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Research Article

INVESTIGATION OF SOIL CHARACTERISTICS AND MICROBIAL DIVERSITY OF SILTY CLAY LOAM SOIL OF PAPANASAM TALUK, THANJAVUR DISTRICT

***Manimekalai, G., Jayasurya, S. and Dhivaharan, V**

Department of Microbiology, Sengamala Thayaar Educational Trust Women's College, Sundarakkottai, Mannargudi – 614 001, India

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ABSTRACT

The present study deals with the diversity of soil fungi and bacteria from different Agricultural fields and uncultivated soils of Papanasam Taluk Thanjavur District, Tamil Nadu. Soil samples were collected at various seasons (Monsoon, Premonsoon, Summer, Postmonsoon) by appropriate method. The physico chemical parameters of soils were identified. 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, Potassium, Phosphorus, calcium, magnesium and micronutrients such as Zinc, Iron, manganese and copper present in three crop land soils of three different villages. Totally 15 different species of soil fungi were observed from the soil collected from Perumalkoil, Rajagiri, and Kabistalam villages. Among the fungal species identified, *Aspergillus niger*, *Aspergillus fumigates*, and *Trichoderma viridae* were predominant in all the soil samples collected from the crop of three villages in four seasons. Totally 20 different species of soil bacteria were observed from the soil samples in three villages namely, Perumalkoil, Rajagiri, and Kabistalam. Among the bacterial species identified, *Bacillus spp*, *E.coli*, *Bacillus subtilis* and *Streptococcus spp* were dominant bacteria. The chemical parameters and microbial population of rhizosphere soils of crop plant have suggested as future course work.

INTRODUCTION

Microbial characteristics of soil area being evaluated increasingly as sensitive of soil health because of the clear relationships between microbial diversity, soil and plant quality, and ecosystem sustainability (Doran *et al.*, 1994). While the understanding of microbial properties such as biomass, activity, and diversity are important to scientists in furthering knowledge of the factor contributing to soil health results of such analyses may also be useful to extension personnel and farmers in devising practical measures of soil quality.

The soil microbes decompose the plant and animal residues entering the soil and convert them in to soil organic matter, which influences on soil physical, chemical and biological properties and on creating a complimentary medium for biological reactions and life support in the soil environment. Nonetheless, enhanced site –specific diversity typically results in higher levels of below ground microbial diversity and production (Olson *et al*., 2000). Large quantities' of readily decomposable organic matter are added to agricultural soils every year as crop residues or animal wastes and have a significant outcome on soil microbial commotions. The plant species growing on the soil also equally influence the population and species of the soil fungi. (Hackle *et al*., 1976).

The soil is one of the most important habitats for microorganisms like bacteria, fungi, yeasts, nematodes, etc. The filamentous fungi are the major contributors to the soil biomass (Alexander 1997). They from the major group of organotrophic organisms responsible for the decomposition of organic compounds. Their activity participates in the biodeterioration and biodegradation of toxic substances in the soil (Rang swami *et al*., 1998). It has been found that more number of genera and species of fungi exist in soil than in any other environment (Nangana *et al*., 2005). Contribution to the nutrient cycle and maintenance of ecosystem fungi play an important role in soil formation, soil fertility, soil structure and soil improvement (Hao-quin *et al*., 2008).

One major function of soil is its use as a habitat soil organisms including maintain of biodiversity, assemblage, and activity for both soil fauna. Soil micro organisms theme selves are involved in major soil processes, such as humification, recycling and mineralization of organic residues, leading to the plant availability of nutrient. The mechanical fragmentation of organic residues, stabilization of soil aggregates, or

Corresponding author: **Manimekalai, G*
Department of Microbiology, Sengamala Thayaar Educational Trust Women's College, Sundarakkottai, Mannargudi – 614 001, India

bioturbation and mixing of organic and mineral substances are governed primarily by soil animals. In turn, these activities positively influence the physico-chemical properties of soil and consequently soil fertility and quality.

