

INTER-RELATIONSHIP BETWEEN ORGANIC CARBON, NITROGEN, ORGANIC PHOSPHORUS AND ORGANIC SULPHUR IN TWO RED LOAM SOIL SERIES OF SOUTH KERALA

It is well known that organic carbon bears to nitrogen a rather constant ratio of 10:1 in soils. Like nitrogen, phosphorus and sulphur are two other elements present in plants and soils in organic combinations. According to the estimates of Swaby (1968) 98% of nitrogen, 80% of sulphur and 60% of phosphorus are associated with organic compounds in soil. However, the inter-relationships among organic C, P and S have not been studied in any detail. Hence the present study was undertaken to investigate the inter-relationships between these elements in two red loam soil series of South Kerala.

Ten surface (0-2 cm) soils each belonging to the Vellayani and Neyyattinkara series were used in this study. The texture of the soils was determined after subjecting them to particle size analysis by the Bouyoucos method (Piper, 1942). The general physico-chemical properties such as pH, EC and CEC were determined by standard analytical procedures. Organic carbon was estimated by Walkley and Black's method (1934) and nitrogen by the micro-kjeldahl method as given by Jackson (1958). Organic phosphorus was determined by the method given by Hesse (1971) and organic sulphur by the method of Evans and Rost (1945) and Chesnin and Yein (1951).

In the Vellayani series organic carbon varied from 0.33 to 0.67% (mean 0.49%) and in the Neyyattinkara series it varied from 0.42 to 0.72% (mean 0.55%). The range in nitrogen was from 0.038 to 0.072% (mean 0.053%) in the

Vellayani series and from 0.048 to 0.072% (mean 0.060%) in the Neyyattinkara series. Organic phosphorus ranged from 0.002 to 0.013% (mean 0.006%) in the Vellayani series and from 0.002 to 0.012% (mean 0.005%) in Neyyattinkara. The variations in organic sulphur were from 0.062 to 0.124% (mean 0.092%) and from 0.088 to 0.138% (mean 0.106%) respectively in the Vellayani and Neyyattinkara series.

The org C/N ratio was remarkably constant in all the soils, the mean value being 9.2 for both the series. This is in close agreement with the generally accepted ratio of 10.0. The org C/org S and N/org S ratios have also tended to be rather constant in all soils, the mean org C/org S ratio being 5.3 and the N/org S ratio 0.58. This shows that the degradation of organic matter in soils proceeds in such a manner that organic C, N and S ultimately maintain a fixed proportion to one another. The proportion of organic P in the soil organic matter is, however, highly varying as is evident from the variations in the org C/org P, N/org P and org P/org S ratios. The org C/org P ratio varied from 25.4 to 240.0 in the Vellayani series with a mean value of 127.3. In the Neyyattinkara series it ranged from 45.8 to 240.0, the mean being 142.7. The mean value of the org C/org P ratio for all soils was 135.5. In a study of six surface soils of Kerala in the pH range of 4.0 to 7.1, Koshy (1952) found that the org C/N, org C/org P and N/org P ratios were in the ranges of 7.1 -11.9 (mean 9.2), 58.7 - 918.2 (mean 310.1) and 6.5 to 90.9 (mean 31.3) respectively. These results also indicated that the proportion of

Table 1. General characteristics of the soils

Sl. No.	Series and location	Text-ure	PH	EC dS/m	CEC cmol (p ⁻)/kg	Org C %	N %	Org P %	Org S %
A. VELLAYANI SERIES									
1	Vandithadam	s	4.6	0.08	2.8	0.46	0.042	0.005	0.090
2	Pachalloor	sl	4.2	0.08	2.0	0.34	0.040	0.006	0.062
3	Thiruvallam	sl	4.6	0.08	2.2	0.33	0.038	0.013	0.068
4	Pallichal	ls	4.0	0.09	4.0	0.67	0.072	0.004	0.124
5	Balaramapuram	ls	4.1	0.40	3.0	0.48	0.056	0.002	0.096
6	Vellayani	sl	3.9	0.09	3.6	0.56	0.058	0.009	0.106
7	Kattachalkuzhi	ls	3.7	0.07	2.6	0.43	0.052	0.002	0.090
8	Kottukal	s	4.2	0.10	2.2	0.37	0.044	0.003	0.070
9	Aralummoodu	s	4.3	0.13	3.0	0.59	0.062	0.008	0.102
10	Koottappana	s	4.3	0.10	2.6	0.65	0.068	0.003	0.110
B. NEYYATTINKARA SERIES									
11	Thozhukkal	s	3.8	0.15	2.4	0.43	0.050	0.006	0.092
12	Vlangamuri	ls	3.4	0.19	2.4	0.55	0.064	0.012	0.098
13	Amaravila	scl	4.1	0.15	3.8	0.46	0.054	0.002	0.094
14	Dhanuvachapuram	sl	4.4	0.13	3.4	0.59	0.060	0.004	0.112
15	Udhiyankulangara	sl	5.0	0.36	3.0	0.58	0.062	0.004	0.108
16	Kodavilakom	ls	4.6	0.49	3.2	0.42	0.048	0.005	0.090
17	Parassala	ls	5.2	0.15	4.2	0.71	0.072	0.004	0.134
18	Inchivila	scl	6.2	0.43	2.8	0.46	0.056	0.005	0.088
19	Cheruvarakonam	sl	5.0	0.49	2.6	0.58	0.062	0.003	0.106
20	Manapuram	ls	4.0	0.15	4.2	0.72	0.069	0.003	0.138
Mean Vellayani series			4.19	0.12	2.8	0.49	0.053	0.006	0.092
Mean Neyyattinkara series			4.57	0.27	3.2	0.55	0.060	0.005	0.106
Mean for both series			4.38	0.19	3.0	0.52	0.057	0.006	0.099

