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SEASONAL VARIATION OF SOIL CHEMISTRY IN DEULIJHOR HOT SPRING, ODISHA, INDIA

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Abstract: The edaphic factor plays an important role to determine the nature and character of life in an environment. Soil system is a complex and dynamic since from its formation. In an environmental condition, the soil profile changes from time to time with interaction of its abiotic and biotic factors. In a climate condition, soil plays a vital role for formation of organic nutrients from its inorganic constituents. Soil act as a substratum for operating bio-geo chemical cycle. Highest C/N ratio during summer and lowest C/N ratio in rainy season. The pH determines nature of soil. It depends upon parent natural, weathering of rocks also influences and transfer its materials due to continuous influx and out flux from different sources. Hydrosere succession level aquatic flora and fauna primarily forms humus soil that is suitable for life in a climax community.

Key words: Seasonal variation; soil chemistry; Deulijhor Hot Spring; edaphic factor; humus.

INTRODUCTION

Soil system is a complex one and undergoes continuous changes starting from its formation. The system is therefore dynamic and all changes are going on in the soil due to number of environment factors. It plays an important role in determining characters of an eco-system. It is a bio-logical substratum on which the organisms survive and hence considered as a "Biological Laboratory" (Jhingran, 1991). In an aquatic ecosystem soil is the source of nutrients for primary productivity of water. Nutrients are produced in water by chemical and bio chemical process as going on in the clay consisting raw organic matters and minerals. Soil is the measure nutrient store house which supply basic requirements for vital functions of plant system. Thus sediment is an independent dynamic body of nature that acquires the properties in accordance with the force which act upon it.

Aquatic flora and fauna play an important role in the formation of soil (Jacot, 1936). They also aid in the production of humus. The chemical elements available in the medium passed from one compound to another. From one stage of the cycle to another, but initially they are released from the store house of the soil (Jhingran, 1978). Chemical condition of soil of different ponds and paddy fields are carried out Lentsch (1924), Hickling (1962), Banerjea (1967) and Malida (1967). Cycling of nutrients between the soil and biota has been studied by Witkamp (1971).

Soil as the natural environment is the uppermost layer of earth crust able to anchor the plant growth and harbor millions of organisms responsible for tremendous bio chemical reactions leading to continuity of life cycle in nature (Waksman, 1952). It is made of constituents of liquid, soil and gaseous nature being grouped in mineral, water and gases (Joffe, 1965).

MATERIALS AND METHODS

Soil samples are collected (Pl-VII) from different spots of the hot spring with the help of Ekman's dredge. Aquatic vegetation and scum of any were cleaned from the sampling soil. The upper Peaty layer over the soil sediments were scrapped off. From the bottom of hot spring 1k.g. of wet soil was collected in plastic bags and was taken to the laboratory. Then the soil sample was air dried completely, powdered on and wooden platform and mixed together thoroughly. By the help of a thick cloth having 0.2mm mesh size the powdered soil sample were sieved and fine powders of soil were collected for chemical analysis.

Chemical analysis of the soil was made seasonally during winter (November to February), Summer (March to June) and rainy (July to October) chemical analysis of the soil was made to estimate the following. (1) PH (2) Organic Carbon (%) (3) Available Nitrogen mg/100gm (4) Organic matter (%) (5) Organic Sulphur (%) (Pandeye *et al.,* 1968, Singh *et al.,* (1998-99).

RESULTS

Chemical Characteristics of the soil from the hot spring

Soil was collected from the hot spring during 2005 and 2006 and chemical composition was determined in the laboratory as per the method cited earlier. The results are recorded in table 1 and 2.

Table 1: Seasonal Variations in Chemical Composition of Soil collected from hot spring during – 2005.

Season	Soil type	pH	% of total Nitrogen	% of organic Carbon	% of total Sulphur	C/N ratio	C/S Ratio	N/S ratio	Organic matter (%)
Winter (Nov-Feb)	Mixed sandy & Loamy	6.8	0.064	0.165	0.509	2.57	0.324	0.125	0.284
Summer (Mar.-Jan)	Mixed sandy & Loamy	7.0	0.025	0.196	0.527	7.84	0.372	0.048	0.337
Rainy (July- Oct.)	Mixed sandy & Loamy	7.1	0.097	0.143	0.491	1.47	0.291	0.197	0.246
Average	---	6.966	0.062	0.168	0.509	3.96	0.329	0.123	0.289

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Table 2: Seasonal Variations in Chemical Composition of Soil collected from hot spring during – 2006.

