Studies on Keen-Raczkowski Measurements and their Relation to Soil test Values in Cultivated Soils of Kerala

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Physical properties of soils like water holding capacity, porespace, volume of expansion etc. measure the soil-water relationships and are broadly expressed as Keen-Raczkowski measurements or single value constants. These constants are considerably influenced by the nature and amount of colloids present in the soil. As the major portion of the plant nutrients are stored in soil colloids it is natural to assume that these constants may be related to the fertility also. Physical condition of the soil plays a significant role in the productivity of the soil and it can be expressed in terms of these constants and texture.

Though the inter-relationships of these constants and soil texture have been worked out and reported by Kandaswami and Dorairaj (1963) for many of the soils occurring in Madras State, there is no work carried out to assess their significance on the fertility factors like available nitrogen, phosphoric acid and potash as assessed by quick soil testing methods. Moreover, no studies on these physical attributes of soils of Kerala have been reported so far. With the object of filling up this lacunae the present investigation was taken up.

Materials and Methods

40 surface samples representing the cultivated soils of Kerala spread over six districts viz., Cannanore, Palaghat, Trichur, Alleppey, Quilon and Kottayam were taken up for the study. These soils were analysed for organic carbon, available phosphoric acid and potash using standard methods employed in the soil testing laboratory. Keen-Raczkowski measurements were determined as per methods outlined by Sankaram (1962). The data obtained were statistically interpreted and appropriate correlations and regression equations worked out.

Results and Discussion

The soil test values and Keen-Raczkowaski measurements are presented in Table I. The correlations and regression equations are presented in Table II.

It is apparent from the data for some of the physical constants presented that these soils show a slightly higher values for apparent specific gravity and true specific gravity. This indicates the heaviness of these soils contributed by the high sesqioxides present in them. The low values for the volume of expansion can be attributed to the occurrence of the inorganic soil colloids of the non-expanding type like Kaolinite and Illite. This assumption is confirmed by the reported observation made on the nature of the inorganic colloids found in soils of similar type. (Manickam and Dorairaj, 1964). Amedium range for water holding capacity and porespace can be explained by the relatively fair distribution of organic matter in these soils.

TABLE I

Physical constants and soil test values

Soil No.	Apparent specific gravity	Absolute specific gravity	Water-holding capacity	Porespace	[illegible]e of [illegible]sion	Organic Carbon per cent	Available Phosphoric acid (ppm.)	Available Potash (ppm.)
1	1.19	2.62	39.50	45.62	6.93	0.66	3.15	12.60
2	1.30	2.22	36.62	49.77	7.84	0.71	2.87	Tr.
3	1.25	2.33	34.62	46.16	6.80	0.65	3.00	18.0
4	1.27	2.40	37.26	47.61	7.74	0.49	1.50	17.8
5	1.25	2.38	36.98	46.70	7.44	0.67	2.00	20.0
6	1.18	1.97	38.89	41.62	2.60	0.66	15.20	39.3
7	1.24	2.15	37.35	43.08	3.30	0.68	3.25	30.1
8	1.47	4.01	24.28	63.36	0.00	0.08	8.30	9.8
9	1.54	2.26	20.93	32.40	0.00	0.06	32.50	21.1
10	1.20	2.11	36.78	42.09	2.17	0.58	30.87	54.5
11	1.33	2.03	23.85	34.66	2.18	0.49	0.0	14.0
12	1.24	2.27	40.68	45.76	4.50	0.50	2.0	40.0
13	1.54	2.25	22.80	31.75	0.77	0.03	15-70	17.1
14	1,07	1·62	45.29	45 75	5.59	0.73	0.0	31.8
15	0.96	1.84	48 22	58.92	3.75	1.20	1.72	12.9
16	1.17	2.00	34.90	41.55	6.20	0.62	5.80	36.8
17	1·33	2.32	31.28	42·36	4 76	0 50	2·80	49·2
18	1-24	2·20	36·52	43.36	8·25	1.11	4·00	46 1
19	1 35	2·29	2941	41·00	4·20	048	0·72	33·0
20	1.27	2·21	32·80	42·61	4·67	0-55	1 00	98
21	121	2·22	37·04	45 62	6 37	0-77	2·00	20 4
22	127	2·51	37·60	49 69	6.31	0·67	2 00	198
23	1·27	2·35	36.21	45·90	713	0·67	3·00	25·8
24	1·28	2-41	36·64	47·15	6 66	0·76	400	11·7
25	1·22	2·31	39·03	47.52	8 49	0·66	1 00	22·3
26	1·19	2.15	38.80	44.53	7.63	0.71	2.00	17.1
27	1·32	2·39	36 30	44·54	10.70	0.60	1 82	15.3
28	1.22	2·22	37 55	64.62	6,46	0.71	2 00	100
29	1.23	2·25	38·50	44 98	7-02	0.67	3.00	20 2
30	1.28	2.37	36.49	44.71	7.69	0.70	3.00	177
31	1.15	2.18	38.25	47.25	4.38	1.25	1.08	21 7
32	1.11	2.15	41.19	48.51	2.97	0.30	00	65.3
33	1.21	2.18	34.42	44.35	6.23	0.74	1.03	50.5
34	1.46	2.43	26.79	38.01	3,60	1.30	0.0	54.8
35	1.46	2.24	22.71	65.24	1.99	0.56	16.30	13.7
36	1.41	2.09	23.04	32.58	1.99	0.28	1.80	21.3

