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Physico-chemical properties of soil collected from Yercaud hills, Salem district, Tamil nadu, India

Geology

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ABSTRACT

The present study has been undertaken to evaluate physico-chemical parameters of soil samples collected from 'Yercaud hills, Salem district, Tamil nadu. The soil characterization was carried out. For parameters like pH, electrical conductivity, total chloride, total alkalinity, sulphate, mineral content, calcium, magnesium, sodium and potassium. During the course of study period, fluctuation in the various parameters were recorded. The variety of values was observed in the different parameters due to the soil quality in different area.

KEYWORDS:

Soil, Total calcium, porosity, mineral content.

INTRODUCTION

Soil is a major component of the biosphere. Soil is the largest surficial global carbon reservoir on earth, and it is potentially one of the most reactive to human disturbance and climate change. As the planet warms, soils will add carbon dioxide to the atmosphere due to its increased biological activity at higher temperatures. Soil is composed of particles of broken rock that have been altered by chemical and mechanical processes that include weathering and erosion (Bridges, 1997). The most possible sources of soil, water and plant pollutions are sewage sludge, residues of industrial factories and intensive fertilization (Abd El-Hady, 2007). The soil texture is determined by the relative proportions of sand, silt, and clay in the soil. Sand and silt are products of physical weathering while clay is the product of chemical weathering (Brown, 2003); it is a mixture of mineral and organic constituents that are in solid, gaseous and aqueous states (Buol *et al.*, 1989). The organic material of the soil has a powerful effect on its development, fertility, and available moisture. The amount of moisture found in soil varies greatly with the type of soil, climate and the amount of humus in that soil (Schoonover and Crim, 2015).

Each layer of soil may have a different pH, which means that pH can vary within the soil, although the differences are usually not too great (Mark *et al.*, 2012). Soil structure is the arrangement of soil particles into aggregates. These may have various shapes, sizes and degrees of development. The soil and vegetation relationship is dynamic as well as temporal. Several studies with regard to soil and correlation with plant growth have been done in deciduous forests of the country (Singhal and Sharma 1985; Minhas *et al.*, 1997).

MATERIALSAND METHODS

Collection site

The Yercaud (Shevaroy) hill is one of the major hill ranges on the southwest of the Eastern Ghats, in Salem district of Tamil Nadu. It is located between 11°46' to 11°77'N latitudes and 78°12' to 78°20'E longitudes. It covers an area of 470 km^2. The elevation ranges from 400 - 1600 m above mean sea level. They are rich in Archaean chamokites with a few belts of granite gneiss (Krishnan, 1956). The soil is red, loamy, lateritic, brown calcareous type. The forest receives both southwest (June - September) and northeast (October - December) monsoon rains, but the latter brings copious rain. The mean annual rainfall is 1500 – 2000 mm.

Collection of soil samples

The study area 'Yercaud' located in Salem District was marked for the characterization of soil samples. From the selective sites, samples were collected (1000 g) in the depth of 10 cm from the surface of land, which were taken in polythene bags. The soil samples were collected in the month of December 2014 from four different selective areas namely village, cultivated land, reserved forest and town area of Yercaud. These samples were brought to the laboratory for further analysis. The physico-chemical analysis of soil samples were carried out by the standard procedure recommended by Trivedi and Goel (1986). The soil samples were dried in oven to 105°C about 24 hours and grinded more finely. This powder was passed through 2 mm sieve and stored in polythene bag. The pH and electrical conductivity of soil can be measured. Total Chloride was determined by titrating it with $AgNO^3$. Total alkalinity was determined by titrating it with N/50 HCl using phenolphthalein and methyl orange as indicator. Sulphate was determined by gravimetric method. Organic matter was determined by titrating with ferrous ammonium sulphate. Na in the soil samples are determined by using the digital flame photometer (Elico Model CL22D).

Results

Plant residues have a carbon to nitrogen ratio (C/N) of 50:1. As the soil organic material is digested by arthropods and micro-organisms, the C/N decreases as the carbonaceous material is metabolized and carbon dioxide (CO_2) is released as a byproduct which then finds its way out of the soil and into the atmosphere. The percentage of organic carbon was found to be higher in village area soil sample (1.71) and it was found to be low in crop cultivated area soil sample (Table 1). The carbon percentages were 1.51 and 1.42 in forest soil sample and town area soil samples respectively (Table 1). The organic matter present in soil improves its structure, aeration and also protects the oxidation and precipitation of micronutrients into unavailable forms (Kumar and Babel, 2011). Nitrogen is the most critical element obtained by plants from the soil and is a bottleneck in plant growth. The total nitrogen content depends on the climate, vegetation, topography, age and soil management (Sommer *et al.*, 2014). Soil nitrogen typically decreases by 0.2 to 0.3% for every temperature increase by 10°C. Usually, more nitrogen is under grassland than under forest (Davis, 2001). Humus formation promotes nitrogen immobilization. Cultivation decreases soil nitrogen by exposing soil to more air which the bacteria can use, and no-tillage maintains more nitrogen than tillage (Busaria et al., 2015), the similar result was observed in the present study, the amount of nitrogen was found to be higher in forest soil sample (10.41) and it was found to be low with cultivated area soil sample (Table 1).

