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THE MOISTURE RETENTION CHARACTERISTICS AND HYDRAULIC CONDUCTIVITY OF THE FOREST LOAM (MOLLISOL AND ALFISOL) SOILS OF KERALA

The forest loams are the products of weathering of crystalline rocks under forest cover. At present, virtually no information is available with regard to the water transmission properties or behaviour of the forest loams which are essential in developing suitable management practices either for forestry or for agricultural purposes. Keeping this objective in view an attempt has been made in this paper to study the water retention, hydraulic conductivity and infiltration rates of these different soil profiles of the forest loam.

Locations were selected at Aryankavu, Thiruvampady and Mankulam to collect the profile samples (Table 1). Undisturbed samples representing the different horizons in each profile were collected with the help of core samplers (16 gauge MS pipe of diameter 5.2 cm cut to a length of 5 cm; one end sharpened to facilitate easy penetration into the soil) for the bulk density measurements (Dakshinamurti and Gupta, 1968). Particle density was determined using psychnometer method (Black, 1965) and mechanical composition of the soils from each horizon of the various profiles was determined by International Pipette Method as outlined by Piper (1942). Water holding capacity was estimated using a Keen–Raczkowski cups by the method described by Wright (1934). The moisture retention characteristics of the soil samples were estimated by the pressure plate (1/3 bar) and pressure membrane (1, 5, 10 and 15 bar) apparatus by adopting the method described by Richard (1954). Available moisture was calculated as the difference between the percentages of moisture retained at 1/3 and 15 bar (Dastane, 1972),

The saturated hydraulic conductivity was measured by adopting the procedure of Dakshinamurti and Gupta (1968) in both distributed as well as undistributed (core) samples. The infiltration rates were determined under field conditions, following the double ring infiltrometer method (Dakshinamurti and Gupta, 1968). General physical properties of the soils were studied (Table 2). Relatively higher amounts of water were held at zero water potential and moisture retention at 1/3,1, 5, 10 and 15 bar (Table 3). Available water, calculated as the difference between the amounts of water held at 1/3 and 15 bar suctions varied widely from soil to soil. It varied from 5.6 to 21.42 per cent. The data indicate a satisfactory status of available water in the surface layers of forest loam soils.

This type of soil yielded very high values of saturated hydraulic conductivity especially in their surface horizons, (Table 3). In this case the saturated hydraulic conductivity decreased with soil depth. Another conspicuous feature of the soils is that the bulk density increased with depth indicating thereby a direct relationship between this parameter and saturated hydraulic conductivity in the individual soil profiles.

Table 1

Morphology of selected horizons of the forest loam soils of Kerala

Soil group, location and depth (cm)	Layer horizon	Colour description & Munsell notation	Texture	Structure	Consistency, moist & wet
Forest loam					
Aryankavu					
0—18	A_1	Very dark grey (5 YR 3/1)	Clay loam	Crumb	Friable slightly, sticky
18-38	A_3	Dark reddish brown (5 YR 3/2)	Clay loam	-do-	-do-
38-70	B_{21}	Yellowish red (5 YR 4/6)	Clay loam	Medium, weak subangular blocky	Hard, sticky & plastic
70-125	B_{22}	Reddish yellow (7.5 YR 6/6)	Clay loam	-do-	-do-
Thiruvampady					
0-6	A_1	Very dark brown (10 YR 2/2)	Sandy clay loam	Moderate, medium crumb	Friable, slightly sticky
6- 18	B_1	Dark, reddish brown (5 YR 3/2)	Clay	-do-	-do-
18—37	B_{22}	Dark, reddish brown (5 YR 3/3)	Clay	Moderate, coarse subangular blocky	Friable & sticky
37-59	B_{23}	Yellowish red (5 YR 4/6)	Clay	-do-	-do-
59-100 +	B_3	Yellowish red (5 YR 5/6)	Clay loam	-do-	Friable, slightly sticky
Mankulam					
0—5	A_1	Dark reddish brown (5 YR 3/2)	Silt loam	Medium moderate crumb	Friable & slightly sticky
5-12	A_3	Brown (7.5 YR 5/2)	Silt loam	Medium moderate subangular blocky	Friable, slightly sticky
12—49	B_{21}	Strong brown (7.5 YR 5/8}	Silty ciay loam	Moderate coarse subangular blocky	Firm, sticky and slightly plastic
49—100 +	B_{22}	Red (2.5 YR 4/6)	Clay	Moderate coarse subangular blocky	Firm, sticky & plastic

