

Full Length Research Paper

Status of micronutrients in terrestrial soils of Thanjavur district, Tamilnadu, India

A Cholarajan¹ and R Vijayakumar²

¹ Research Scholar, Department of Microbiology, Bharathidasan University Constituent College for Women, Orathanadu - 614 625, Thanjavur Dt., Tamilnadu, India

² Department of Microbiology, Bharathidasan University Constituent College Perambalur – 621 107, Tamilnadu, India.

Accepted 31 May, 2013

The micronutrient status of rhizosphere soils of Thanjavur district, Tamilnadu was made at 9 different locations. The objective of the present study was to analyze the status of micronutrients and their relationship with various physiochemical properties. Soil samples were collected at a depth of 0-30cm and analyzed zinc (Zn), copper (Cu), iron (I) and manganese (Mg). The Zn, Cu, I and Mg ranged from 0.56 - 0.96, 0.57 - 0.96, 4.16 - 5.36 and 2.03 - 2.65 mg/kg⁻¹ respectively. Nutrient management is an integral part of profitable agrisystems, but in some areas of Tamilnadu inputs of fertilizer and manure nutrients in excess of crop requirements have led to a buildup of nutrient concentrations that are of environmental concern. There is an increasing awareness of the need to pay greater attention to the role of trace elements in plant nutrition as we seek to explain the adverse effects of deficiencies and toxicities, and avoid suboptimal concentrations that limit the attainment of optimum economic yields of crops. But some elements can accumulate even as traces to concentrations that are toxic to the plant. For example, plant growth is adversely affected by excess manganese (Mn) and aluminium (Al) in many soils if they are allowed to become acid, or by nickel (Ni), cobalt (Co) or chromium (Cr) in acid soils derived from minerals in which there is a natural abundance of these elements. In other soils, concentrations of trace elements have increased as a consequence of human activity and such pollution often results in increased plant uptake with adverse effects on humans, as for example with cadmium (Cd). In these cases it is essential to ensure that the concentration of the element in the soil solution does not exceed an agreed critical value.

Keywords: rhizosphere soil, physico-chemical properties, micro nutrients, terrestrial ecosystem, agricultural field.

INTRODUCTION

Soil is the thin layer on the surface of the Earth on which the living beings of the earth survive since it is the layer of materials in which plants have their roots. A productive soil builds the foundation for any successful crop land. The higher soil quality, the better it performs. Soil is made up of many things like weathered rock particles and decayed plant and animal matter with varying ratios of minerals, air, water and organic material. Soil fertility is an important factor, which determines the growth of plant. Soil fertility is determined by the presence or absence of nutrients i.e. macro and micronutrients. Out of the 16

plants nutrients, Zn, Cu, I, Mg, Mo, Cl and B are referred as micronutrients. These elements are required in minute quantities for plant growth, but have the same agronomic importance as macronutrients have and play a vital role in the growth of plants. Micronutrients also increase plant productivity, leaf and grain yield. Most of the micronutrients are associated with the enzymatic system of plants. Whenever a micronutrient is deficient, the abnormal growth of plant results which sometime cause complete failure of crop plants. Grains and flower formation does not take place in severe deficiency. The main sources of these micronutrients are parent material, sewage sludge, town refuse, farmyard manure (FYM) and organic matter. These nutrients are present in small amounts ranging from few mg kg⁻¹ to several thousand

