attempt was made in this paper, for the classification of the black soils of Tamil Nadu according to soil taxonomy.

MATERIALS AND METHODS

Detailed studies on the black soils were carried out in Coimbatore, Salem, Dharmapuri, Tirunelvelli, Tiruchirapalli and Ramanathapuram districts of Tamil Nadu during the soil survey and mapp-

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ing. The studies comprised detailed morphological examination in the field as outlined in the manual published by the All India Soil and Land Use Survey (1970) and F. A. O. Guidelines (1970) and characterisation of soil in the laboratory (Table I). Besides, observations on the following special features were made to satisfy or otherwise the criteria for placing the soils in vertisols.

1) Gilgai or micro relief and period of opening of cracks (ii) Slickensides at some depth between 25cm and one metre close enough to intersect, (iii) Wedge shaped structure at some depth between 25cm and 1 metre, (iv) Lithic or paralithic contact within 50cm. of the surface and (v) clay percentage in all the horizons.

TABLE I. Classification of Black Soils of Tamil Nadu

Soil series differential	Name of the soil	Order	Suborder	Great group	Subgroup	Soil family
Strongly calcareous throughout the solum. solum is deep (more than 1 m)	Peelamedu series	Vertisols	Usterts	Chromu-sterts	Typic chromu-sterts	Peelamedu fine, montmorillonitic, isohyperthermic
Very strongly calcareous throughout the solum with gypsum in the 'C' horizon, solum is deep	Kovilpatty series	,,	,,	,,	,,	Kovilpatty, fine monmorillonitic, isohyperthermic
Very strongly calcareous and alkaline on the surface. Solum is deep. Multiple profile with a yellowish red highly calcareous 'C' horizon	Periyanaicken palayam series	,,	,,	,,	,,	Periyanaicken-palayam, fine montmorillonitic isohyperthermic
Strong to very strongly calcareous, solum is deep lying over cretaceous rocks	Kallakudi series	,,	,,	,,	Entic chro musterts	Kallakudi fine, montmorillonitic isohyperthermic
Strongly calcareous on the surface, very strongly calcareous in the sub-surface horizons, with lithological discontinuvity in the solum Solum is deep	Malur series	Inceptisols	Ochrepts	Ustochrepts	,, Fluventic Ustochepts	Mallur, fine loamy, mixed, isohyperthermic
Strongly calcareous in the surface, very strongly calcareous in the subsurface solum is shallow	Sathiyamangalam series	,,	,,	,,	Typic Ustochrepts)	Sathiyamangalam fine loamy mixed, isohyperthermic

Morphological descriptions of representative black soil profiles

I **Peelamedu series:** Dark greyish brown to very dark grey, deep to very deep, fine, calcareous, moderately alkaline soil developed on gneissic rock mixed with calcium carbonate. Distinct slickensides in subsurface horizons and surface cracks of more than 1 cm width and 60 cm depth are present.

Peelamedu series is a member of fine, montmonillonitic, isohyperthermic family of *Typic chromusterts*.

Location: Peelamedu Village, Coimbatore Taluk.

Typifying pedon: Peelamedu clay loam - fallow.

Horizon	Depth in cm	Description
Ap	0 - 25	Very dark grayish brown (10 YR 3/2); Clay loam; fine subangular blocky structure; violent effervescence with dil. HCl; gradual to diffuse wavy boundary.
C_1	25 - 115	Very dark brown (10 YR 2/2); clay with a few lime concretions; fine moderate subangular blocky structure; prominent intersecting slickensides; violent effervescence with dil. HCl; diffuse wavy boundary.
Cea	115	Caliche

Distribution: This series has been mapped in extensive areas in Coimbatore, Avanashi, Gobichettipalayam, Palladam and Perambalur and Lalgudi taluks of Trichy district. Similar soils were also found in extensive areas and described as Dharmapuri series (Dhamapuri taluk) Subramaniapuram series (Kovilpatti taluk) and to a limited extent as Suramangalam series (Salem taluk).

II. Kovilpatty series

Very dark grayish brown to very dark brown, deep to very deep, fine, calcareous, moderately well drained, neutral to moderately alkaline soil developed over gneiss mixed with calcium carbonate. Gypsum is present in lower part of the solum. Distinct slickensides and surface cracks of more than 1 cm width to a depth of 60 cm are observed.