Season	Soil type	pH	% of total Nitrogen	% of organic Carbon	% of total Sulphur	C/N ratio	C/S Ratio	N/S ratio	Organic matter (%)
Winter (Nov-Feb)	Mixed sandy & Loamy	6.9	0.067	0.163	0.507	2.43	0.321	0.132	0.281
Summer (Mar.-Jan)	Mixed sandy & Loamy	6.9	0.023	0.197	0.520	8.56	0.378	0.044	0.339
Rainy (July- Oct.)	Mixed sandy & Loamy	7.0	0.099	0.142	0.496	1.43	0.286	0.199	0.244
Average	---	6.933	0.063	0.163	0.507	4.14	0.325	0.125	0.288

Soil at the bottom of the hot spring was mixed sandy and loamy type throughout the year. Soil texture did not change appreciably of its configurations.

Hydrogen ion Concentration (pH)

Hydrogen ion concentration (pH) of soil was found to be maximum i.e. 7.1 in rainy season and minimum 6.8 in winter season during 2005. However the average annual pH ranges from 6.93 to 6.97 during 2005 and 2006. Therefore the soil is slightly acidic (pH<7) or Neutral.

Average Nitrogen (%), Sulphur (%) and Organic Carbon (%)

The seasonal variations in percentage of nitrogen, sulphur and organic carbon of the soil ranged from 0.023 to 0.099, 0.491 to 0.527 and 0.142 to 0.197 respectively. The highest value (0.099) of total Nitrogen was reported during rainy 2006 and lowest (0.023) during summer 2006. Average value was obtained 0.062 during 2005 and 0.063 during 2006.

The highest value (0.527) of total sulphur was reported during summer season 2005 and lowest (0.491) during rainy 2005. Average value was 0.509 during 2005 and 0.507 during 2006.

The highest value of organic carbon (0.197) was reported during summer 2006 and lowest (0.142) during rainy 2006. Average value was 0.168 during 2005 and 0.167 during 2006.

Organic matter

The percentage of organic matter varied from 0.246 to 0.343. Higher concentrations were reported during summer 2006 whereas lower concentrations were reported during rainy 2005. Average value was 0.289 during 2005 and 0.291 during 2006.

C/N, C/S and N/S Ratio

C/N, C/S and N/S Ratio varied in different seasons according to the percentage of organic carbon, nitrogen and sulphur contents of the soil. The highest value of C/N ratio (8.56) was reported during summer 2006 and lowest (1.43) during rainy 2006. Average value was 3.96 during 2005 and 4.14 during 2006. The highest value of C/S ratio (0.378) was reported during summer 2006 and lowest (0.286) during rainy 2006. Average value was 0.329 during 2005 and 0.325 during 2006. The highest value of N/S ratio (0.199) was reported during rainy 2006 and lowest (0.044) during summer 2006. Average value was 0.123 during 2005 and 0.135 during 2006.

DISCUSSION

pH is one of the most important characteristics of the soil and is affected by CO_2 and solutes of the medium(waksmann,1932, Zobell,1946 , Daubemire, 1947, Nayak, 1986). it depend on the nature of the parent material, degree of weathering and extent of activities including de composition. It acts as a specific limiting factor for the population and index of overall conditions, influencing on the transformation of the soluble phosphate and controlling the absorption and release of ions of essential nutrients at soil water inter face (Nayak,1986).

The pH of bottom soil was observed to be near to neutral and slightly acidic. This may be accounted for continuous agitation of water due to sulphur flux (Vapour). According to the report of sand and Antoine (1979), the neutrality of hot spring water may cause due to well aeration of bottom, sediments and effect of Phytoplankton population. The hot spring environment is hot and humid for Phytoplankton growth; therefore, the causative factor neutral pH may be referred to the sulphur load in the water. Mohanto (2000) said that pH level during rainy season is comparatively high and further argued that the value is referred to the heavy accumulation of water through run off from the upland area which carry certain minerals, nutrients and either as factors responsible for the low pH. In summer and winter, pH value decreases vary little making the bottom soil slightly acidic.

Organic Carbon, Sulphur and total Nitrogen present in the soil of the substratum (bottom sediments) determine soil fertility. Always total Nitrogen is much less (about 5%) than the organic carbon (>45%). As per the Mishra (1968) and Patra (2007) nitrogen and Carbon contents of the soils are 0.06% and 0.09% and 0.6% and 0.5% respectively. The present study reveals both nitrogen and carbon contents of the bottom soil are of 0.06% and 0.17% respectively. Such poor soils incapable of supporting rich and healthy bacterial population. This supports the above researcher's views. Maximum value of carbon and nitrogen concentration was observed during summer season and according to Boralkar (1981) and Nayak (1986) this may be due to high temperature, hot and humid condition, accumulation of more content of organic carbon and organic sulphur in summer.

