

Aliyar Series – A New Series for Exploration in Pollachi Taluk, Coimbatore Dt., Tamil Nadu

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ABSTRACT: Soil series is the fundamental unit of soil classification. Achieving potential yields of crops relies on the native soil fertility status of the land which is tailored through appropriate crop management options developed for the soil series and cannot be generalized across pedons. Identification of new soil series and developing series specific management strategies is an essential pre requisite of precision agriculture. Three profiles were explored at Coconut Research Station, Aliyarnagar, the morphological and physico-chemical properties were assessed and correlated with the related soil series. Since the profiles at Aliyarnagar were diagnostically different from the already designated red calcareous soil series viz., Tulukkanur, Palladam and Palathurai series in attributes like depth, soil colour, texture, land use and vegetation, a new soil series viz., Aliyar (Alr) series was denominated. Crop management options viz., crop selection, irrigation and nutrient management can be modified to suit the pedon characteristics of the identified series and can be further followed by Soil Survey and Land Use Organization, Tamil Nadu.

Keywords: Aliyar, Palathurai, Palladam, Soil series, Tulukkanur.

INTRODUCTION

Agriculture in India is the pivotal sector for ensuring food and nutritional security to the ever burgeoning population even in the heightened pandemic situation. Sarkar, (2011) has cautioned that Indian Agriculture is presently at cross roads with vast untapped potential on one hand and the dismal situation arising from sluggish agricultural growth, degradation and pollution of natural resources, decline in nutrient and water use efficiencies, deceleration of total factor productivity together with the disastrous impact of climate change. Soil is the most vital and precious natural resource for the existence of mankind and the pressure on this vital resource has increased to such an extent that the relationship between the living beings and soil has become critical (Sarkar, 2005). Soil is not only the medium for agriculture but also a component of ecological processes and cycles, a repository for waste disposal, an ameliorator of water quality, medium for bioremediation and engineering uses (Miller, 1993). Soil survey, incorporating field sampling, laboratory analysis, data processing, and mapping, aims to classify soil types and soil attributes within a specific area and produce soil maps as the ultimate products (McBratney *et al.*, 2003). Ideally, different parent materials within a solum can be distinguished by lithologic discontinuities

that are identifiable in the field and confirmed in the laboratory (Schaetzl, 1998). In soil classification, soil series is the most detailed hierarchical category which is practically independent from the classification system to which they refer (Boulaine, 1980). Each soil series represents a specific soil class with a unique set of physical, chemical and mineralogical characteristics and is the most homogenous category in taxonomy.

The soil series concept was developed more than 100 years ago and serves as the fundamental mapping concept. Accurately identifying the soil map unit component at a specific point-location within a landscape is critical for implementing sustainable soil management (Maynard *et al.*, 2020). There is close association between soil series and land use and is an essential vehicle for transferring soil information and knowledge from one place to another. It is the category of soil classification upon which the crop production perspectives are planned and executed. Hence identification, demarcation and denomination of new soil series based on differentia from the already existing soil series can aid in better land management and resource utilization. The paper focuses on a new soil series identified during soil survey at Coconut Research Station, Aliyarnagar which is diagnostically different from that of the other related calcareous soil series.

MATERIAL AND METHODS

Coconut Research Station, Aliyarnagar of Tamil Nadu Agricultural University is located near Western Ghats ($10^{\circ} 29' 499''\text{N}$ and $76^{\circ} 58' 821''\text{E}$) in the Western Zone of Coimbatore district of Tamil Nadu, at an elevation of 260 m above MSL with an undulating topography. Detailed survey was undertaken at the station to bring out the spatial variability in distribution of macro and micronutrients across the farm. The station with an acreage of 22 hectares is divided into three blocks viz., A, B and C for the ease of management. Three master profiles were explored (Bhattacharya *et al.*, 2009) one each in the three blocks, soil samples of each horizon of representative pedons were collected, processed and analyzed for important physico chemical properties employing standard procedures (Sarma *et al.*, 1987). Soil texture was determined by feel method and colour by employing Munsell Colour Chart.