In the case of cultivated soils, every single farming practice may influence soil fertility and quality status either in a positive or negative manner as a consequence the German soil protection Law (Busch., 1998).

Prescribes a range of farming practices which are favorable to conserve soil fertility and quality (i.e. conservation of soil organic matter and microbial activity) or which help to protect soil from negative farming influences like soil compaction and erosion. Hence the present study undertaken to analyse the microbial diversity of crop land soils from papanasam taluk, Thanjavur District.

Study Area

The present study focused on the area in and around Thanjavur District. The study area is situated in Tamilnadu state (Lat.11'10-11'30 N and Long 78'15-78'30 E) with the significant features of evergreen forests and al so it was a less explored ecosystem for the investigation of fungal and bacteria population for the enumeration of soil samples were collected by aseptic manner at a depth of 5-10 cm according to the V-shaped method, at thirty different location in and around the Thanjavur district from each site, seasons from soil sample were collected and pooled together and considered as one sample. The soil sample were brought to the laboratory and kept in the refrigerator for further process. Research on the fungal diversity provides a basis for estimation the fungal role of fungi in ecosystem (Wang *et al*,. 2008).

MATERIALS AND METHODS

Sample Collection

Soil samples were collected from the three villages viz, Perumalkoil, Rajagiri and Kabistalam at Papanasam 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), pH was measured with a pH 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 Perumalkoil(s_1), Rajagiri(s_2) and Kabistalam (s_3). Analysed then macro and micro nutrient in Papanasam Taluk, Thajavur District pre monsoon to monsoon (September to December). The physicochemical parameter such soils were identified.

Physicochemical Parameters

The physical parameter includes analysis of pH, moisture content and temperature of the soils. The chemical parameters

includes the analysis of chemicals such as, Carbon, Nitrogen, Calcium, Phosphorus, Potassium, Magnesium, Phosphate, Zinc, Copper, Iron and Manganese from four seasons (Monsoon, Premonsoon, Postmonsoon and Summer).

Physical Parameters

pH

Among the pH ranges observed from the twelve different soil samples of three villages, there was no great difference found in seasonal analysis. The pH values were 7.14, 7.35 and 7.63 (Postmonsoon), 7.09, 7.32 and 7.26 (Summer), 7.30, 7.17 and 7.32 (Premonsoon), 7.15, 7.01 and 7.33 (Monsoon).

Moisture

The moisture values recorded were (Postmonsoon), 39.57, 40.06 and 40.02 %, (Summer), 35.56, 41.06 and 42.03% (Premonsoon), 40.07, 32.05 and 36.01% (Monsoon). The high level of moisture content level present in Summer season.

Temperature

The present investigation of temperature values were recorded in different seasons. The temperature values were 35, 32 and 32 ^{o}C (Postmonsoon), 42, 43 and 46 ^{o}C (Summer), 38, 35˚ and 35 ^{o}C (Premonsoon) 25, 28 and 25 ^{o}C, (Monsoon). The high level of temperature was recorded in Summer season.

Chemical Parameters

Estimation of Macronutrients

The availability of organic carbon, Nitrogen, phosphorus, potassium, magnesium, phosphate and Calcium analyzed for Perumalkoil, Rajagiri and Kabistalam.

Estimation of organic carbon

The total organic carbon values were 1.12, 0.85 and 0.89 Kg/ac (Postmonsoon), 0.80, 0.50, and 0.15 Kg/ac (Summer), 1.8, 0.47 and 1.85 Kg/ac (Premonsoon), 1.19, 0.17 and 1.24 Kg/ac (Monsoon). The high level of carbon content was observed in Postmonsoon season.

