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SOIL PHYSICO-CHEMICALCHARACTERISTICS OF AN AGROECOSYSTEM FROM IMPHAL VALLEY,MANIPUR,NORTHEAST INDIA

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ABSTRACT In a study, soil physicochemical properties were studied in a paddy agroecosystem, NE India. Soil properties viz. texture, moisture, pH, bulk density, Organic Carbon,Available Nitrogen, Available Phosphorus and Available Potassium were studied at 0-10,10-20 and 20-30 cm depths at the study site ,investigation was carried out in kharif season of 2015 in case of rainfed *Oryza sativa* L. crop prior to transplantation after twenty annual cycles of rice-vegetables cropping sequence with annual application of inorganic fertilizers .Soil was found to be acidic with textural classification as sandy clay type. Organic Carbon was positively correlated with nutrients and clay and negatively with Bulk Density, sand and silt. Average storage value of nutrients upto 30 cm soil depth in the agroecosystem of Imphal reveal low status of Nitrogen and medium status of Phosphorus and Potassium indicating that continuous cycles of cultivation reduces the soil quality

KEYWORDS : Soil, Organic Carbon ,Nutrients,Storage,Agroecosystem

INTRODUCTION

Soil Organic matter influences many soil functions and occupies a key position in the global Carbon Cycle (Lal,2004). Cultivation is known to result in changes in soil physico-chemical and biological properties (Houghton et al,1999). Agricultural practices may rapidly diminish soil quality and lead to permanent degradation of land productivity when severely deteriorated (Kang and Juo, 1986; Nardi et al,1996; Islam and Weil,2000). Different management practices can affect soil structure, soil organic carbon and other nutrients reserve (Yeshanew et al,2003).

MATERIALAND METHODS

STUDY SITE

A study was conducted in paddy agro-ecosystem at Imphal East district, Manipur, North East India located at 24°46′ 21.76"N Latitude and 93°57′ 23.76"E Longitude at an elevation of 779 mMSL. The climate is subtropical, the climatic features are represented in the Ombrothermic Diagram (Fig1). The agroecosystem is rainfed with fertilizer-based cultivation of rice followed conventionally. In rabi season, cultivation of vegetables is preferred like potato, peas, tomato, cabbage etc. After harvesting, rice residue was annually removed in the studied site.

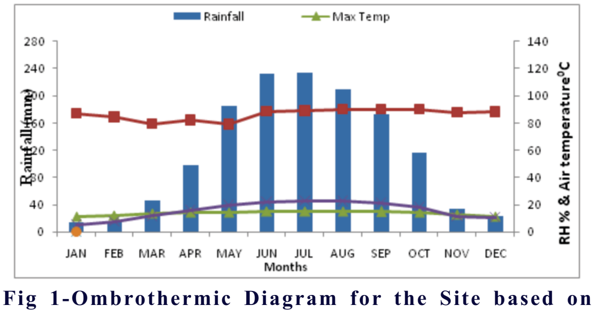


Fig 1-Ombrothermic Diagram for the Site based on meteorological data (2005- 2015).

In a study, soil physicochemical properties were studied after twenty annual cycles of rice-vegetables cropping sequence with an annual application of inorganic fertilizers Weeds were controlled by hand and by the use of herbicides. From the undisturbed soil at the studied site, an investigation was carried out in kharif season of 2015 in case of rainfed rice (*Oryza sativa* L.)crop prior to transplantation.

METHODS

Three replicates of soil samples were collected randomly at 0-10,10-20 and 20-30 cm depths. The samples collected from the plot were mixed, air dried, processed to pass through a 2 mm sieve and stored in polythene bags for analysis. The soil texture was determined by international pipette method of mechanical analysis given by Piper (1966). Determination of physico-chemical characteristics of soil viz. pH, Soil Moisture, Bulk Density, Organic Carbon, Available Nitrogen, Available Phosphorus, Available Potassium was done by following standard methods (Jackson, 1973).

All analyses were done by taking three replicates and data presented are the mean values of the three replicates from the study site. The concentration of nutrient obtained was multiplied by bulk density and depth of soil to get the amount of nutrient on a hectare basis. The objective was to evaluate the soil C stocks and nutrient storage profiles in a subtropical agroecosystem. Multiplying the soil organic carbon by 1.72 resulted in the SOM (Nelson and Sommers, 1996).

