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INVESTIGATION ON STRUCTURAL INDICES OF ALFISOL AND ENTISOL SOILS

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Structural indices of Alfisol (Red) and Entisol (Alluvial) soil profiles studied are reported in this paper. The stability index, aggregate stability, structural coefficient and aggregation index are considered to be reliable structural indices and accordingly the structure of Red and Alluvial soils could be considered as moderately developed. It was observed that the mean weight diameter was very closely related to both aggregates and primary particles of larger sizes comparatively, as revealed from almost linear relationships established.

As the soil aggregation has profound influence on various physico-chemical characteristics of the soil, the soil structure is considered as key to soil fertility Further the structural indices like aggregate stability, aggregation index and stability index are responsible for the aggregation of clay into larger secondary units. The importance of Fe_2O_3 on aggregate stability was brought out by Chesters *et al* (1975). Ameer (1970) observed correlations of coarse sand with stability index, and aggregate stability and of the aggregation index with fine sand and sesquioxides, and of stability index with clay, were also recorded. Aggregate stability was negatively correlated with coarse sand, sesquioxides and clay.

Sahi *et al.* (1976) observed that the stability index was 2½ times greater in alluvial soils. In this paper an attempt was made to study the different structural indices of the Red and Alluvial soil profiles.

MATERIALS AND METHODS

Forty eight soil samples from the different horizons of the sixteen profiles of Red and Alluvial soils of Salem District were studied. Hundred gm of soil was kept on the top of a set of sieves having apertures of 4, 2, 1, 0.5, 0.25 and 0.1 mm. These were subjected to wet sieving for a period of 10 minutes. The oven dry weight of aggregates and primary particles in each sieve was recorded. From these data the following were calculated as described by Dakshinamoorthy and Gupta, 1967.

1. Per cent aggregate stability

$$\frac{\text{(Weight of soil particle} > 0.25\text{-weight of sand} > 0.25)}{\text{Oven dry weight of soil sample-weight of sand} > 0.25} \times 100$$

2. *Stability index (SI)*

S. I. = Ea -- Em

Where,

Ea = sum of percentages of soil particles > 0.25 mm

En = sum of percentages of primary particles > 0.25 mm

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3. *Aggregation index*

The differences between the mean weight diameter of the soil particles and the dispersed sample given the aggregation index.

4. *Mean weight diameter (MWD)*

$$MWD - \frac{n}{\lesssim xiwi}$$

$i - 1$

n = number of fractions (0-0.0, 0.1-0.25, 0.25-0.5, 0.5-1.0, 1.0-2.0, 2.0-4.0 and 4.0-8.0 cm)

xi = Mean diameter of the fraction i (0.05, 0.175, 0.375, 0.75, 3.0 and 6.0 mm)

wi = Proportion of total sample weight occurring in the fraction

5. *Structural coefficient (SC)*

$$SC = \frac{D-S}{D}$$

Where,

D = Percentage of primary particle, less than 0.25 mm in diameter by mechanical analysis

S = Percentage of soil aggregate > 0.25 mm by wet sieving

6. *Geometric mean diameter*

The logarithm of the weight of aggregates in a given size fraction is multiplied by the meandiameter of the fraction value for all fractions summed up and indicated as Geometric mean diameter.

RESULTS AND DISCUSSIONS

The structural indices and other related proportion of the soil profiles studied are furnished in Table 1.

Stability index

The stability index ranged from 12.1 per cent to 58.4 per cent with a mean of 32.9 per cent in red soils. For alluvial soils it varies from 26.7 to 57.9 with a mean of 42.8. Vannappatti series recorded the highest value in the sub soil layers. Stability index increased with depths in Vannappatti series at Koranampatti and Puliyampatti profiles and Salem series and Tulukkanur series. The profiles of Vannappatti series at Mechery and Nangavalli showed a consistent decrease of stability index with depth immediately below the surface soil. Stability index has positive significant relationship CEC and wilting coefficient (Ameer, 1970). The stability index showed negative correlation with primary particles of > 0.5 mm size. These indicated clearly that the stability index is quite independent of primary particles of larger sizes (> 0.5 mm). However the primary particles of 2.0 mm size were positively correlated with stability index. It wes noteworthy that the stability index had significant positive relationship with silt and clay which revealed the influence of finer fractions on stability index of soil.

2. *Aggregate stability*

The aggregate stability ranged from 13.7 to 72.7 per cent, the mean value being 43 5 per cent in red soils, while in alluvial soils the range was from 30.1 to 126.0 per cent with a mean of 71.2 per cent The highest values were recorded in the soils of sub surface horizon of Pulampatti alluvium and Mohanur alluvium. Aggregate stability quite markedly increased with depth in the profiles of Vannappatti series, Salem series and Tulukkanur series, possibly due to the fact that the bulk density increased with depth in these series thereby facilitating for the increased aggregate stability. Aggregate stability had positive correlations with stability index. aggregation index and structural coefficient. Subashchandra Bose (1971) and Sundaramoorthy (1973) also made similar observations. Aggregate stability also had positive correlations with CEC and wilting coefficient. As it could be expected the significant influence of silt and clay on aggregate stability was brought out.