Estimation of Nitrogen

The total Nitrogen values recorded in different seasons were 85.9, 87.2 and 85.94 Kg/ac (Postmonsoon), 85.5, 82.4 and 87.8 Kg/ac (Summer), 87.2, 88.2, and 88.2 Kg/ac (Premonsoon), 85.6, 87.9 and 85.2 Kg/ac (Monsoon). The high level of Nitrogen content recorded in Premonsoon season.

Estimation of phosphours

The total phosphorus values recorded in different seasons were 3.12, 2.17 and 4.13 Kg/ac (Postmonsoon), 3.85, 3.87 and 2.34 Kg/ac (Summer), 3.05,4.62 and 4.8 Kg/ac (Premonsoon), 3.12, 2.24 and 4.12 Kg/ac (Monsoon). The high level of phosphours recorded in Premonsoon season.

Estimation of potassium

The total potassium values recorded in different seasons were 70.1, 69.1 and 68.5 Kg/ac (Postmonsoon), 65.5 , 71.0 and 71.5 Kg/ac (Summer), 72.6, 69.8 and 70.1 Kg/ac (Premonsoon), 76.3, 74.5 and 73.5 Kg/ac (Monsoon). The high level of potassium was observed in Monsoon season followed by Premonsoon.

Estimation of Calcium

The total calcium values recorded in different seasons were 3.09, 3.6 and 4 ppm (Postmonsoon), 3.5, 3.2 and 3.3ppm (Summer), 4.1, 3.1 and 3.8 ppm (Premonsoon), 3.7, 4.2 and 4.5ppm (Monsoon). The high level of calcium was recorded in Premonsoon season.

Estimation of Magnesium

The total magnesium values recorded in different seasons were 8.1, 8.2 and 8.4ppm (Postmonsoon), 9.0, 9.2 and 9.5 ppm (Summer), 9.8, 9.2 and 9 ppm (Premonsoon), 10.5, 10.4 and 9.7 ppm (Monsoon). The high level of magnesium was recorded in Monsoon season followed by Premonsoon season.

Estimation of Micronutrient

The availability of macro nutrients such as Copper, iron, manganese and Zinc was relatively in present in Nagapattinam taluk of three places such as Perumalkoil, Rajagiri and Kabistalam.

Estimation of Zinc

The availability of Zinc was estimated and the total was recorded in different seasons. The values were 0.75, 0.75 and 0.84 ppm (Postmonsoon), 0.86, 0.85 and 7.03 ppm (Summer), 0.73, 0.81 and 0.89 ppm (Premonsoon), 0.82, 0.89 and 0.88 ppm (Monsoon). The high level of Zinc was present in Premonsoon season.

Estimation of Copper

The availability of copper was estimated and the total was recorded in different seasons. The values were 0.75, 0.72 and 0.76 ppm (Postmonsoon), 0.99, 0.85 and 0.88 ppm (Summer), 1.8, 1.6 and 1.2 ppm (Premonsoon), 0.95, 0.99 and 0.97 ppm (Monsoon). The high level of Copper present in Summer season.

Estimation of Iron

The availability of iron was estimated and the total was recorded in different seasons. The values were 6.34, 5.27 and 4.78 ppm (Postmonsoon), 4.65, 4.52 and 4.23ppm (Summer), 4.5, 4.37 and 4.46ppm (Premonsoon), 4.65, 4.52 and 4.53 ppm (Monsoon). The high level of Iron recorded in Premonsoon season.

Estimation of Manganese

The availability of manganese was estimated and the total was recorded in different seasons. The values were 2.1, 2.5 and2.4 ppm (Postmonsoon), 3.1, 3.2 and 1.1 ppm (Summer), 1.3, 1.5 and 1.8 ppm (Premonsoon), 2.5, 2.2 and 2.7 ppm (Monsoon). The high level of manganese was present in Postmonsoon season followed by Monsoon season.

Identification of Fungi (Gillman, 1957)

Totally 16 different species of soil fungi where observed from the soil samples collected from three different villages. The colonies showed a characteristic colour of black, green, white and brown and they were confirmed by identifying their morphological characters and by Ellis Manual.

