

Water retention characteristics of soils of Mohol Agricultural Research Station, Solapur, Maharashtra

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Abstract: The water retention characteristics of six soil series of Mohol Agricultural Research Station, Solapur district, Maharashtra revealed that the water retention decreased with increasing soil water suction. The water retentivity at 33 and 1500 kPa tensions was significantly and positively correlated with clay, silt +clay, CEC and exchangeable Ca+Mg but negatively with sand content. The effect of organic carbon on water retentivity, both at 33 and 1500 kPa tensions, was non-significant. The soil series with high clay content had more water storage capacity suggest their suitability for growing two crops in a year whereas the shallow rooted crops of short duration can only be grown on the soil series with low clay, shallow depth and lower water retention capacity.

Additional Keywords : Soil characteristics, water storage capacity, soil depth, crop planning

Introduction

Water retention characteristics of soil provides information on the ability of soil to store water and availability of the stored water for the crop. The retention and release of soil moisture is influenced by a number of physical and chemical characteristics of the soils. The rate of release of moisture and retention in relatively fine textured soils is more gradual and higher

than the relatively coarse textured soils (Chinchmalatpure *et al.* 2001). In a microwatershed, the AWC based crop planning of soil series is important for scientific crop planning (Challa 1995) and suitable soil and water conservation measures particularly in the dryland region. Keeping this in view, the present study was undertaken to investigate the water retention characteristics of identified soil series

of Mohol Agricultural Research Station for rational crop planning.

Materials and methods

The study area is a research farm of Mohol Agricultural Research Station, situated between 17° 75' N latitude and 75° 50' E longitude at an elevation of about 457 m above msl in Solapur district of Maharashtra. The geology of the area is deccan basalt. The climate is characterized by hot semiarid with mean annual rainfall of 641 mm. The soil moisture regime is *ustic* and the temperature regime is *isohyperthermic*. Horizon-wise soil samples were collected from representative pedons of soil series (Mohol 1 to 6) and analysed following standard procedures. Water retentions at various tension *e.g.* 33, 100, 500, 1000 and 1500 kPa were determined by using Pressure Plate Apparatus (Richard 1948). Available soil water content is expressed as a difference in volume of water retained at 33 and 1500 kPa. Available soil water storage capacity was determined for the actual depth specified for a given soil pedon.

Results and discussion

The soils belonging to Inceptisol and Vertisol had clay content ranging from 38.8 to 72.4 (Table 1) through depth. The surface horizons of Mohol-4 and Mohol-1 had clay loam texture. These soils possessed smectitic mineralogy. In general, the water retention decreased with increasing soil water suction (Table 2). The soils of Mohol-1 series exhibited lowest water

retention of 0.27 and 0.17 cm³ cm⁻³ at 33 and 1500 kPa respectively which is attributed to relatively low clay and organic carbon content. The highest moisture release and moisture content were recorded in the soils of Mohol-5 series followed by soils of Mohol-2,3 and 6 series due to the higher clay content (Kale *et al.* 1987).

The correlation study (Table 3) indicates that water retentions at 33 kPa and 1500 kPa tension were significantly and positively correlated with clay, silt+clay, CEC and exchangeable Ca+Mg but negatively with sand. It suggests that amount and nature of clay have a dominant role in water retention of the soils. Similar results were also reported by Mungare *et al* (1982) and Srivastava *et al* (1998). The positive effect of organic carbon on water retentivity of soil was, however, non-significant due to low and similar quantities of organic carbon in these soils.

The available water content in soils was found to be dependent on distribution of clay (Gajbhiye 1990). The available soil water storage capacity was lower in Mohol-1 series because of shallow depth and low clay content as against higher water storage capacity in Mohol-2, 5 and 6 series having higher clay content and deeper solum.

The soils of Mohol-1, 3 and 4 having lower water retention and available water storage capacity need to be put under shallow rooted crops of short duration and drought resistant crops *viz.* green gram, black gram, pearl millet, groundnut,

