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STUDIES ON THE NATURE AND COMPOSITION OF HUMUS IN SOME COASTAL SOILS OF LITILE ANDAMAN

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Soil samples collected from the little Andaman Forest Division were analysed for their humus composition. The study revealed that unlike the soil of tropical dry deciduous forests the soil of these tropical evergreen forests have lignin rich humus in their surface horizons. The content of resistant carbon and nitrogen is also maximum in surface horizons. The composition of humus indicates predominance of humic acids over fulvic acids with very high Cha/Cfa ratio similar to Chestnuts and Chernozems of Eastern Siharia. The aromatic nature of the surface humic substances along with their tendency towards coagulation in aqueous medium makes the soil more favourable for the plant growth.

The nature of soil together with topographical features influences the distribution and composition of forests in Andaman (Seth and Yadav, 1960), According to Yadav (1967) soil is the most dominating edaphic factor in controlling the growth of the trees since climate and altitude show little variations. Yadav (1967) emphasized that for proper and effective forest management an adequate content of humus and clay must be maintained a in these soils. However, very little work seems to have been done in this direction and the soils of Andaman tend to loose their accumulated fertility with every deforestation operation. Hence in order to understand the nature and composition of humus for its maintenance in the soils, the present study was taken up in certain parts of Little Andamans forest Division where the rainfall and temperature conditions greatly favour rapid mineralization of the humus (Anon. 1975).

MATERIAL AND METHODS

Soil samples were collected from three profiles in the compartment No. 1 of the Little Andaman Forest Divison, which lie west of Butlor Bay along the sea cost. The underlying rocks consist of serpentine series and vegetation mainly consist of *Dipterocarpus incanus*. The other species present are *Pterocymbium tinctorium*. *Terminalia procera*, *Artocarpus spp.* and *Tetrameles nudiflora*. The soils are acidic in nature with fairly rich amount of organic carbon and potash, and medium amount of nitrogen and phosphorus and have been described earlier (Bhargava, 1956; Yadav, 1967, Anon, 1975). For the present investigation the soils after initial processing were analysed for peroxidisable, alkali extractable and acid hydrolysable humus with the help of 30%. H_2O_2, 0.5 N NaOH and 35 precent HCl respectively as per the method described

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by Singh (1954-55) and followed by Singhal *et al.* (1975) for some similar forest soils of the country. Optical densites of the humate solutions (.136g/l) were recorded over Coleman Junior Model II Spectrophotometer between 465 and 725 mm wave length after extraction with sodium pyrophophate-sodium hydroxide solution (Kononova & Belchikova, 1961), whereas the group composition of the humus fractions was determined by the rapid method of Kononova & Belchikova (1950) as modified by Kononova (1966) and carbon by Tyurin's (1951) method.

RESULTS AND DISCUSSION

From the Table I it can be seen that there is no appreciable change in the colour of soils on peroxide treatment. The retention of brownish colour almost by all samples can be accounted for the presence of MnO_2 and montmorillonite type of clay minerals in these soils. Since hydrogen peroxide gets completely decomposed in acid solution during reduction of manganese dioxide to manganous form and the dispersion of the very large surface of the montmorillonitic type of clays enhances the effectiveness of the colour of the soils. Another possibility of colour retention may be the increase in the amount of bases in these low lying sites and their high calcium status as reported earlier by Tamhane *et al.*, (1956) and Yadav (1967). Futher the higher percentage of resistant carbon in the sub-surface horizons indicates high content of lignin in the surface layers of these soils since hydrogen peroxide generally dissolves the whole of lignin of the humus (Shrikhande, 1947). High content of lignin of the surface in these horizons is also reflected by the higher optical densities of their alkali extracts which gradually decrease with depth down the profile. However, the intensity of dark colouration (Corresponding to 20 mg of organic carbon) is not as high as in the case of other forest soils under sal, eucalyptus, oak and conifers, studied earlier (Singhal *etal.*, 1975) Singh & Singhal, 1975) probably due to lesser humification and presence of montmorillonoides in clay which might have held the pigments more tenaciously and made the organic matter of the present soils mo:e resistant.

