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SEASONAL CHANGES IN THE DIVERSITY OF BACTERIA AND FUNGI IN THE SOILS OF MAYILADUTHURAI TALUK, NAGAPATTINAM DISTRICT, TAMIL NADU, INDIA

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ABSTRACT

The present study deals with the diversity and distribution of fungal and bacterial population in various seasons (Monsoon, Premonsoon, Summer, Postmonsoon) from three different places of Mayiladuthurai Taluk.The physicochemical parameters of the collected soil samples were collected. The physical parameters includes the analysis of soil colour, texture, Electrical conductivity, salinity, p^H, moisture content and temperature. The chemical parameters include the analysis of Calcium, Magnesium. Zinc, Iron, Manganese and Copper present in three different villages of Mayiladuthurai Taluk. Thus the present study reveals the presence of bacterial and fungal populations in the soil samples collected from Mayiladuthurai Taluk. Biodiversity of the soils represents the fertility of the soil. The surface soil consists of high content of organic matter which increases the biodiversity. So, frequent study on the biodiversity keeps up to date knowledge about the fertility. Seasonal climatic changes also influence the biodiversity of the soil by changing the physico chemical parameters. Bacteria and fungi have direct impact on crop production with different environmental conditions. These microbes are able to supply nutrients to crop to encourage plant growth for example, through the production of plant hormones and control or inhibit the activity of plant pathogen.

INTRODUCTION

Soil is the topmost layer of the earth's surface. It consists of a mixture of minute particles of disintegrated rocks, minerals, organic matter and bacteria. Soil is formed when forces of nature such as temperature, rain, wind, waves, animals and plants act on rocks and break them into tiny pieces over a long period of time. The depth of soil is not the same in all parts of the country. Soil may be only a few centimeters deep in some places while in others it may extend to as much as 30 meters. Soil consists of four layers. The first or topmost layer of soil is made up of minute soil particles and decayed plant and animal matter. This layer is vital for the cultivation of crops. The second layer is made up of fine particles like clay; the third layer is a combination of weathered basic rock materials and soil while the fourth layer consists of un-weathered hard rocks.

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India has various types of soil ranging from the fertile alluvial of the Indo-Gangetic plains to the black and red soils of the Deccan Plateau. For example, if one is travellers through the State of Tamil Nadu, one may observe that the ploughed fields in the districts of Salem and Periyar are red while those in Coimbatore and Ramanathapuram are black. Each type of soil benefits different types of crops through their unique physical, chemical and biological properties. Alluvial soil is a fertile soil rich in potassium. It is highly suitable for agriculture, especially for crops such as paddy, sugarcane and plantain. Red soil has high iron content and is fit for crops like red gram, Bengal gram, green gram, groundnut and castor seed. Black soil is rich in calcium, potassium and magnesium but has poor nitrogen content. Crops like cotton, tobacco, chilly, oil seeds, jowar, ragi and maize grow well in it. Sandy soil is low in nutrient content but is useful for growing trees such as coconut, cashew and casuarinas in areas with high rainfall.

NUTRIENT STATUS OF SOIL

Micronutrient plays a vital role in maintaining soil health and also productivity of crops.

These are needed in very small amounts. The soil must supply micronutrients for desired growth of plants and synthesis of human food. Increased removal of micronutrients as a consequence of adaption of HYVs and intensive cropping together with shift towards high analysis NPK fertilizers has caused decline in the level of micronutrients in the soil to below normal at which productivity of crops cannot be sustained. The deficiencies of micronutrients have become major constraints to productivity, stability and sustainability of soils. Soils with finer particles and with higher organic matter can generally provide a greater reserve of these elements whereas, coarse textured soils such as, sand have fewer reserves and tend to get depleted rather quickly.

Mineral resources

Major minerals

The important major minerals available in Nagapattinam District are Crude oil, Natural gas, Silica sand, Lime shell and Heavy mineral sand (Garnet, Iluminite, Rutile Zircon, Monozite).

Minor minerals

In Nagapattinam district, minor minerals such as sand and brick earth quarries are available. There are 8 sand quarries operating in this district in kollidam river, thirumalairajan river and vettar areas.

