https://doi.org/10.29321/MAJ.10.A02699

Madras Agric J. 69 (2): 111–116. February, 1982.

Status of soil Carbohydrates in some Evergreen Forests of South Andaman

R. M. SINGHAL & S. D. SHARMA

Total polysaccharide contents of soil hydrolysates (hexose, methly hexoses and 6-deoxy hexoses) which react with anthrone were measured in the soils of Jirkatang and Kalatang blocks of South Andaman Island. The study reveals that the content of carbohydrates is higher at the upper horizons of these soils and it decreases with depth down the profile. Relatively the soils of Jirkatang have lesser content of carbohydrates than Kalatang. However, when their absorption spectra were compared with the soils of tropical dry deciduous forests the present soils were found to possess greater dispersibility of carbohydrates in them. They also had greater resistance towards electrolytes and as such more susceptibility towards the erosion.

The tropical evergreen forest to Andaman adds a large quantity of litter to its soil surface every year but the content of soil organic matter remains appreciably low due mainly to the local conditions of temperature and rainfall coupled with rapid rate of decomposition. According to Yadav (1967) this enhaced rate of decomposition although accelerates the circulation of plant nutrients between the forest vegetation and the soils but at the same time presents a complex problem of maintaining a satisfactory level of organic matter in them also, as such maintaining of humus with protection against any deterioration has become an essential requirement for the management of these forests.

Carbohydrates which occur in the soils as a component of plant tissues and of the lime from micro-organisms, play an important role in structural aggregation and formation of favourable crumb structure in them. They also provide energy during the formation of humus in them. Earlier studies also reveal their role in various soil microbiological activitiss under different conditions (Bernier, 1958; Brink et al, 1960; Johnston 1961; Singh & Singhal 1974, Singhal & Dev 1977 & C). In view of the above it was felt that such study in the soils of South Andaman would be of immense value for obtaining information about their carbohydrate status and microbiological strength of these soils against any deterioration. The present study therefore deals with carbohydrate status of some soils of South Andaman Island which are situated on the tops of the hills with substantial exposive towards the risk of erosion due to forest exploitation.

EXPERIMENTAL

Study site

The study was carried out in the Jirkatang and Kalatang blocks of South Andaman Island, description of which has been given elsewhere (Sharma *et al* 1980) and Condensed in table 1. The area under study in general is undulating with underlying rocks consisting of

Forest Soil-Vegetation Survey Forest Research Institute & Colleges, Dehra dun.

sandstones and extensive intrusion of serpentine. The climate is wet tropical with mean maximum and minimum temperature of 34.0°C and 20.7°C respectively. The rainfall of the area ranges between 3200mm and 3400mm with common occurrence of South - West monsoon (May to October) and North-East monsoon (November to December) *Dipterocarpus Kerrii* is the most common species on the hill tops but is absent in the valley and flat lands. The other species present are *Artocarpus cheplasha, Planchoria andamanica Pterocymbium aceroides, Myristica and amanica* etc., with good regeneration of *Dipterocarpus kerrii*. The soils are generally acidic in nature with fairly rich amount of nitrogen and available phosphorous. High rainfall and heavy leaching have probably removed the clay of the surface layer to the lower layers. The *in situ* soils at the hill tops and mounds are generally pale brown in colour with higher organic matter and higher exchange capacity as compared to the soils of adjoining valley lands which are richer in magnesium content (Sharma *et al* 1980). Organic accumulation and weak grades of structure were the other morphological features which were found prominent in these soils.

MEASUREMENT OF CARBOHYDRATES

The carbohydrates in the soils were measured by the method of Morris (1948) as modified by Brink *et al.* (1960) and Singh & Singhal (1974). For this purpose 5g of the soil was hydrolysed with 50 ml of $3N/H_2SO_4$ for 24 hours at 85°C, and colour developed in 5 ml of the dilute hydrolysates in a 12×1.3cm Pyrex test tube with 0.2 percent anthrone. The optical densities of the clear green solutions so obtained were read at 625 mμ wavelength on Systronic spectrophotometer against a water-anthrone blank. Since aminosugars and sugar alcohols do not give any colour with anthrone, and penteses and uronic acids produce negligible absorption at 625mμ wavelength, the carbohydrates measured were mainly hexoses, methyl hexoses and 6-deoxy hexoses. Absorption spectra of glucose (75 mg/100ml) and soil hydrolysates were also obtained between 400 and 800 mμ for the purpose of comparison.

RESULTS AND DISCUSSION

The content of carbohydrates (Table 2) is maximum in the surface horizons of all the profiles under study and decreases with depth down the profiles, due mainly to higher availability of carbohydrates in fresh litter (Sowden & Ivarson 1962). This also shows an intense microbial activity in the mineral horizons and *in situ* formation of the polysaccharides (Bernier, 1958) in these soils. It was interesting to see that the soils of Jirkatang (Profile III) contain less carbohydrates and their carbons as compared to soils of Kalatang which can be accounted for their lower humic acids content and lesser attachment of sugar molecules with them as reported earlier (Singhal & Sharma 1980). However when these soils are compared with the soils of dry deciduous forests (Singhal & Dev 1977), it is seen that they contain lesser amount which is probably due to difference in the degree of microbical activity and the content of lignin in their litter.

