

Studies on the Morphology and Classification of the Soils of Hosur Cattle Farm

By

T. M. THIYAGARAJAN¹, H. HAMEED KHAN², C. S. BALASUNDARAM³, S. RAMANATHAN¹ and M. JAYARAMAN³

ABSTRACT

A detailed study of the soil of Hosur Cattle Farm was made. Five soil series, *v/z.*, Mattagiri, Punapalle, Jeegur, Karanur and Simpson were established. Their morphology described. Based on their morphology, physical and chemical characteristics, their genetic make up is explained. The variation in morphology among different series and other allied characteristics is due to topography and hydrological conditions, the parent material remaining uniform suggesting a catenary sequence. The soils have also been placed under the comprehensive system of soil classification.

INTRODUCTION

To gain a working knowledge of any polypedon the primary step is to study the morphology of the soil. The selection of a pedon that is to be sampled and the accuracy of the morphological studies at the site, lay the basis for selecting actual samples for laboratory investigations (Kellogg, 1962). Hosur Cattle Farm, one of the largest of its kind offers vast potential for improvement and hence detailed studies of all the aspects of soil and water (Balasundaram *et al.*, 1973, 1974) were made. The study of morphology of the individual pedons of different series formed the basis for the present study. This paper gives information

about the morphology of the soils based on which the genesis and classification are suggested.

Physiography

The farm is spread over 666 hectare situated at an altitude of 1005 meters above Mean Sea Level in Mattagiri, 7 Km away from Hosur in Dharmapuri district of Tamil Nadu. The entire area has a flat to undulating topography with normal to subnormal relief. It appears that topography seems to play a vital role in deciding various morphological and physical properties of the soil.

Climate

The average rainfall is 840 mm which is well distributed with a maxi-

1, 2 and 4 : Instructors 3. Assistant Professor, Department of Soil Science and Agricultural Chemistry 5. Assistant Professor, Department of Physical Sciences, Tamil Nadu Agricultural University, Coimbatore - 641003.

mum precipitation during North-East monsoon. In general, the climate is cool, with a relative humidity of 80 per cent, maximum temperature of 30°C and the minimum being 15°C. The well distributed rainfall coupled with a cool climate makes the place ideal for pasture growing and animal breeding.

Geology

The rocks of the area can be classified under the great gneissic series. The biotite and hornblende bearing gneisses predominate. Even though coarse grained trap dykes are observed in the taluk, none seem to traverse the farm.

Vegetation

Natural vegetation includes *Acanthospermum hispidum*, *Croton sparciflorus*, *Ocimum* sp., *Pongamea glabra*, *Santalum album*, *Tamarindus indica*, etc.

Most of the area of the farm is maintained as paddock with spear grass. The garden lands comprising 121.4 ha are under perennial grasses. Leguminous crops like lucerne, berseem, horsegram and cereals like rice, sorghum, ragi, maize are also grown.

MATERIALS AND METHODS

A detailed soil survey of the cattle farm was carried out following the techniques laid down in the All India Soil Survey Manual (1970). Twenty five profiles were examined at different places, based on which five soil series were established. The morphological characteristics depicted by the heterogenous media are discussed below.

Profile description

Descriptions of the typical profiles representing the established five soil series are given below :

1. Mattagiri Series (Mtg)

Mattagiri consists of slightly acidic to neutral, very deep, reddish brown, insitu soils developed from weathered gneisses rich in biotite and hornblende minerals. These are moderately well drained, non-calcareous soils with a characteristic iron gravel band and occurring on slightly undulating topography.

Horizon	Depth in cm	Macromorphology
A	0-10	Reddish brown (5YR 4/4) dry; dark red (5 YR 3/6) moist; sandy loam; moderate, coarse, crumb; non-sticky and non-plastic; firm moist; hard dry; rapid permeability; abundant, fine roots pH 6.5; abrupt, smooth boundary.

