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ANALYSIS OF SOIL TYPES FOR ITS PHYSICO-CHEMICAL PARAMETERS AND THE SEASONAL DISTRIBUTION OF ACTINOMYCETES FROM THIRUVARUR DISTRICT, TAMIL NADU

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ABSTRACT

The loose surface layer that covers the majority of the land is referred to as soil. The Thiruvarur district's villages provide the soil. The area's eight different soil types include loamy sand, clay, silty clay, saline alluvial and saline alkaline, as well as sandy clay loam, clay loam saline alluvial and silty clay alluvial. A variety of physico-chemical characteristics, including pH, temperature, moisture, loss of ignition, electrical conductivity, nitrogen, potassium, phosphorus, sulphur and hydrogen sources were examined for monsoon, post-monsoon, summer and pre monsoon seasonal soil types. *Actinoplane sp, Actinomyces sp*, and *Micromonospora sp* were discovered as a result of this inquiry. During the monsoon season, *Nocardia* was exclusively present.

Keywords: Soil, loamy sand, summer, Actinomyces and Micromonospora sp.

INTRODUCTION

Soil is made up of organic matter, minerals, gases, liquids, and organisms, all of which work together to support life. The pedosphere, or body of soil on Earth, serves four major functions: it serves as a substrate for plant growth, a source of water for storage, supply, and purification, a moderator of the atmosphere, and a habitat for species. Soil is an important part of the planet's ecosystem. The effects of soil processes on the world's ecosystems are far-reaching, ranging from ozone depletion and global warming to rainforest destruction and water contamination. Soil is a major carbon reservoir in the Earth's carbon cycle, and it may be one of the most sensitive to human disturbance and climate change. Due to increased biological activity at higher temperatures, soils are expected to add carbon dioxide to the atmosphere as the world warms, a positive feedback loop (amplification). However, in light of more recent research on soil carbon turnover, this forecast has been called into question (Davidson *et al.,* 2006).

Soil is a significant provider of ecosystem services since it serves as an engineering medium, a habitat for soil organisms, a recycling system for nutrients and organic wastes, a regulator of water quality, a modifier of atmospheric composition, and a medium for plant growth. Because soil has such a diverse range of niches and habitats, it holds the majority of the world's genetic diversity. A gram of soil can contain billions of creatures from thousands of different species, the majority of which are microbial and completely unknown.

The term "microbial diversity" or "biodiversity" has become so well-known that even a public servant knows what it means. The heterogeneity among living organisms is referred to as microbial diversity. Evolution is the primary driver of microbial diversity on Earth. Any cell's structural and functional variety is an evolutionary event that occurred as a result of Darwin's natural selection theory. Microbial diversity is an underappreciated national and international

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resource that requires more attention than it now receives. It refers to the range of variety found in all forms of microorganisms in the natural world, as well as how it has been influenced by human intervention. Understanding the microbial ecology in soil and other habitats necessitates microbial diversity research (Atlas, 1984).

It is significant in both natural and agricultural settings. Plant and animal diversity in forests and agro-ecosystems receives a lot of scientific attention, but microbe diversity is frequently overlooked. As a result, much more work needs to be done to better understand the role of microbes, inventory their diversity, and identify strategies to benefit from them. Soil bacteria are one of the most significant biotic components in terrestrial ecosystems that regulate decomposition and nutrient mineralization (Bardgett *et al*., 2005).

Although there have been numerous studies on the factors that influence soil microbial communities in various ecosystems such as agricultural fields, grasslands, and forests, there is relatively little information on the relationship between soil properties and microbial communities in broadleaved forest soils, which are distinct from those in other terrestrial ecosystems. Microbial diversity must be studied not only for basic scientific inquiry, but also to comprehend the relationship between diversity and community structure and function (Nusslein and Tiedje, 1999).

Keeping all the information's in mind, the present study was planned with the collection of the major seasonal (Monsoon, Post monsoon, Summer and Pre monsoon) soil types, analysis of physical characters, micronutrient, macronutrient and heavy metals and isolation and identification of seasonally varied actinomycetes of soil samples in Thiruvarur district.

MATERIALS AND METHODS

Topographical location of Sampling sites of Thiruvarur district

Thiruvarur district is one of the 32 districts in the Tamil Nadu state of India. The district occupies an area of 2161 Km^2. It lies between Nagapattinam district on the east and Thanjavur district on the west, and is bounded by the Palk Strait on the south. The district headquarters is at Thiruvarur town.

Geographical position

Date of District formation : 01.01.1997

Latitude (North – South) : Between 10°20′ and 11°07′

Longitude (East – West) : Between 79°15 and 79°45′

Mean sea level : 10 meters

Area (sq. km) : 2161

Meteorological information

The maximum temperature was around 35.19°C, while the minimum was around 26.39oC. The average relative humidity is around 73.2 %, with a range of 36.9 % to 95.6 %. The pressure at the station ranges from 1008 to 999 hPa, with an average of 1017 hPa. In Tamil Nadu, there were four distinct seasons.

