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RESEARCH ARTICLE

STATUS OF MACRO AND MICRONUTRIENTS AND MICROBIAL DIVERSITY OF SILTY CLAY LOAM SOIL OF THANJAVUR TALUK, THANJAVUR DISTRICT

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ABSTRACT

The present study deals with the analysis of macro and micronutrients and microbial diversity of soils from Thanjavur Taluk, Thanjavur District, Tamil Nadu. Soil samples were collected at various seasons (Monsoon, Pre monsoon, Summer, Post monsoon) from three villages namely Thanjavur, Sengipatti and Sadayarkovil. The physico chemical parameters of soils were analysed. The physical parameter includes the analysis of p^H, moisture content and temperature of the soils. The chemical parameter includes the analysis of macronutrients such as carbon, nitrogen, pottasium, phosphorus, calcium, magnesium and micronutrients such as zinc, iron, manganese and copper present in three crop land soils of three different villages. Totally 21 different species of soil bacteria were observed from the soil samples in three villages namely Thanjavur, Sengipatti, Sadayarkovil. Among the bacterial species identified, *Staphylococcus spp, E.coli, Bacillus Spp* and *Entrobacter spp* were dominant in bacteria. Totally 19 different species of soil fungi were observed. Among the fungal species identified, *Rhizopus spp, Fusarium solani, Aspergillus spp,* and *Gliocladium spp* were predominant in fungi. The chemical parameters and microbial population of rhizosphere soils of crop plant have suggested as future course work.

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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.

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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 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). All organisms in the biosphere depend on microbial activity (Pace, 1997). Soil microorganisms are vital for the continuing cycling of nutrients and for driving above-ground ecosystems (van der Heijden *et al*., 1998; Cairney, 2000; Klironomos *et al*., 2000; Ovreas, 2000). Scientific understanding of microbial biogeography is particularly weak for soil bacteria, even though the diversity and composition of soil bacterial communities is thought to have a direct influence

on a wide range of ecosystem processes (Schimel., 1995; Balser *et al*., 2002). Much of the recent work in soil microbial ecology has focused on cataloging the diversity of soil bacteria and documenting how soil bacterial communities are affected by specific environmental changes or disturbances. As a result, we know that soil bacterial diversity is immense (Dunbar *et al*., 2002; Tringe *et al*., 2005) and that the composition and diversity of soil bacterial communities can be influenced by a wide range of biotic and abiotic factors (Buckley, Schmidt., 2002). However, almost all of this work has been site-specific, limiting our understanding of the factors that structure soil bacterial communities across biomes and regions. Soil microbial communities develop in response to constraints and selection pressures in their environment (physical, chemical, and biological). The chemical and biological constraints have been studied extensively (e.g., Bending and Lincoln, 2000; Bressan *et al*., 2008; Crecchio *et al*., 2007; Hackl *et al*., 2004). In contrast, ways in which the physical environment of soil exerts control over community structure and diversity are more poorly understood. Nonhomogeneous distributions of bacteria are created by numerous environmental factors and have been observed at a range of spatial scales, from sub-centimeter (Becker *et al*., 2006; Dechesne *et al*., 2003; Nunan *et al*., 2003; Grundmann and Debouzie, 2000) to meter (Bent *et al*., 2003; Nunan *et al*., 2002; Bundt *et al*., 2001) to kilometer or more (Fierer and Jackson, 2006; Cho and Tiedje, 2000). Micro-scale distribution is influenced by, among other factors, pore structure (Nunan *et al*., 2003), chemical conditions (Becker *et al*., 2006), and proximity to other bacterial taxa (Grundmann and Debouzie, 2000).