As can be seen from table 3 the values of optical density are higher at the surface as compared to sub-surface They are comparatively higher in the soils of Kalatang than Jirkatang which indicates increased rate of polymerisation in the former. However this is better judged by their absorption spectra where the resemblance between the sub surface and glucose is well expressed. The above observation thus clearly indicates a hexose nature of the carbohydrates at the surface with lesser degree of condensation of aromatic rings in them. The higher absorptions in the Kalatang soils may be accounted for the dispersion of their carbohydrates and their greater resistance towards electrolytes which may be comparatively more favourable for the formation of crumb structure in them (Forsyth, 1948). However in comparison to the soils of dry deciduous forests the soils of South Andaman forests seem to have greater dispersibility of carbohydrates and resistance towards electrolytes and as such more susceptible to the action of erosion due to forest exploitation.

The Junior author is thankfull to Dr. S. C. Mishra, Research Officer, Forest Entomology Branch for providing facilities of Spectrophotometer and to the members of Soil Survey party, Forest Soil-Vegetation Survey, F. R. I. & Colleges, Dehra Dun, which visited Andamans in 1976 for their help during the collection of soil samples.

REFERENCES

BERNIER, B. (1958). Characterization of Polysaccharides isolated from forest soils *Biochem J.*, 70: 590-96

BRINK Jr., R. H., DUBACH P. and LYNCH, D.L. 1960). Measurement of carbohydrates in soil hydrolysates with anthrone *Soil Sci.*, 89; 157-67.

FORSYTH, W.G.C. (1948). Carbohydrate Metabolism in the soil *Chem. & Ind.* (London), 41: 515.

JOHNSTON, H. H. (1961). Common sugars found in soils. *Proc. Soil. Sci. Soc. Amer.*, 28: 415

MORRIS, D L. (1948). Quantitative determination of carbohydrates with Dregwood's Anthrone Reagent. *Science*, 107 : 254-255.

SHARMA, S K. BANERJEE, S. P. & SHARMA, S. D. (1980) *Indian Forester* (under publication)

SINGH S. and SINGHAL, R.M. (1974), Measurement of carbohydrates in the Acid Hydrolysates of some outer Himalayan soils. *J. India Soc. Soil Sci*, 22: (4) 290-93.

SINGHAL, R. M. and DEV SATINDER (1977) Alteration in soil Carbohydrates consequent upon growing *Eucalyptus* in natural sal (*Shorea robusta*) areas of Doon valley, *Ind. For.* 103 (6). 403-410.

SINGHAL. R. M. & SHARMA, S. D (1980) Presented in the Golden Jubillee session of National Academy of Sciences (Allahabad) in October, 80

SOWDEN, F. J. and IVARSON, K C. (1962) Decomposition of forest litters III. Changes in the carbohydrate constituents, *Pl Soil* 16: 389-400.

YADAV, J S P., (1967) Soil studies in Andaman Evergreen Forests *Ind. For.* 93 (9): 649

YADAV, J S.P., BANERJEE, S.P., BADOLA, K.C. and SINGH K (1973) Changes in soil properties in forest soils of west Dehra Dun Division consequent upon growing *Eucalyptus* in sal (*Shorea robusta*) zone. *Indian J. Agril. Chemist.*, 6

TABLE 1 Physico - Chemical Properties of the Soils

Locality	Depth (cm)	Colour (Dry)	Clay %	*Texture	Organic Carbon %	Total nitrogen %	pH
1	2	3	4	5	6	7	8
Kalatang	0 – 9	10YR 7/3	19.39	L.	1.78	.123	4.3
	9 – 36	10YR 7/4	26.37	C.L.	0.48	.070	4.8
	36 – 85	10YR 7/4	33 54	C.L.	0 36	.051	5.1
	85 – 103	10YR 7/4	31.61	C.L.	0.28	.042	4.8
	03 – 165	10YR 7/4	33.68	C.L.	0.18	.022	5 0
Kalatong	0 – 17	70YR 6/3	21.81	S.C.L	1.48	.118	5.3
	17 – 37	10YR 6/3	16.29	S L.	0.80	.091	5.1
	31 – 110	10YR 6/3	32 68	C.L.	0.84	.072	4 8
Jirkatang	0 – 9	10YR 8/4	34.72	C.L.	1.70	.147	4.9
	9 – 53	10YR 8/3	53.36	C.	0.62	.068	4.7
	53 – 86	2.5Y 8/4	57.53	C.	0.44	.061	4.7
	86 – 110	2.5Y 8/4	59.36	C.	0.32	.037	4.9

*SL = Sandy Loam, L = Loam, CL = Clay loam, SCL = Sandy Clay loam, C = Clay

TABLE 2 Carbohydrate Content of the soils

Profile No.	Depth (cm)	Carbohydrate (mg/100g soil)	Carbohydrate Carbon* %
1	2	3	4
1	0–9	760	.304
	9–36	400	.160
	36–85	290	.116
	85–103	160	.064
2	0–17	680	.272
	17–31	250	.100
	31–110	60	.024
3	0–9	420	.168
	9–53	276	.110
	53–86	260	.104
	86–110	224	.089

*Carbohydrate Carbon =40% of total Carbohydrate

TABLE 3 Absorption spectra of Carbohydrates in the soil hydrolysates (surface and sub-surface layers)

Profile No.	Dept (cm)	Optical densities at wavelength (mμ) 400	500	600	625	700	800
1	2	3	4	5	6	7	8
1	0–9	.136	.589	.789	.825	.330	.275
	9–36	.102	.288	.495	.515	.175	.125
2	0–17	.133	.550	.678	.700	.300	.235
	17–31	.070	.123	.265	.300	.111	.075
3	0–9	.101	.450	.575	.600	.275	.190
	9–53	.075	.150	.300	.330	.125	.075
4	Glucose (75mg/100ml)	.100	.350	.850	.905	.280	.180