MATERIALS AND METHODS

Sample Collection

Soil samples were collected from the villages namely melamaruthanthanallur, Managudi and ulluthukuppai in mayiladuthurai taluk of Nagapattinam District .They were geographically with dry lands, urban and flood affected area thereby with different variety of soil viz, clay loam and sandy clay soil. A V- shaped cut was made with a spade to remove 1 to 2 cm slice of soil. The sample may be collected on the blade of the spade and put in a bucket. In this way collected samples from all the spots marked for one sampling unit. Pour the soil from the bucket on a piece of clean paper or cloth and mixed thoroughly. Spread the soil evenly and divided it into 4 quartess. Reject two opposite quarters and mix the test of the soil again. Repeat the process till left with about half kg of the soil collect it and put in a clean cloth bag. Each bag should properly marked to identify the sample. A depth within 30 cm from the surface of the soil and collected samples were brought to the laboratory in sterilized polythene bags handpicked, air dried and stored in containers for further investigation.

Study Area

Nagapattinam District in Tamilnadu State of India is spread over eight taluks with a total geographical extent of 2715.83 sq.km. with the head quarter at Nagapattinam. This District lies on the shores of the Bay of Bengal between Northern Latitude 10.7906 degrees and 79.8428.Degrees Eastern longitude with eight taluks and eleven panchayat unions. The study area is spread over in 2, 32, 257 hectares of land and has 499 revenue villages.

Mayiladuthurai is a town in Nagapattinam district in the South Indian state of Tamil Nadu. It is the headquarters of the Mayiladuthurai taluk. The town is located at a distance of 60 km (37 mi) from the district headquarters Nagapattinam and 281 km (175 mi) from the state capital Chennai. Mayiladuthurai is known for the Mayuranatha swami Temple, a prominent Shaivite shrine. Arulmigu Mayuranathar temple is located here. According to the Hindu mythology, Annai Parasakthi danced in the form of a peacock and hence the place is called Mayiladuthurai. Devotees after worshipping Mayuranathar can travel from here to all places of navagrahas and other important temples by bus. The festival of holy bath known as kadai muzhukku in the river Cauvery is celebrated in the month of ippasi.

Physical parameter of the soil

The physical parameters includes of soil colour, texture, p^H (Booth, 1961), moisture content (Griffin, 1970), temperature (Ahmed 2003) and electrical conductivity were analyzed in the collected soil samples.

Chemical parameters of the soil

The chemical parameters contain macro nutrients and micro micronutrients. The macro nutrients includes Carbon (Walkely and Black,1934), Nitrogen (Subbaiah and Asija,1956), Potassium (Toth and Prince, 1949), Phosphorus (Jackson and Bray,1973), Calcium (Jackson and Bray,1973) and Magnesium (Williams,2006) and the micro nutrients includes Copper, Iron, Zinc and Manganese were analyzed by using Atomic Absorption Spectrophotometer method.

Isolation of bacteria and fungi

The isolation of Serial dilution was performed by using the collected soil sample to isolate the fungal and bacterial population from the soil samples. The soil samples were diluted with conical flask containing 90ml of sterile distilled water and mixed thoroughly to make 1:10 dilution (10^{-1}). Then 10 ml of diluted sample was transferred to the next conical flask and serially diluted into the series of conical flask having 90ml of sterile distilled water with sterile pipettes, up to 10^{th} dilutions. Here, 10^4 to 10^7dilutions were taken for the bacterial isolation. The Warcup method was used to isolate the fungal species.

Identification of bacteria and fungi

Gram staining, motility test and biochemical tests, Indole, MR-VP, Citrate Utilization test, Oxidase test, Catalase test, Triple Sugar Iron test and Carbohydrate Fermentation test were used to identify bacterial species and conforming Bergey's Manual of Determinative Bacteriology. Lactophenol cotton blue technique was used to identify the fungi and by the fungal Manual, Dematiaceous Hypomycetes (Ellis, 1971).

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.

Number of CFU's of fungi per gram dry weight of soil =

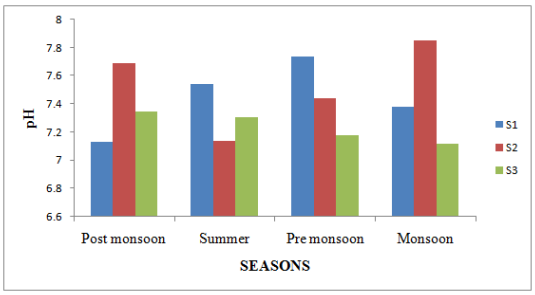
$$\frac{\text{Mean no.of colonies}}{\text{Dry weight of the soil.}} \times \text{Dilution factor}$$