*Corresponding authors: E-mail: chola_rajan2000@yahoo.com

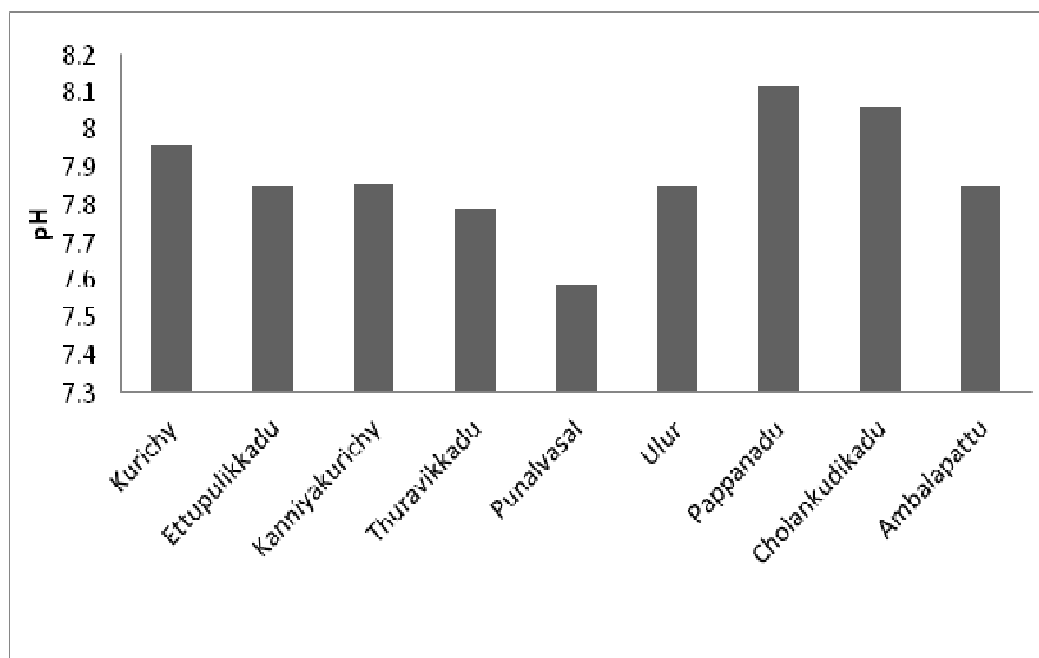


Figure 1: Variations of soil pH in the terrestrial ecosystem

mg kg⁻¹ in soils (Rajkumar *et al.*, 1996).

The availability of micronutrients is particularly sensitive to changes in soil environment. The factors that affect the contents of such micronutrients are organic matter, soil pH, lime content, sand, silt, and clay contents revealed from different research experiments. There is also correlation among the micronutrients contents and above-mentioned properties (Sheeja *et al.*, 1994).

The total area under cultivation of Thanjavur district of Tamilnadu is approximately 1,50,000 hectares. The major crops cultivated are rice, coconut and casuarinas while minor crops include gram, pulse, oil seed and vegetables. Thanjavur district divided into seven administrative Taluks namely; Thanjavur, Pattukkotai, Peravurani, Orathanadu, Kumbakonam, Papanasam, Thiruvaiyaru and Thiruvaidaimarudhur. The soils of this region are generally used for rice, coconut, vegetables and crop production. The objective of the present study was to determine the physical and chemical properties of rhizosphere soil from various locations of Thanjavur district, Tamilnadu.

MATERIALS AND METHODS

Sample Collection

In the present study, the soil samples were collected from eight different locations of Thanjavur district, Tamilnadu namely Kurichy, Ettupulikkadu, Kanniyakurichy, Thuravikkadu, Punalwasal, Ulur, Pappanadu, Cholankudikadu and Ambalapattu. Soil samples were

collected from rhizosphere zone of plants in sterile containers. Four to six pits were dug for each sampling station at a depth 0-30cm. A composite sample of about 1kg was taken through mixing of represented rhizosphere soil sample. All composite samples were dried in shade condition and passed through 2mm sieve. After sieving all the samples were packed in sterile polythene bags for laboratory investigations.

Analysis of Soil physic-chemical properties: The Zn, Cu, I and Mg were determined using the standard method given by Havlin and Sultanpour (1981). Rhizosphere soil pH was determined in 1:5 (soil: water) suspensions (U.S.D.A. Hand Book, 1954). Organic matter was determined by the methods of Walkely. Lime content was determined by acid neutralization method (Black, 1965). Rhizosphere soil texture was determined by hydrometer method (Koehler *et al.*, 1984).

RESULTS AND DISCUSSION

Thanjavur district of Tamilnadu has deep and fertile soils. It can be grouped into two categories namely 1) alluvial soil and 2) lateritic soil. Alluvial soil is found to occur in the old delta region comprising the major portion of the zone lying in the northern part whereas, lateritic soil covers new delta region lying in the southern part of the district. The alluvial soils are clayey in texture with 40 - 45 per cent clay fraction (Cauvery Delta Zone – Status Paper; Proper Literature not found). In the present study, edaphic factors results (Figure: 1) showed that the rhizosphere soils of Thanjavur district were alkaline in

