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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF PHYSICO-CHEMICAL CHARACTERISTICS OF LATERITE SOIL.

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Abstract

The study examined certain physico-chemical characteristics of laterite soil of Pathanamthitta District, Kerala during three different seasons. Ten composite soil samples were collected from 10 different sites of Catholicate College Campus, Pathanamthitta District, Kerala, India. The physio-chemical characteristic features of the soil viz. pH, temperature, total soluble salt, organic carbon, phosphorous and potassium were analyzed by standard methods. The result showed that soil temperature varied such as 32^0c to 37^0c . pH of the soil varied from 6.5 to 7.5 and 4.6 to 7.0 in different soil samples. Total soluble salt remains constant in all the sites. Average value of organic carbon varies from 1.87 to 2.8 %. However average value of phosphorous and potassium varies from 31.05 to 34 Kg/Ha and 246 to 400 Kg/Ha respectively. The soil fertility characteristics have the ecological role on diversity and distribution of flora in the ecosystem.

Introduction:-

Soil is a complex heterogeneous living system placed between the lithosphere and the atmosphere (Basic 2013). It is an essential silicate mineral which exhibits bio productivity (Basic 2013). The nature and distribution pattern of different bio-community depends on the soil parameters (Paudel & Sah 2003; Iwara et al.2011).The soil parameters influences the chemistry and fertility management of tropical soils of Kerala (Byju and Varghese, 2001).The soil of Kerala is an acidic ferruginous, which is referred as lateritic soil of the regions of the Western Ghats of the South India.

The‘laterite’ or ‘lateritic soils’ of Kerala, belonging to the southern region of the Western Ghats of south India, have greater importance in industry and agriculture. ‘Laterite’ is equivalent to *Oxysalt* in USDA soil classification system (Chandran et al. 2005). Prolonged rainfall with intermittent dry seasons is the prime environmental conditions which influencing laterite formations in Kerala (Narayanaswamy 2005; Byju 2005). *Oxic Dystrustepts* (Soil Survey Staff 1999) in Kerala are considered as a kind of *inceptisols* enriched with iron and aluminium, developed by intensive and long lasting weathering of the underlying parent rock. These soils mainly occur in the midlands and part of low lands at an elevation of 10 to 100m above main sea level (msl) as a strip between the coastal belt and hilly mid-uplands of Kerala (Soil survey Organization 2007).

The seasonal variation mainly climate has a role in the soil formation (Byju, 2005).Data on fertility characteristics of many different soils are available (Kara and Bolat 2008; Ashagrie et al. 2004; Scroth et al. 2002; Bhojvaid and Timmer 1998; Maro et al.1993) whereas on wet tropical soils of south India, Pathanamthitta are quite negligible

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(Soil Survey Organization 2007). The major objective of this study was the analysis of sensitive fertility characteristics of laterite soils of Pathanamthitta District, Kerala during three different seasons.

Materials and methods:-

Area of study:-

Soil samples were collected in triplicate from Catholicate College, Pathanamthitta District ($9^0$16'N $76^0$47'E),Kerala during the three different seasons viz southwest, northeast and summer seasons. The climate of the Pathanamthitta District is humid with a short summer (January to April) and plentiful rainfall (average annual rain fall in the district is 2610.3 mm) available in two monsoon seasons - the southwest (May to August) and the northeast (September to December) monsoons. The annual average temperature of the area is 28.00 ºC (Soil Survey Organization, 2007).Among the three types of laterite soils in the State the soil under the current investigations belonged to a shallow soil type of less than 50 cm depth, having indurated laterite and laterite outcrops. This soil has five different series such as the Airavon, Adoor, Ayroor, Kumaranperur and Gudarakal. The study sites of the present investigation were distributed in the Ayroor series in the district (Soil Survey Organization, 2007).

Soil samples were collected from 10 different sites of the study area. Soil sampling and physico-chemical analyses were carried out as per standard methods (Jackson, 1973).Soil samples from 1-2 cm layer were taken for the analysis by using a sterilized blade. For physico-chemical studies, soil samples were randomly taken in each season. The different random samples were thoroughly mixed together to a general composite sample of about 500 gm and carried to the lab in separate cotton bags for further studies. Altogether 30 composite samples belonging to the three different seasons were collected from the study area for physico-chemical studies of soils.

Certain physico-chemical characteristic features of the soil viz. pH, total soluble salt, temperature, organic carbon,available phosphorous and potassium were analyzed. Soil *pH* and TSS were measured from 1:2 (neutral distilled water) soil pastes of air dried sample. Soil *pH* was measured using a pH meter (Systronics 324) and TSS using an electrical conductivity bridge (Systronics Conductivity Bridge 303). The temperature of the soil samples were measured directly from the field using a thermometer. Organic carbon, Available phosphorous (P) and available K were estimated as per Jackson (1973).

Results and Discussion:-

The variations in physico-chemical characteristics viz. pH, total soluble salt, temperature, organic carbon, available phosphorous and potassium of tropical laterite soils have been studied and the data were summarized in the table 1.

Soil Temperature:-

In all the spots, average temperature of the soil was highest during summer seasons (37^0c) and least was observed during southwest (32^0c) and northeast monsoon seasons. Similar results were observed in all other sites. Temperature is one of the soil forming factors which help in weathering and soil development (Sandeep et al. 2014).

Soil pH:-

Data on soil pH reveals that soils were acidic to neutral and alkaline in reaction; lowest pH was noted during the summer seasons (6.8) and highest pH was observed at monsoon seasons (7.5).The pH of all the sites varied from 6.5 to 7.5 and 4.6 to 7.0. The lower pH of certain sites was mainly due to leaching of bases by rainfall. Higher pH of certain sites may be due to the accumulation of bases.