In order to assess the dominance of individual species site percentage contribution was worked out as follows,

$$\% \text{ contribution} = \frac{\text{Total number of colonies}}{\text{Total number of individual colonies}} \times 100$$

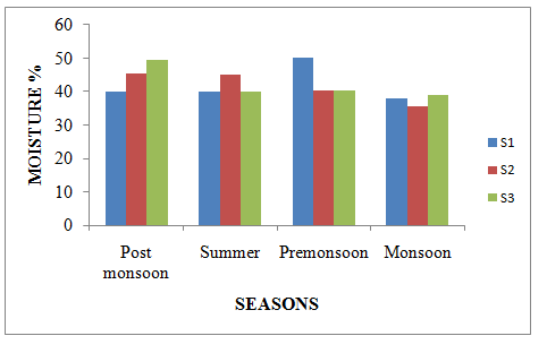
RESULTS AND DISCUSSION

Diversity of bacterial and fungal isolates was high, perhaps due to the nutritive status of the soil. The villageswise (Melamaruthanthanallur, Manakkudi and Ulluthukkuppai) extractable macro nutrients (C, N,P and K) and micronutrients (Fe, Mn, Zn and Cu) contents were systematically determined for the entire district.The content of Zn, Fe, Cu and Mn varied for three villages on the basis of critical limits suggested by Tandon (1999).The physicochemical parameters studied were represented in Fig-1-3 & Table-1.



S1 - MELAMARUTHANTHANALLUR
S2 – MANAKKUDI
S3 - ULLTHUKUPPAI

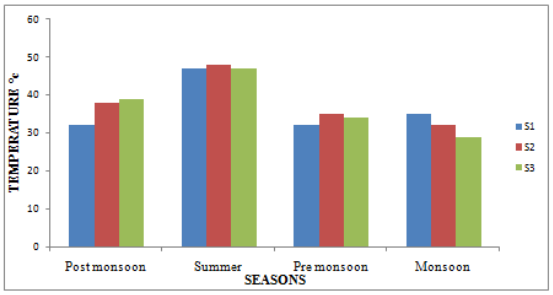
Figure 1. Analysis of ph in different seasons from mayiladuthurai taluk



S1 - MELAMARUTHANTHANALLUR
S2 – MANAKKUDI
S3 - ULLTHUKUPPAI

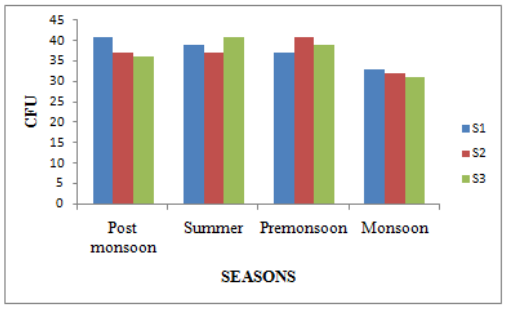
Figure 2. Estimation of moisture content from different seasons

The bacteria and fungi were isolated in the dilution plate technique. Soil moisture was analyzed the values are 40.02, 45.5 and 49.5% (Post monsoon), 40.02, 40.12 and 40.03% (Summer), 50.3, 40.2 and 40.3% (Pre monsoon), 37.8, 35.5 and 38.9% (Monsoon) (Fig-2).



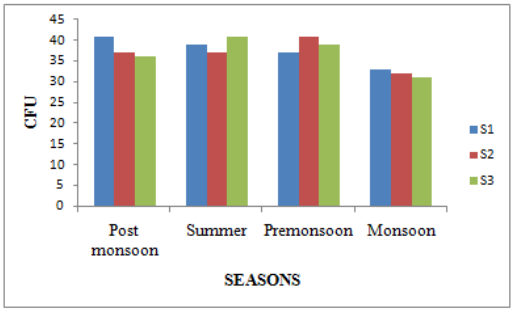
S1 - MELAMARUTHANTHANALLUR
S2 – MANAKKUDI
S3 - ULLTHUKUPPAI

Figure 3. Analysis of temperature from mayiladuthurai taluk in different seasons



S1 - MELAMARUTHANTHANALLUR
S2 – MANAKKUDI
S3 – ULLTHUKUPPAI

Figure 4. Colony forming units of bacterial species from mayiladuthurai taluk in different seasons