Our knowledge of soil microbial diversity is limited in part by our inability to study soil microorganisms. Torsvik *et al*. (1990) estimated that in 1 g of soil there are 4000 different bacterial ‘‘genomic units’’ based on DNA–DNA reassociation. It has also been estimated that about 5000 bacterial species have been described (Pace, 1997, 1999). Approximately 1% of the soil bacterial population can be cultured by standard laboratory practices. It is not known if this 1% is representative of the bacterial population (Torsvik *et al*., 1998). An estimated 1,500,000 species of fungi exist in the world (Giller *et al*., 1997). But unlike bacteria, many fungi cannot be cultured by current standard laboratory methods (Thorn, 1997; van Elsas *et al*., 2000).

Although molecular methods have been used to study soil bacterial communities, very little research has been undertaken for soil fungi (van Elsas *et al*., 2000). In light of these considerations, soil community structure and diversity shows promise as part of a set of criteria used to identify or match forensic soil samples, Since temporal variability due to moisture, temperature or other environmental factors complicates their use as stand-alone indicators (Meyers and Foran, 2008). Hence the present study deals with the isolation of bacteria and fungi from the silty clay loam soil of Thanjavur district and the physico chemical parameters of soil samples were analyzed at periodical interval.

MATERIALS AND METHODS

Sample Collection

Soil samples were collected from the three villages viz, Thanjavur, Sengipatti, Sadayarkovil, at Thanjavur Taluk, Thanjavur District – Tamil Nadu. The soil samples were taken during the four seasons in agricultural field and uncultivated soils. Samples were collected from 10 – 15 cm deep pits dug in the area to be sampled. The samples were collected in polythene bags. Soil from 8 – 10 pits was pooled together and mixed in the same polythene bag. Then, soils were subjected to physical, chemical and microbial analyses.

Soil characteristics

Soil samples were analyzed for major exchangeable cations using an ion exchange method (Rowell, 1996), p^H was measured with a p^H meter. Organic matter and totel nitrogen were estimated using Walkely and Black; Micro-kjeldahl methods respectively as mentioned in (Rowell, 1996), estimation of available phosphorus was done according to the Olsen‘s method; Calcium, Megnesium by Versene method; flame photometer was used for estimation of sodium and potassium (Rowell, 1996). The soil samples were ground, passed through 2mm sieve and analyzed for DTPA (Diethylene Triamine Penta Acetic acid) extractable micronutrients (Fe,Mn,Zn and Cu) as per method proposed by Lindsay and Norvell (1978) and the concentrations of Fe,Mn,Zn and Cu were determined using Atomic Absorption Spectrophotometer.

Isolation Of Bacteria From Soil

Soil samples were taken from each container and subjected to serial dilution followed by pour plate method.

Pour Plate Method

Nutrient agar medium was used for pour plate method. Nutrient Agar Medium was sterilized at 121°c for 15 minutes. Petriplates were sterilized and labelled as control A, B, C and 1ml of sample from 10^{-3}, 10^{-5} and 10^{-7} dilution was transferred into the respective plates. Finally, the cooled medium was poured into the sample containing plates and incubated at 37°C for 24 hours and the colonies were counted.

Identification of bacterial isolates

The isolated species were identified using with some modifications also done by Nopparat *et al*. (2007) based on characters such as morphology, staining reactions, nutritional, cultural characteristics , physiology and biochemical test results for specific metabolic end products. Also following criteria based identification conformed viz., Gram staining, Motility Test, Starch hydrolysis, Gelatin hydrolysis, Lipid hydrolysis, Carbohydrate fermentation test, Urea hydrolysis test, Hydrogen Sulphide Production test, Indole production test, Methyl Red test, Voges-Proskaeur test, Citrate utilization test, Oxidase test and Catalase test (Dubey and Maheshwari, 2000) .

Isolation of Fungi From Soil

Plating Technique (Warcup, 1950)

Rose Bengal Agar medium or Potato Dextrose Agar medium was prepared and sterilized at 121°C for 5 minutes. Then it was supplemented with 1% streptomycin to prevent bacterial growth. The medium was poured into sterile petriplates.

The serially diluted soil samples were directly inoculated into petriplates containing Rose Bengal Agar medium or Potato Dextrose Agar medium up to 10^{-3} to 10^{-4}. The inoculated plates were incubated at 28± 2°C for 3 days.