Table 2

General physical properties of forest profile samples

Soil group and location	Pro-file No	Sample No	Depth (cm)	Mechanical composition (per cent)					Volume/mass relationship		
				Coarse sand	Fine sand	Silt	Clay	Textural class	Particle density (g/cm³)	Bulk density (g/cm³)	Total porosity (%)
Forest loam											
Aryankavu	1	1	0–18	36,3	10.9	22.6	30.2	Clay loam	2.50	1.01	59.60
		2	18-38	32,0	10.2	22.5	35.3	-do-	2.51	1.05	58.17
		3	38-70	31.4	11.2	23.4	34.0	-do-	2,58	1.32	48.17
		4	70–125	34.1	11.8	21.2	32.9	- do-	2.55	1.35	47.06
Thiruvampady	II	5	0-6	37.3	27.6	4.8	30.3	Sandy clay	2.45	1.02	58.37
		6	6-18	40.8	14.0	9 2	36.0	Clay	2.61	1.05	59.77
		7	18–37	22.4	13.1	18.7	45,8	Clay	2,65	1.34	49.43
		8	37–59	33.0	16.0	12,7	38.3	Clay	2.53	1.36	46.25
		9	59–100 +	43.4	7.2	16.9	32 5	Clay loam	2.57	1.39	45.91
Mankulam	III	10	0-5	31.6	10.3	35.9	22.2	Silt loam	2.34	1.12	52.14
		11	5–12	35.8	8.2	32.1	23.9	Silt loam	2.34	1.16	50.43
		12	12–49	28.5	10.9	28.7	31.9	Silt clay loam	2.48	1.36	45.16
		13	49-100 +	36.5	10.8	15.8	36.9	Clay	2.54	1.38	45.67

Table 3

Moisture retention, saturated hydraulic conductivity and infiltration rate of forest loam soils

Soil location	Profile No.	Sample No.	Depth (cm)	Moisture retention at different lentions, bar						Available water	Saturated hydraulic conductivity (cm h)		Infiltration rate (cm/h)
				0	1/3	1	5	10	15		Undisturbed samples	Disturbed samples	
Aryankavu	I	1	0–18	61,41	37.70	32.63	26,43	19,91	16.28	21.42	48.69	45 68	17.0
		2	18-38	59.10	35.64	30.10	24,76	19.72	16,15	19.49	39,33	37.11	
		3	38-70	39.36	21.16	18.89	16.39	13.04	12.51	8.65	24.19	2223	
		4	70–125	37,78	20.73	18.71	16.61	13.21	12.64	8.09	21.01	20.17	
Thiruvam-pady	II	5	0-6	59.33	36.61	30.53	24.98	18.87	16.13	20,48	50.81	48.79	16.80
		6	6-18	60.24	36.14	29.91	23.92	18.24	16.71	19.93	45.77	42.72	
		7	18-37	39.88	22.04	19.73	16.36	14.79	13.94	8.10	20.18	19.10	
		8	37 59	36.94	20.26	13.81	16.47	15.06	13.50	6.76	21.45	20.72	
		9	52-100+	36.02	19.91	17.07	15.28	1484	1431	5.60	26.27	22,36	
Mankulam	III	10	0-5	49.55	34.35	28.39	22.75	17.01	14.32	20.03	45.08	47.64	17.50
		11	5-12	46.57	33.82	27.74	21.36	16.34	14.94	18.88	42.21	40.17	
		12	12-49	36.19	21.51	17.27	15.01	13.28	14.13	7.38	19.01	18.22	
		13	49-100+	36,04	23.62	20,31	17.70	15.85	13.49	10.13	22,36	21.14	

These soils exhibited higher infiltration rates varied from 16.8 to 17.5 cm, h. Generally high saturated hydraulic conductivity observed for the Kerala soils is in conformity with the findings of Wilkinson (1975), Lal (1 976), Wilkinson and Aina (1976), Haridasan (1978), Lal and Cummings (1979) and Vamadevan (1980) all of whom have reported similar results for the soils developed under humid tropical conditions.

The forest soils showed higher ranges of moisture retention at 0, 1.3, 1, 5, 10 and 15 bar tensions. Similarly, higher content of available water was observed. The saturated hydraulic conductivities were relatively very high. The hydraulic conductivities of the undisturbed soils were found to be more than that of the disturbed samples even for the same bulk densities. The infiltration rates of the soils were relatively high.

സംഗ്രഹം

വനമണ്ണ് 0, 1/3, 1, 5, 10, 15 എന്നി ബാർ ശക്തികളിൽ ജലം മണ്ണിൽ പിടിച്ചു നില്ക്കുന്നതിൽ ഉയർന്ന നിലവാരം പുലർത്തി. അപ്രകാരം തന്നെ പെടികാംക്ഷ് ലഭ്യമാകുന്ന ജലത്തിന്റെ അളവും പൂരിത ഹൈഡ്രോളിക് കണ്ടക്റ്റിവിറ്റിയും, ഇൻഫിൽറ്റ്രേഷൻ നിരക്ക് എന്നിവയും സാധാരണ മണ്ണിനെക്കാൾ കൂടുതലായി കണ്ടു.

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