Soil series was characterized considering the properties like position in the landscape, slope, sequence of horizons, structure, colour, depth, drainage, permeability, mineralogy, cation exchange capacity and soil fertility parameters across the horizons. Correlation of the properties of the explored profiles was done with that of the related soil series of the region. Based on the deviation of the soil profile characteristics from the already existing soil series, a new series was denominated.

RESULTS AND DISCUSSION

Soil classification is an important element of soil research and data processing, serving mainly as an organizational framework for the description of soil properties (Shi *et al.*, 2010; Gray *et al.*, 2011; Pásztor *et al.*, 2012)

A. Morphological properties

The morphological characteristics of the horizons of the profiles explored are depicted in Fig. 1. The texture of the surface horizons in profiles 1 and 3 were sandy clay loam while that of the sub surface horizons was sandy loam in profile 1. In profile 2, the texture was loamy sand in the surface horizons (Ap – Bw1) and sandy clay loam beneath. In profile 3, sandy clay texture was noticed in Bt₁ horizon and sandy texture in Bt2 horizon. Colour of the horizons across the profiles was 7.5 YR hue with varying value and chroma. All the three profiles were red calcareous in nature with strong effervescence (s) in the surface horizons of profiles 1 and 3 and violent effervescence in the subsurface horizons. The boundaries of the horizons were either clear smooth (CS) or gradual smooth (GS) as depicted in the Fig. 1 and the representative pedon in Fig. 2.



Fig. 1. Horizonation of the soil profiles of CRS, Aliyarnagar.

B. Chemical properties

The chemical properties of the horizons of the profiles are presented in Table 1. pH of the horizons ranged from 7.42 to 8.80 which is mainly attributed to the calcareous nature of the soil (Sudhalakshmi *et al.*, 2017). Electrical conductivity of the soil samples ranged from 0.04 to 0.13 dSm⁻¹. Relatively low electrical conductivity can be corroborated to the sandy texture of the soil. Cation exchange capacity gives an insight into the fertility and nutrient retention capacity of soil. Cation exchange capacity (CEC) of the soil ranged from 3.40 to 13.2 cmol (p+) kg⁻¹ and the low CEC is due to the predominance of sandy nature in the soil. The results are in close compliance with Dai Yunan *et al.* (2018) who established positive correlation between the contents of clay, silt and organic matter and negative correlation with sand to cation exchange capacity of soil. Base saturation percentage varied from 51.2 to 79.2 % and the values were higher in the horizons predominant in clay. The contents of KMnO₄-N varied from 97.2 to 250.9 kg ha⁻¹, Olsen – P from 4.8 to 16.1 and NNNH₄OAc-K from 105.6 to 198 kg ha⁻¹. Phosphorus fixation is a combination of surface adsorption on clay and lime surfaces and precipitation of calcium phosphate minerals (Leytem and Mikkelsen, 2005). Thus in the present survey low availability of phosphorus was noticed in the calcareous horizons across the profiles. Organic carbon content in the horizons varied from 0.90 to 6.90 g kg⁻¹ and hot water soluble boron from 11.8 to 15.6 ppm.