Kovilpatty series is a member of fine, montmonillonitic isohyperthermic family of *Typic Chromusterts*.

Location: Ettayapuram, Aruppukkottai Road (North east) Typifying pedon: Kovilpatty clay - fallow.

TABLE II

Series	Depth in cm	E. C.	pH	Mechanical composition				Organic carbon %
				Coarse sand %	Fine sand %	Silt %	Clay %	
Peelamedu	0-25	0.2	8.6	20.35	19.60	28.40	30.00	0.39
	25-115	0.2	8.0	14.95	24.80	24.10	37.50	0.40
Kovilpatty	0-19	0.11	7.5	35.90	6.20	13.99	44.40	0.63
	19-37	1.15	7.4	37.26	9.49	5.00	58.39	0.71
	37-87	0.95	7.4	15.25	13.91	14.65	56.24	0.35
	87-107	0.28	7.4	19.94	4.70	7.02	60.39	0.40
Periyanayaken-palayam	0-16	0.3	8.0	22.1	21.2	11.1	43.7	0.38
	16-45	0.3	8.0	21.7	19.5	5.9	52.3	0.30
	45-102	0.4	7.9	14.5	24.5	2.5	58.2	0.36
	102-135+	0.4	7.9	25.5	33.5	17.2	21.6	0.08
Kallakudi	0-11	0.2	8.4	10.90	13.31	0.70	42.90	0.41
	11-54	0.2	8.3	8.64	17.50	6.50	46.27	0.36
	54-95	0.2	8.1	6.48	8.67	0.87	50.10	0.26
	95-120	0.2	8.0	5.73	8.00	2.52	44.85	0.39
	120-142+	0.2	8.4	9.06	37.41	7.27	28.20	0.30
Mallur	0-18	0.7	7.0	24.85	25.79	28.25	20.50	0.68
	18-68	0.3	8.3	34.45	23.63	11.75	30.25	0.42
	68-89	0.2	8.5	57.31	36.06	—	3.75	0.36
	89-150	0.4	8.1	9.41	16.15	36.00	35.75	0.12
Sathyamangalam	0-13	0.3	8.0	14.95	19.53	17.06	48.46	0.47
	13-23	0.2	8.4	14.97	15.60	16.22	53.21	0.51

Horizon	Depth in cm	Description
Ap	0 - 19	Very dark grayish brown (10 YR 3/2) moist; dark grayish brown (10 YR 4/2) dry; clay; weak, coarse, crumb, strong effervescence with dil. HCl; clear smooth boundary.
C_1	19 - 37	Very dark grayish brown (10 YR 3/2) moist and dry; clay; medium; moderate, subangular blocky; indistinct intersecting slickensides; violent effervescence with dil. HCl; diffuse boundry.
C_2	37 - 87	Very dark brown (10 YR 2/2) moist and dry; clay; strong, medium angular blocky prominent interesecting slickensides,

		violent effervescence with dil HCl; diffuse boundary.
C_2	37 - 87	Very dark brown (10 YR 2/2) moist and dry; clay; strong, medium angular blocky; prominent intersecting slickensides, violent effervescence with dil. HCl; diffuse boundary.
C_3	87 - 107	Very dark grayish brown (10 YR 3/2) moist and dry; clay; coarse subangular blocky structure, in distinct intersecting slickensides. Violent effervescence with dil. HCl; abrupt smooth boundary.
C-Ca ÷CS	107-123	CaCO3 mixed with gypsum.
Distribution		This series covers extensive areas in Kovilpatty taluk of Tirunelveli district. Similar soils were mapped as Dasarapatty series in Dharmapuram, Palladam and Pollachi taluks of Coimbatore District.

iii. Periyanaickenpalayam series

Very dark grayish brown to very dark grey, very deep, fine, clacareous, moderately well drained, neutral to moderately alkaline soil occuring on red soil material, of transported origin. Surface cracks of more than 1 cm width, to a depth of 60 cm, and prominent, slickensides are present upto a depth of 102 cm.

Periyanaickenpalayam series is a member of fine, montmorillonitic, isohyperthermic family of *Typic chromusterts*.

Location: Narasimhanayakkanpalayam, on Coimbatore-Ooty Road.

