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MOISTURE RETENTION CHARACTERISTICS OF ALLUVIAL SOILS OF KERALA *

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Scheduling irrigation based on the percentage depletion of available water is currently being followed for upland crops, the soil water being replenished to field capacity when all the readily available water is just exhausted. A pre-requisite for arriving at the readily available water content is an estimate of the field capacity and wilting coefficient values. However, estimation of these values using laboratory methods is not often handy. An attempt was made to work out the above constants of the alluvial soils of Kerala, from some important soil properties like texture and organic carbon content. Similar works on these lines have been reported earlier by Haridasan (1978) and Thulasidharan (1983) on laterite soils of Kerala.

Materials and Methods

The investigation was conducted in the College of Horticulture, Vellanikkara during 1982-'83, with soil samples collected from different districts of Kerala viz., Trivandrum, Quilon, Ernakulam, Trichur and Calicut. Three profiles each from one established series of each district was included in the study and soil samples were taken from five depths (0-30 cm, 30-60 cm, 60-90 cm, 90-120 cm and 120-150cm) in each profile.

The moisture retaining capacity of the soil was measured at six tensions viz., 0.3, 1, 3, 5, 10 and 15 bar using pressure plate apparatus (Richards, 1947), after air-drying and sieving of the soil. Each sample was run thrice for moisture retention determination and the mean values were worked out. The particle size distribution of the soil was determined by international pipette method using sodium hydroxide as the dispersing agent (Piper, 1966). Waikley and Black rapid titration method as proposed by Jackson (1958) was made use of in the estimation of organic carbon. Bulk density of each sample was found out using core samplers of length 10 cm and diameter 4.4 cm. The moisture retaining capacity of the soil was related to the textural components and organic carbon content by simple and multiple regression analysis (Snedecor and Cochran, 1967).

Results and Discussion

Data on the mean moisture retaining capacity of the soil at different tensions are presented in Table 1. A trend of decreasing moisture content with increasing

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suction was apparent and 50 per cent of the available was removed at a tension slightly above 1 bar. More than 70 percent of it was depleted at 3 bar suction. At 0.3 bar suction, the soil had a mean moisture retention capacity of 25.8 per cent and at 15 bar 13.9 per cent. The mean content of available water was 11,9 per cent. A prediction model was developed for moisture characterisation and the best fit obtained was Cobb–Douglas function. The graphical presentation along with the equation is given in Fig. 1.

Table 1
Overall mean moisture retention at different tensions
(percentage by weight)

Depth cm	Soil moisture tension (bar)						Available water
	0.3	1.0	3.0	5.0	10.0	15.0	
0–30	21.1	16.0	13.4	12.5	11.1	10.2	10.9
30–60	26.2	20.3	17.5	16.7	15.1	14.1	12.1
60-90	26.4	20.8	18.1	17.4	15.8	14.7	11.7
90–120	26.7	20.8	18.1	17.4	15.9	14.8	11.9
120–150	28.7	22.4	19.6	18.7	17.0	15.9	12.8
Mean	25.8	20.1	17.3	16.5	15.0	13.9	11.9

The fractions greater than 2 mm size being practically nil, moisture retention by that fraction was not attempted separately. Table 2 furnishes data on the mean organic carbon content and textura! composition of the soil. The organic carbon content showed little consistent variation between series. However, with depth, there was a steady decrease in its content, the topmost layer of 0.30 cm giving the highest value in all the series.

The series, however, varied in their textural composition. There was change from layer to layer within some of the series. Almost the same degree of textural variation was noted between profiles of the same series (Data not presented). Such variations were to be normally expected for alluvial soils of recent origin.

The contents of available water and moisture held at 0.3 and 15 bar suctions were correlated to the textural fractions and organic carbon content (Table 3). It was observed that organic carbon had no bearing on moisture holding capacity as indicated by the non-significant correlation coefficients. In Punjab soils where the organic matter content ranged berween 0.1 and 0.4 per cent, Sekhon and Arora (1967) obtained similar results. Observations of Rajagopal (1967) and Rid (1968) also tally with the above findings. Since colloidal fraction is the main determining factor of moisture retention, a significant correlation was expected with content of organic carbon. The observed non-significance may be due to the dominance of fine textural components and low content of organic matter. This view was supported by Jamison and Kroth (1958), and Thulasidharan (1983) based on studies of laterite soils of Kerala.