Summer – March, April and May

Pre monsoon – June, July and August

Monsoon – September, October and November

Post Monsoon – December, January and February

Sample collection

Soil samples were obtained from the villages listed below in the Thiruvarur district of Tamil Nadu, India (Kannan Pandian *et al*., 2011). In a plot, five areas were set aside for taking on a composite soil mixture. The field's surface was scraped away in order to acquire uniformly thick slices of soil from the plough depth in each location. To remove 1 to 2 cm of earth, a V-shaped cut was made with a shovel. The shovel blade sample was taken and placed in a clean bucket. Similarly, a sample was taken from each of the places chosen for one sampling unit. As a result, the samples were dumped onto clean paper and well mixed. After that, the samples were evenly distributed and divided into four equal halves. The remaining samples were combined after the two opposing

quarters were rejected. The technique was continued until half a kilogram of soil was reached. The sample was taken in a clean bag and properly labeled. The bag's mouth was knotted with care.

The district has eight different types of soil, such as sand clay loam, clay loam saline alluvial, silty clay alluvial, loamy sand, clay, silty clay, saline alluvial, and saline alkaline soil are the different types. Sandy coastal alluvium and red loam are the most common soil types in the district. The alluvial soil can be found in the riverbed and neighboring parts of the Cauvery River, while the sand soil can be found along the beach. These soils are extremely fertile. The Cauvery River is the district's principal water source. Some of the seasonal rivers in this district include Vennar, Vettar, Koraiyar, Paminiyar, Mullaiyar, Harichandra Nadi, Arasalar, Vanchiar, Nattar, and others. The entire district is irrigated by canals that run for 612 kilometres and are supported by the Cauvery system. Clay soil covers the remaining portion of the district. Soil samples were collected over various seasons and analyzed for physico-chemical characteristics and collecting location, as shown in table 1.

Analysis of Physico-chemical parameters of soil

The soil samples were tested to various physico-chemical parameters like pH (Ghosh *et al*., 1983; Hanway and Heidal, 1952), temperature (Van Bavel and Hillel, 1976), Electrical conductivity (Richards, 1954), Moisture content (Muhr *et al*., 1965), organic carbon (Walkley and Black, 1934), Nitrogen (Subbiah and Asija, 1956), Nitrates (Subbiah and Asija, 1956), ammonia (Subbiah and Asija, 1956), Phosphate (Olsen *et al*., 1954), available Potassium (Toth and Prince, 1949), available Sulphur (Chesnin and Yien, 1950), Calcium, Magnesium and other heavy metals (Cheng and Bray 1951).

Isolation of actinomycetes (Aneja, 2002)

From 10^{-4} to 10^{-7} dilutions, 0.1 ml of serially diluted sample was placed on Starch Casein agar plates and incubated at 30-35ºC for 7 to 14 days. The plates were examined for colony formation after incubation. The isolated organisms were then streaked on selective medium like Eosin Methylene Blue agar, MacConkey agar, Mannitol salt agar, and Violet red bile agar aseptically.

Table 1: Description of Sampling Sites Located in Thiruvarur District, Tamil Nadu (Kannan Pandian *et al*., 2011)

S.No	Sample code	Village name	S.No	Sample code	Village name
1.	SATpS1	Thirupattur	28.	SDNSI	Chettichathram
2.	SATpS2	Rayanallore	29.	SDNSI	Bhagavathamangalam
3.	SATpS3	Chettiyamolai	30.	SDNSI	Munnavalkottai
4.	SANS1	Kovilvenni	31.	SENSI	Vadapathimangalam
5.	SANS2	Nagar	32.	SENSI	Rhishiyur
6.	SANS3	Parappanamedu	33.	SENSI	Laxmangudi
7.	SAMS1	Muthalsethi	34.	SEMSI	Palaiyur
8.	SAMS2	Nalamsethi	35.	SEMSI	Vengathangudi
9.	SAMS3	Serankulam	36.	SEMSI	Peruvidaimaruthur
10.	SAKS1	Viswanathapuram	37.	SEKS1	Paruthiyur
11.	SAKS2	Mangudi	38.	SEKS1	Thiyagarajapuram
12.	SAKS3	Kalathur	39.	SEKS1	Kamalapuram
13.	SANaS1	Pandaravadai	40.	SENaS1	Kollapuram
14.	SANaS2	Nemmeli	41.	SENaS1	Kurungulam
15.	SANaS3	Thirunaichur	42.	SENaS1	Kumarakudi
16.	SAVS1	Valangaiman	43.	SEVS1	Padagacheri
17.	SAVS2	Regunathapuram	44.	SEVS1	Puliyakudi
18.	SAVS3	Melavidayal	45.	SEVS1	Chandrasekarapuram
19.	SBTpS1	Vellore	46.	SFTS1	Vilamal
20.	SBTpS2	Manali	47.	SFTS1	Vijayapuram
21.	SBTpS3	Keerakkolore	48.	SFTS1	Thandalai
22.	SCTpS1	Pamani	49.	SGTS1	Alivalam
23.	SCTpS2	Korukkai	50.	SGTS1	Aamoor
24.	SCTpS3	Desingurajapuram	51.	SGTS1	Kalyanamahadevi
25.	SDTpS1	Pinnathore	52.	SHTS1	Thappalampulliyur
26.	SDTpS2	Keelaperumazhai	53.	SHTS1	Vengatesapuram
27.	SDTpS3	Sanganthi	54.	SHTS1	Karrappur