S1 - MELAMARUTHANTHANALLUR
S2 – MANAKKUDI
S3 – ULLTHUKUPPAI

Figure 5. Colony forming units of fungal species from mayiladuthurai taluk in different seasons

The effect of soil moisture on the ecology of soil fungi was reviewed (Griffin, 1970). The p^H value was slightly changed in three villages along four season (Fig-2). The soil reaction (p^H) in relation to soil microflora (Griffin, 1972). Microbial population was estimated at different soil. The bacterial colonies and fungal colonies were formed. Microbial population numbers were estimated at two different soil depth in microphalang scared groove forest of Meghalaya. In general the number of bacteria and fungi were higher in the surface layer (0- 10 cm) than in deep layer of soil (10-20 cm). 26 species of bacteria and 22 species of fungi isolated were distributed to all depths (Kayang, 2006).

Table 1. Physico Chemical Parameters Of The Soil

Name of the parameters	Post monsoon			Summer			Pre monsoon			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
carbon(%)	0.42	0.48	0.49	0.36	0.25	0.30	0.18	0.48	0.14	0.29	0.85	0.26
Nitrogen(Kg/ac)	90.28	85.5	93.2	88.6	82.6	82.6	88.5	87.5	90.6	95.6	85.6	90.2
Potassium(kg/ac)	76	74.6	72.5	68	69.1	63.7	70.7	72.2	71	72.3	70.8	70.1
Phosphorus(kg/ac)	4.12	4.15	3.16	2.15	2.36	4.2	2.19	2.57	1.24	2.54	2.35	3.24
Magnesium(ppm)	10.5	10.1	9.7	8	8.2	8.5	9.5	9.8	10	9.5	9.7	9.3
Calcium(ppm)	8.4	7.9	9	7	7.1	7.3	8.8	8.6	9.5	9.4	9.5	9.6
Copper(ppm)	0.78	0.79	0.84	1.9	1.4	1.8	0.96	0.88	0.92	1.8	1.6	1.9
Iron(ppm)	2.34	2.55	2.65	3.3	3	2.25	4.7	4.6	4.9	2.5	2.8	2.6
Zinc(ppm)	0.87	0.78	0.76	0.67	0.81	0.74	1.8	2.7	2.5	0.7	1.5	2.3
Manganese(ppm)	2	2.5	2.8	2.1	1.7	2.4	3.5	3.8	3	2.2	1.7	2.8
Electrical conductivity	1.5	1.8	1.3	1.2	1.6	1.5	1.2	1.9	1.5	1.9	1.4	1.8

S1 – MELAMARUTHANTHANALLUR, S2- MANAKUDI, S3- ULUTHUKUPPAI

Table 2. List of bacteria and fungi isolated from mayiladuthurai taluk

Seasons	Name of the fungi			Name of the bacteria		
Sampling places	S1	S2	S3	S1	S2	S3
Post Monsoon	*Rhizopus nigricans, Alternaria alternate, Aspergillus terreus, Aspergillus nidulans, Aspergillus sulphureus*	*Cladosporium sp, Aspergillus niger, Fusarium sp, Curvularia lunata*	*Aspergillus terrus, Penicillium janthinellum*	*Bacillus cereus, P.fluorescens, Aerobacter aerogenes*	*E.coli, Pseudomonas spp, Bacillus coagulans*	*Flavibacterium, Pseudomonas spp, Bacillus spp.*
Summer	*Aspergillus niger, Trichoderma viride Rhizopus Aspergillus flavus*	*Fusarium sp, Vibrio spp Trichoderma harzianum, Mucor , Proteus vulgaris*	*Rhizopus spp, Aspergillus flavus, Fusarium oxysporum, Alternaria alternate*	*E.coli, Bacillus subtilis, Bacillus cereus*	*Enterococcus spp, Micrococcus luteus, Pseudomonas spp*	*Enterobacter spp, Flavobacterium spp, Staphylococcus spp, Streptococcus spp*
Pre monsoon	*Aspergillus niger, Aspergillus fumigates, Rhizopus oryzae, Fusarium sp*	*Aspergillus spinulosus, Fusarium oxysporum, Pencillium spp*	*Colletotrichum falcatum, Fusarium semitectum*	*Proteus vulgaris, Pseudomonas alkaligens, Enterobacter spp.*	*E.coli, Streptococcus, Vibrio spp, Micrococcus*	*Staphylococcus spp, B.licheniformis, Streptococcus spp*
Monsoon	*Aspergillus niger, Pecillium, Rhizopus, Mucor*	*Aspergillus niger, Pencillium, Fusarium,*	*Aspergillus niger Rhizopus Mucor*	*Bravibacterium spp, Agrobacterium spp, Bacillus spp*	*Bacillus circulans, B.mycoides, Brevibacterium spp*	*P.pudita, Staphylococcus spp, Streptococcus spp*