Table 2

Correiation coefficients of moisture retention and available water with organic carbon content and textural composition

Moisture retention (bars)	Organic carbon	Clay	Silt	Clay + Sitt	Fine sand	Coarse sand
0.3	0.108	0.680**	0.809**	0.952**	-0.240 *	—0.777**
15.0	0.047	0.720**	0 822**	0.948**	—0.405**	—0.671**
Available water	0.158	0 509**	0.645**	0.713**	—0.005	—0.757**

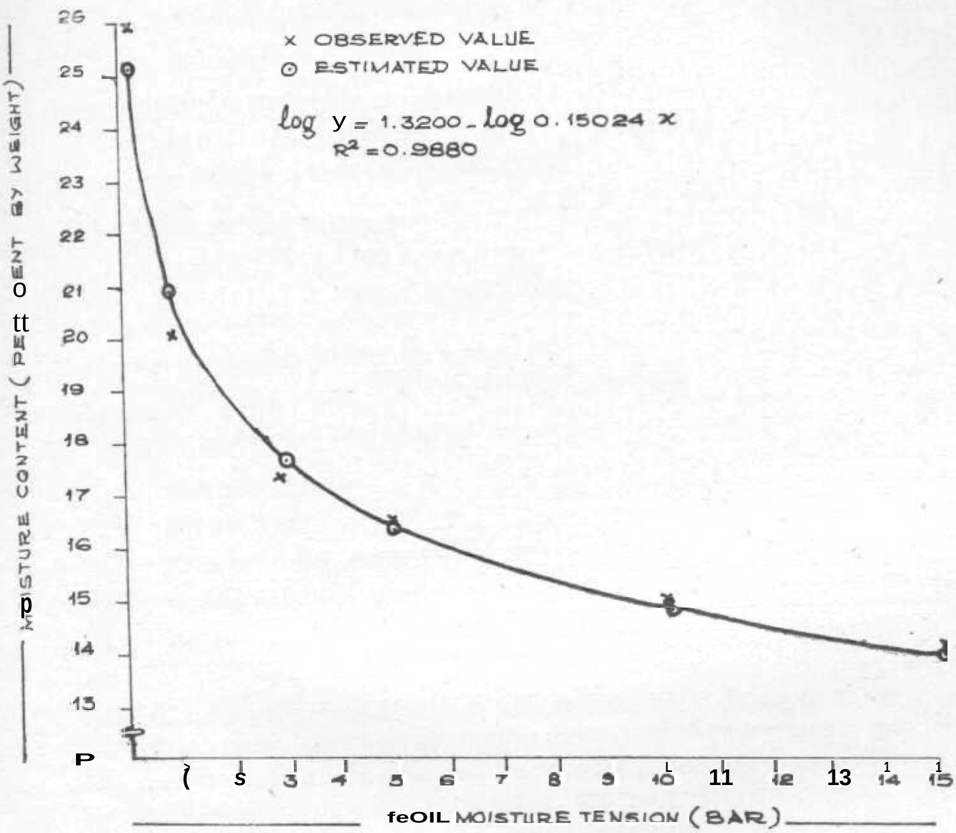
Table 3

Overall mean textural composition and organic carbon content (per cent by weight)

Depth cm	Organic carbon	Clay	Silt	Fine sand	Course sand	Textural class
0-30	0.625	21.4	18.2	34.4	23.5	Sandy clay loam
30-60	0.436	27.0	24.3	31.6	14.4	Sandy clay loam
60-90	0.339	26.7	26.4	31.2	14.0	Sandy clay loam
90-120	0,238	26.9	25.3	28.0	17.8	Sandy ciay loam
120—150	0.253	23,9	28,7	27,0	18.3	Sandy clay loam
Mean	0.378	25.2	24.6	30.4	17.6	Sandy clay loam

The clay and silt fractions independently and together gave significant positive correlation, indicating their prominent role in deciding the retention capacity. The results obtained by Salter and Williams (1965), Soong and Yap (1977), Satyanarayana *et al.* (1977) and Talha *et al.* (1979) are also in agreement with the above results.

Fig.1 MOISTURE CHARACTERISTIC CURVE FOR THE ALLUVIAL SOILS OF KERALA



The coarse fractions (fine sand and coarse sand) gave significant negative correlation with the above soil moisture constants, but for the fine sand with the available water content. Such a negative relationship was already reported by other workers like Modgal (1965), Petersen *et al.* (1968) and Kohad *et at.* (1975).