Phosphorus is the second most critical plant nutrient. The soil mineral is the most common mineral source of phosphorus. Phosphorus is largely immobile in the soil and is not leached but actually builds up in the surface layer if not cropped (Busaria et al., 2015). Total phosphorus is about 0.1 percent by weight of the soil, but only one percent of that is available. The amount of phosphorous was found range from 1.18-1.26. Calcium is one percent by weight of soils and is generally available but may be low as it is soluble and can be leached. It is thus low in sandy and heavily leached soil or strongly acidic mineral soil (Donahue Miller Shickluna, 1990). Calcium is supplied to the plant in the form of exchangeable ions and moderately soluble minerals. Calcium is more available on the soil colloids than is potassium because the common mineral calcite, CaCO3, is more soluble than potassium-bearing mineral (Donahue Miller Shickluna, 1990). The amount of calcium ranges from 38.74-53.43 (Fig. 1). A soil high in sodium, also known as a "sodic" soil, is one in which sodium occupies an excess amount of space on soil exchange sites. As soil sodium levels increase soluble calcium levels decrease. And its soluble calcium that gives soils its friable, loamy, permeable structure. A common mineral source of magnesium is the black mica mineral, biotite. Magnesium is generally available in soil, but is missing from some along the Gulf and Atlantic coasts of the United States due to leaching by heavy precipitation (Tharavathy, 2016). The sodium amount is high (10.26) in forest area soil sample and low (8.94) in cultivated area soil sample. In village soil sample (9.89) and town soil sample (9.95) is moderately equal amount (Fig. 1).

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Iron is a common constituent in soils. The iron content of soils is typically in the range of 0.5 % to 5 %, and is dependent upon the source rocks from which the soil was derived, transport mechanisms, and overall geochemical history (Zinati, 2005). Manganese (Mn) is an essential micronutrient in most organisms. In plants, it participates in the structure of photosynthetic proteins and enzymes. The highest concentrations of soluble and exchangeable Mn are found after hot, dry summers and under warm waterlogged conditions in acid soils. This is probably due to the inhibition of Mn-oxidizing organisms, thereby allowing the chemical reduction of Mn oxides in these soils (Sparrow and Uren, 1987; Conyers *et al*, 1997). The amount of ferrous was found to be higher in forest soil sample (1.52) and it was found to be low in village soil sample (1.21). The amount of manganese was found to be higher in reserved forest soil sample (0.64) and it was found to be low with town soil sample (0.58). The amount of copper was found to be higher town soil sample (1.30) and it was found to be low with village soil sample (0.122). The amount of zinc was found to be higher in reserved forest soil sample (1.15) and it was found to be low with town soil sample (0.05). The amount of boron was found to be higher forest soil sample (0.05) and it was found to be low with cultivated soil and town of soil samples (0.04). The boron (0.045) was in village land. The amount of sulphate was found to be higher village soil sample (1.76) and it was found to be low with town soil sample (1.41). The sulphate was 1.18 and 1.451 in cultivated area, forest soil samples respectively.

Soil minerals play a vital role in soil fertility since mineral surfaces serve as potential sites for nutrient storage. A Primary mineral comes directly from rock like pyrite. These minerals break down into different types of clay minerals. However, different types of soil minerals hold and retain differing amounts of nutrients. There are numerous types of minerals found in the soil. These minerals vary greatly in size and chemical composition. All of these different types of materials have different abilities to hold onto different nutrients and chemicals. The total minerals were found to be higher in cultivated land soil sample (24.31) and it was found to be low in (22.42) town of Yercaud soil samples (Fig. 2).