Table 1. Physical and chemical properties of soils

Horizon	Depth (cm)	Particle-size distribution (%)			pH	Exchangeable		CEC	Org. carbon	CaCO ₃ carbon
		Sand	Silt	Clay		Ca ⁺⁺	Mg ⁺⁺			
						—cmol (+) kg ⁻¹ —				
Mohol-1: Loamy Typic Ustorthent (1-3% slope)										
Ap	0-20	44.5	24.9	30.5	7.8	20	14	40	2.4	31.9
Mohol-2 : Very-fine Vertic Haplustepts (0-1% slope)										
Ap	0-16	15.8	24.3	59.9	8.5	37	19	60	4.5	102.3
Bw ₁	16-35	11.8	27.0	61.2	8.7	38	25	66	3.8	103.4
Bw ₂	35-65	5.8	22.1	72.1	8.7	39	28	69	3.3	112.2
Bw ₃	65-80	6.2	21.4	72.4	8.8	37	26	68	3.0	118.5
Mohol-3: Clayey Typic Haplustepts (0-1% slope)										
Ap	0-15	21.2	29.0	49.8	7.7	29	16	51	2.9	47.4
Bw	15-38	14.1	27.4	58.5	7.8	34	14	54	3.3	47.4
Mohol-4: Clayey Typic Haplustepts (0-1% slope)										
Ap	0-12	39.6	21.6	38.8	8.3	22	16	42	3.5	86.9
Bw ₁	12-28	31.5	26.5	42.0	8.3	31	12	46	2.6	86.9
Bw ₂	28-42	44.0	20.5	35.5	8.2	19	15	40	2.4	94.6
Mohol-5: Very-fine Typic Haplustepts (1-3% slope)										
Ap	0-15	6.6	26.2	67.2	7.5	36	24	60	3.5	31.8
Bw ₁	15-30	5.3	23.4	71.3	7.6	38	28	69	3.3	31.8
Bw ₂	30-50	5.0	23.5	71.5	7.8	37	25	66	3.0	32.6
Mohol-6: Very-fine Typic Haplusterts (0-1 % slope)										
Ap	0-18	10.7	23.5	65.8	8.0	28	17	59	5.1	59.4
Bw ₁	18-45	8.1	25.3	66.6	8.2	34	25	62	4.7	63.8
Bw ₂	45-75	8.8	23.3	67.9	8.3	35	25	62	4.2	61.6
Bss ₁	75-100	9.6	23.0	67.4	8.4	38	22	64	4.0	80.3
Bss ₂	100-145	10.3	25.0	64.7	8.4	26	18	60	2.6	126.4

Table 3. Correlation coefficients (r) between soil properties and water retention at different tensions.

Soil properties	33 kPa	1500 kPa
Clay	0.841**	0.791**
Silt	0.194	0.140
Sand	-0.872**	-0.811**
Silt+clay	0.871**	0.811**
Clay +org. carbon	0.850**	0.791**
Silt+ org. carbon	0.210	0.150
CEC	0.759**	0.714**
Org.carbon	0.308	0.279
Exch. Ca	0.651**	0.573*
Exhc. Mg	0.618**	0.627**
Exch. Ca+Mg	0.681**	0.639**

** Significant at 1 per cent level * significant at 5 per cent level

Table 2. Water retention characteristics of soils

Horizon	Depth (cm)	Water retention at different kPa (cm cm ⁻³)					Available soil water (cm cm ⁻³)	Available soil water storage capacity (mm)
		33	100	500	1000	1500		
Mohol-1: Loamy Typic Ustorthent (1-3% slope)								
Ap	0-20	0.27	0.25	0.20	0.18	0.17	0.10	26.80
Mohol-2: Very-fine Vertic Haplustepts (0-1% slope)								
Ap	0-16	0.35	0.33	0.30	0.25	0.20	0.15	
Bw ₁	16-35	0.34	0.32	0.32	0.26	0.21	0.13	
Bw ₂	35-65	0.36	0.34	0.33	0.27	0.22	0.14	
Bw ₃	65-80	0.39	0.37	0.33	0.30	0.23	0.16	138.57
Mohol-3: Clayey Typic Haplustepts (0-1% slope)								
Ap	0-15	0.38	0.37	0.33	0.27	0.23	0.15	
Bw	15-38	0.39	0.35	0.33	0.26	0.22	0.17	68.62
Mohol-4: Clayey Typic Haplustepts (0-1% slope)								
Ap	0-12	0.29	0.28	0.25	0.23	0.18	0.11	
Bw ₁	12-28	0.31	0.30	0.25	0.22	0.19	0.12	
Bw ₂	28-42	0.23	0.23	0.21	0.19	0.14	0.09	52.85
Mohol-5: Very-fine Typic Haplustepts (1-3% slope)								
Ap	0-15	0.45	0.43	0.40	0.37	0.30	0.15	
Bw ₁	15-30	0.46	0.44	0.40	0.35	0.31	0.15	
Bw ₂	30-50	0.48	0.44	0.39	0.37	0.32	0.16	97.55
Mohol-6: Very-fine Typic Haplusterts (0-1% slope)								
Ap	0-18	0.37	0.36	0.33	0.31	0.24	0.13	
Bw ₁	18-45	0.45	0.37	0.35	0.32	0.29	0.15	
Bw ₂	45-75	0.43	0.42	0.36	0.34	0.27	0.16	
Bss ₁	75-100	0.42	0.41	0.36	0.34	0.27	0.15	
Bss ₂	100-145	0.45	0.44	0.37	0.36	0.29	0.16	267.46

mothbean or dryland horticultural trees like ber, wood apple, tamarind under proper soil and water conservation measures (Umrani *et al* 1987; Jagdish Prasad 1993). The soils of Mohol-2, 5 and 6 having higher water storage capacity (97 to 267 mm) are suitable for growing two crops in a year *viz.* *kharif* short duration legume crops followed by *rabi* sorghum or safflower.

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