RESULTS AND DISCUSSION

Soil size distribution and water stability of soil aggregates would be influenced by crop types as well as soil management practices (Arshad and Coen, 1992). Sand content is a physical parameter affected by soil erosion and, hence, can be measured and used as an indicator for evaluating soil degradation (Ayoubi,2011). In paddy agro-ecosystem, sand content increased most likely as a result of preferential removal of silt and adding sand in soil surface by accelerated water erosion. Soil texture in the study site was found to be as sandy clay type with sand being the dominant particle followed by clay at all the three depths (Fig.2).

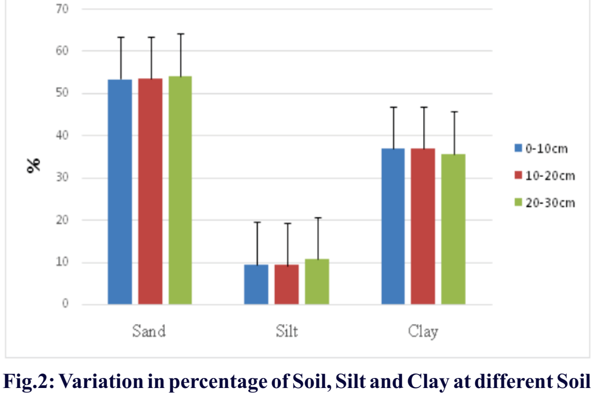


Fig.2: Variation in percentage of Soil, Silt and Clay at different Soil depths in an Agro ecosystem, Imphal.

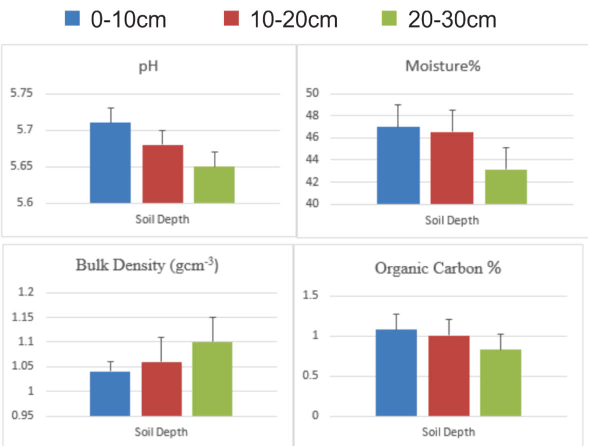
Soil water is the major component of the soil in relation to plant growth. The maximum average percentage moisture content of 47.00±3.19 at the surface was recorded which decreased with increase in depth. Soil moisture was found to be slightly higher under cover crops with higher biomass production (Ward et al., 2011).

The soils of agriculture land had the high bulk densities. According to Celik (2005) subsequent tillage practices resulted in increase in bulk density for surface soil. The results of this study are consistent with Ayoubi(2011).

Soil pH affects the physiology of plants like osmotic concentrations, thus affecting nutrient absorption.Its value was found to increase with depth. Similar results have been reported by Jayanthi et al. (2015) , Patton et al,(2005); Sharma et al. (2005) , Singh and Bordoloi (2011) for the soils in North-Eastern regions.

Soil organic carbon is one of the most important indicators of soil fertility, productivity and quality. It is both a source and sink of plant nutrients forming the most important renewable resource in soils (Duxbery et al., 1989). Annual mean soil organic carbon percentage was recorded as 1.08±0.47 at the surface that decreased with depth. About 30–60% Soil organic C concentration reduction has been reported on continuous long-term cultivation for a variety of soils from different agro climatic regions of India (Lal,2004).

Shukla et al (2006) reported that SOM has been the most powerful indicator for assessing soil potential and productivity and managements in the world. Cultivated soils generally have low organic matter content compared to native ecosystems, since cultivation increases aeration of soil, which enhances decomposition of SOM (Kizilkaya and Dengiz ,2010).The value of Organic matter recorded from the Paddy agro-ecosystem ranged from15.70±0.54 to 22.91±0.41 Mg ha-1 at the three depths with maximum value at the surface. The variation in depth of various parameters are reflected in the Fig.3.