With the objective of predicting the available water content and the moisture contents at 0.3 and 15 bar suctions from the contents of organic matter and textural composition, multiple regression equations were developed. These are given below.

a) Moisture percentage at 0,3 bar (Y_1)

$$Y_1 = 10.3387 + 0.3405\,x_1 + 0.3610\,x_2 + 0.0030\,x_3 - 0.1170\,x_4 + 0.0176\,x_5 \quad (R^2 = 0.87)$$

b) Moisture percentage at 15 bars (Y_2)

$$Y_2 = -14.11 + 0.4309\,x_1 + 0.4198\,x_2 + 0.1575\,x_3 + 0.1547\,x_4 - 1.6651\,x_5 \quad (R^2 = 0.91)$$

c) Percentage of available water (Y_3)

$$Y_3 = 24.7534 - 0.0936\,x_1 - 0.0618x_2 - 0.1576x_3 - 0.2748x_4 + 1.6790x_5 \quad (R^2 = 0.65)$$

where $X_1 =$ clay per cent
$X_2 =$ silt per cent
$X_3 =$ fine sand per cent
$X_4 =$ coarse sand per cent
$X_5 =$ organic carbon per cent

The relatively high predictability values obtained indicate that these equations can be dependably used for calculating these moisture constants from texture and organic matter content. It is also to be concluded that the variables considered can define moisture retention with reasonable accuracy showing again that the differences in the quality of soil organic matter and fine fractions in the alluvial soils are not substantial.

Summary

An investigation on the moisture retention characteristics of alluvial soils of Kerala was carried out in the College of Horticulture, Vellanikkara, during 1982-'83, using soil samples collected from different parts **of** the state. Moisture retention was measured at six tensions and a prediction model was developed for moisture characterisation. More than 70 per cent of the available water was found

to be removed at a tension of 3 bars. The moisture contents of different tensions were correlated to the contents of organic carbon and textural components. Organic carbon content showed no significant correlation with moisture retention. The textural components were apparently the determining factors for moisture retention as indicated by the significant positive correlation with the fine fractions (clay and silt) and significant negative correlation with the coarse fractions (fine sand and coarse sand). Multiple regression equations were developed to predict the available water content and moisture contents at 0.3 and 15 bar suctions from the contents of organic matter and textural components.

സംഗ്രഹം

എക്കൽ മണ്ണിന്റെ ഈർപ്പം പിടിച്ചു നിർത്താനുള്ള കഴിവിനെക്കുറിച്ച് ഹോർട്ടികൾച്ചർ കോളേജിൽ 1982–83 വർഷത്തിൽ ഒരു പഠനം നടത്തുകയുണ്ടായി. കേരളത്തിന്റെ പല ഭാഗങ്ങളിൽ നിന്നും ശേഖരിച്ച സാമ്പിളുകളാണ് ഇതിന് ഉപയോഗിക്കപ്പെട്ടത്. ആറു വ്യത്യസ്ഥ മർദ്ദങ്ങളിൽ നിലനിർത്തപ്പെടുന്ന ജലാംശത്തിന്റെ അളവ് നിരീക്ഷണ വിധേയമാക്കിയതിൽ നിന്നും ചെടികൾക്ക് വലിച്ചെടുക്കാവുന്ന ഈർപ്പത്തിന്റെ ഏതാണ്ട് 70 ശതമാനത്തോളം 3 ബാർ ffltSgrannTttfi നഷ്ടപ്പെടുന്നതായി കണ്ടു. മണ്ണിന്റെ രചന മണ്ണിൽ ഈർപ്പം പിടിച്ചു നിർത്തുന്നതിൽ നിർണ്ണായകമായ പങ്കു വഹിക്കുന്നുവെന്ന് പരീക്ഷണ ഫലങ്ങൾ തെളിയിച്ചു. എന്നാൽ ജൈവ കാർബണും ജലാംശവുമായി എടുത്തു പറയത്തക്ക ബന്ധം കണ്ടില്ല. 0.3 ബാറിലും 15 ബാറിലും നിലനിർത്തപ്പെടുന്ന ജലാംശം കണ്ടു പിടിക്കുന്നതിന് മണ്ണിന്റെ രചനയിലെ വിവിധ ഘടകങ്ങൾ, ജൈവ കാർബൺ എന്നിവയെ അടിസ്ഥാനമാക്കി സമവാക്യങ്ങൾ രൂപപ്പെടുത്തുകയുണ്ടായി.

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