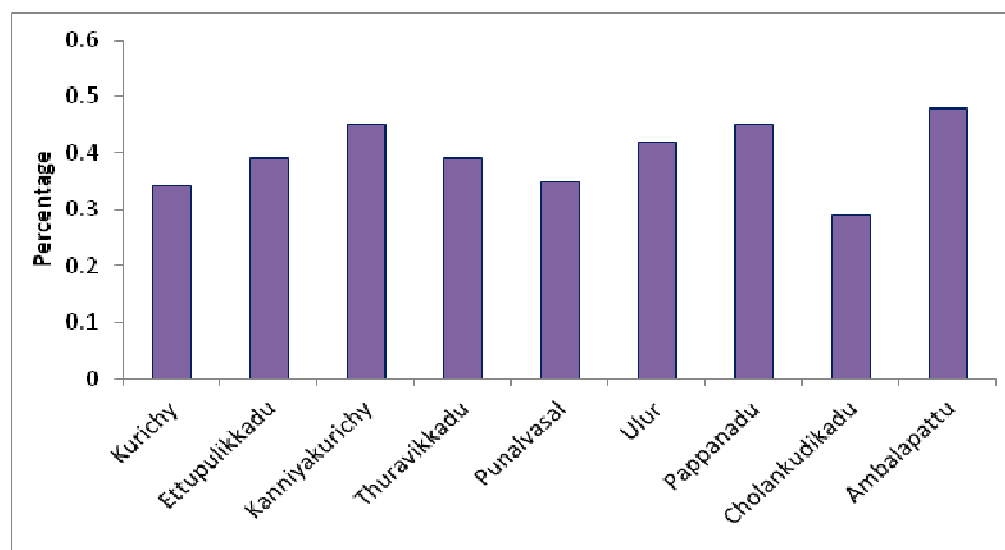


Figure 2: Variations of soil organic matter in the terrestrial ecosystem

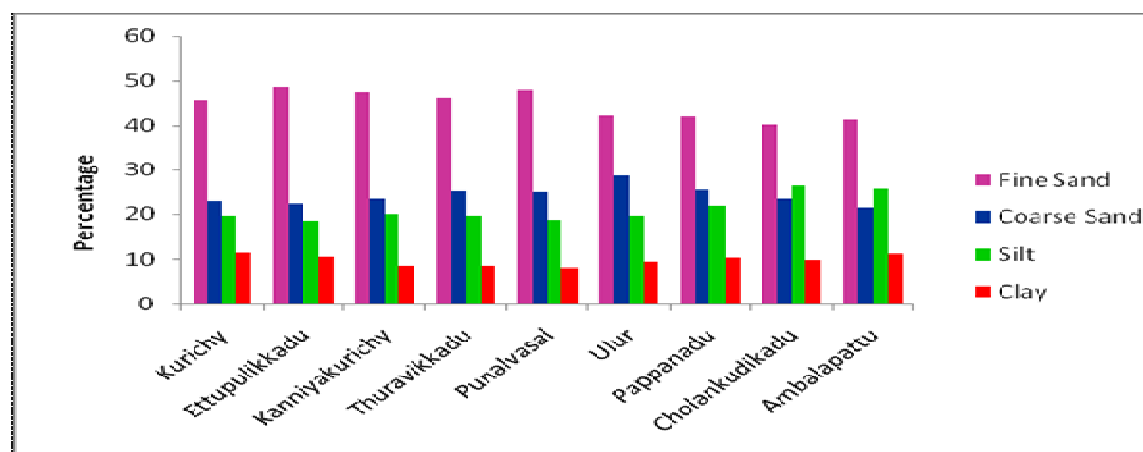


Figure 3: Variations of soil texture in the terrestrial ecosystem

nature. The maximum soil pH (8.12) was recorded at Pappaandu, whereas minimum pH (7.59) was recorded at Punalvasal soils. The present study also recorded average pH of the rhizosphere soil as 7.88 from eight locations of Thanjavur district.