B ₁	10-18	Yellowish red (5YR 4/6) dry; dark reddish brown (2.5 YR 3/4) moist; sandy clay loam; moderate, medium, sub-angular blocky; sticky and plastic, firm moist, very hard, dry; moderately rapid permeability; many, fine roots; pH 6.9; clear, smooth boundary.
B ₂₁ t	18-143	Dark reddish brown (2.5 YR 3/4) dry and moist; clay; strong, coarse, sub-angular blocky; breaking to finer peds; very sticky and plastic; moist firm, very hard dry; patchy, thin, clay films on ped faces; few, small (1-3 mm) round iron concretions; moderately slow permeability; fine roots; pH 6.8; abrupt smooth boundary.
B ₂₂ cn	143-161	Dark reddish brown (2.5 YR 3/4) dry and moist; gravelly clay; weak, medium, sub-angular blocky, breaking to granular; sticky and non-plastic, friable moist; very hard dry, patchy, thin, clay films bridging iron gravel; small round to irregular iron concretions (40-50%); moderately rapid permeability; few, fine roots; angular quartz pieces as a horizontal line is seen amidst the iron concretion; pH 6.9; abrupt, smooth boundary.
B ₂₃	161-191	Dark reddish brown (2.5 YR 3,4) dry and moist; clay loam; weak, medium, sub-angular blocky; breaking to granular peds; slightly sticky and slightly plastic, friable moist; small few iron concretions; moderately rapid permeability; few, fine roots; gneissic fragments, mixed with soil; pH 6.2.
C	191 +	Weathered gneiss.

II. Punapallee Series (Pnp)

Punapallee series consists of slightly acidic to neutral, very deep, reddish brown to brown insitu soils developed from highly weathered gneiss rich in biotite and hornblende minerals. These are moderately well drained, non-calcareous soils occurring on gently sloping to undulating lands.

Horizon	Depth in cm	Macromorphology
A	0-10	Reddish brown (5 YR 4.5/4) dry, dark reddish brown (5 YR 3/4) moist; sandy loam; weak, medium crumb; non-sticky and non-plastic, friable moist, hard dry; few, small iron concretions; rapid permeability; abundant roots; pH 6.5; abrupt, smooth boundary.
B ₁	10-22	Reddish brown (5 YR 4/4) dry, dark reddish brown (5 YR 3/3) moist; sandy loam; weak, medium sub-angular blocky, breaking to granular; slightly sticky and slightly plastic, firm moist, hard dry; few small, iron concretions; moderately rapid permeability; pH 6.8; diffuse boundary.
B _{21t}	22-47	Red (2.5 YR 4/6) dry, dark reddish brown (2.5 YR 3/4) moist; clay loam; strong, coarse, sub-angular blocky; sticky and plastic, friable moist; hard dry; patchy, thick, clay skins on ped faces; common, small, iron concretions; moderately rapid permeability; many, coarse roots; pH 6.9; clear, smooth boundary.
B _{22t}	47-131	Dark red (2.5 YR 3/6) dry; dark reddish brown (2.5 YR 3/4) moist; clay; strong, coarse, sub-angular blocky; sticky and plastic friable moist; hard dry; continuous, thin, clay skins on ped faces; many small, iron concretions; moderately slow permeability; few, fine to coarse roots; pH 6.9; clear, smooth boundary.
C	131-161+	Weathered gneiss.

III. Jeegur Series (Jgr)

Jeegur series consists of very deep, dark greyish brown, non-calcareous imperfectly drained soils occupying slightly lower physiographic positions than their associated soils.

Horizon	Depth in cm	Macromorphology
Ap	0-26	Very dark greyish brown (10 YR 3/2) moist; many, medium, faint, strong brown (7.5 YR 5/6) mottles; sandy clay loam; weak, coarse, sub-angular blocky; sticky and plastic, very firm moist; few, small, round to irregular iron concretions; moderately rapid permeability; abundant, very coarse roots; pH 7.3; clear, smooth boundary.
B ₁	26-46	Dark greyish brown (10 YR 4/2) moist rubbed; many, medium, faint, dark yellowish brown (10 YR 4/4) mottles; saddy clay loam; medium, coarse, sub-angular blocky; sticky and plastic, very firm moist; few, small, round to irregular iron and manganese concretions; moderately rapid permeability; plentiful, coarse roots; pH 7.2; diffuse boundary
B ₂₁	46-86	Dark greyish brown (10 YR 4/2) moist; many medium, faint, yellowish brown (10 YR 5/6) mottles; silty clay loam; medium, coarse, sub-angular blocky; sticky and plastic, very firm moist; very few, small, round to irregular, iron and lime concretions; slow permeability; roots; pH 7.2; clear, smooth boundary.
B ₂₂ G	86-161 +	Dark gray (5 YR/4/1) moist; few, fine, distinct, yellowish brown (10YR 5/6) mottles; silty clay loam; strong, coarse, angular blocky; sticky and plastic, very firm moist; few, small, round to irregular iron, manganese and lime concretions; very slow permeability; few, fine to coarse roots; pH 7.4.