S1- MELAMARUTHANTHANALLUR, S2- MANAKUDI, S3- ULUTHUKUPPAI

Generally fungi and bacteria found in deep layer or slow growing due to unavailability of mineral nutrients and compaction of soil along depth (Dkhar and Mishra, 1992). One gram of the soil sample thus prepared was added to 10 ml sterilized distilled water and serial dilutions were made (Johnson, 1957). Nutrient agar medium was used to isolate the bacterial species from the soil. Here, 10^4 to 10^7dilutions were taken for the bacterial isolation. Fungal population present in the soil sample were determined by plating the soil dilution of 10^{-2} to 10^{-5} dilution over solidified Rose Bengal Agar medium and Potato Dextrose Agar medium

Isolation of bacteria

Totally, 26 different species of soil bacteria were observed from soil samples. The bacterial species were identified by their morphological character and confirmed using Bergey's Manual of Determinative Bacteriology. The bacterial species were *Bacillus cereus, P. fluorescens, Aerobacter aerogenes, E.coli, Pseudomonas spp, Bacillus coagulans*, *Flavibacterium, Pseudomonas spp, Bacillus spp,* are present in post monsoon season. *E.coli, Bacillus subtilis, Bacillus cereus, Enterococcus spp, Micrococcus luteus, Pseudomonas spp, Enterobacter spp, Flavobacterium spp, Staphylococcus spp, Streptococcus spp* were present in summer season. *Proteus vulgaris, Pseudomonas alkaligens, Enterobacter spp. E. coli, Streptococcus, Vibrio spp, Micrococcus, Staphylococcus spp, B. licheniformis, Streptococcus spp,* were present in pre monsoon season. *.Achromobacter spp, Agrobacterium spp, Bacillus spp Bacillus cirulans, B.mucoides, Brevibacterium spp P.pudita, Staphylococcus spp, Streptococcus spp* were present in monsoon season (Table – 2 & 3).The predominant bacterial species were *E.coli, Pseudomonas spp, Staphylococcus spp, Bacillus cereus* and *Streptococcus spp* in three different places during four seasons in Mayiladuthurai Taluk.

Isolation of fungi

Totally, 24 different species of soil fungi were 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 fungal species *Rhizopus nigrigans, Alternaria alternate, Aspergillus terreus, Aspergillus nidulans, Aspergillus sulphureus,*

Cladosporium sp, Aspergillus niger, Fusarium sp, Curvularia lunata, Candida albicans, Pencillium janthinellum were present in post monsoon seaso (Table – 2). *Aspergillus niger, Trichoderma viride Rhizopus Aspergillus flavus, Fusarium sp, Vibrio spp Trichoderma harzianum,, Mucor , Proteus vulgaris, Rhizopus spp, Candida albicans, Fusarium oxysporum, Alternaria alternate* were present in summer season. *Aspergillus niger, Aspergillus fumigates, Rhizopus oryzae, Fusarium sp, Aspergillus spinulosus, Fusarium oxysporum, Pencillium spp, Colletotrichum falcatum, Fusarium semitectum* were present in pre monsoon season.*Aspergillus niger , Pecillium , Rhizopus, Aspergillus niger, Pencillium ,Fusarium , Aspergillus niger, Rhizopus, Mucor* were present in monsoon season. The predominant microbes were *Aspergillus niger, Rhizopus, Mucor* and *Fusarium sp.* (Table 2).

Summary and Conclusion

Biodiversity of the soils represents the fertility of the soil. The surface soil consists of high content of organic matter which increases the biodiversity. So, frequent study on the biodiversity keeps up to date knowledge about the fertility. Seasonal climatic changes also influence the biodiversity of the soil by changing the physico chemical parameters. Bacteria and fungi have direct impact on crop production with different environmental conditions. These microbes are able to supply nutrients to crop to encourage plant growth for example, through the production of plant hormones and control or inhibit the activity of plant pathogen.

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