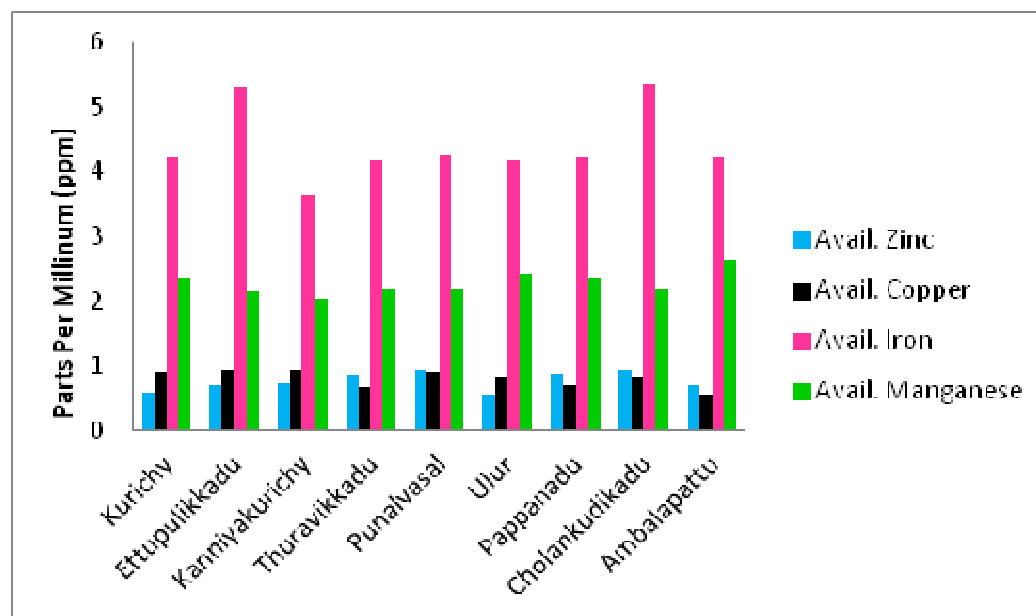
The maximum organic matter of the soil was (0.48%) recorded at Ambalappattu, whereas minimum (0.29%) was recorded at Cholankudikkadu soils (Figure: 2). The average organic matter content of the soil was as 0.39 %. The maximum fine and coarse sand contents of the soil were recorded from Ettupulikkadu (48.62%) and Ulur (28.65%) respectively. Further, the average fine and coarse sand contents of the soil were 44.72% and 24.33% respectively. The silt and clay content of was maximum in Cholankudikkadu (26.41%) and Kurichy (11.51%) respectively (Figure: 3). The average silt and

clay content of the rhizosphere soil was 21.16% and 9.77% respectively. Similar type of work has been reported by many workers physico - chemical properties of the rhizosphere soil of the *Curcuma longa* L. was analyzed by Sumathi *et al.* (2008); rehabilitated and secondary forests soil physico – chemical properties by Akbar *et al.*, (2010).

In addition, most of the rhizosphere soils of the present study were appeared blackish brown in colour and texture was sandy clay loam in nature. The lime content of the soil was present only in Pappanadu and Cholankudikkadu. The heavy metals (ppm) also present in all the eight sampling stations (Table 1). The crop rhizosphere soils were also analyzed for its micronutrients such as available Zn, Cu, I and Mg. The maximum content of available Zn (0.96 ppm),

Table 1. Variations in the structure of terrestrial soils

Parameter	Kurichy	Ettupulikkadu	Kanniyakurichy	Thuravikkadu	Punalvasal	Ulur	Pappanadu	Cholankudikadu	Ambalapattu
Colour	Blackish Brown	Blackish Brown	Blackish Brown	Blackish Brown	Blackish Brown	Blackish Brown	Blackish Brown	Blackish Brown	Blackish Brown
Texture	Sandy Clay	Sandy Clay Loam	Sandy Clay Loam	Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam
Lime Status	Nil	Nil	Nil	Nil	Nil	Nil	Present	Present	Nil
Heavy metals (ppm)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

**Figure 4:** Variations of soil micronutrients in the terrestrial ecosystem

Cu (0.96 ppm), I (5.36 ppm) and Mg (2.65 ppm) was recorded in rhizosphere soils of the Punalvasal, Kanniyakurichy, Cholankudikkadu and Ambalapattu respectively (Figure. 4).

Similarly, Perveen *et al.* (1993) studied micronutrient status of some agriculturally important soil series of the Northwest Frontier Province, Pakistan and their relationship with

various physico-chemical properties for 30 soil series. Most sandy soils (coarse texture) are deficient in micronutrients. Clay soils (fine texture) are not comparatively to low in plant available

micronutrients. Chhabra et al., (1996) studied that available Mg and I decreased with soil pH and available Cu increased with clay and organic carbon content and available I decreased with sand content. Hence, the correlation co-efficient analysis between the soil physico-chemical parameters and microbial population of rhizosphere soils of crop plant have suggested as future course work.