3. *Aggregation index*

The aggregation index ranged from 0.13 to 0 67 for red soils and it was from 0.1 to 1.93 for alluvial soils. The mean values were 0.69 and 0.44 respectively. The value at the subsurface layer for Pulampatti alluvium was 1 93. Aggregation index increased with depth at all the places of Vannappatti series and the in Tulukkanur series It decreased with depth at Anuppur and Alagapuram of Salem series. Aggregation index was found to have positive relationship with bulk density indicating the role of compaction, a physical phenomenon in increasing the aggregation index.

4. *Mean weight diameter*

The mean weight diameter of red soils ranged from 0.292 to 3.01 with a mean of 1.39, while in the alluvial soils it ranged from 0.001 to 3.84 with a mean of 0.717. The value of 3.8 was recorded in the sub soil layers of Pulampatti alluvium. It increased with depth in all the profiles of Vannapatti series but no regular pattern could be noticed in the Tulukkanur series with the depth. The MWD decreased at a depth of 22 cm and 60 cm in Upparapatti alluvium and Paramathi alluvium respectively.

The MWD recorded significant positive relationships with aggregates of 4.0 mm size, aggregates of > 2.00 mm size, aggregates of > 1.00 mm size and primary particles of > 4.00mm size > 2.00 mm size and > 1.00 mm size. It was interesting to observe that the mean weight diameter was very closely related to both aggregates and primary particles of larger sizes comparatively as revealed from linear relationship established. As the sizes of aggregates of primary particles decreased the values of correlation coefficient also decreased indicating their reduced importance on mean weight diameter.

5. *Structural coefficient*

The structural coefficient varied from 0.121 to 0.584 and the mean was 0.315 in the red soils. In the alluvial soils it ranged from 0.267 to 0.579. Structural coefficient increased with depth in all the profiles of Vannappatti series, Salem series and Tu-

Table 1. The distribution of different structural indices and other related properties of alfisol and entisol soils profiles.

Name of the soil series, profile number and location	Depth in cm	Stability index	Aggregate stability	Aggregation index	Mean weight diameter	Structural coefficient	Geometric mean diameter	Wilting coefficient	Aggregates > 0.1 mm	Aggregates > 0.5 mm	CEC
1	2	3	4	5	6	7	8	9	10	11	12
					Non-calcareouse red soil						
1. Vannappatti (Vpt)											
1. Koranampatti	0-20	15.5	18.3	0.13	0.34	0.15	0.53	3.6	3.90	12.70	15.2
	20-40	58.4	72.7	1.66	2.42	0.58	0.10	11.2	4.30	5.70	14.7
2. Puliyampatti	0-18	42.5	60.1	0.42	1.23	0.42	0.81	4.8	5.80	3.80	7.8
	18-38	45.0	70.8	1.61	0.40	0.45	0.12	5.3	4.50	3.20	15.5
3. Mechery	0-10	24.5	40.6	0.26	0.49	0.24	0.04	4.1	4.70	8.60	11.3
	10-25	41.5	52.7	0.26	0.43	0.41	0.03	13.6	4.50	4.90	17.9
	25-50	38.6	67.1	1.50	2.26	0.38	0.29	14.8	8.70	8.70	18.9
4. Nangavalli	0-19	22.3	32.7	0.41	1.41	0.22	0.78	4.5	7.00	4.40	8.5
	19-30	54.2	66.9	0.38	0.51	0.54	0.13	7.7	6.90	3.60	14.7
	30-52	43.1	54.6	1.67	1.91	0.43	0.13	12.6	8.30	4.10	13.2
2. Salem (Slm)											
1. Anupuur	0-9	29.5	44.1	0.30	0.81	0.29	0.91	4.2	7.20	7.70	11.0
	9-17	49.0	50.2	0.27	0.29	0.49	0.06	6.0	2.00	6.40	15.4
2. Thukkiyampaleyan	0-12	17.1	33.9	0.41	3.18	0.17	0.30	2.7	3.80	9.00	13.5
	12-33	26.2	46.2	0.25	0.62	0.26	0.06	5.2	5.20	15.10	16.8
	33-51	44.3	48.2	0.26	0.36	0.44	0.19	10.1	3.10	1.30	14.0
3. Karipatti	0-6	22.6	29.2	0.25	0.82	0.22	0.08	10.1	0.90	15.00	7.4
	6-24	22.7	29.3	0.21	0.76	0.22	0.07	11.8	1.60	15.60	7.5
	24-35	41.6	71.2	0.35	0.87	0.41	0.09	12.9	1.20	13.70	11.4
4. Alagapuram	0-34	19.2	23.7	0.37	1.69	0.19	0.12	11.0	4.10	9.10	10.2
	34-55	27.3	37.5	0.25	0.67	0.07	0.07	6.10	6.10	15.20	10.4
	55-61	38.8	62.9	0.23	0.32	0.38	0.19	2.5	2.20	1.50	12.8