Conidial Population

The number of Colony Forming Units (CFU) present in 1 gram of the soil samples were determined by multiplying the number of colonies with dilution factors.

Identification of Fungi (Gillman, 1957)

The fungal culture were identified by using manual such as Manual of Soil Fungi (Gillman, 1957), Dematiaceous Hypomycetes (Ellis, 1971), more Dematiaceous Hypomycetes (Ellis and Ellis, 1976), Hypomycetes (Subramaniam, 1971).

RESULTS

Sample Collection

The present study was carried out to isolate the bacterial and fungal species of different crop field soils from Thanjavur(s_1), Sengipatti(s_2) and Sadayarkovil(s_3) and analysed the macro and micronutrients in Thanjavur taluk, Thanjavur district pre monsoon to monsoon (September to December). The physico chemical parameter such soils were identified.

Physical Parameters

P^H

Among the pH ranges observed from the twelve different soil samples of three villages , there was no observable changes. The P^H values was no great difference found in seasonal analysis. The P^H values are 7.74, 7.14 and 7.17(post monsoon), 7.69, 7.87 and 7.79 (Summer), 7.38, 7.14 and 7.18 (pre monsoon), 7.42,7.28 and 7.07 (monsoon) (Table -1).

Moisture

The present investigation reveals there was high values are reported during summer and pre monsoon seasons. The moisture values were recorded. The values are 40.07, 42.25 and 43.05 (post monsoon), 40.13, 38.09 and 39.57 (Summer), 44.05, 46.51 and 45.05 (pre monsoon), 42.15, 42.01 and 48.06 (monsoon).The high level of moisture content level present in pre monsoon season (44.05, 46.51 and 45.05) (Table -1).

Temperature

The present investigation of temperature values were recorded in different seasons. The temperature values are 30°c, 31°c and 31°c (post monsoon), 48°c, 47°c and 48°c (Summer), 39°c, 40°c and 38°c (Pre monsoon). 30°c, 25°c, and 27°c , (monsoon). The high level of temperature present in summer season (48°c, 47°c and 48°c) (Table -1).

Chemical Parameters

Estimation of Macro Nutrients

The availability of organic carbon, nitrogen, phosphorus, potassium, magnesium, phosphate and calcium analyzed for three places (Thanjavur, Sengipatti, Sadayarkovil).

Estimation of organic carbon

The total organic carbon values to be recorded in different seasons. The values were 1.74, 1.41 and 1.14 (post monsoon), 1.69, 1.74, and 1.38 (Summer), 0.27, 0.24 and 0.47 (Pre monsoon), 0.17, 0.25 and 1.27 (monsoon). The high level of carbon content present in summer season (1.69, 1.74, and 1.38) (Table -1).

Estimation of nitrogen

The total nitrogen values to be recorded in different seasons. The values were 82.6(kg/ac), 85.9(kg/ac) and 88.6(kg/ac) (post monsoon), 88.5(kg/ac), 82.6(kg/ac) and 84.2(kg/ac) (Summer), 80.6(kg/ac), 98.5(kg/ac), and 96.3(kg/ac) (Pre monsoon), 93.4(kg/ac), 86.9(kg/ac) and 94.3(kg/ac) (monsoon). The high level of nitrogen content present in monsoon season 93.4(kg/ac), 86.9(kg/ac) and 94.3(kg/ac) (Table -1).

Estimation of phosphours

The total phosphours values to be recorded in different seasons. The values were 4.15(kg/ac), 3.14(kg/ac) and 3.13(kg/ac) (post monsoon), 4.12(kg/ac), 2.96(kg/ac), and 1.87(kg/ac) (Summer), 3.56(kg/ac), 3.68(kg/ac) and 2.8(kg/ac) (Pre monsoon), 2.36(kg/ac), 3.25(kg/ac) and 1.24(kg/ac) (monsoon). The high level of phosphours present in post monsoon season 4.15(kg/ac), 3.14(kg/ac) and 3.13(kg/ac) (Table -1).