The nature of the organic matter of the present soils has been reflected by their acid hydrolysis (Table2). The contents of resistant carbon and nitrogen in these soils are as high as 55.99 percent and 34.16 percent respectively, with maximum in the surface and minimum in the lowest layers of the profile. This indicates once again that the greater proportion of lignin is in the surface as compared to other horizons since lignin is the only plant component which offers maximum resistance to acid hydrolysis. It was however, interesting to see that nitrogenous compounds of all these soils have been affected more by the hydrolysis than their non nitrogenous organic fractions as reflected by the low C/N ratios of their hydrolysable organic matter. It appears that during the process of hydrolysis most of the proteinous compounds have been hydrolysed and non-proteinous fraction left behind as evidenced by the C/N ratio of the residues which have become much higher than their original soils.

The composition of humus (Table III) shows that the humic acids of these soils predominate over fulvic acid fraction and its preponderence, judging from high Cha/Cfa ratio (0.1 to 9.5) is well expressed. These values although quite high in comparison to some other forest soils studied earlier (Singhal *et al.*, 1976, Singh & Singhal, 1976) resemble with some other castal soils of Eastern Sibaria such as chestnuts and chernozems (Kononova 1966) which were accounted for the link between humic acid and calcium and magnesium. The sudden decrease however in the fulvic acid fraction of the sub-surface horizons of the present soils can be accounted to greater leaching of iron and aluminium fulvates from the sub-surface to the lower horizons.

The nature of humus of the soils under investigation is also reflected its optical properties since the optical density of alkaline solutions of humic acids characterises the ratio of aromatic part of the carbon to the side radicals. When there is a predominance of aromatic network, the optical density is higher with steepness on the curve whereas with the predominance of the aliphatic groups reverse is the case(Kononova, 1966,). When the data of Table IV are analysed with these generalisation it is seen that the values of optical density are higher for the surface horizons as compared to sub-surface with greater steepness in their curves (Table IV). This makes humic acids of the surface more aromatic, greater polymerised and as such more humified as compared to those of sub-surface horizons. The humic acids of of surface samples also appear to be more hydrophobic, more succeptible to coagula ion by electrolytes and as such physically more favourable to plant growth as compared to other horizons. These observations are in contradiction to those made by Singhal *et al.*, (1975), Singh & Singhal (1976) and Ghosh, *et al*, (1977) for the humus of other tropical soils in which humic acids of sub-surface horizons were found more humic and aromatic in nature with greater degree of humification than the surface horizons. It appears that the prevailing optimal moisture and temperature conditions of the area under study have caused responsible for this variations in the present soils, which however, still needs more investigationl

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Table-1 Peroidisable and alkali Extractable humus of the soils

Profile No.	Depth (cm.)	Clay %	Carbon before peroxidation %	Colour (day) before peroxidation	Carbon after peroxidation %	Colour (day) after peroxidation	R. C. x 100 / T. C.	Amount of soil corresponding to 20 mg organic carbon (g)	Optical density of alkali alkali extract containing 20 mg organic carbon at 600 mμ
								(9)	
I	0-10	27.23	2.58	10 YR 5/3	0.32	10, YR 6/8	12.40	0.78	0.065
	10-25	35.65	1.02	10 YR 5/8	0.19	10 YR 6/6	18.63	1.96	0.050
	25-55	53.25	0.60	10 YR 6/6	0.04	10 YR 6/8	6.60	3.33	0.030
	55-78	46.39	0.40	10 YR 6/6	0.04	10 YR 7/4	—	5.00	0.025
II	0-6	32.82	2.20	10 YR 4/4	0.23	10 YR 5/8	10.45	0.91	0.070
	6-19	42.29	1.30	10 YR 4/4	0.21	10 YR 6/6	16.15	1.54	0.030
	19-84	53.47	0.82	10 YR 5/4	0.04	10 YR 5/6	4.88	2.44	0.020
	84-138	59.57	0.50	10 YR 5/4	—	10 YR 5/6	—	4.00	0.010
III	0-14	33-16	2.64	10 YR 6/4	0.36	10 YR 7/8	13.64	0.76	0.060
	14-33	61.94	1.44	10 YR 6/8	0.11	10 YR 7/4	7.64	1.39	0.045
	33-72	75.30	0.48	10 YR 6/6	—	10 OR 7/6	—	4.17	0.020
	72-90	65.35	0.42	10 YR 7/4	—	10 YR 7/6	—	4.70	0.010