Aspergillus fumigatus, Rhizopus stolonifer, Fusarium oxysporum, Aspergillus spp, Trichoderma viride, Aspergillus

nidulans, Pencillium citrinum, Pencillium conidia, Aspergillus flavus, were present in Postmonsoon season. *Aspergillus nidulans, Fusarium oxysporum, Aspergillus oryzae, Trichoderma viride, Aspergillus clavatus* were present in Summer season.

Aspergillus fumigatus, Rhizopus stolonifer, Pencillum citrinum, Penicillum conidia were present in Premonsoon season. *Aspergillus fumigatus, Aspergillus niger, Aspergillus nidulans, Trichoderma viridae and Penicillium conidia* were present in Monsoon season.

Table – 1 Physico - Chemical Parameters of the Soil from Papanasam Taluk

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	7.15	7.01	7.33	7.14	7.35	7.63	7.09	7.32	7.26	7.30	7.17	7.32
Moisture	41.07	33.09	431.5	39.57	40.06	40.02	35.56	41.06	40.03	40.07	38.5	40.0
Temperature	25	28	25	38	35	35	42	43	46	35	32	32
Carbon (%)	1.19	0.17	1.24	1.12	0.85	0.89	0.80	0.50	0.15	1.8	0.47	1.85
Nitrogen (Kg/ac)	85.6	87.9	85.2	85.9	87.2	85.94	85.5	82.4	87.8	87.2	88.2	88.2
Potassium (Kg/ac)	76.3	74.5	73.5	70.1	69.1	68.5	65.5	71.0	71.5	72.6	69.8	70.1
Phosphorus (Kg/ac)	3..12	2.24	4.12	3.12	2.17	4.13	3.85	3.87	2.34	3.05	4.62	4.8
Magnesium (ppm)	10.5	10.4	9.7	8.1	8.2	8.4	9.0	9.2	9.5	9.8	9.2	9
Calcium (ppm)	3.7	4.2	4.5	3.09	3.6	4.3	3.5	3.2	3.3	4.1	3.1	3.8
Copper (ppm)	0.95	0.99	0.97	0.75	0.72	0.76	0.99	0.85	0.88	1.8	1.6	1.2
Iron (ppm)	4.65	4.52	4.53	6.34	5.27	4.78	4.65	4.52	4.23	4.5	4.37	4.46
Zinc (ppm)	0.82	0.89	0.88	0.75	0.75	0.84	0.86	0.85	7.03	0.73	0.81	0.89
Manganese (ppm)	2.5	2.2	2.7	2.1	2.5	2.4	3.1	3.2	1.1	1.3	1.5	1.8

S1- Perumalkoil, S2- Rajagiri, S3- Kabistalam

Table 2 Isolation of Soil Bacterial From Papanasam Taluk

Organisms	Monsoon			Postmonsoon			Summer			Premonsoon		
	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	+	5	+	_	_	_	+	_	_	+	_	_
Alcaligenes	+	_	+	_	+	_	_	+	_	_	_	+
Bacillus mesentericus	+	_	_	+	_	_	_	_	_	_	_	_
Bacillus cereus	_	+	_	_	_	+	_	_	_	_	_	_
Alcaligeges spp	_	+	_	_	_	_	+	_	_	_	_	_
E.coli	_	_	+	_	_	_	_	+	_	_	_	_
Enterobactersp	_	_	+	_	+	_	_	_	_	_	_	_
Vibrio spp	_	_	+	_	_	+	_	_	_	_	_	+
Bacillus licheniformis	_	_	+	_	_	_	_	_	_	_	_	_
Bacillus subtilis	_	_	_	+	_	_	_	_	+	+	_	_
Micrococcus	_	_	_	+	_	_	+	_	_	_	_	+
P.putida	_	_	_	+	_	_	_	_	_	_	_	_
Aerobacter spp	+	_	_	+	_	_	_	_	+	_	_	_
Agrobacterium spp	_	_	+	_	+	_	_	_	_	_	_	_
Streptococcus spp	_	+	+	_	+	_	+	_	_	+	_	+
Neisseria	+	_	_	_	+	_	_	_	_	_	+	_
P.aerogenes	_	_	+	_	_	+	_	_	_	_	_	_
Enterococcus	_	+	_	_	_	_	+	_	_	_	_	_
Bacillus cereus	_	_	_	_	_	_	_	+	_	_	_	_
Flavo bacterium	_	+	_	_	_	_	_	_	+	_	_	_