Estimation of potassium

The total potassium values to be recorded in different seasons. The values were 70.1(kg/ac), 69.2(kg/ac)and 67.3(kg/ac)(post monsoon), 72.5(kg/ac), 72.1(kg/ac) and 70.1(kg/ac) (Summer), 67.5(kg/ac), 69.1(kg/ac) and 68.3(kg/ac) (Pre monsoon), 73.1(kg/ac),75.1(kg/ac) and 76.2(kg/ac) (monsoon). The high level of potassium present in monsoon 73.1(kg/ac), 75.1(kg/ac) and 76.2(kg/ac) and summer 72.5(kg/ac), 72.1(kg/ac) and 70.1(kg/ac) (Table -1).

Estimation of calcium

The total calcium values to be recorded in different seasons. The values were 3.42(ppm), 3.51(ppm) and 3.32 (ppm) (post monsoon), 3.52(ppm), 4.01(ppm) and 3.41(ppm) (Summer), 3.48(ppm), 3.35(ppm) and 3.41(ppm) (Pre monsoon), 3.39(ppm), 4.05(ppm) and 3.41(ppm) (monsoon). The high level of calcium present in pre monsoon season 3.39(ppm), 4.05(ppm) and 3.41(ppm) (Table -1).

Estimation of magnesium

The total magnesium values to be recorded in different seasons. The values were 8.4(ppm), 9.1(ppm) and 8.6(ppm) (post monsoon), 9.2(ppm), 9.5(ppm) and 9.4(ppm) (Summer), 9.1(ppm), 8.9(ppm) and 9.3(ppm) (Pre monsoon), 10.2(ppm), 9.8(ppm) and 10.4(ppm) (monsoon). The high level of magnesium present in monsoon season 10.2(ppm), 9.8(ppm) and 10.4(ppm) and summer season 9.2(ppm), 9.5(ppm) and 9.4(ppm) (Table -1)

Table 1. Physico-Chemical parameters of the soil

Name of the parameters	Monsoon			Post monsoon			Summer			Pre monsoon		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
pH	7.42	7.28	7.05	7.74	7.14	7.17	7.69	7.87	7.79	7.38	7.14	7.18
Moisture	42.15	42.01	48.06	40.07	42.25	43.05	40.13	38.09	39.57	44.05	46.51	45.05
Temperature	30	25	27	30	31	31	48	47	48	39	40	38
carbon(%)	0.17	0.25	1.27	1.74	1.41	1.14	1.69	1.74	1.38	0.27	0.24	0.47
Nitrogen(Kg/ac)	93.4	86.9	94.3	82.6	85.9	88.6	88.5	82.6	84.2	80.6	98.5	96.3
Potassium(kg/ac)	73.1	75.1	76.2	70.1	69.2	67.3	72.5	72.1	70.1	67.5	69.1	68.3
Phosphorus(kg/ac)	2.36	3.25	1.24	4.15	3.14	3.13	4.12	2.96	1.87	3.56	3.68	3.8
Magnesium(ppm)	10.2	9.8	10.4	8.4	9.1	8.6	9.2	9.5	9.4	9.1	8.9	9.3
Calcium(ppm)	3.39	4.05	3.41	3.42	3.51	3.32	3.52	4.01	3.41	3.48	3.35	3.41
Copper(ppm)	0.87	0.78	0.69	1.2	1.5	1.6	0.98	0.85	0.78	1.5	1.7	1.4
Iron(ppm)	2.5	2.7	2.9	3.4	3.2	3.1	4.5	4.3	4.2	4.2	4.9	3.9
Zinc(ppm)	0.87	0.57	0.76	0.78	0.18	1.2	1.5	0.9	2.2	0.9	1.7	1.4
Manganese(ppm)	2.9	3.1	2.8	3.5	3.3	3.6	3.4	3.6	3.2	2.5	2.7	2.9