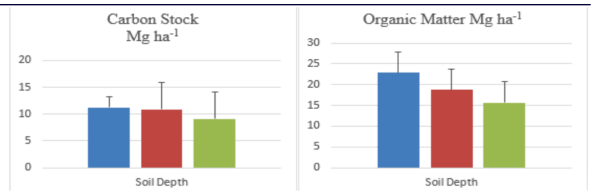


Fig.3: Variation in Physico-chemical Soil Characteristics (a)pH (b)Moisture (c) Bulk density (d) Organic Carbon (e) Carbon Stock (f) Organic Matter in Agro ecosystem , Imphal.

Nitrogen is an important limiting factor in the productivity of agro-ecosystems. Plants take up nitrogen from the soil in the form of ammonium and nitrate ions. The amount of available soil nitrogen was found to be higher in the upper layer of soil (0-10cm) and decreased with increase in the depth coinciding with high organic carbon in upper layer of the soil. Phosphorus in the soil solution is found in relatively low concentrations. Available phosphorus was found to decrease with depth and was recorded highest in the topmost layer due to the higher soil organic matter status. Vitousek (2004) has reported that loss of soil phosphorus (both inorganic and organic forms) by leaching is negligible in strongly-weathered soils. Potassium is a macro element among the minerals and very much essential for plant growth. The higher availability of potassium at surface layer is attributed to solubilisation of insoluble forms of potassium present in soil due to organic decomposition products and liberation of potassium from organic matter by decomposition (Mathew et al. 1977, Kumar et al. 1998).

The storage of nutrients up to 30 cms depth was computed respectively as 258.80±13.52 Kg ha^{-1}, 15.34±0.20 Kg ha^{-1} and 253.70±19.51 Kg ha^{-1} of the Available Nitrogen, Phosphorus and Available Potassium respectively which is reflected in the Box Plot Diagram in the agroecosystem of Imphal (Fig.4).

Fig.4 : Box Plot Diagram of Nutrients Storage up to 30 cm Soil depth in Agro ecosystem, Imphal.

Available Nitrogen storage was found to be maximum followed by Available Potassium and Available Phosphorus in the studied site.

Statistical Analysis

Pearson product moment correlation was worked out for the various physico-chemical soil parameters (Table 1).

Table 1 : Pearson Correlation Matrix for Physio-chemical Soil Characteristics in Agro- ecosystem, Imphal.

Parameters	Moisture	Bulk Density	Organic carbon	Available N	Available P	Available K	Sand	Silt	Clay
pH	.913**	-.982**	.969**	.983**	.998**	1.000**	-.866**	-.798**	.866**
Moisture		-.974**	.985**	.973**	.939**	.901**	-.995**	-.974**	.995**
Bulk Density			-.998**	-1.000**	-.993**	-.976**	.945**	.898**	-.945**
Organic carbon				.998**	.984**	.962**	-.962**	-.922**	.962**
Available N					.993**	.977**	-.944**	-.896**	.944**
Available P						.995**	-.899**	-.838**	.899**
Available K							-.852**	-.781**	.852**
Sand								.992**	-1.000**
Silt									-.992**

Correlation is significant at the 0.01 level (2-tailed)..

Organic Carbon was positively correlated with nutrients and clay and negatively with sand and silt. Similarly, all the Available nutrients were positively correlated with clay and negatively with sand and silt. Among soil particles sand was found to be positively correlated with silt but negatively correlated with clay. All the values were found to be significant at the 0.01 level (2-tailed).

CONCLUSION

Soil degradation is also exacerbated by soil nutrient depletion due to continuous cropping, incorrect management and absence of adequate soil nutrients. Loss of organic matter is expected to have soil aggregates easily broken down, and consequently the finer particles are transported by erosion whereas increased SOM improves aggregation, water holding capacity, nutrient-retention capacity and biodiversity in soil (Ayoubi,2011).

High amount of bulk density in agriculture land reveals weak and sensitive condition of cultivation land soil surfaces.Subsequent cultivation of soils had the negative effects on measured soil properties. Management practices that increase OC, Available Nitrogen ,Phosphorus and Potassium in the system should be included, when the land is continuously cultivated.

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