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Water Retention Characteristics of Associated Red and Black Soils of North Karnataka

Crop growth and yield depend on available water which in turn depends on stored water and soil properties influencing its retention and release. The information on water retention characteristics of associated red and black soils is meagre. Thus present study was taken up to understand water retention characteristics of four pairs of closely associated red and black soils of north Karnataka. An attempt has also been made to study the retentionship of water retention with some properties of soil.

Horizonwise soil samples were collected from four pairs of closely associated red (Inceptisols / Alfisols) and black (vertisol) soil profiles distributed in the northern districts of Karnataka (Table 1) to study the water retention characteristics of these soils. Water retention at 33 and 1500 kPa was determined using pressure plate membrane apparatus and difference between these two is taken as available water (Richards; 1965). Other physico-chemical properties related to moisture retention viz., particle size class, organic carbon, specific surface area (SSA) and cation exchange capacity (CEC) were determined following the standard procedures.

Dominant textural class was clay in both red and black soils except in P_3 where it was sandy clay loam. Irrespective of red and black soils organic carbon content was more in Bidar and less in Gulbarga soils. Whereas SSA and CEC were more in black soils and less in red soils (Table 1), which indicated that the dominant clay minerals may be smectite in black soils and illite in red soils. Similar observations were made by Satyanarayana and Biswas (1970). Among the red soils SSA was more in P_1 as it is derived from the easily weatherable and clay forming Deccan trap, whereas CEC was more in P_7 may be due to the presence of expanding type of clay in appreciable amount which is indicated by the surface cracks.

Water retained both at 33 and 1500 kPa and available water content were more in black soils than in red soils. Available water is ranged from 3.7 to 11.5 per cent in red soils and from 11.4 to 20.0 per cent in black soils (Table 1). The relationship between water retention and physico-chemical properties of soils has been reported by many workers (Ravendarsigh and Nayak (1999), Yadav and Vyasa (1998), Ramakrishnaprasad *et al.* (1998) and Kaushal *et al.* (1996). In both red and black soils clay, SSA and CEC had significant positive correlation and sand and significant negative correlation with field capacity (33 kPa) and permanent wilting point (1500 kPa). Available water was positively and significantly influenced by clay SSA and CEC in black soils where as in red soils only CEC had positive and significant influence on available water (Table 2). Water at 1500 kPa was closely related with clay and SSA (r=0.894** and 0.909**) than at 33 kPa (r=0.834** and 0.854**) in red soils. On the contrary water at 33 kPa was strongly correlated with clay and SSA (r=0.892** and 0.910**) than at 1500 kPa (r=0.672** and 0.630**) in black soils. Challa and Gaikwad (1987) also observed the similar relationship between water retention and clay in red and black soils. Water at 33 kPa was closely correlated with CEC in red soils (r=0.641**) than in black soils (r=0.622**). On the contrary water at 1500 kPa was closely correlated with CEC in black soils (r=0.571**) than in red soils (r=0.530**). Available water was positively and significantly correlated with clay, SSA and CEC (r=0.65**, 0.717** and 0.350**) in black soil whereas in red soils only CEC had positive and significant influence (r=0.520**) on available water. Organic carbon had positive and non-significant influence on 33 and 1500 kPa and available water in both red and black soils however relationship was comparatively more close in red soils. Multiple regression equations (Table 2) indicated that the physico-chemical properties studied have contributed to