S1- THANJAVUR, S2- SENGIPATTI, S3- SADAYARKOVIL

Table 2. Isolated Bacteria in Thanjavur Taluk

Name of the organisms	Monsoon			Post monsoon			Summer			Pre monsoon		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
Bacillus spp	+	-	-	-	-	-	-	-	-	+	-	-
Bacillus cirulans	-	+	-	-	-	-	-	-	-	-	+	-
B.mucoides	-	+	-	-	-	-	-	-	-	-	+	-
Brevibacterium spp	-	+	-	-	-	-	-	-	-	-	+	-
Staphylococcus spp	-	-	+	-	-	-	-	-	+	-	-	+
Streptococcus spp	-	-	+	-	-	-	-	-	-	-	-	+
Bacillus plvifaciens	-	-	-	+	-	-	-	-	-	-	-	-
Micrococcus luteus	-	-	-	+	-	-	-	-	-	-	-	-
M.rosens	-	-	-	+	-	-	-	-	-	-	-	-
E.coli	-	-	-	-	+	-	-	-	+	-	-	-
Enterobacter spp	-	-	-	-	+	-	-	-	+	-	-	-
P.alkaligens	-	-	-	-	+	-	-	-	-	-	-	-
Rhizobium spp	-	-	-	-	-	+	-	-	-	-	-	-
B.cogulans	-	-	-	-	-	+	-	-	-	-	-	-
Bacillus cereus	-	-	-	-	-	-	+	+	-	-	-	-
Bacillus subtilis	-	-	-	-	-	-	+	+	-	-	-	-
Vibrio spp	-	-	-	-	-	-	+	-	-	-	-	-
P. aerogenosa	-	-	-	-	-	-	-	+	-	-	-	-
Achromobacter spp	-	-	-	-	-	-	-	-	-	+	-	-
Agrobacterium spp	-	-	-	-	-	-	-	-	-	+	-	-
P.pudita	-	-	-	-	-	-	-	-	-	-	-	+

Table 3. Isolated Fungi in Thanjavur Taluk

Name of the organisms	Monsoon			Post monsoon			Summer			Pre monsoon		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
Alternaria spp	+	-	-	+	-	-	-	-	-	-	-	-
Rhizopus nigrans	+	-	-	+	-	-	+	-	-	-	-	-
Rhizopus stolonifer	+	-	-	+	-	-	+	-	-	-	-	-
Aspergillus luchensis	+	-	-	+	-	-	+	-	-	-	-	-
Gliocladium virens	-	+	-	-	+	-	-	+	-	-	-	-
Pencillium glaucum	-	+	-	-	+	-	-	+	-	-	-	-
Aspergillus nidulans	-	-	+	-	-	+	-	-	+	-	-	-
Fusarium solani	-	-	+	-	-	+	-	-	+	-	-	-
Aspergillus repens	-	-	+	-	-	+	-	-	+	-	-	-
Candida albicans	-	-	+	-	-	+	-	-	-	-	-	-
Pencillium levitum	-	-	-	-	-	-	-	-	-	+	-	-
Aspergillus silvaticus	-	-	-	-	-	-	-	-	-	+	-	-
Cladosporium herbarum	-	-	-	-	-	-	-	-	-	+	-	-
Verticillium spp	-	-	-	-	-	-	-	-	-	-	+	-
Curvularia subulata	-	-	-	-	-	-	-	-	-	-	+	-
Trichoderma viride	-	-	-	-	-	-	-	-	-	-	+	-
Aspergillus niger	-	-	-	-	-	-	-	-	-	-	+	-
Aspergillus fumigates	-	-	-	-	-	-	-	-	-	-	-	+
Cladosporium sp	-	-	-	-	-	-	-	-	-	-	-	+

Estimation of micro nutrients

The availability of macro nutrients such as copper, iron, manganese and zinc was relatively in present in Thanjavur taluk of three places such as (Thanjavur, Sengipatti, Sadayarkovil).

