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HYGROSCOPIC MOISTURE IN HUMID TROPICAL OXISOLS

The moisture adsorbed by the soil particles on its surfaces from the atmosphere is commonly referred as hygroscopic moisture and it is more relevant for humid tropical conditions. Very little information is available on the hygroscopic moisture content of oxisols where high value tree crops are normally grown. The objective of the present work was to determine the hygroscopic moisture of laterite soil as may be obtained under natural conditions and to find out its relationship with soil properties so as to estimate the former by knowing the latter which are commonly analysed.

Twenty eight soil samples from four soil profiles representing Kunnamangalam series of laterite soils were taken up for the study from the Kottamparamba Campus of the Centre for Water Resources Development & Management. The samples were taken at 15 cm intervals upto 105 cm. The basic physico-chemical properties were analysed by standard procedure (Black, 1965). For finding out hygroscopic moisture content (HMC), the soil samples were taken in moisture boxes and after estimating the initial moisture content, they were equilibrated in the laboratory atmosphere by keeping them open for a period of 15 days every time. The air temperature and relative humidity of the laboratory were observed regularly. After the equilibration period the moisture content of a sub-sample were determined and it is considered as HMC. The period of observations were divided into two viz., dry period (December to May) and wet period (June to September). Statistical analysis was done with HMC and related soil properties.

The mean values of the hygroscopic moisture content (HMC) and the related parameters are given in Table 1. The mean HMC varied from 1.07 to 1.67% (oven dry basis) for December to May and from 1.55 to 3.12% for June to September period. The corresponding relative humidity values for the periods range from 78 to 87% and 83 to 98%. The relationship between RH and HMC is shown in Fig. 1 and the correlation is significant (r=0.76). Since HMC is the absorbed water content on the surfaces of the soil particles, the water content in the air (RH) is directly related to HMC. In humid tropical conditions as it is prevailing in Kerala the relative humidity has much significance with regard to HMC. Whether HMC has any buffering effect on the soil moisture conditions during extreme dry periods is not clearly known.

It is well known that the various soil particles like clay, silt, gravel and organic carbon content are related to HMC. However, what seems to be interesting in the present study is the distinct variability in HMC for the dry and wet periods and the relative correlations with the soil parameters. The correlation matrix between HMC at two periods viz., Y0 (December-May) and Y1 (June-September) with the soil parameters are given in the Table 2. Eventhough the 'r' values are small, multiple regression of the parameters with HMC for Y0 and Y1 periods show significant estimating equation. The HMC has negative relationship with gravel content. In highly

Table 1

Hygroscopic moisture contents and related soil properties

Sl. No.	Hygroscopic moisture (%)		Organic carbon (%)	Silt (%)	Clay (%)	Gravel(%) (>2mm)
	Y0	Y1	X1	X2	X3	X4
1	2	3	4	5	6	7
1	1.34	2.24	0.84	20.0	37.0	51.0
2	1.24	2.12	0.84	17.0	35.0	59.6
3	1·32	1.89	0.60	16.0	41.0	66.7
4	1.08	1.81	0.51	20.0	30.0	63.8
5	1.52	2.61	0.51	24.0	39.0	31.2
6	1.44	2.32	0.36	19.0	37.0	46.0
7	1.49	2.17	0.36	16.0	41.0	36.0
8	1.34	2.27	0.90	18.0	40.0	41.3
9	1.39	2.70	0.55	19.0	41,0	41.7
10	1.48	2.07	0.37	18.0	40.0	34.9
11	1.67	2.26	0.72	16.0	45.0	54.4
12	1.42	2.49	0.60	20.0	40.0	64.8
13	1.52	2.86	1.08	20.0	43.0	62.4
14	1.59	2.61	0.42	18.0	39.0	56.8
15	1.07	2.02	1.14	18.0	45.0	56.4
16	1.62	2.32	0.97	20.0	40.0	67.2
17	1.67	2.91	0.72	26.0	41.0	57.1
18	1.49	2.41	0.78	18.0	39.0	58.5
19	1.21	1.81	0.55	22.0	41.0	68.6
20	1.31	2.42	0.13	22.0	42.0	64.2
21	1.66	2.88	0.18	23.0	45.0	65.8
22	1.52	2,56	1.62	18.0	45.0	85.9
23	1.10	1.86	0.51	22.0	41.0	86.4
24	1.40	2.58	0.66	14.0	56.0	56.4
25	1.73	3.12	0.66	20.0	51.0	64.4
26	1.15	1.55	0.54	20.0	47.0	68.0
27	1.29	2.11	0.15	24.0	41.0	74.5
28	1.36	2.42	0.45	18.0	50.0	76.1

weathered soils as laterites presence of gravel in different proportions is a common phenomenon. The negative relationship show that the adsorbing surface on the soil decreases with increasing gravel content and also that gravels which are concretionary in nature may not adsorb atmospheric moisture.