Table 2. The ratios between organic carbon, nitrogen, organic phosphorus and organic sulphur in the soils

Sl. No.	Soil series and location	Org C/N	Org C/ Org P	Org C/ Org S	N/org P	N/org S	Org P/org S
A. VELLAYANI SERIES							
1	Vandithadam	11.0	92.0	5.1	8.4	0.47	0.05
2	Pachalloor	8.5	46.7	5.5	6.7	0.65	0.09
3	Thiruvallam	8.7	25.4	4.9	2.9	0.56	0.19
4	Pallichal	9.3	167.4	5.4	18.0	0.58	0.03
5	Balaramapuram	8.6	240.0	5.0	28.0	0.58	0.02
6	Vellayani	9.7	62.2	5.3	6.4	0.55	0.08
7	Kattachalkuzhi	8.3	215.0	4.8	26.0	0.58	0.02
8	Kottukal	8.4	123.3	5.3	14.7	0.63	0.04
9	Aralummoodu	9.5	73.8	5.8	7.8	0.61	0.08
10	Koottappana	9.6	216.7	5.9	22.7	0.62	0.03
B. NEYYATTINKARA SERIES							
11	Thozhukkal	8.6	71.7	4.7	8.3	0.54	0.07
12	Vlangamuri	8.6	45.8	5.6	5.3	0.65	0.12
13	Amaravila	8.5	230.0	4.9	3.0	0.57	0.02
14	Dhanuvachapuram	9.8	147.5	5.3	15.0	0.54	0.04
15	Udhiyankulangara	9.4	145.0	5.4	15.5	0.57	0.04
16	Kodavilakom	8.8	84.0	4.7	9.6	0.53	0.06
17	Parassala	9.9	177.5	5.3	18.0	0.54	0.03
18	Inchivila	8.2	92.0	5.2	11.2	0.64	0.06
19	Cheruvarakonam	9.4	193.3	5.5	20.7	0.58	0.03
20	Mariapuram	10.4	240.0	5.2	23.0	0.50	0.02
	Mean Vellayani series	9.2	127.3	5.3	14.2	0.58	0.06
	Mean Neyyattinkara series	9.2	142.7	5.2	13.0	0.57	0.05
	Mean for both series	9.2	135.5	5.3	13.6	0.58	0.06

organic P in relation to organic C and N was highly variable. It is, therefore, to be concluded that the decomposition of organic matter in soils tends to result in the accumulation of resistant compounds with fixed proportions of C, N and S and with highly varying proportions of organic P compounds.

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REFERENCES

- Chesnin, L. and Yien, C.N. 1951. Turbidimetric determination of available sulphates *Proc. Soil Sci. Soc. Am.* 15: 149-151
- Evans, C.A. and Rost, C.O. 1945. Total organic sulphur of Minnesota soils. *Soil Sci.* 59: 125-137
- Hesse, P.R. 1971. *A Text Book of Soil Chemical Analysis*. John Murray Ltd., London, p. 261, 317
- Jackson, M.L. 1958. *Soil Chemical Analysis*. Prentice Hall. Inc., USA, p. 183-190
- Koshy, M.M. 1952. Phosphate studies in Travancore-Cochin soils. M.Sc. thesis, University of Travancore, Trivandrum
- Piper, C.S. 1942. *Soil and Plant Analysis*. Hans Publishers. Bombay, p. 77-79
- Swaby, R.J. 1968. Stability of soil organic matter and its significance in practical agriculture. *Study Week on Organic Matter and Soil Fertility*. North Holland Publishing Co., Amsterdam, p 583-613
- Walkley, A. and Black, I.A. 1934. An examination of the Deglgareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Sci.* 37: 29-38