Further, the Nitrogen concentration in rainy season was found to be more (0.09%) in present investigation. Rise of Nitrates, Nitrogen content during rainy season may be attributed to the addition of nitrogen compounds due to leaching and run of water from nearby upland areas. (i.e. hilly zone). Microorganisms and blue green algae are responsible to place nitrogen cycle of water in the substratum soil where elementary nitrogen is

converted into complex proteineous state (Mishra, 1968). These nitrogenous materials in this form of nitrogen or allied compounds in the soil are broken down into simpler ammonia. In way nitrification ammonia is converted to nitrate by bacteria (i.e. in hot spring under study certain symbiotic bacteria are persisting and supply to the autotrophs. Carbon and Nitrogen ratio (3.96) is responsible to determine the fertility of the substratum soil.

Alexender (1961), Pillai and Sreenivasan (1975) and Jhingran (1991) reported that poor oxidation of soil sediments is not conductive for rapid decomposition of organic matter. Pillai and Sreenivasan (1975) recorded higher decomposition of organic matters at higher temperature. Therefore, higher temperature during summer accelerates the process of decomposition increasing the concentration of organic matter. In the present study it is observed that during rainy season percentage of organic matter slightly comes down because of (i) more dilution of water due to inflow of shower water and leaching process (ii) heavy rain fall increasing the water level thereby increasing the volume of water in the hot spring (iii) removal or expulsion of organic components from the soil sediment through outlet to the nearby channel. The concentration of organic matter in the substratum soil is also influenced by climate condition and variation in temperature, pH, rate of accumulation of dead tissue, topography and soil texture (Choudhuri, 1991)

Carbon and Nitrogen ratio (C/N) is most important for soil fertility as it is the indicative in the rate of decomposition of organic matter. This ratio is mainly responsible for the productivity of the system. According to Fork and Turk (1972) low C/N ratio indicates low rate of decomposition. Banarjee (1967) has classified the soil into four categories on the basis of C/N ratio so far as the productivity is concerned.

1. C/N value < 5 indicates poor production.
2. C/N value = 5 to 10 stands for better production.
3. C/N value = 10 to 15 stands for ideal production.
4. C/N value > 15 indicates less favourable for production

In this present investigation mean average C/N ratio per annum ranges from 3.90 to 4.14 which indicate poor production throughout the year. But during summer C/N ratio ranges 7.84 to 8.56 which is the maximum in both the study years. Similarly during rainy season C/N ratio ranges from 1.43 to 1.47 which is the minimum in both the years. In two occasions C/N ratio observed was less than 5 during rainy season indicating poor production (Table 1 and 2).

In hot spring C/N, C/S and N/S ratio and production can be improved if the hot spring is managed properly keeping away from bad habits of throwing of worship materials such as – flowers, fruits, leaves and other food materials. Seasonal de-siltation, causing siltation and finally turn into eutrophication creating awareness among the visitors and local people to protect the hot spring environment should be the motto of every person.

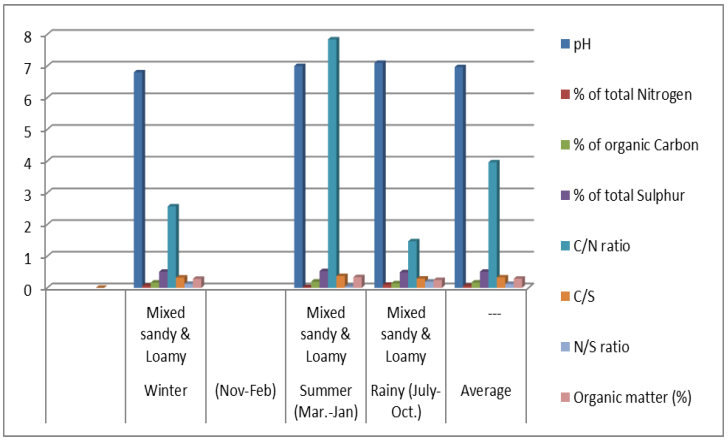

Fig.1: Average seasonal variation in Chemical composition of Hot spring Deulijhor (2005)

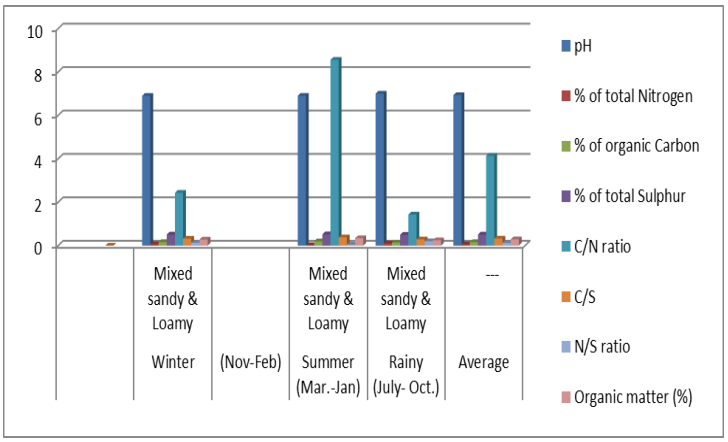

Fig.2: Average seasonal variation in Chemical composition of Hot Spring Deulijhor (2006)

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