IV. Karanur Series (Knr)

These are very deep, calcareous, dark yellowish brown, neutral, heavy textured soils occurring in lower physiographic positions and are imperfectly drained.

Horizon	Depth in cm	Macromorphology
A _p	0-10	Dark yellowish brown (10 YR 3/4) dry, dark brown (7.5 YR 3/2) moist; clay; strong, coarse, crumb; sticky and plastic, very firm moist, very hard dry; moderate permeability; abundant, medium roots; pH 6.7; abrupt smooth boundary.
B ₂₁	10-32	Dark reddish brown (5 YR 3/4) dry and moist; clay; strong, coarse, sub-angular blocky; sticky and plastic, very firm moist, very hard dry; patchy thin, clay skins on ped faces; strong effervescence; moderate permeability; abundant roots; pH 7.2; clear, smooth boundary.
B ₂₂	32-51	(Similar to above except the following) Clay, very few, small iron concretions) moderately slow permeability; pH 7.0.
B ₂₃	51-59	Dark brown (7.5 YR 4/4) moist; gravelly clay loam; moderate, coarse, sub-angular blocky; sticky and plastic; patchy, thin, clay skins on ped faces; few, small, iron concretions; strong effervescence; moderately rapid permeability; abundant, fine roots; pH 7.1; abrupt, smooth boundary.
B ₂₄	59-94	Dark brown (7.5 YR 4/4) moist; common, fine, reddish brown (5 YR 4/4) mottles; silty clay; weak coarse, sub-angular blocky; sticky and plastic, friable moist; patchy, thin, clay skins on ped faces few, small iron concretions; strong effervescence; moderately rapid permeability; plentiful fine roots; pH 7.5; abrupt, smooth boundary.

B ₂₀ -G	94-118	(Similar to above except the following) Yellowish brown (10 YR 5/6) moist; common, fine, greyish brown (2.5 Y 5/2) mottles; very sticky and very plastic; few, fine roots; pH 7.6; clear smooth boundary.
B ₂₀ G	118-180+	(Similar to above except the following) Common, medium, prominent light grey (5 YR 7/0) mottles, very few, small, iron and lime concretions.

V. Simpson Series (Ssn)

Simpson series consists of very deep, brown, non-calcareous, slightly acidic to neutral insitu soils developed from weathered gneisses. These are moderately well drained and occur on very gently sloping lands.

Horizon	Depth in cm	Macromorphology
Ap	0-22	Brown (7.5 YR 3/4) dry, dark reddish brown (5 YR 3/4) moist; sandy loam; moderate, coarse, crumb; non-sticky and non-plastic, very friable moist, hard dry; few, small, iron concretions, rapid permeability; abundant, coarse roots; pH 6.2; abrupt, smooth boundary.
B ₁₁	22-56	Yellowish red (5 YR 4/6) dry and (5 YR 4.5/6) moist; clay loam; moderate medium, sub-angular blocky; slightly sticky and slightly plastic, friable moist, hard dry; patchy, thin clay skins on ped faces; few, small, iron concretions; moderately rapid permeability; few, fine roots; pH 6.5; clear, smooth boundary.
B ₁	56-80	Yellowish red (5 YR 5.5/6) dry and (5YR 4/6) moist; sandy loam; weak, coarse, sub-angular blocky; non-sticky and non-plastic, friable moist; hard dry; very few, small, round to irregular iron concretions; rapid permeability, few fine, roots, pH 6.4; clear, smooth boundary.