Table I–Continued

37	1.34	2.29	30.45	39.46	3.73	0.99	14.00	5.6
38	1.53	2.30	20.47	32.54	1.67	0.97	35.60	21.0
39	1.39	2.11	27.71	44.93	2.86	0.56	0.90	9.0
40	1.31	2.16	30.27	39.46	3.49	0.55	0.95	10.4
Average value	1.28	2.27	33.96	44.94	4.93	0.64	5.80	24.18

TABLE II

Correlation coefficients and Regression equations

x x y	'r'	Regression equation
Ap. Sp. Gr, (x) x Ab. Sp. Gr.	+ 0.435 **	y = 1.15 x + 0.79
Ap, Sp. Gr. (x) X WHC (y)	— 0.895 ***	y = 39.99 — 4.71 x
Ap. Sp. Gr. (x) X Porespace (y)	— 0.728 ***	y = 47.45 — 1.96 x
Ap. Sp. Gr. (x) X Vol. of Ex.	— 0.534 **	y = 6.30— 1.08 x
Ap. Sp. Gr. (x) x Org. C.	— 0.295	y = 1.49 x — 0.66 x
Ap. Sp. Gr. (x) x Av. P.	+ 0.398 **	y = 2.785 x + 2.20
Ap. Sp. Gr. (x) x Av. K.	+ 0.508 ***	y = 6.105 x + 16.36
True Sp. Gr. x Av. P.	+ 0.396 **	y = 1.047 x + 3.42
WHC X Porespace	+ 0.867 ***	y = 0.445 x + 25.84
WHC x Experi.	+ 0.612 ***	y = 0.235 * — 3.05
WHC x Org. C.	+ 0.438	y = 0.0187 x + 0.004
WHC x Av. P.	+ 0.473	y = 27.22 — 0.631 x
Porespace x Expansion	+ 0.476 **	y = 0.356 x— 11.06
Porespace x Org. C.	+ 0.382 *	y = 0.032 x - 0.786
Porespace x Av. P.	— 0.621 ***	y = 78.17 — 1.61 *
Porespace x Av. K.	— 0.474 **	y = 119.07 — 2.11 x
Expansion x Org, C.	+ 0.376 *	y = 0.042 * + 0.438
Exp, X Av. P.	— 0.533 ***	y = 14.93 — 1.85 *

* Significant at 5 per cent level
** do. 1 per cent level
« do. 0.1 per cent level.

The correlation studies presented in Table II indicate the inter-relationships of these constants, as well as their relation to organic carbon (which is generally reckoned as the Nitrogen status of the soil), available phosphoric acid and potash. The apparent specific gravity is found to be positively correlated to true specific gravity, available phosphoric acid and potash, and negatively correlated to water holding capacity, porespace and volume of expansion. The correlation is found to be statistically significant at 0.1 and 1 per cent levels. In the case of organic carbon alone the relationship is not statistically significant. The true specific gravity values indicate a significant positive correlation to the available phosphoric acid content only. The relationships of these constants, viz., apparent and true specific gravity, to the available phosphoric acid suggest that the availability of the same in soils might be influenced by the coarser fractions of the soil.

The water holding capacity, porespace, volume of expansion and organic carbon are positively related to one another and negatively correlated to phosphoric acid. This suggests that these physical constants are closely related to the texture and colloids of the soil.

It is apparent from the relationships presented that the physical constants determined in the present study can be broadly divided into two groups, one consisting of true and apparent specific gravity and the other water holding capacity, porespace, and volume of expansion. The first group appears to be a measure of the non-colloidal phase of the soil while the second group measures the colloidal phase both in quantity and quality.

One important relationship that has become very apparent in the present study is the one indicated by the apparent specific gravity to other physical constants and soil test values (available phosphoric acid and potash). The relationship suggests that within certain limits the apparent specific gravity values can be taken as an index of the availability of phosphoric acid and potash in soils. The apparent specific gravity of the soil can be easily and rapidly assessed and the present study suggests the possibility of utilising the apparent specific gravity measurements of soils for its rapid assessment of fertility.

It is not known how far this relationship will hold good when soils of varying physico-chemical characteristics are taken up and the relationships studied. It is also desirable to know the range in which these relationships hold good.

Summary and Conclusions

A study of the physical constants of the cultivated soils of Kerala, their inter-relationships and the relation to the soil test values were studied and appropriate correlations and regression equations worked out.

The study has revealed the significant relationship of these constants among themselves and to the soil test values. True specific gravity, apparent specific gravity. and available phosphoric acid and potash appear to be a function of the coarser particles of the soil while waterholding capacity, porespace, volume of expansion and organic carbon are related to the finer particles of the soil, both in quantity and quality. The apparent specific gravity is found to be a very convenient measure of other physical constants besides the available phosphoric acid and available potash in soils.

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