Discussion

The lithospheric layer of the earth's crust is a vital seam in the discipline of physical geography. The earth surface and its topography therefore are an intersection of climatic, action with geologic processes. Soil profiles and chemistry to learn about the history of a particular landscape and understand how climate, biota, and rock interact. From the results, it is concluded that the pH ranges (6.46-7.56) are moderately similar to all the soil samples (Table 1). The percentage of organic carbon was found to be higher in village area soil sample (1.71), may be anthropogenic activities this area. The amount of carbon is almost similar distribution in all the type of soil samples in the studied locations. The organic matter present in soil improves its structure, aeration and also protects the oxidation and precipitation of micronutrients into unavailable forms. Within the soil, CO_2 concentration is 10 to 100 times that of atmospheric levels but may rise to toxic levels if the soil porosity is low or if diffusion is impeded by flooding. Trace elements namely ferrous, manganese, copper, zinc, boron and sulphate are poor distribution in all the soil samples. In cultivated soil sample found high range of total minerals (24 %) due to the anthropogenic activities. Nitrogen contents in the all samples content similar the ranges from 9.86 to 10.41. Soil nitrogen typically decreases by 0.2 to 0.3% for every temperature increase by 10°C. Usually, more nitrogen is under grassland than under forest.

Humus formation promotes nitrogen immobilization. Cultivation decreases soil nitrogen by exposing soil to more air which the bacteria can use, and no-tillage maintains more nitrogen than tillage. The calcium content higher (53.43) in reserved forest (Fig. 1), its one percent by weight of soils and is generally available but may be low as it is soluble and can be leached. It is thus low in sandy and heavily leached soil or strongly acidic mineral soil. Calcium is supplied to the plant in the form of exchangeable ions and moderately soluble minerals; it is more available on the soil colloids than is potassium because the common mineral calcite, $CaCO_3$, is more soluble than potassium-bearing mineral (McKee and Wolf, 1963). The analyzed soil sample showed higher magnesium content (18.19) in reserved forest soil (Fig. 1); as soil sodium levels increase soluble calcium levels decrease, and its soluble calcium that gives soil its friable, loamy, permeable structure. A common mineral source of magnesium is the black mica mineral, biotite; it is essential to improve nitrogen and phosphorus content in the soil as NPK is a major essential nutrient required for the biotic components. The analysis of entire array of chemicals allow us to conclude that understanding of the levels of soil behavior under different heads and different physico chemical conditions require deep knowledge of internal structure of soil and the process involved in its response to these impacts and conditions.

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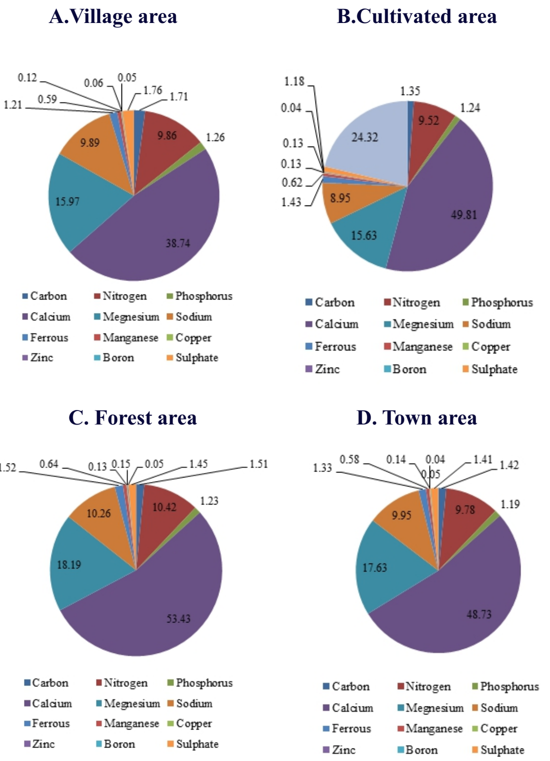
Table. 1 Physio-chemical properties of soil samples collected from different areas fromYercaud hills,Tamil nadu.

Analysis	Village area	Cultivated area	Forest area	Town area
pH	7.56	7.08	6.46	6.69
EC	0.12	0.42	0.48	0.51
Carbon (%)	1.71	1.35	1.51	1.42
Nitrogen (Kg/acre)	9.86	9.52	10.42	9.78
Phosphorus (Kg/acre)	1.26	1.24	1.23	1.19
Calcium (mg/kg)	38.74	49.81	53.43	48.73
Megnesium (mg/kg)	15.97	15.63	18.19	17.63
Sodium (mg/kg)	9.89	8.95	10.26	9.95
Ferrous (mg/kg)	1.21	1.43	1.52	1.33
Manganese (mg/kg)	0.59	0.62	0.64	0.58
Copper (mg/kg)	0.12	0.13	0.13	0.14
Zinc (mg/kg)	0.06	0.13	0.15	0.05
Boron (mg/kg)	0.05	0.04	0.05	0.04
Sulphate (mg/kg)	1.76	1.18	1.45	1.41
Total minerals (kg/acre)	22.84	24.32	23.07	22.43

Fig. 1 Physio-chemical properties of soil samples collected from different areas fromYercaud hills,Tamil nadu.



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