The increasing order of correlations between soil parameters and HMC for Y0 period (December-May) is clay>gravel>organic carbon> silt and for the Y1 period (June-September) it is clay>silt>gravel >organic carbon. In both periods

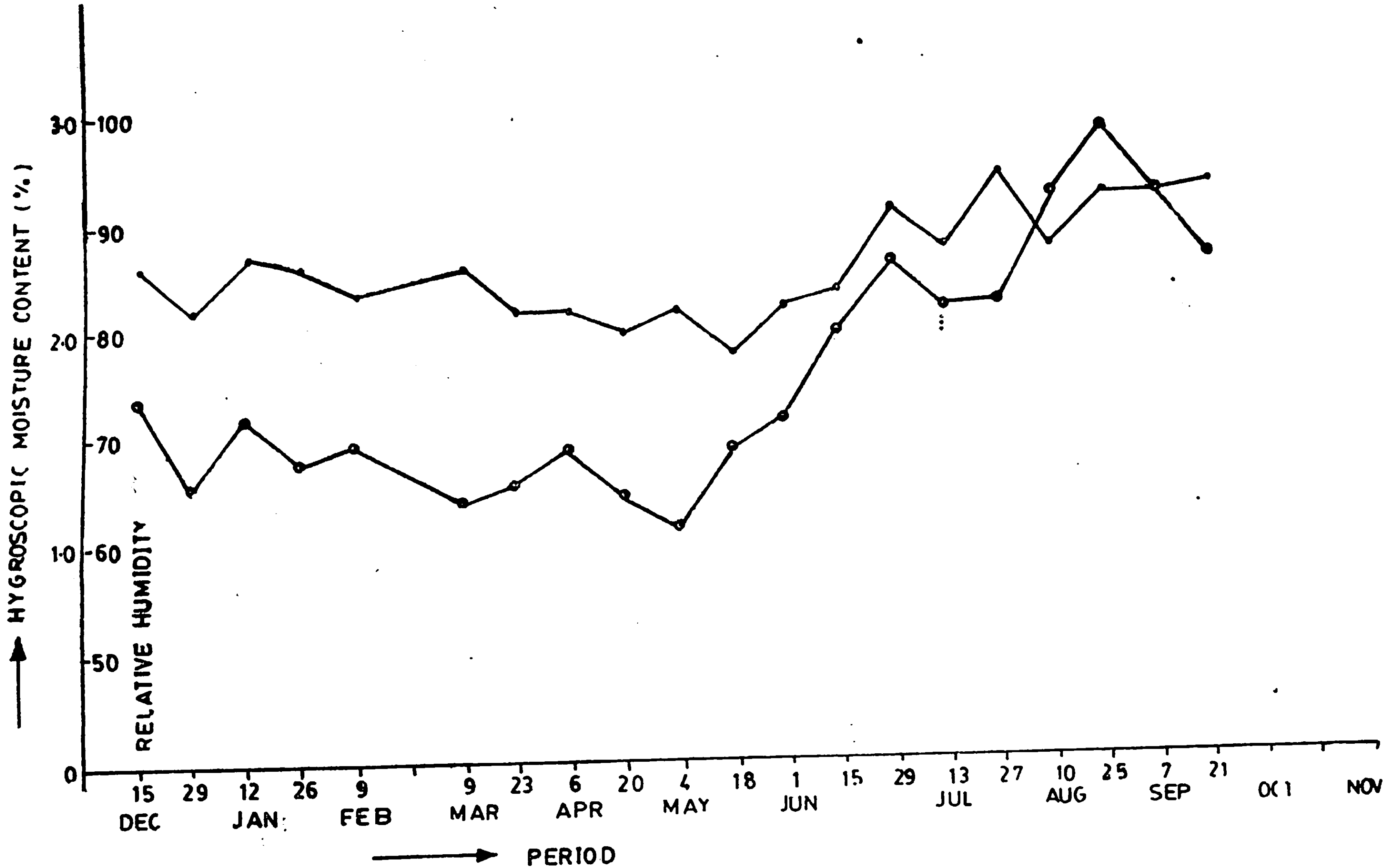

Fig. 1. Relationship between hygroscopic moisture and relative humidity at different periods

Table 2

Correlation matrix between HMC and soil parameters

	Y_0	Y_1	X_1	X_2	X_3
Y_1	—				
X_1	0.051	0.039			
X_2	0.045	0.178	0.281		
X_3	0.243	0.322	0.258	0.233	
X_4	-0.266	-0.137	0.180	0.172	0.236

Y_0 = HMC during December to May period
Y_1 = HMC during June to September period
X_1 = Organic carbon
X_2 = Silt
X_3 = Clay
X_4 = Gravel

clay has a greater degree of relationship with HMC as is expected. The organic carbon do not have a significant relationship with HMC in these soils possibly because of its low concentration.

The estimating equations for the two periods are Y0 = 0.760 + 0.894 X1 + 0.613 X2 + 0.138 X3 — 0.00513 X4. Y1 = 0.096 + 0.289 X1 + 0.58 X2 + 0.0361 X3 — 0.0099 X4. The standard error of estimate (sy) is 18.1% for the estimating equation for the dry period while it is 34.1% for the wet period (June-September). The higher degree of relationship and consequent estimation of HMC during dry periods may be due to wider variations in RH values during that period and its effects on HM adsorption by the different constituents of the soil. Thus, the relationship between HMC and soil parameters in humid tropical situations show clearly that 1) there exists a negative relationship between HMC and gravel 2) for estimation of HMC the four soil parameters viz. clay, silt, organic carbon and gravel may be taken 3) HMC is highly related to relative humidity and 4) organic carbon seems to have little effect on HMC in highly weathered soils.

The hygroscopic moisture content (HMC) was determined for humid tropical oxisol. The HMC was distinctly different for wet and dry periods of the year. The soil properties like clay, organic matter content and silt were significantly related to HMC. Estimation equations are given for HMC in relation to soil properties. HMC is related also to relative humidity which varies from 78 to 95%.

Centre for Water Resources Development
and Management, Calicut 673 571, India

K. M. Varadan
Joyce Syriac

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