B ₂₁	80-120	Brown (7.5 YR 5/4) dry; dark brown (7.5 YR 4/4) moist, rubbed; common, medium, faint, (5 YR 4/6) mottles; sandy clay loam; moderate, medium, sub-angular blocky; slightly sticky and slightly plastic, firm moist, very hard dry; many, small, iron and manganese concretions; moderately slow permeability; few, very fine roots; pH 5.6; diffuse boundary.
B ₂₂ G	120-177+	Dark brown (7.5 YR 4/4) moist, rubbed many, medium, prominent, greyish brown (2.5 Y 5/2) and many, medium, distinct, dark reddish brown (5 YR 3/4) mottles; clay loam, moderate medium, angular blocky; sticky and plastic, very firm moist, very hard, dry; many, small round to irregular iron and manganese concretions, moderately slow permeability; few, very fine roots; pH 6.3

DISCUSSION

The physico-chemical characteristics of the soils are presented in table I. The Mattagiri series are very deep, reddish brown soils. The textural behaviour evidences a genetic relationship between the horizons, suggesting its well developed nature (Barshad, 1958). In addition to an argillic horizon, there is also a gradual strengthening of structure down the profile. The most striking feature is the presence of a iron concretionary band with a quartz vein embedded in it. Jenny (1941) suggested that presence of iron gravel as band as indicative of relative age or maturity of the soil. The presence of a quartz gravel line offers doubt about the lithology of these soils (Ruhe, 1959). However the distribution, the form and shape of the quartz

pieces, indicate an in-situ origin (Hameed Khan, 1974). The sand fraction is maximum in the surface horizon and gradually decreases with depth, which is indicative of the sedentary nature of the soil (Roonwal and Bhumbla, 1968/69). As revealed by morphology, the soils of Mattagiri series are in-situ formations developed from underlying gneissic rocks.

The morphology of Punapallee series revealed the presence of an argillic horizon and absence of conspicuous iron-gravel concretionary band and mottling. However the solum projects the presence of some iron concretions, whose intensity and size increases with depth. The presence of concretions may be due to hydrological effect. The textural behaviour, development of

Table 1. Physico-chemical characteristics of soil series

S. No.	Name of Soil series	Depth in cm	pH	E. C.	Coarse sand %	Fine sand %	Silt %	Clay %	Organic carbon %	CEC Me. e / 100 g
I.	Mattagiri	0-10	6.5	0.20	17.6	59.6	0.25	18.25	0.73	7.9
		10-18	6.9	0.10	25.5	23.6	1.00	49.00	1.00	9.6
		18-143	6.8	0.20	19.9	14.9	5.75	55.75	0.57	9.3
		143-161	6.9	0.20	25.5	14.2	5.25	51.25	0.76	8.7
		161-191	6.2	0.15	34.8	4.5	7.50	50.00	0.28	7.8
II.	Punapatte	0-10	6.5	0.20	40.4	33.1	4.75	21.25	1.48	11.7
		10-22	6.8	0.10	30.6	26.5	5.50	32.75	1.32	10.0
		22-47	6.9	0.10	30.9	30.0	5.17	30.86	0.92	11.3
		47-131	6.9	0.20	22.3	17.2	6.25	52.49	0.97	12.2
		0-26	7.3	0.10	34.3	27.5	6.25	28.75	1.66	11.8
III.	Joogur	26-46	7.2	0.20	24.3	21.8	8.00	44.50	1.29	12.4
		46-83	7.2	0.15	24.3	18.7	6.50	33.75	0.79	13.2
		83-161	7.4	0.35	34.7	20.0	3.95	43.55	0.32	21.8
		0-12	6.7	0.15	21.1	22.4	13.36	33.89	0.98	16.3
		12-32	7.2	0.20	27.1	17.1	22.38	38.40	0.68	12.2
IV.	Karanur	32-51	7.0	0.30	23.0	26.9	7.75	35.14	0.13	9.7
		51-59	7.1	0.25	23.8	22.1	13.19	35.39	0.32	9.3
		59-94	7.5	0.30	25.5	17.3	4.50	48.89	0.15	11.0
		94-118	7.6	0.60	22.6	25.1	6.75	41.65	1.17	14.5
		118-180	7.6	0.10	2.3	7.6	14.86	70.59	1.17	19.2
V.	Simpson	0-22	6.2	0.20	42.5	35.3	5.00	18.50	0.07	6.5
		22-56	6.5	0.10	36.0	31.8	9.00	24.75	0.34	6.5
		56-80	6.4	0.10	49.8	31.3	8.25	13.76	0.10	5.4
		80-120	5.6	0.10	44.2	29.1	6.00	20.75	0.25	7.8
		120-177	6.3	0.10	38.1	21.7	5.00	35.00	0.67	10.9

structure, nature of boundaries, between successive horizons, indicate a sedentary nature for Punapalle series.