Typifying: Periyanaickanpalayam clay loam-fallow.

Horizon	Depth in cm	Description
AP	0-16	Very dark grayish brown (10 YR 3/2) moist and dry; clay loam; weak, fine to medium crumb; violent effervescence with dilute HCl; clear smooth boundary.
C1	16-45	Very dark grayish brown (10 YR 3/2) moist and dry; clay; moderate, medium, subangular blocky structure; violent effervescence with dil. HCl; gradual diffuse boundary.
C21	45-102	Very dark grey (10 YR 3/1) moist and dry; clay; strong, medium, angular blocky; prominent intersecting

	slickensides; violent effervescence with dil. HCl; diffuse boundary,
Ca	102-135+	Yellowish brown (10 YR 5/6) moist and dry; sandy clay loam; structureless; violent effervescence with dil. HCl.
Distribution		This is a profile developed on colluvial material. This is mapped in Coimbatore taluk and as Jayapuram series in Harur taluk of Dharmapuri District.

IV. Kallakudi series

Dark grayish brown to very dark brown, very deep, fine, calcareous, moderately well drained, mild to strongly alkaline soil occuring on cretaceous rocks consisting of limestone, gypseous clay, phosphatic and ferrugenous nodules. The soil develops cracks of 1 cm width extending to a depth of 80 – 100 cm with stickensides at lower horizons.

Kallakudi series is a member of fine, montmorillonitic, isohyperthermic family of *Entic chromusterts*.

Location: Kallakudi to Tappay road, Trichy district.

Typifying pedon: Kallakudi clay-fallow.

Horizon	Depth in cm	Description
AP	0-11	Dark grayish brown (10 YR 4/2) moist and dry; clay; weak; medium, sub-angular blocky; small, lime concretions; clear, smooth boundary.
C_1	11-54	Dark grayish brown to very dark grayish brown (10 YR 3.5) moist clay; moderate, coarse, strong effervescence with dil. HCl; diffuse, wavy boundary.
C_2	54-94	Very dark grayish brown (10 YR 3/2) moist; clay; strong, coarse, subangular blocky; violent effervescence with HCl; distinct slickensides; gradual, smooth boundry.
C_3	95-120	Very dark gray (10 YR 3/1) moist; clay; strong, medium to coarse, subangular blocky; violent effervescene with dil. HCl; common, prominent, yellowish brown (10 YR 5/4) mottles, gradual, smooth boundary.
C_4	120-142+	Dark grayish brown (10 YR 3/2) clay;

		strong, medium, angular blocky; strong effervescence with dil. HCl; distinct slickensides; grading to horizon below.
Distribution		In Lalgudi and Perambalur taluks of Trichy district.

V. Mallur series

Dark brown to dark grayish brown, deep to very deep, calcareous, moderately well drained, neutral to moderately alkaline soil developed on weathered gneiss mixed with calcium carbonate. The texture is fine loamy to fine but intermittent sandy layer causing lithological discontinuity is characteristic of the series.

Mallur series is member of fine loamy, mixed isohyperthermic family of *Fluventic ustochrepts*.

Location: Mallur village, Mallur - Rasipuram, Main road, Salem taluk.

Typifying pedon: Mallur silty loam - cultivated.

Horizon	Depth in cm	Description
Ap	0-18	Very dark grayish brown (10 YR 3/2) moist, dark grayish brown (10 YR 4/2) dry; silty loam; strong, medium, subangular blocky; violent effervescence with dil. HCl; clear smooth boundary.
B_1	18-68	Colour as the above, clay loam; strong, medium, angular blocky; violent effervescence with dil. HCl; abrupt, smooth boundary.
II C	68-89	Dark brown (7.5 YR moist; sand, single grain structure; non-calcareous, *Teritella* sp shells, clear, smooth boundary.
III B_2	89-150	Very dark gray (10 YR 3/1) moist; gray (10 YR 5/1) dry, silty clay; moderate, fine, angular blocky structure; thick clay skins on ped faces; violent effervescence, with dil. HCl; clear, smooth boundary.
III C	150^+	Weathered gnesis with calcium carbonate.
Distribution		Mapped in Salem taluk, Salem District.