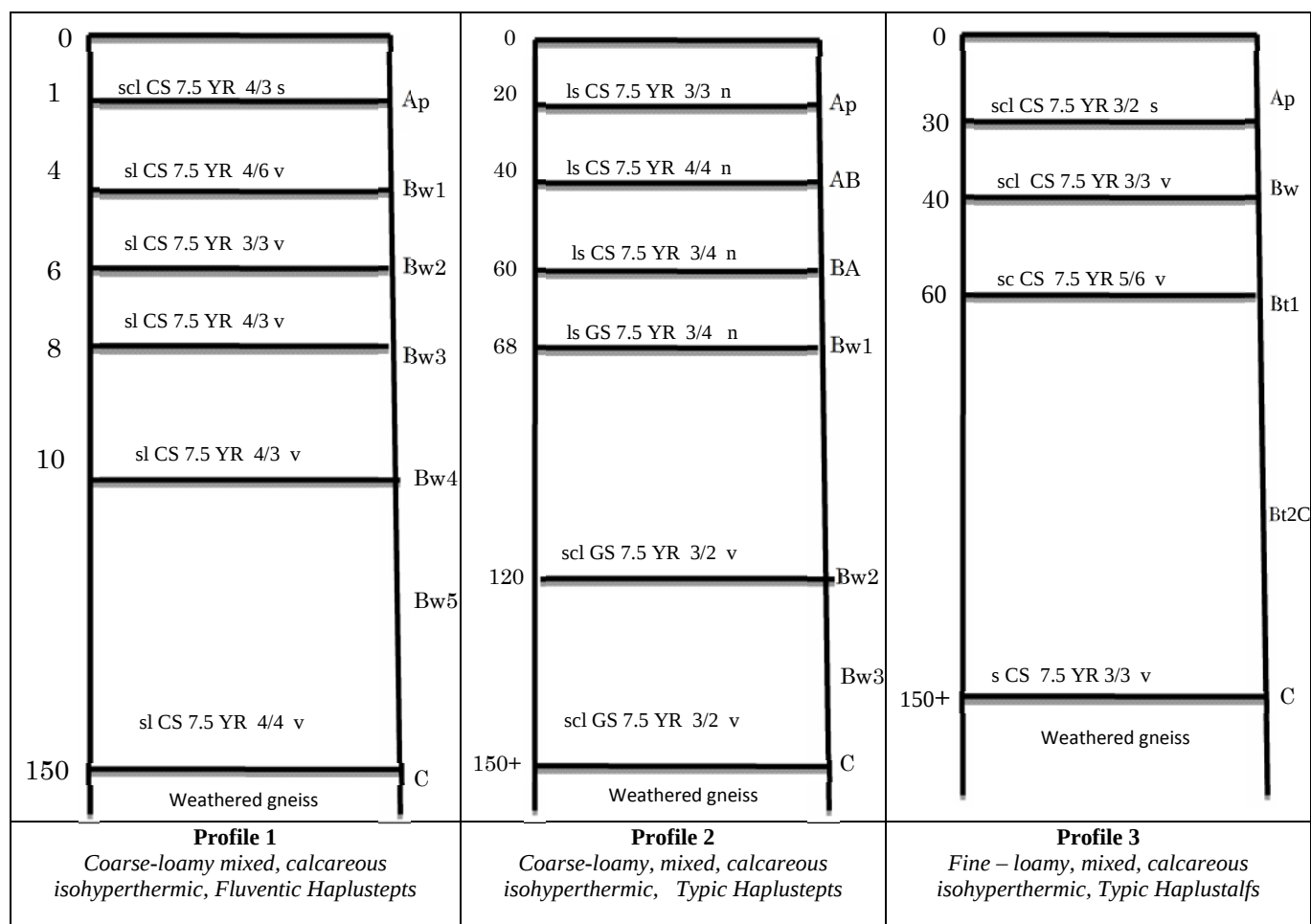


Fig. 2. Horizonation of the profile of CRS, Aliyarnagar.

Table 1: Soil chemical properties of the horizons of the profiles.

