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MACROMORPHOLOGY AND WATER MANAGEMENT RELATED PROPERTIES OF KOTHAKOTTAI SOILS-A TYPIC USTOCHREPT IN A LATERITIC SOIL TRACT

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ABSTRACT

The Kothakottai series is a major soil of Sivagangai taluk. It is a medium textured, reddish brown, deep, excessively drained, neutral and in situ formed lateritic soil from weathered quartzitic gneiss. The texture is sandy loam to sandy clay loam in solum. This is relatively the coarsest textured soil of the tract. Water retentivity is meagre, frequent irrigation is needed. The hydraulic conductivity and infiltration rate are rapid. Soil and moisture conservation is the prime problem of the soil. Soil breeding and organic waste incorporation are suggested to improve the moisture retentivity.

Irrigation water is the costliest input in agriculture requiring to be judiciously used, considering the potentialities and problems of soils. In a typical lateritic soil tract of Sivagangai taluk,the Kothakottai series (Kkt) is the predominant soil, a typic Ustochrept. This sub-group of soil occurs on 30.87 per cent of the area in this taluk (Balasubramaniam et al., 1984). Details on this series with respect to water management are not available and hence this investigation

MATERIALS AND METHODS

The observations of profiles and augers were made as per the standard soil survey procedure given in soil survey manual. Four pedons were dug up in different places of Sivagangai taluk. The climate is sub tropical with average annual rainfall of 742.5mm.

The average annual temperature is 28.7°. Mean summer temperature is 30.3°C and mean winter temperature is 24.9°C. Standard methods were followed for the analysis of samples in laboratory.

RESULTS AND DISCUSSIONS

As the four pedons studied resemble closely, only one typical pedon's description is given below:

Soil series : Kothakottai
Physiography : Mid upland
Elevation : 95 m above MSL
Parent materials : Quartzitic gneiss mixed with plinthite
Vegetation : Opuntia, prosopis, calotropis etc.
Location : 5th km in Sithalangudi to S.Kottai road; left side of road 200 m away

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Remarks Well drained, moderately eroded.

HORIZON DEPTH AND DESCRIPTION

Ap-0-13 cm, reddish brown (5 YR 4/4); sandy loam; massive; loose, friable, slightly sticky and non-plastic; many very fine and fine roots; many very fine pores; rapid permeability; pH 6.6; clear, wavy boundary.

B 11-13-38 cm; reddish brown (5 YR 4/4); sandy loam; strong medium, sub angular blocky; soft friable. slightly sticky and non-plastic; few, medium, Fe and Mn concretion; few fine and very fine roots and pores; rapid permeability; pH 6.9, gradual, smooth boundary.

B 12-38-84 cm, yellowish red (5 YR 4/6); sandy clay loam, strong medium, subangular blocky; soft friable, slightly sticky and non-plastic, few medium, Fe and Mn concretions; very few, fine to very fine pores and roots; moderately rapid permeability; pH 7.0, clear, smooth boundary.

C-Quartzitic gneiss with plinthite

RANGE IN CHARACTERS

The surface colour ranges from reddish brown (5YR 4/4) to yellowish red (5YR 5/6) and surface texture from sandy loam to sandy clay loam. The solum depth ranges from 75 to 88 cm.

From the macromorphology,it is revealed that the Kothakottai series have pedon with a 'cambic' sub surface diagnostic horizon (Soil Survey Staff, 1975a and 1975b). The profile group falls into VII (similar to II of alluvial plains) as per guidelines of Storie (1964). Fairly high amount of Fe and Mn concretions indicate the unweathered nature of this soil.

The data on some water management related physical properties of this series are presented in table 1 and moisture retentivity of this soil in table 2. The total clay content ranges from 16.54 to 22.56 per cent in Ap horizon without significant clay increase and hence qualifying for 'cambic' horizon and satisfying the order 'Inceptisol'. The fine clay is in the range of 1.85 - 3.20 per cent in AP horizon with slight increasing trend in pedon as the depth increases indicating the beginning of illuviation. The clay was positively and significantly correlated with bulk density, CEC, Al_2O_3 and exchangeable Ca^{++} and Mg^{++} and negatively correlated with sand, hydraulic conductivity and acid insolubles as revealed from correlations worked out by Sampath (1987) for this series. These conclusions are in agreement with those of Kandasamy (1961) and Antony (1981).

The silt content is in the range of 2.95-5.65 per cent in Ap horizon with a slight increase with depth, again confirming the inception of pedogenesis (Mayalagu, 1975 and Soil Survey Staff, 1975). Due to less clay and silt content with sandy loam to sandy clay loam texture through out the solum, the water and nutrient retentions would be less, demanding frequent irrigation and more split doses of recommended fertilizer nutrients (Bhatia and Vardhani, 1982).

The sand content is in the range of 74.49-80.01 per cent in Ap horizon and decreases with depth in pedon. Coarse sand is higher than fine sand indicating unweathered nature of primary minerals. The gravel content in Ap horizon is in the range of 4.55-15.27 per cent with an irregular pattern with depth owing to the begining stage of soil development. The relatively high amount of gravel points out the resistance to weathering and unavailability of moisture to hasten weathering of primary minerals.

The hydraulic conductivity and infiltration rate values are relatively higher than the fine textured soil series of the tract (Sampath, 1987) suggesting that there is no drainage problem. The bulk density in Ap horizon is in the range of 1.45-1.53 g/cm^3 with a slight increase in middle of solum. This soil may be made to retain more water by use of organic wastes like coir pith, filter cake etc. @20 t/ha and/or soil breeding ie., mixing of heavy black soil or tank silt @ 50 t/ha (Jaganathan,1985).