VI. Sathyamangalam series

Yellowish brown to dark yellowish brown, shallow to moderately deep, calcareous, moderately well drained, neutral to moderately alkaline soil derived from gniessic rocks inter bedded with calcium carbonate.

The soil is a member of fine loamy, mixed, isohyperthermic family of *Typic Ustocrepts*.

Location : Nalu road (Koduveri village), Gobi taluk, Coimbatore district.

Typifying pedon : Sathiyamangalam clay - fallow.

Horizon	Depth in cm	Description
Ap	0-13	Dark yellowish brown (10 YR 4/4) moist, yellowish brown (10 YR 5/4) dry; clay, strong, medium crumb, strong effervescence with dil. HCl; clear, smooth boundary.
B_2	13-23	Yellowish bown (10 YR 5/3) dry; clay; weak, medium subangular blocky; violent effervescence with dil. HCl; clear wavy boundary.
Ca	23^+	Caliche
Distribution		Mapped in Gobichettipalayam taluk, Coimbatore District.

RESULTS AND DISCUSSION

Black soils of Tamil Nadu to the extent studied so far are found to occur in different physiographic positions such as uplands, flood plains and valley bottoms. The depth of the above soils also varies according to the physiographic situations. In the discussions the following depth classes have been adopted as proposed in soil taxonomy.

a) Shallow : Less than 1 metre
b) Deep : More than 1 metre

Classification at higher categorical level:

Shallow black soils : The soils are mapped as Sathyamangalam series in Coimbatore district. Some shallow black soils were also studied and included in Kovilpatty series and Subramaniapuram series in Kovilpatty taluk, Peelamedu and Periyanaickenpalayam series in Udumalpet and Coimbatore taluks respectively. In addition several shallow black soils in Ramanathapuram, South Arcot and Salem districts, which have not been given any series status is also considered. These soils cannot be placed under the order 'Vertisols' as they lack typical characters of Vertisols. Since these soils possess only an 'Ochric epipedon', and calcic horizon they can be placed under the order Inceptisols. These soils have a paralithic contact or underlined by a calcium carbonate 'C' horizon. Hence these can be classified as 'Typic Ustochrepts' or 'Paralithic Ustochrepts' (Srinivasan *et al.*, 1969). The typical shallow black soils can be separated at lower category levels.

Deep black soils: The deep black soils with depth more than one metre would readily qualify to be cealssified under the order 'Vertisols' as they exhibit typical characters of vertisols

such as gilgai, more than one cm. wide deep cracks extending to 50 cm and above, slickensides and wedge shaped structure. But there are certain other soils like Mallur series of Salem taluk which can be only classified as 'Inceptisols'.

As far as the true black clayey soils are concerned, viz., Peelamedu, Periyanaickenpalayam, Kovilpatty and Kallukudi series and the typical black clayey soils of Ramanathapuram and South Arcot districts, they can be placed under the order 'Vertisols'. From the observations made by the authors and the meteorological data, these soils fall under the suborder 'Usterts' (Cracks remain open for 90 cumulative days or more, but not throughout the year, mean annual temperature of the soil is 22°C (72°F or more) and great group 'Chromusterts' (soils with moist chromas more than 1.5). Regarding subgroup all the typical regurs of Tamil Nadu can be classified as 'Typic chromusterts' except Kallakudi series which can be classified as Entic chromusterts as the moist colour value is above 3.5. But Srinivasan *et al.* (1969) is of opinion that vertisols of South India can be grouped under 'Typic Pellusters'.

Classification at lower category levels : The lower category classification is useful in understand- the intimate details of soils regarding particle size, minerology, reaction, soil temperature etc. These come under family differential.

Recently Ramanathan (1974) reported montmonillorite minerology for black soils. The brown or otherwise black soils have a mixed minerology Meteorological observations in Tamil Nadu also place these soils under Isohyperthermic regime (The difference between mean annual winter (27.7°C) and summer (32.3°C) soil temperature is less than 5°C). Hence the pedons qualifying for Vertisols would have 'Montmonillonitic isohyperthermic' and others will have mixed isohyperthermic in common. As the clay content is generally less than 60 per cent the soils are placed under fine families'. Very fine families are rare in Tamil Nadu. Regarding the shallow black soils, particle size, soil reaction, calcareousness. Depth and minerology are the criteria for family differentiation.

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