Estimation of zinc

The availability of zinc values to be estimated and the total values to be recorded in different seasons. The values were 0.78(ppm), 0.18(ppm) and 1.2(ppm) (post monsoon), 1.5(ppm), 0.9(ppm) and 2.2(ppm) (Summer), 0.9(ppm), 1.7(ppm) and 1.4(ppm) (Pre monsoon), 0.87(ppm), 0.57(ppm) and 0.56(ppm) (monsoon). The high level of zinc present in summer season 1.5(ppm), 0.9(ppm) and 2.2(ppm) (Table -1).

Estimation of copper

The availability of copper values to be estimated and the total values to be recorded in different seasons. The values were 1.2(ppm), 1.5(ppm) and 1.6(ppm) (post monsoon), 0.98(ppm), 0.85(ppm) and 0.78(ppm) (Summer), 1.5(ppm), 1.7(ppm) and 1.4(ppm) (Pre monsoon), 0.87(ppm), 0.78(ppm) and 0.69(ppm) (monsoon). The high level of copper present in post monsoon season 1.2(ppm), 1.5(ppm) and 1.6(ppm) (Table -1).

Estimation of iron

The availability of iron values to be estimated and the total values to be recorded in different seasons. The values were 3.4(ppm), 3.2(ppm) and 3.1(ppm) (post monsoon), 4.5(ppm), 4.3 (ppm) and 4.2(ppm) (Summer), 4.2(ppm), 4.9(ppm) and 3.9(ppm) (Pre monsoon), 2.5(ppm), 2.7 (ppm) and 2.9(ppm) (monsoon). The high level of copper present in summer season 4.5(ppm), 4.3 (ppm) and 4.2(ppm) (Table -1).

Estimation of manganese

The availability of manganese values to be estimated and the total values to be recorded in different seasons. The values were 3.5(ppm), 3.3(ppm) and 3.6(ppm) (post monsoon), 3.4(ppm), 3.6(ppm) and 3.2(ppm) (Summer), 2.5(ppm), 2.7(ppm) and 2.9(ppm) (Pre monsoon), 2.9(ppm), 3.1(ppm)and 2.8(ppm) (monsoon). The high level of manganese present in post monsoon season 3.5(ppm), 3.3(ppm) and 3.6(ppm) and summer season 3.4(ppm), 3.6(ppm) and 3.2(ppm) (Table -1).

Bacterial Isolates

Totally 21 different species of soil bacteria were observed from soil samples. The bacterial species are identified their morphological character and Bergey's manual of determinative bacteriology. The predominant bacterial species are *Bacillus subtilis, B.cereus, E.coli, Enterobacter spp, Staphylococcus spp, Bacillus spp, Bacillus cirulans, B.mucoides, Brevibacterium spp* (Table-2).

Fungal Isolates (Gillman, 1957)

Totally 19 different species of soil fungi where observed from the soil samples collected from three different villages.

The colonies showed a characteristic color of black, green, white and brown and they were confirmed by identifying their morphological characters and by Ellis Manual. The predominant fungal species are *Alternaria spp, Rhizopus nigrans, Rhizopus stolonifer, Aspergillus luchensis, Gliocladium virens, Pencillium glaucum, Aspergillus nidulans, Fusarium solani, Aspergillus repens, Candida albicans* (Table-3).

DISSCUSSION

Thanjavur Taluk of Tamilnadu has deep and fertile soils. In the present study , physico chemical parameters results showed that the soils of Thanjavur District were alkaline in nature . The maximum p^H (7.87) was recorded at Sengipatti, whereas minimum p^H (7.05) was recorded at Sadayarkovil soils. The present study also recorded average p^H of the soil as (7.69) from three locations of Thanjavur District. Similar type of work has been reported by many workers physico – chemical properties of the rhizosphere soil of the *Curcuma longa* L. was analysed by Sumathi *et al*. (2008); rehabited secondary forests soil physico – chemical properties by Akbar *et al*. (2010).