(+ Present,-Absent,S1- Perumalkoil,S2-Ragagiri,S3-Kabistalam)

Table -3 Identification of Bacterial Biochemical Characteristics

S.No	Organisms	Shape	Gram staining	Motility	Indole	MR	VP	Citrate	Urease	Catalase	Oxidase
1	*Staphylococcus spp*	cocci	Positive	Motile	+	_	+	_	_	+	+
2	*Streptococcus spp*	cocci	Positive	Motile	+	_	_	+	+	+	_
3	*Staphylococcus auricularis*	Cocci	Positive	Motile	_	+	_	+	_	+	_
4	*Aerobacter spp*	Rod	Negative	Non motile	+	_	+	_	_	+	_
5	*Agrobacterium spp*	Rod	Negative	Motile	+	+	_	+	+	_	_
6	*E . coli*	Rod	Negative	Motile	_	_	+	_	+	_	+
7	*Enterobacter spp*	cocci	Positive	Non motile	+	_	+	_	_	_	+
8	*Vibrio spp*	Rod	Positive	Motile	_	+	_	+	_	+	+
9	*B.licheniformis*	Cocci	Positive	Non motile	+	_	+	_	+	+	_
10	*Micrococcus*	Cocci	Positive	Motile	+	_	_	+	_	_	_
11	*P.putida*	Rod	Positive	Non motile	_	_	+	+	_	+	+
12	*P.aerogenes*	Cocci	Negative	Non motile	+	_	+	_	+	_	_
13	*Pseudomonas*	Rod	Negative	Motile	_	+	_	+	_	_	+
14	*Candida albicans*	Rod	Negative	Nonmotile	+	+	_	+	+	_	_
15	*Flavobactrrium*	Cocci	Positive	Motile	_	+	_	+	_	+	_
16	*Pseudomonas aeruginosa*	Rod	Negative	Non motile	+	_	+	_	_	+	+
17	*B.cereus*	Rod	Positive	Motile	_	+	_	+	_	_	+
18	*Rhizobium meliloti*	Cocci	Positive	Motile	_	+	+	_	_	_	_

Table 4 Population Density of Bacterial Isolates From Different Location of Papanasamtaluk

S.no	Season	Name of location	Number of Population $\times 10^{-3}$ DILUTION CFU/ g SOIL
1	Monsoon	Perumalkoil	98
		Rajagiri	70
		Kabistalam	81
2	Postmonsoon	Perumalkoil	84
		Rajagiri	89
		Kabistalam	100
3	Summer	Perumalkoil	97
		Rajagiri	86
		Kabistalam	98
4	Premonsoon	Perumalkoil	85
		Rajagiri	100
		Kabistalam	98

100 cfu/g was observed in postmonsoon and premonsoon for S2-Rajagiri,S3-Kabistalam,soil sample.

Identification of Bacteria

The bacterial species *E.coli, B.licheniformis, Streptococcus spp, Vibrio spp, Neisseria spp, P.aerogenes* and *P.putida* were present in Postmonsoon season.

Alcaligenes, Bacillus subtilis, Bacillus cereus, Bacillus spp, Bacillus mesentericus, Aerobacterium and *Agrobacterium* were present in summer season.