The moisture retentivity of this soil at 1/3 bar ranges from 11.86-12.23 per cent in Ap horizon while that at 15 bar from 3.10-3.41 per cent (Table 2). The maximum available water in soil ranges from 8.76-8.90 per cent in Ap horizon. These rententivities of moisture slightly increase with depth in pedon. The relatively poor water retentivity of Kkt series in the tract (Sampath, 1987) indicates clearly the relatively coarser texture and kaolinitic type of clay mineralogy as stated by Pillayar and Durairaj, (1969) and Antony (1981). The moisture retained expresses a more rapid decline from 1/3 bar to 4 bar tension than at higher tensions accounting for 70 to 80 per cent depletion of maximum available soil moisture retentivity. This would lead to quick drying of this series demanding frequent irrigation and hence less economy of irrigation water use. Growing rice in these soils would prove to be less beneficial resulting in low yield and nutrient use efficiency. The available water holding capacity in whole solum ranges from 9.80-11.56 cm suggesting that any excess depth of water received either as irrigation or rain will be lost by seepage and thereby ending up in losses of nutrient. Thus, the Kkt series soils require careful water and nutrient management for a successful agricultural use.

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Table 1. Mechanical analysis and some water movement related properties of Kothakottai series.

Horizon	Depth in cm	Gravel content (%)	Mechanical analysis (per cent) cs	fs	si	c	fine clay <1 μ	Textural class	In-situ bulk density (g/cm^3)	Hydraulic conductivity (cm/hr)	Infiltration rate (cm/hr)
	Pedon I	Stithalangudi. Sithalangudi - S.Kottai road - 5 km - left side - 200 m.									
AP	0-13	6.95	39.43	36.40	4.65	18.32	3.24	sl	1.48	3.05	
B11	13-18	4.55	38.85	34.94	7.27	18.94	2.83	sl	1.50	2.96	31.
B12	38-84	8.21	37.89	34.86	8.00	19.25	2.69	sl	1.52	2.81	
	Pedon II	Maravankulam. Sivagangai - Maravankulam road - 12 km - left side - 200 m.									
AP	0-13	9.33	39.34	35.15	2.95	22.56	1.85	scl	1.53	2.86	
B11	13-33	7.65	41.71	31.38	3.66	23.25	2.62	scl	1.55	2.72	2.6
B12	33-80	15.27	40.48	29.81	3.84	25.87	1.54	scl	1.56	2.69	
	Pedon III	Somanathamangalam. Somanathamangalam - Vettikulam road - 3.5 km stone - left - 100 m									
AP	0-18	7.70	39.36	37.72	4.64	18.28	2.95	sl	1.47	3.34	
B11	18-35	11.64	38.54	36.22	5.29	19.95	2.74	sl	1.49	3.15	2.9
B12	35-75	10.94	43.86	33.22	5.65	17.27	2.85	sl	1.46	3.41	
	Pedon IV	Vettikulam. Vettikulam road diversion to Somanathamangalam - 1/2 km from Vettikulam-left - 250m									
AP	0-17	5.62	42.23	37.78	3.45	16.54	3.15	sl	1.45	3.58	
B11	17-36	7.15	41.34	35.33	4.54	18.79	3.45	sl	1.47	3.29	3.2
B12	36-88	12.49	41.21	34.10	4.96	19.73	3.21	sl	1.49	3.18	

Table 2. Some water movement related properties of Kothakottai series.

Horizon	Depth in cm	Moisture content at different tension bars (per cent)						AWC	Available water holding power of soil(cm)	
		1/3	1	4	8	12	15		In each layer	Whole profile
	Pedon I	Stithalangudi. Sithalangudi - S.Kottai road - 5 km - left side - 200 m.								
AP	0-13	12.05	8.80	7.64	6.15	4.84	3.25	8.80	1.69	
B11	13-18	12.52	8.69	7.89	6.40	5.20	3.60	8.92	3.34	11.52
B12	38-84	12.94	9.68	7.95	5.36	4.90	3.65	9.29	6.49	
	Pedon II	Maravankulam. Sivagangai - Maravankulam road - 12 km - left side - 200 m.								
AP	0-13	12.23	8.68	7.91	6.48	5.08	3.41	8.82	1.75	
B11	13-33	12.46	9.20	7.99	6.52	5.97	3.50	8.96	2.77	11.22
B12	33-84	13.00	9.52	8.15	6.85	5.05	3.86	9.14	6.70	
	Pedon III	Somanathamangalam. Somanathamangalam - Vettikulam road - 3.5 km stone - left - 100 m								
AP	0-18	12.10	8.70	7.60	6.05	4.64	3.20	8.90	2.35	
B11	18-35	12.85	9.40	8.05	6.70	4.95	3.77	9.08	2.29	9.80
B12	35-92	12.00	8.65	7.52	6.00	4.51	3.15	8.85	5.16	
	Pedon IV	Vettikulam. Vettikulam road diversion to Somanathamangalam - 1/2 km from Vettikulam-left - 250m								
AP	0-17	11.86	8.51	7.43	5.86	4.40	3.10	8.76	2.16	
B11	17-36	12.08	8.90	7.82	6.35	5.15	3.20	8.88	2.48	11.56
B12	36-111	12.49	9.32	8.00	6.61	4.90	3.55	8.94	6.92	

AWC - Available water content

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A MATHEMATICAL MODEL FOR PREDICTING THE YIELD OF MAIZE UNDER MOISTURE DEFICIT

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ABSTRACT

Yield prediction of maize grown under different levels of moisture over a range of sowing times during summer and *kharif*, using a mathematical model was attempted. The growth stage model involving yield response ratio could predict the yield of maize with minimal prediction error indicating the suitability of the model for predicting maize yields under varied levels of moisture deficit through different phenophases.

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