Soil fertility is important factor, which determines the growth of plant. Soil fertility is determined by the presence or absence of nutrients i.e., macro and micro nutrients. A basic soil test will provide information on soil texture, organic matter, P^H, buffer index, phosphorus, potassium and nitrate. Most of the soil tests will give a range for the nutrients, such as low range, 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, the soil will influenced by the annual crop rotation practice, quality of water used for irrigation and application of chemical fertilizer and so on.

Mn is essential to all organisms and is responsible for the production of molecular oxygen in plants during photosynthesis (Saucer 1980). The deficiency of Mn leads to infertility. Mn deficiency from the study area was found to be 50.46 percent. When compared to the other micronutients, Mn is considerably, sufficently present in all the samples and this result corroborated with the findings of Sharma *et al*., (2006). The maximum Calcium (4.05 ppm) was recorded at Sengipatti, whereas minimum Calcium (3.32 ppm) was recorded at Sadayarkovil soils. The present study also recorded average Calcium of the soil as (3.39 ppm) from three locations of Thanjavur District. Similarly Praveen *et al*., (1993) studied micronutrient status of some agriculturally important soil series of the Northwest Frontier Province, Pakistan and their relationship with various physic chemical properties for 30 soil series. Most silty soils (coarse texture) are deficient micronutrients. Clay soils (fine texture) are not comparatively to low plant available micronutrients. Chhabra *et al*. (1996) studied that available Mg and I decreased with soil P^H and available Cu increased with clay and organic carbon 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.

The bacteria isolate during Monsoon 6, Post monsoon 8, Summer 9, Premonsoon 9 species for all sampling stations, respectively. The fungi isolated during the present study was during Monsoon 10, Post monsoon 10, Summer 8, Premonsoon 11 species for all sampling stations, respectively. Generally the low critical value (1.08 mg kg^{-1}) for Cu may be due to its incorporation in living systems when the atmosphere shifts from reducing to oxidizing state (Broda 1975). Whenever Cu deficiency is noticed in standing crops, 2 to 3 foliar sprays of 0.025% $CuSO_4$ can be done before flowering. In case of crops like rice, banana and sunflower, foliar application of $CuSO_4$ either singly or in combination with other micronutrients may enhance yield as well as the quality of the product. The bacterial species were identified as *Bacillus subtilis, Pseudomonas aeruginosa* and *Micrococcus sp*. This finding is supported by an earlier report that says that most efficient and frequently encountered phosphate solubilizing bacteria belonging to the genus *Pseudomonas* or the genus *Bacillus* (Sundaram, 1994). Venkateswaran and Natarajan (1983) reported *Pseudomonas sp*. and *Bacillus sp*. as dominant inorganic phosphorus compounds solubilizing microbes. The fungal isolates capable of solubilizing the phosphate present in the media were identified as *Aspergillus niger* and *Penicillium sp*. These findings also correlate with the findings of Nahas *et al*., (1990) who suggested that *A.niger* is a well-known phosphate solubilizing fungi. *Penicillium sp*. was also identified as efficient phosphate solubilizer. The P-solubilizing activity is determined by the microbial biochemical ability to produce and release organic acids, which through their carboxylic groups chelate the cations (mainly Ca) bound to phosphate converting them into the soluble forms (Kpomblekou and Tabatabai, 1994; Glick, 1995).

Conclusion

An increasing interest has emerged with respect to the importance of microbial diversity in soil habitats. The extent of the diversity of microorganisms in soil is seen to be critical to the maintenance of soil health and quality, as a wide range of microorganisms is involved in important soil functions. The present study analysed the macro and micronutrients and microbial diversity of the soil in Thanjavur thaluk, Thanjavur district. The diversity and abundance of soilborne microbes may be strongly influenced by some abiotic and biotic factors. Further studies are necessary in order to confirm these preliminary field data.

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