3. Tulukkanur (Tlk)					*Calcareouse red soil*						
1. Idappadi	0-15	28.3	48.3	0.59	1.77	0.28	0.13	[illegible]	6.70	11.20	10.7
	15-40	32.0	52.2	0.41	1.88	0.32	0.05	5.2	3.70	11.70	14,8
	40-65	40.4	66.8	0 56	1,11	0.40	0.09	5.2	3.70	11.00	16.9
2. Omalur	0-16	37.7	55.1	0.64	1.47	0.37	0.12	3.9	5.90	4.40	18.9
	16-30	37.8	53.3	0.86	1.58	0.37	0.13	4.5	3.50	4.20	19.5
3. Bhuminaickenpatti	0-17	29.6	54.2	0.79	2.56	0.29	0.14	4.6	4.70	5.90	12 0
	17-34	25.7	61.7	1.07	3.00	0.25	0.15	8.0	2.40	5.40	15.9
	34-56	33.8	68.7	1.24	2.38	0.33	0 15	11.2	1.50	8.10	13.2
4. Kapilamalai	0-12	12.1	13.7	0.27	1.16	1.12	0 11	3.5	3.00	10.80	14.7
	12-23	18.1	40.6	0.50	2.09	0.12	0.13	4.4	0.10	8.00	15.8
4. Alluvial (Al)					*Calcareous alluvial soil*						
1. Upparappatti	0-18	53.4	101.6	0.23	0.50	0.50	0.04	12.5	1.20	7.00	21.6
	18-65	36.1	56.4	0.35	1.02	0.36	0,10	12.6	5.60	7.70	20.8
	65-100	49.9	65.1	0.42	0.67	0.49	0.85	20.6	4.00	6.20	27,2
2. Paramathi	0-9	46.5	60.9	0.52	0.76	0.46	0.07	16.4	5.60	6 80	16.2
	9-47	50.9	104.0	1.15	1.90	0.30	0.01	18.8	1.60	1.00	15 8
	47-78	40.3	61.2	0.72	1.27	0.40	0.11	19.5	1.20	8.50	16.0
	78-99	57.9	73.0	0.00	0.00	0.57	0.15	8.9	2.00	0.20	8.2
	99-132	30.8	55.6	0.20	0.65	0.30	0.05	19.8	2.70	16.50	14.8
3. Mohanur	0-8	41.3	70.4	0.13	0.34	0.52	0.14	16.1	4.90	1.50	18.1
	8-40	52.22	109.0	0.17	0.25	0.52	0.01	16 4	1.60	1.40	16 4
	40-65	26.7	38.9	0.18	0 18	0.26	0.05	19.2	0.70	0.30	19 8
	65-92	36.1	56.4	0.10	0.12	0.36	0.00	4.4	3.30	0.10	10.7
	92-100	36.2	36.7	0.20	0.10	0.36	0.08	17.7	0.80	1.00	16.3
4. Pulampatti	0-14	28.2	39.2	0.22	0.47	0.28	0.04	11.1	1.50	6.00	24.5
	14-31	33.6	50.6	0.35	0.00	0.33	0.10	11.5	5;80	6.80	26.8
	31-63	55.6	125.2	0.53	0.80	0.55	0.07	12.0	5.10	5.10	25.2
	63-72	55.8	126.2	1.93	3.83	0.55	0.16	12.4	1.30	3.90	27.9

Table 2 : Relationship between soil structural indices (X) and other properties (Y)

X	Properties Y	Correlation coefficient (r)	Regression equation
1	2	3	4
1. Stability index	Wilting coefficient	0.392**	Y=3.990+0.169x
	CEC	0.313*	Y=10.782+0.127x
	Primary particles of 0.5 mm size	(−)0.502**	Y=13.946−0.138x
2. Aggregate stability	CEC	0.454**	Y=10.059+0.092x
	Wilting coefficient	0.383**	Y=5.348+0.083x
3. Aggregation index	Bulk density	0.411**	Y=1.452+0.105x
4. Mean weight diameter	Aggregation of >4.0 mm size	0.928**	Y=3.507+12.373x
	Aggregation of >2.0 mm size	0.739**	Y=1.034+4.320x
	Aggregation of >1.0 mm size	0.472**	Y=5.113+2.573x
	Primary particles of >2.0 mm size	0.664**	Y=0.309+2.058x
	Primary particles of >1.0 mm size	0.567**	Y=2.648+2.399x
5. Structural coefficient	Wilting coefficient	0.411**	Y=3.859+17.273x
	CEC	0.313**	Y=10.916+12.296x
6. Geometric mean diameter	Wilting coefficient	(−)0.325**	Y=11.681−10.486x
	Sesquioxides	(−)0.358*	Y=12.355−9.723x

lukkanur series. Structural coefficient recorded positive relationships with wilting coefficient and CEC. The relationships of structural coefficient with other coarser primary particles were negative.

6. *Geometric mean diameter*

Ranged from 0.031 to 0.815 with a mean of 0.182 for red soils. For alluvial soils it ranged from 0.003 to 0.166 with a mean of 0.156. Geometric mean diameter decreased with depth in Vannappatti series at Koranampatti and Puliyampatti profiles. It increased with depth at Mechery and Nangavalli.

Geometric mean diameter was negatively correlated with wilting coefficient and sesquioxides.

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