Parameter	Profile – A Block			Profile – B Block			Profile – C Block		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
pH	8.50	8.80	8.67	7.42	8.61	8.11	8.31	8.65	8.48
Electrical Conductivity (dSm ⁻¹)	0.07	0.13	0.09	0.04	0.10	0.07	0.09	0.11	0.10
Cation exchange capacity (cmol (+) kg ⁻¹ soil)	10.4	12.2	11.07	7.80	11.9	9.37	3.40	13.2	10.5
Base Saturation (%)	65.6	72.2	68.7	56.8	69.6	61.6	51.2	79.2	70.0
KMnO ₄ – N (kg ha ⁻¹)	97.2	232.1	137.5	125.4	244.6	171.9	241.5	250.9	246.9
Olsen – P (kg ha ⁻¹)	8.10	15.8	11.6	7.6	17.8	13.2	4.8	16.1	8.98
NNH ₄ OAc – K (kg ha ⁻¹)	105.6	198	122.1	107.8	130.9	118.9	105.6	110	107.8
Organic carbon (g kg ⁻¹)	3.80	6.90	5.50	2.20	3.70	3.00	0.90	2.20	1.60
Exchangeable Ca (meq 100 g ⁻¹)	4.3	9.0	5.90	2.00	5.20	3.10	3.70	10.5	5.80
Exchangeable Mg (meq 100 g ⁻¹)	7.40	13.8	10.6	2.80	12.5	7.13	8.30	14.7	11.3
Hot water soluble B (ppm)	12.3	15.6	13.7	11.8	12.8	12.4	12.7	14.1	13.5

