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INFILTRATION RATE, HYDRAULIC CONDUCTIVITY AND MOISTURE RETENTION CHARACTERISTICS OF SOME SOILS OF LOWER BHAVANI PROJECT COMMAND AREA, TAMIL NADU

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ABSTRACT

Five typical soil profiles under Lower Bhavani Project Command area, representing various physiographic situations were the materials for this study. Soil texture, pH, Electrical conductivity and organic carbon content etc. were influenced by physiographic units. The infiltration rate and hydraulic conductivity were high in Lithic Haplustalf and low in Typic Haplustalf and Typic Chromustert (Black clay loam soil). The study of moisture retension at variation tension indicated that upper terraced to middle terraced soils (Lithic Haplustalf, Typic Ustochrept, Typic Ustifluvent, Typic Haplustalf) are having low available water content compared to lower physiography Typic Chromustert.

KEY WORDS : Infiltration rate, Hydraulic Conductivity, Moisture retention, LBP area.

The Lower Bhavani Project command area covers 83,805ha cultivable area of Periyar district ofTamil Nadu which comprises of mostly red sandy loam (Alfisol) and black clay loam soils (Vertisol) with less area of Inceptisol and Entisol. The importance of soil texture, organic matter in water retention and behaviour of different soils and extent of available water play a vital role in crop production and soil water management. The present study area was undertaken to investigate the water transmission and retention characteristics of command area soils and to correlate them with other soil parameters.

MATERIALS AND METHODS

The Lower Bhavani Project Command area covering the taluks of Sathy, Gobi, Erode, Bhavani, Perunthurai, Kangayam of Periyar district, Tamil Nadu lies between 77^{0}2' to 77^{0}6' and 11^{0}28' to 12^{0} 00' N. This study area is 171.91m above mean sea level. The slopes ranged from 3 to 8 per cent. The area experiences mean annual precipitation of about 685.81mm, 50 per cent of which is received during September, October and November while January to April are the driest period. The mean annual winter and summer temperatures are 32.0^{0}, 30.5^{0} and 34.7^{0} respectively. The soil temperature and moisture regimes for the area . are "Iso hyperthermic" and Ustic respectively. The physiography of the study area generally has terraced conditions slopping towards Bhavani river which serves as draining line.

The natural vegetation of the area comprises of Nutgrass (*Cyprus rotundus*) Hariyali grass (*Cynodon dactylon*), *Acacia sp.* and Neem (*Azardirachta indica*). The geological formation of the study area consists rocks of Dharwat age followed by charnokites and peninsular gneiss. Five pedons were studied for the present investigation.

The soils collected horizon wise were analysed for mechanical composition, pH, EC and organic carbon. Infiltration studies were conducted at each location using double ring respectively (Dakshinamurthi and Gupta, 1968). Hydraulic conductivity was determined using the undisturbed core soil samples collected in the gun metal bushels as per the method of Dakshinamurthi and Gupta (1968) and expressed in ms 1. Water retention at different tensions from 0.33 Mpa (field capacity to 15M pa (wilting point) pressure determined using pressure membrane apparatus respectively.

RESULTS AND DISCUSSION

Infiltration rate

The results of infiltration rate (Table 1) shows that the clay tends to reduce the proportion of larger pores in the soil and there by reduce the infiltration rate. The high rate of infiltration (4.6cm h) was recorded in Lithic Haplustalf (red sandy loam) because of relatively coarser in the whole pedon and also due to the presence of large quantities of gravels. High rates of infiltration

Table 1. Infiltration, Hydralic conductivity and moisture retaining power of pedons.

Horizon	Depth (cm)	Moisture content at different tenion M Pa						Available water content (per cent)	Available water holding power of soil (cm)		Hydraulic conductivity	Infiltration rate
		0.33	1	4	8	12	15		for each layer	in whole profile	ms	cm,h
Pedon I. Upperterrace, excessivelydrained, heavyerosion, weatheredgneiss, 3-8% slope												
Lithic Haplustalf												
Ap	0 - 9	11.5	9.0	8.9	8.1	7.9	6.2	5.3	0.69		3.6	
Bt	9 - 13	17.1	13.3	9.5	8.8	8.2	7.2	9.9	2.26	4.5	1.6	4.6
C	23 - 45	10.7	8.6	6.9	6.4	6.1	5.9	4.8	1.57		4.8	
Pedon II. Middleterrace, moderatelydrained, slighterosion, quartzyticgneiss, 3-5% slope												
Typic Ustochrept												
Ap	0 - 16	18.9	14.7	10.3	9.4	8.8	8.6	10.3	2.50		2.8	
BA1	16 - 38	22.2	16.2	13.6	11.6	10.7	9.8	12.4	4.41		3.0	2.2
BA2	38 - 82	23.1	16.8	14.4	12.3	11.4	9.8	13.3	9.29	21.33	2.8	
C	82 - 125	14.6	11.5	8.7	7.9	7.1	6.3	8.3	5.13		3.6	
Pedon III. Alluvialfan, moderatelydrained, slighterosion, mixedweatheredgneiss, 1-3% slope												
Typic Ustifluvent												
Ap	0 - 18	19.6	15.8	12.9	11.2	10.5	9.0	10.6	2.94		4.2	
A	18 - 52	23.8	18.4	15.6	14.9	14.2	12.5	11.3	6.42		2.1	
C1	52 - 78	17.8	13.2	10.1	9.7	9.4	9.1	8.7	3.53	24.98	3.6	1.9
C2	78 - 148	23.2	16.3	14.6	13.9	13.0	12.9	10.3	12.09		1.8	
Pedon IV. Middleterrace, poorlydrained, moderateerosion, weatheredgneiss, 1-3% slope												
Typic Haplustalf												
AP	0 - 21	22.9	17.2	12.9	11.2	10.9	9.3	13.6	4.19		1.4	
Bt1	21 - 46	26.5	20.8	16.3	15.6	13.8	12.4	14.1	5.71		0.9	0.92
Bt2	46 - 75	28.3	22.8	18.4	16.9	14.2	13.8	14.5	6.90	20.15	0.9	
C	75 - 112	16.5	13.6	11.3	10.9	10.6	10.4	6.1	3.35		1.3	
Pedon V. Plain, imperfactdrainage, moderateerosion, graniticgneiss, 1-3% slope												
Typic Chromustert												
AP	0 - 18	26.1	20.6	14.8	13.4	12.5	11.9	14.2	3.43		2.2	
A12	18 - 46	32.9	24.7	18.9	16.3	14.9	13.2	19.7	8.05		0.8	
A13	46 - 90	34.7	25.1	19.7	17.3	15.6	14.2	20.5	13.77	54.36	0.8	0.86
A14	90 - 145	36.2	27.9	19.3	17.2	15.0	14.8	21.4	18.18		1.0	
CCa	145 - 190	22.2	16.7	11.5	10.8	9.5	8.9	13.3	10.93		2.8	