Table 1. Range values of water retention and other properties of soils

Pedons	n	Sand	Silt	Clay	OC[a]	SSA[b] ($m^2 g^{-1}$)	CEC[c] (C. mol P^+kg^{-1})	Water retention (kPa) 33	1500	Aw[d]
Neelamhalli (Bidar)										
Inceptiosol (P_1)	4	6.8 to 18.2	15.9 to 29.7	61.3 to 77.1	0.42 to 0.87	110 to 173	23.2 to 29.4	21.2 to 26.8	11.4 to 19.0	7.8 to 9.9
Vertisol (P_2)	10	1.9 to 7.4	19.0 to 32.1	64.5 to 76.7	0.10 to 0.60	401 to 607	52.6 to 67.4	35.2 to 41.2	18.2 to 22.7	17.0 to 20.0
ARS Farm, B. Gudi (Gulbarga)										
Alfisol (P_3)	5	50.3 to 77.1	9.6 to 23.1	13.3 to 32.6	0.18 to 0.44	44 to 113	10.3 to 18.4	14.8 to 22.0	7.4 to 10.6	9.1 to 11.4
Vertisol (P_4)	7	25.8 to 49.8	12.1 to 22.1	38.1 to 58.2	0.30 to 0.60	296 to 443	41.5 to 66.7	29.4 to 39.3	14.0 to 20.6	11.4 to 19.1
Agril. College Farm, Dharwad										
Alfisol (P_5)	5	42.5 to 57.2	9.6 to 29.2	28.3 to 46.0	0.14 to 0.83	88 to 123	9.6 to 21.2	17.3 to 23.7	8.8 to 13.3	7.3 to 10.4
Vertisol (P_6)	7	9.4 to 13.7	24.7 to 27.6	57.5 to 64.0	0.21 to 0.68	382 to 467	61.5 to 69.0	34.2 to 37.2	19.1 to 22.0	15.1 to 16.1
Mantagani (Dharwad)										
Inceptisol (P_7)	5	30.2 to 62.1	17.6 to 24.1	17.0 to 51.4	0.11 to 0.52	57 to 136	18.4 to 37.9	11.0 to 26.2	7.3 to 14.7	3.7 to 11.5
Vertisol (P_8)	10	10.5 to 39.1	18.5 to 30.0	41.1 to 66.7	0.11 to 0.60	325 to 579	42.5 to 68.7	31.2 to 69.5	16.8 to 20.6	14.4 to 18.9

Note : n = no. of horizons, a = Organic carbon, b = Specific surface area c = Cation exchange capacity d = Available water

Table 2. Correlation co-efficients and multiple regression equations

Water parameters	Sand	Silt	Clay	OC	SSA	CEC	Multiple regression equations
			Soil properties				
Red soils (Inceptisols and Alfisols)							
33 kPa	-0.728**	-0.127	+0.834**	+0.839	+0.854**	+0.641**	Y = -285.0414+2.990 (X1)+2.816 (X2)+3.072 (X2) +4.389 (X4)+ 6.393 (X5) + 7.714 (X6) R^2=0.842
1500 kPa	-0.798**	-0.079	+0.894**	+0.347	+0.909**	+0.530*	Y = -328.904+3.357 (X1) +3.236 (X2) + 3.468 (X3) -5.516 (X4)+5.165 (X5) -3.336 (X6) R^2=0.970
Available water	-0.287	-0.149	+0.361	+0.291	+0.378	+0.520*	Y = -35.539-2.842 (X1) -3.383 (X2) - 3.100 (X3)+1.166 (X4) +1.270 (X5) +1.1068 (X6) R^2 = 0.334
Black soils (Vertisols)							
33 kPa	-0.723**	+0.183	+0.892**	+0.204	+0.910**	+0.622**	Y = 4.767+1.400 (X1)+5.714 (X2) + 2.975 (X3) -1.286 (X4) +1.409 (X5) + 7.058 (X6). R^2=0.896
1500 kPa	-0.551**	+0.131	+0.672**	+0.132	+0.630**	+0.571**	Y = 6.684+2.653 (X1) -6.653 (X2) + 1.580(X3)-1.489 (X4) -4.376 (X5) +8.324 (X6). -R2 = 0.540
Available water	-0.519**	+0.139	+0.650**	+0.170	+0.717**	+0.350*	Y = -1.917+1.135 (X1) + 1.124 (X2)+ 1.395 (X3)+2.026 (X4)+1.453 (X5)+1.266 (X6). R^2=0.525

Note : X1 - Sand, X2 - Silt, X3 - Clay X4 - Organic carbon, X5 - Specific surface area X6 - Cation exchange capacity Y - Water parameter

33 and 1500 kPa, and available waters to the tune of 84.2%, 97.0% and 33.4%, respectively in red soils and to the tune of 89.6%, 54% and 52.5%, respectively in black soils.

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