The Karanur and Jeegur series are distinctly different from the rest of the soils of the farm. These occupy a comparatively lower physiographic positions and are confined to the depressions connecting the two major natural water tanks, the effect of which being much pronounced in the morphology. The Jeegur series occupies slightly higher physiographic position than the Karanur. The influence of the hydrological conditions is well pronounced in Karanur series. There are heavy clayey soils with well developed structure and developing shallow cracks when dry. With the absence of any vertic characters, the mottlings and concretions in addition to gleying in B_{24} , B_{25} G horizons reveal the ill drained nature. The uniform distribution of clay with a maximum 70 per cent in the B_{26} G horizon indicates mechanical illuviation as well as synthesis of clay.

The Jeegur series are non-calcareous soils, moderately heavy on the surface, with well developed structure. These are imperfectly drained and subjected to reduced conditions as evidenced by the presence of mottlings, gleyed horizons (B_{22} G) and concretions.

The Simpson series are nothing but extension of Karanur series but differ from the latter in view of its present soil environment. From the morphological study it appears that the Simpson series had been once under the influence of moisture from the Karanur tank, under

high water table for a long time which might have receded. This has left imprints on the morphology and colour of the soils. The presence of mottlings and iron concretions throughout the solum are again indicative of imperfect drainage and reduced conditions. The gleyed nature of B_{22} G horizon at a depth of 120-177 cm is due to the fact that the lower horizons are still under the influence of excessive moisture.

In conclusion these soils are in-situ formations developed from weathered gneisses. The topography and effect of hydrology have contributed much as reflected by variation in morphology is suggestive of a catenary sequence.

Soil Classification

An attempt has been made to place the soil series identified according to the 7th approximation system and the tentative classification done upto the family level is presented below. The soils were found to be mostly alfisols.

1. Mattagiri series

Typic Rhodustalfs - clayey - mixed-non-acid Isohyperthermic

2. Punapalle Series

Typic Paleustalfs-fine loamy-mixed-non-acid isohyperthermic

3. Jeegur series

Typic tropaqualfs-fine loamy-mixed-non-acid isohyperthermic

4. Karanur series

Typic tropaqualfs-fine clayey-mixed isohyperthermic

5. Simpson series

Ultic Haplustalfs-fine loamy-mixed-non-acid isohyperthermic.

REFERENCES

- ANONYMOUS. 1970. All India Soil and Land Use Survey Organisation, I A R I, New Delhi.
- BALASUNDARAM, C. S., T. M. THIAGARAJAN, S. RAMANATHAN, H. HAMEED KHAN and G. RAJENORAN. 1973. Quality of irrigation waters of Hosur Cattle Farm and their suitability for Irrigation. *Madras agric. J.* 60 : 796-8.
- BALASUNDARAM, C. S., T. M. THIAGARAJAN, H. HAMEED KHAN, S. RAMANATHAN, and M. JAYARAMAN. 1974. Fertility status of the soil of the Hosur Cattle Farm, Dharmapuri district. *Indian J. Agric. Res.* 5.
- BARSHAD, I. 1958. Reinifold Publishing Corporation, New York.
- HAMEED KHAN, H. 1974. Morphology, Genesis and Classification of two Red Soil Series of Coimbatore District, Tamil Nadu. M. Sc.(Ag). Thesis submitted to the Banaras Hindu University, Uttar Pradesh.
- JENNY HANS, 1941. Factors of Soil Formation. McGraw Hill Book Co. Inc., New York & London.
- KLEGG, C. E. 1962. The place of Laboratory in soil Classification and Interpretation. U. S. D. A. *Soil Conservation Service Bulletin, June.*
- PIPER, C. S. 1950. *Soil and Plant Analysis.* Interscience Publication, Inc, New York.
- ROONWAL, G. S. and D. R. BHUMBLA. 1968-69. Contribution to the mineralogy and geochemistry of the soils developed over gneissic rocks in the Kulu areas (Central Himalayas, India) *Geoderma*, 2 : 309-19.
- RUHE, R. V. 1959. Stone Lines in Soils. *Soil Sci.* 87 : 223-31.