observed in the present study have been reported in red loam soils of Kerala by Ushakumari *et al.* (1987). Due to rapid infiltration, acidity may develop as time progress as a result of leaching soluble salts from soil. Continuous irrigation will lead to the development of salinity in low lying areas because of leaching of salts from upper physiographic position and accumulation of them in the lower levels. The very slow infiltration rate in Typic Haplustalf and Typic Chromustert is due to its fine textured nature in subsoil horizon. Because of low infiltration, the drainage would be less and retention of nutrients and water would be high. It appears that when water moving downward came across a sub soil layer of low hydraulic conductivity, the infiltration rate was reduced abruptly.

Hydraulic conductivity

The saturated hydraulic conductivity (Table 1) was the highest (4.8 m s) in Lithic Haplustalf indicating highly porous nature while the lowest was recorded in Typic Chromustert (0.8 m s). Its rate generally decreases with depth in pedons having an opposite pattern to that of clay distribution. The irregular pattern in Typic

Ustifluvent might probably due to alternate coarse and finer textured sub-surface horizons. The distinct decrease with depth in Lithic Haplustalf is due to the clogging of most of the macropores thus causing compaction in the sub-surface argillic horizon. The next least closely followed by Typic Chromustert should lead to higher water and nutrient retentivity than others which have more drainability. The moderate hydraulic conductivity in Typic Ustochrept and Typic Ustifluvent would indicate moderage leaching and drainage leading to no salinity and alkalinity problems But in Typic Haplustalf and Typic Chromustert, there is a possibility of developing salinity hazard as time advances. Hydraulic conductivity maintained a highly significant correlation with coarse sand (0.643), clay (-0.562) and moisture retention (0.764 at 0.33 and 0.842 at 4 Mpa).

Moisture retention at various tentions

The moisture retained (Table 1) ranges from 10.7-17.1, 14.6-23.1, 17.8-23.8, 16.5-28.3 and 22.2-36.32 per cent at wilting point (15 Mpa) and 5.3-9.9,8.3-13.3,8.7-11.4,6.1-14.5 and 13.3-21.4 per cent at available water holding capacity in Lithic Haplustalf, Typic Ustochrept, Typic Ustifluvent, Typic Haplustalf and Typic Chromustert respectively. In general, upper terrace to middle terrace soil contained lower percentage of available water compared to those soils at lower physiography (Typic Chromustert). Das *et al.* (1989) also reported similar results in the soils of Kangsabati command area, Bankura, West Bengal.

In al the pedons, moisture retentivity at 0.33 and 15 M pa and the maximum available water holding capacity increased with depth. The higher content of moisture at 0.33 and 15 M pa in sub soil horizon may be attributed to the higher content of clay. The more moisture retention in Typic Chromustert was probably due to the montmorillonite type of clay mineralogy. The quantum of available water content in Typic Chromustert was higher and uniformly distributed than others due to high clay coupled with higher exchangeble sodium and uniform distribution in the profiles. The available water content in Lithic Haplustalf (red sandyloam) was the least at all tensions among the pedons. Similar views were also reported in red loam soils of Kerala. This type of coarse texture is demanding improvement by addition of suitable organic residues, compost etc, thereby reducing the frequency of irrigation. Soil breeding methods by way of incorporation of black soil or tank silt to coarse textured soils would permanantely enhance the moisture retentivity.

In all the pedons, the variation was restricted to low tension (1.33 and 4.OMpa) as the structure and pore geometry of the soils play an important role in retention, where as at high tention (8.12.15 MPa), there was a little variation possibly due to moisture retention on surfaces of the clays. Higher field capacity values associated with clay showed a corresponding increase in water retention a 15 M Pa.

The highest moisture storing capacity in Typic Chromustert closely followed by Typic Haplustalf, Typic Ustifluvent pedons may be due to the result of higher clay and silt content, available moisture at individual layer desireable solum depth etc. In the case of Typic Chromustert pedon, even with almost equal amount of clay like Typic Haplustalf, it has more moisture retentivity, indicating the possibility of some dominance of montmorillonite type of clay minerals in it. The relatively least moisture retention in Lithic Haplustalf pedon is due to the shallow depth coupled with coarse texture with kaolinitic type of clay mineral. The correlation studies indicated that soil water content at 0.33 and 15 M Pa were negatively correlated with clay and organic carbon content. Moisture held at 0.33 and 1 MPa is positively correlated indicating influence of organic carbon at low tensions. Similar result was also reported by Bharambe *et al.* (1990) in Jayakawadi command area of Maharashtra.

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