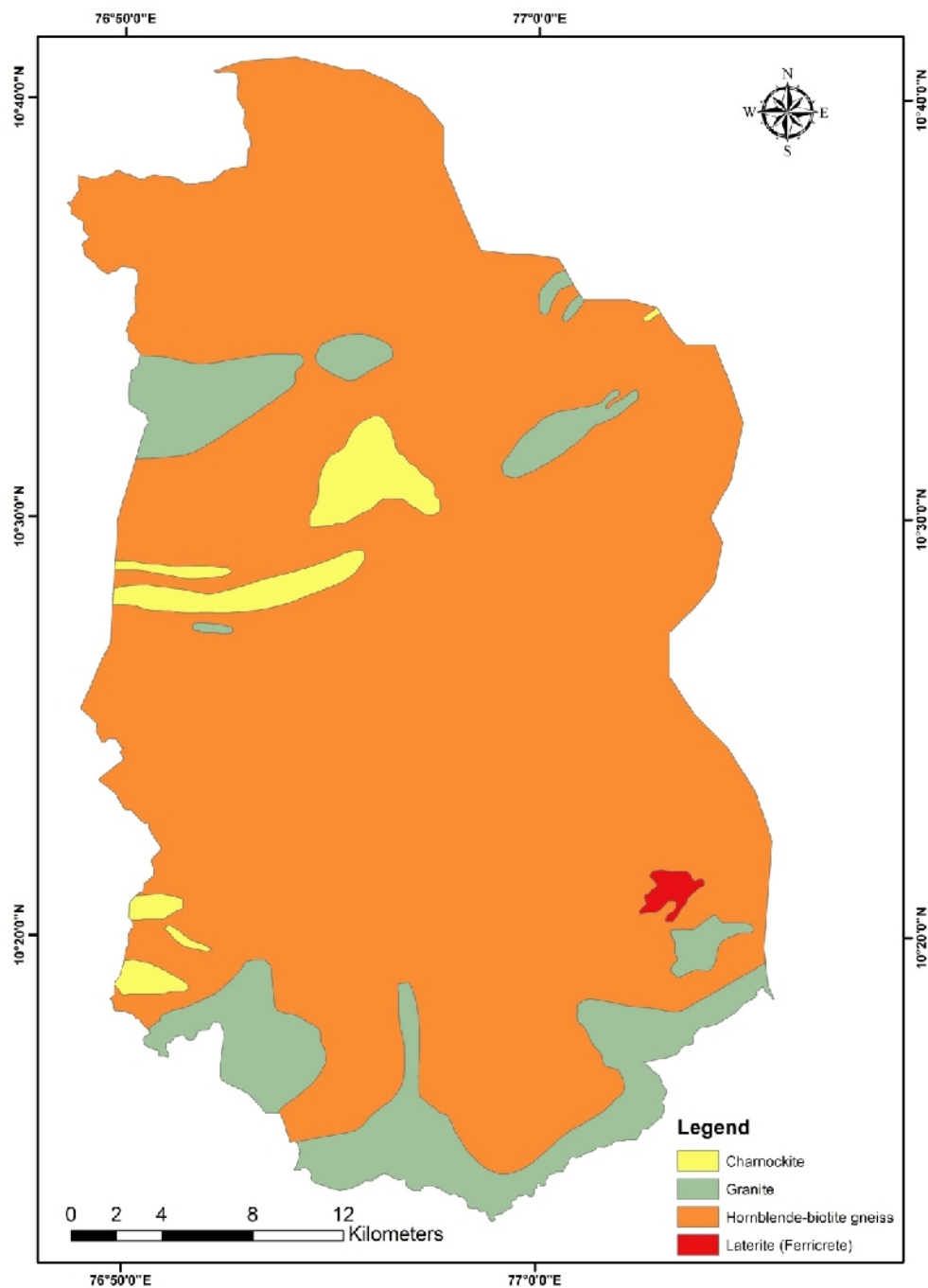


Fig. 3. Geology Map of Anaimalai block at 1:50,000 scale.

C. Competing Soil Series and Differentia

Competing red calcareous soil series are Palladam series, Tulukkanur series and Palathurai series. The profile characteristics of the series are presented in Tables 2, 3 and 4. Colour of Tulukkanur soil series is 5 YR 4/4 – 5.0 YR 4/6, Palladam series is 5 YR in the surface and 2.5 YR in the subsurface horizons and that of Palathurai series is 7.5 YR in the surface and 5 YR in the sub surface horizons. The newly identified soil

series at Aliyarnagar has 7.5 YR hue with varying value and chroma across horizons. Palladam soil series consists of shallow depth interbanded with CaCO_3 , the depth of Tulukkanur series is 85 cm and that of Palathurai series is 120 cm. The new soil series at Aliyarnagar has 150+ cm permitting cultivation of perennial and deep rooted crops. Taxonomic classification of Palladam series is *Loamy, mixed, isohyperthermic, noncalcareous, Lithic Haplustepts*,

Tulukkanur series is *Coarse-loamy, mixed, isohyperthermic, calcareous, Typic Haplustepts* and Palathurai series is *Fine-loamy, mixed, isohyperthermic, calcareous, Typic Haplustalfs*. The newly identified

series is taxonomically classified as *Coarse-loamy mixed, calcareous isohyperthermic, Fluventic Haplustepts*.

Table 2: Pedon characteristics of Tulukkanur soil series.

Horizon	Depth (cm)	Description
Ap	0-15	Yellowish red (5 YR 4/6); (gravelly) sandy loam; weak, medium, granular; slightly sticky, friable moist, loose dry; frequent, round to irregular, lime concretions; violent effervescence; very few, medium and fine roots; rapid permeability; clear, smooth boundary
B1-1	15-30	Reddish brown (5 YR 4/4); (gravelly) sandy loam; weak, medium, subangular blocky; friable moist; frequent, round to irregular, lime concretions; violent effervescence; few, fine and very fine roots; rapid permeability; diffuse, wavy boundary
B1-2	30-50	Reddish brown (5 YR 4/4); (very gravelly) sandy loam; weak, medium, granular; friable moist; very frequent; 0.5-4 cm size, lime concretions; violent effervescence; very few, very fine roots; rapid permeability; gradual, wavy boundary
Cca	50+	Gneiss mixed with CaCO ₃ nodules

Table 3: Pedon characteristics of Palathurai soil series.