Soil fertility is an important factor, which determines the growth of plant. Soil fertility is determined by the presence or absence of nutrients i.e. macro and micronutrients. A basic soil test will provide information on soil texture, organic matter, pH, buffer index, phosphorus, potassium and nitrate. Most of the soil tests will give a range for the nutrients, such as low, medium and high, to give an indication of relative amounts of nutrients in the soil. When a nutrient is in the low range, it means that added inputs of that nutrient will likely show a strong growth response in the next crop planted. A conventional soil laboratory will provide fertilizer recommendations based on the next crop. On the whole, it was reported that the physico – chemical properties of the soil will be influenced by the annual crop rotation practice, quality of water used for irrigation and application of chemical fertilizer and so on.

CONCLUSION

The soil texture greatly influences water availability. The sandy soil can quickly be recharged with soil moisture but is unable to hold as much water as the soils with heavier textures. As texture becomes heavier, the wilting point increases because fine soils with narrow pore spacing hold water more tightly than soils with wide pore spacing. The texture of soil on the basis of water holding capacity was found to be Loam sandy.

There is an increasing awareness of the need to assess plant micronutrient requirements and their availabilities in soil as deficiencies of macronutrients are corrected. The quantity of a micronutrient that is available for plant uptake is invariably very much less than the total amount in soil and the availability of each micronutrient depends on the form – mineral or organic complex – in which it can be taken up by plant roots. A complicating factor of great importance is the fact that the relative proportions of the forms in which micronutrients occur in soil can change with soil pH and redox potential and the amount of soil organic matter.

Thus the availability of micronutrients changes with soil conditions and this makes generalizations extremely difficult. Improvements in analytical techniques for determining micronutrients in plant tissue and available forms in soil in recent years suggest that refinements in estimating critical concentrations in plants and soils should be possible. With such information, correcting deficiencies, recognizing toxicities and defining suboptimal micronutrient levels in soils and plants should ensure that no nutrient limits the attainment of optimum economic yields of crops and performance of animals. But to achieve this will also require that the best forms and ways of delivering micronutrients, i.e. by foliar application or by addition to the soil, are adequately researched.

REFERENCES

- Akbar MH, Ahmed OH, Jamaluddin AS, Nik Ab. Majid NM, Abdul-Hamid H, Jusop S, Hassan A, Yusof KH, Abdu A (2010). Differences in soil physical and chemical properties of rehabilitated and secondary forests., *American J Appl Sci*, 7:1200-1209
- Black CA (1965). *Methods of soil analysis – part - II*. Soc. Agron. Inc. Publ., Madison. Wisconsin, USA
- Chhabra G, Srivastava PC, Ghosh D, Agnihotri AK (1996). Distribution of available micronutrient cations as related to soil properties in different soil zones of Gola - Kosi interbasin., *Crop Res*, 11:296-303
- Havlin JL, Sultanpour PN (1981). Evaluation of the AB-DTPA soil test for iron and zinc., *Soil Sci American J*, 45:55-70
- Koehler FE, Moodie CD, McNeal BL (1984). *Laboratory Manual for Soil Fertility*., Washington State University, Pullman, Washington, USA
- Perveen S, Tariq M, Farmanullah J, Khattak K, Hamid A (1993). Study of micronutrient status of some important sites of NWFP Pakistan., *Sarhad J Agri*, 9:467-473
- Rajkumar GR, Patil CV, Prakash SS, Yeledhalli NA, Math KK (1996). Micronutrient distribution in paddy soils in relation to parent material and soil properties., *Karnataka J Agri Sci*, 9:231-235
- Sheeja S, Kabeerathamma S, Pilla NG, Nair MM (1994). Availability and distribution of micronutrients in cassava growing soils of Andhra Pradesh., *J Root Crops*, 20:75-80
- Sumathi CS, Balasubramanian V, Ramesh N, Rajesh Kannan V (2008). Influence of biotic and abiotic features on *Curcuma longa* L. plantation under tropical condition., *Middle-East J Sci Res*, 3:171-178
- US Salinity Laboratory Staff (1951). *Diagnosis and improvement of saline and alkaline soils*., U.S.D.A Hand Book No. 60, Washington DC