R. C. = Resistant carbon.

T. C. = Total carbon.

Table II Acio Hydrolysable organic matter of the Soils

Profile No.	Depth (cm)	Before Hydrolysis			After Hydrolysis			T. C.-R. C. / T. N.-R. N.	R. C. x 100 / T. C.	R. N. x 100 / T. N.
		Carbon %	Nitrogen%	C/N	Carbon%	Nitrogen%	C/N			
I	0,10	2.58	.202	12.77	1.29	.069	18.69	9.69	50.00	34.16
	10-25	1.02	.101	10.09	0.40	.028	14.28	8.49	39.22	27.76
	25-55	0.60	.067	8.95	0.17	.012	14.61	7.82	28.33	17.91
	55-78	0 40	.048	8.33	0.07	.004	17.50	7.50	17.50	8.33
II	0-6	2.20	.165	13.33	1.23	.049	25.10	8.36	55.91	29.70
	6-19	1.30	.151	8.61	0.57	.037	15.40	6.40	43.85	24.50
	19-84	0.82	.095	8.63	0.30	.013	23.08	6.34	36.58	13.68
	84-138	0.50	.067	7.46	0.11	.006	18.33	6.39	22.00	8.95
III	0-14	2 64	.204	12.94	1.32	.066	20.00	9.56	50.00	32.35
	14-33	1.44	.112	12.86	0 55	.020	27.50	9.67	38.19	17.86
	33-72	0.48	.053	9.06	0.12	.006	20.00	7.66	25.00	11.32
	72-90	0.42	.042	10.00	0.08	.905	16.00	9.19	19.05	11.90

T. C. — Total Carbon, T. N. — Total Nitrogen, R. C. — Resistant Corbon, R. N. — Resistant Nitrogen.

Table. III. Composition of humus of the soils

Profils No.	Depth (cm)	Total Organic Carbon %	Humic acid carbon %	Fulvic acid Carbon %	Carbon in residue %	Cha/Cfa
I	0-10	2,58	1,82	0,19	0,33	9,58
	10-25	1,02	0,68	0,08	0.12	8,50
	25-55	0,60	0,10	0.20	0,08	0,38
	55-78	0,40	0,03	0.24	0.07	0,13
II	0-6	2,20	1,71	0,20	0,22	8,55
	6-19	1,30	0,72	0,10	0,20	7,20
	19-84	0,82	0,16	0,38	0.16	0,42
	84-138	0,50	0,03	0,28	0,06	0,11
III	0-14	2,64	1,84	0,20	0,30	9,20
	14-33	1.44	0.76	0,09	0,18	8.44
	33-72	0.48	0.12	0.28	0.05	0,43
	72,90	0,42	0.04	0,28	0.03	0,14

Table. IV. Optical Densities of Humate Solutions (Carbon Concentration 0.136 g/l)

Profils No.	Depth (cm)	Value of optical density at wavelength mμ							
		465	496	533	574	619	665	726	E4 . E6
I	0-10	0.14	0.10	0.08	0.06	0.05	0.04	0.04	3.50
	10-25	0.10	0.07	0.05	0.04	0.03	0.02	0.01	5.00
II	0-6	0.18	0.12	0.10	0.08	0.06	0.06	0.05	3.00
	6-19	0.11	0.09	0.07	0.05	0.04	0.03	0.03	3.67
III	0-14	0.15	0.11	0.08	0.06	0.04	0.03	0.03	5.00
	14-33	0.09	0.06	0.05	0.03	0.02	0.02	0.02	4.50