Pseudomonas spp, Micrococcus spp, Brevibacterium, Flavobacterium, E.coil, Enterococcus spp, Bacillus subtilis and Bacillus cereus were present in Premonsoon season.

Bacillus spp, Alcaligenes, Bacillus subtilis, Aerobacter spp and Bacillus cereus were present in Monsoon season.

The predominant bacterial species were *Alcaligenes, E.coli, Bacillus subtilis and Bacillus cereus.*

DISSCUSSION

Papanasam 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 pH (7.63) was recorded at Kabistalam, whereas minimum pH (7.01) was recorded at Rajagiri soils. The present study also recorded average pH of the soil as (7.33) 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, PH, 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

Table-5 Isolation of Soil Fungal From Papanasam Taluk

Organisms	Monsoon			Postmonsoon			Summer			Premonsoon		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
Aspergillus Fumigates	+		+	–	–	+	–	–	–	+	–	+
Aspergillus flavus	–	–	–	–	+	–	–	–	–	–	–	+
Aspergillus niger	–	+	–	+	–	–	–	–	–	–	–	–
Aspergillus nidulans	–	+	–	–	–	+	–	–	–	–	–	–
Rhizopus oryzae	–	+	–	–	+	–	+	–	+	–	–	–
Trichoderma viridae	–	–	+	–	–	–	–	+	–	–	–	–
Fusarium oxysporum	–	–	+	–	+	–	+	–	–	–	+	–
Penicillium citrinum	–	+	+	–	–	–	–	–	–	–	–	+
Aspergillus repens	–	+	–	+	–	+	+	–	–	–	+	–
Rhizopus stolonies	–	–	–	–	+	–	+	–	+	–	+	–
Penicillium conidia	–	+	–	+	–	–	–	–	–	–	–	–
Penicillium levitum	–	+	–	–	–	+	–	–	–	–	–	–
Penicillium citrinum	–	+	–	+	–	–	–	–	–	+	–	–
Curvularia subulata	–	–	+	–	–	–	–	–	+	–	–	–
Cladosporium herbarum	+	–	+	–	+	–	–	+	–	+	–	–

Table -6 Population Density of Fungal Isolates From Different Location of Papanasan Taluk

S.NO	Season	Name of Location	NUMBER OF POPULATION $\times 10^{-3}$ DILUTION CFU/ g SOIL
1	Monsoon	Perumalkoil	91
		Rajagiri	96
		Kabistalam	85
2	Postmonsoon	Perumalkoil	85
		Rajagiri	70
		Kabistalam	100
3	Summer	Perumalkoil	93
		Rajagiri	82
		Kabistalam	98
4	Premonsoon	Perumalkoil	97
		Rajagiri	100
		Kabistalam	94

100 cfu/g was observed in postmonsoon and premonsoon for S3-Kabistalam,S2-Rajagiri,soil sample**.**

The predominant microbes were *Aspergillus niger, Aspergillus terrus and Trichoderma viride.*

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 micronutrients, Mn is considerably, sufficiently present in all the samples and this result corroborated with the findings of Sharma *et al*., (2006). The maximum Calcium (4.5 ppm) was recorded at Kabistalam, whereas minimum Calcium (3.1 ppm) was recorded at Rajagiri soils. The present study also recorded average Calcium of the soil as (3.7 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 PH 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 16, Post monsoon 12, Summer 11, Premonsoon 8 species for all sampling stations, respectively. The fungi isolated during the present study was during Monsoon 13, Post monsoon 12, Summer 7, Premonsoon 8 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% CuSO4 can be done before flowering. In case of crops like rice, banana and sunflower, foliar application of CuSO4 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 *Alcaligenes, E.coli, Bacillus subtilis and Bacillus cereus*. 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, Aspergillus terrus and Trichoderma viride*. 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 Papanasam Taluk, Thanjavur district. The diversity and abundance of soil borne 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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