Horizon	Depth (cm)	Description
Ap	0-12	Dark brown (7.5 YR 3/2) (slightly gravelly) clay loam; weak, fine subangular blocky; sticky and slightly plastic, firm, hard; slight effervescence, few, fine and very fine pores; common fine roots; moderate permeability, gradual wavy boundary
A3	12-52	Dark reddish brown (5YR 3/3) (slightly gravelly) sandy clay loam; weak medium and subangular blocky; slightly sticky, slightly firm, hard; few fine and very fine pores; moderately rapid permeability, clear wavy boundary
Bt	52-83	Dark reddish brown (5YR 3/4); (slightly gravelly) clay loam; moderate coarse subangular blocky; sticky and slightly plastic, firm, hard; thin patchy clay films; violent effervescence; few medium and fine pores; rapid permeability; clear wavy boundary
Cr	83-98	Weathered gneiss

Table 4: Pedon characteristics of Palladam soil series.

Horizon	Depth (cm)	Description
A _p	0-16	Yellowish red (5 YR 4/6), sandy clay loam; weak, medium, subangular blocky; friable moist, slightly hard dry; few, fine and very few, medium pores; very few, fine roots; rapid permeability; clear, smooth boundary
B ₁₋₂	16-27	Red (2.5 YR 4/6); (slightly gravelly) sandy clay; massive breaking to gravels; sticky and slightly plastic, friable moist; very few, irregular quartz gravels of 1 cm size; few, fine and very fine pores; very few, very fine pores; very few, very fine roots; moderately rapid permeability; gradual, irregular boundary
B ₂₋₂	27-48	Red (2.5 YR 4/6); (gravelly) clay massive breaking to granules; slightly sticky, friable moist, loose dry; dominant, irregular 1-5 cm. quartz gravels; very few, fine and very fine pores; very few very fine roots; rapid permeability; gradual, irregular boundary
B ₃	48-70	Dark red (2.5 YR 3/6); (very gravelly) clay massive breaking to granules; slightly sticky, friable moist, loose dry; very frequent, below 1 cm size, quartz gravels and fragments of gneiss; few, fine and very fine pores; very few; very fine pores; very few, very fine roots; rapid permeability
C	70+	Weathered granitic gneiss

D. Parent material and Texture

The major and predominant geological formations of Aliyar are of granite gneiss, biotite gneiss and charnockite in general. Massive gneissic outcrops are observed along the Aliyar river. The foliation trend is north-east to south-west with a south easterly dip. The thickness of the weathered zone ranges from 3 to 4 meters in general. Texture of Tulukkanur and Palathurai soil series is loamy and Palladam series is gravelly clay /loamy whilst the newly identified series is predominantly sandy textured.

E. Natural Vegetation

Crops like sorghum and green gram are being cultivated in Tulukkanur series while coconut, cotton and pearl millet find a place in Palathurai series. In Palladam series, coconut, vegetables and onion are being widely cultivated. Natural vegetation noticed in Tulukkanur series are *Cassia auriculata*, *Borassus flabellifer*, in Palathurai series, *Azadirachta indica*, Agave and in Palladam series, *Azadirachta indica*, *Calotropis* sp, *Borassus flabellifer*, *Lantana* sp, *Tamarindus indica* and *Cyanodon dactylon* are observed In Aliyar series,

coconut, cocoa, nutmeg, groundnut and vegetables are the principal crops and the natural vegetation include *Azadirachta indica*, *Tamarindus indica* and *Acacia* sp.

CONCLUSION

During detailed soil survey, a new soils series was identified at Coconut Research Station, Aliyarnagar called Aliyar (Alr) Series which is diagnostically different from that of the already existing red calcareous soil series viz., Palladam series, Palathurai series and Tulukkanur series in attributes like soil colour, depth, texture and land use. The depth of the denominated soil series is 150+cm with strong to violent effervescence in the horizons when tested with dilute Hydrochloric acid indicating that it is intensely calcareous. Coconut, groundnut, cocoa, nutmeg and vegetables are the predominant crops of the series because of the sandy texture of the soil. The new series warrants specific management practices for achieving higher productivity in crops. The information will help the officials of the Soil Survey and Land Use Organization, Government of Tamil Nadu for further follow up during survey and for undertaking appropriate land use planning.

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Conflict of Interest. The authors declare no conflict of interest.

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