The slightly acidic pH in the tropical soil (4.6) is similar to the previous reports elsewhere in the region (Soil Survey Staff 2007). In general, such soils are found to be more favorable than alkaline soils to support the diverse vegetation (Diaz-Maroto and Vila-Lameiro 2007). Since soil *pH* influence fertility management of tropical soils and the knowledge of its variations in soils enable understanding of the rate at which the laterisation precedes in a particular land use system (Byju 2001), the present study is useful to assess the ecology of soil fertility of tropical laterite soils in general.

TSS (Total Soluble Salts):-

Total soluble salts of all the study sites were quite same as 0.1ds/m. It indicates that low salt content was present in all the studied soil.

Organic Carbon:-
The data on organic carbon content ranged from 1.87 to 2.8 %. All soils of the study area fall under low to medium content category. During southwest monsoon season organic carbon was low (1.87) and slightly elevated in northeast monsoon and summer seasons (2.8). The differences in the amount of organic carbon are probably due to the differences of litter decomposition rate. The good percentage of organic carbon in the study sites was due to deposition processes and low soil erosion. This observation is in accordance with the results of Tsui et al (2004). The range in variations of soil organic carbon observed currently in the soils is comparatively higher than the observations of Karthikakuttyamma et al. (1998). But according to Sheikh et al. (2009) low amount of organic carbon in soils is due to wider spacing between trees, resulting in lower litter input. Balagopalan et al. (1992) found that higher organic carbon and exchangeable bases in soils depends on both the vegetation as well as climate, altitude and soil minerals.

Available phosphorous:-
The rate of available phosphorous (34 kg/ha^{-1}) was almost same in all the seasons. The present observation does not agree with that of Choudhury et al. (2006). The current observations of comparatively higher amount of available Phosphorous might be because of fast mineralization of litter in the wet season. Moreover, Phosphorous leaches out only very slowly from laterite soils (Jessy et al. 2009; Mathew and Thampatti 2007). According to Pandey and Srivastava (2009) plant available Phosphorous would increase with high rainfall. Phosphorous is reported to be the major limiting nutrient for productivity in tropical regions (Drinkwater and Snapp 2007), especially in the laterite soils of Kerala (Jessy et al.2009).

Available Potassium:-
The average rate of available potassium in all the sites was 400 kg/ha^{-1} in all the seasons. In general laterite soil is considered to be poor in Potassium (Ambily et al.2000). But a general increase in the amount of available Potassium noticed in all the regions in all the seasons, which agrees with the observations of Anu and Sabu (2007) in similar soil systems.

In general, physico-chemical characteristics of soils vary in space and time because variation in topography, climate, weathering processes, vegetation cover, microbial activities and several other biotic and a biotic factors. Plant tissues are the main source of organic matter, which influences the physico-chemical characteristics of soil (Johnston 1986).

Table 1:- Physico-chemical characteristics of tropical laterite soil

Samples No.	Seasons	Temperature (0C)	pH	C (%)	P(kg. /ha.)	K (kg. /ha.)	T.S.S (EC in mh cos /cm)
S1	SWM	32	7.3	1.87	34.5	400	0.1
	NEM	32	7.5	2.8	34.0	400	0.1
	SUM	37	6.8	2.8	34.0	400	0.1
S2	SWM	30	6.5	2.49	34.0	400	0.1
	NEM	29	7.5	2.03	34.0	400	0.1
	SUM	32	6.8	1.67	34.5	400	0.1
S3	SWM	25	6.8	2.4	34.5	291	0.1
	NEM	26	7.0	2.8	34.0	241	0.1
	SUM	36	7.0	0.54	34.0	297	0.1
S4	SWM	34	6.0	2.18	31.5	392	0.1
	NEM	32	7.5	1.96	34.0	400	0.1
	SUM	39	7.9	2.16	22.5	358	0.1
S5	SWM	26	5.7	1.46	34.5	392	0.1
	NEM	27	4.6	1.77	24.3	168	0.1
	SUM	34	7.0	1.04	34.0	207	0.1
S6	SWM	33	4.4	1.88	34.5	246	0.1
	NEM	36	6.5	2.70	30.5	358	0.1
	SUM	32	6.8	1.55	34.0	400	0.1

S7	SWM	36	4.2	2.03	34.5	400	0.1
	NEM	38	5.9	1.81	33.8	291	0.1
	SUM	37	6.8	1.90	31.0	400	0.1
S8	SWM	31	6.2	1.98	34.5	336	0.1
	NEM	32	7.0	1.96	30.1	400	0.1
	SUM	33	7.4	2.44	23.6	400	0.1
S9	SWM	39	6.5	2.48	31.0	400	0.1
	NEM	36	7.0	2.8	14.0	319	0.1
	SUM	36	6.7	2.54	20.4	400	0.1
S10	SWM	32	6.1	1.72	34.5	325	0.1
	NEM	31	6.7	2.08	20.9	258	0.1
	SUM	33	6.6	2.36	20.0	400	0.1

Abbreviations: S1 to S10- The ten different spots, SWM-South West Monsoon, NEM-North East Monsoon, Sum-Summer seasons, C- Organic Carbon, P- Available Phosphorous, K- Available Potassium, TSS- Total Soluble Salts

Conclusion:-

After the investigation it is clear that physic-chemical parameters of the soil vary significantly with seasons. During the transition of southwest monsoon to northeast monsoon, the temperature was almost stable; however high temperature was observed at the summer seasons. There was a significant increase in the soil pH observed during the transition of seasons. There was an increase in phosphorous and organic carbon content in season transition while the potassium content was varied.

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