Total Cell Count

Direct counting of cell suspension in a counting container of known volume using a microscope is the most popular way of enumerating total microbial cells. Neubauer counting chamber is one example of such a counting chamber. Colony counter, an electrical gadget, is another technique. The number of cells in this instrument is counted indirectly by measuring the loss of conductance as

the cells move through a tiny passage. Total cell count can also be done using the membrane filtering method.

Identification of actinomycetes

Gram's staining technique, Motility test and Biochemical test were used to identify the isolated actinobacteria after incubation.

RESULTS

Soil sample collection

In the years 2014–2015, different seasonal (monsoon, post monsoon, summer and pre monsoon) soil samples were taken in the Thiruvarur district of Tamil Nadu. There were eight different soil types detected in this district (sandy clay loam, clay loam – saline alluvial, silty clay alluvial, loamy sand, clay, silty clay, saline alluvial, and saline alkaline) and their textural analysis was provided in this study (Table -2).

Table-2: Details of texture of soil collected from Thiruvarur district

S. No	Soil classes/ textural name	Range in relative % of soil samples		
		Sand	Silt	Clay
1	Sandy soil	85-100	0-15	0-10
2	Loamy sand	70-90	0-30	0-15
3	Sandy loam	43-80	0-50	0-20
4	Loam	23-52	28-50	7-27
5	Silt loam	0-50	50-88	0-27
6	Silt	0-20	88-100	0-12
7	Sandy clay loam	45-80	0-28	20-35
8	Clay loam	20-45	15-53	27-40
9	Silty clay loam	0-20	40-73	27-40
10	Sandy clay	45-65	0-20	35-45
11	Silty clay	0-20	40-60	40-60
12	Clay	0-45	0-40	40-100

Soil physico-chemical parameters analysis

There were eight different types of soil samples obtained in Thiruvarur districts, Tamil Nadu, including sandy clay loam, clay loam-saline alluvial, silty clay alluvial, loamy sand, clay, silty clay, saline alluvial, and saline-alkaline. Soil samples had their physico-chemical characteristics examined.

Isolation and identification of actinomycetal species

Thiruvarur district has eight different (Sandy clay loam, Clay loam –saline alluvial, Silty clay alluvial, Loamy sand, Clay, Silty clay, Saline alluvial and Saline alkaline) soil types, according to the study. There was one actinomyces present in all monsoon seasonal soil types. Except for loamy sand and saline alkaline soil, two actinomycetal species were found in six soil types. Micromonospora species (Actinomycetes) were discovered in four different soil types: sandy clay loam, clay, silty clay and saline alluvial soil.

Table – 3: Isolation of bacteria and actinomycetes from soil samples of Thiruvarur district, Tamil Nadu (2014-2015)

S. No	Monsoon	Post Monsoon	Summer	Pre Monsoon
1	*Actinomyces sp*	*Actinomyces sp*	*Actinomyces sp*	*Actinomyces sp*
2	*Actinoplanes sp*	*Actinoplanes sp*	*Actinoplanes sp*	*Actinoplanes sp*
3	*Micromonospora sp*	*Micromonospora sp*	*Micromonospora sp*	*Micromonospora sp*
4	*Microbispora sp*	-	*Streptomyces sp*	*Microbispora sp*
5	*Nocardia sp*	-		*Nocardia sp*

Two actinomycetes were found in all soil types during the post- monsoon season. Except for saline alkaline and loamy sand, actinomycetes were found in six soil types. Only an actinomycetes were found in all summer seasonal soil types. Except for loamy sand, seven soil types included two actinomycetes. Clay, silty clay, saline-alluvial, clay loam-saline alluvial, and saline alkaline soil

types all had Micromonospora and Salmonella species. Clay, silty clay, saline alluvial, and sandy clay loam were all shown to include Actinomyces was found in all soil types during the pre-monsoon season. In sandy clay loam, clay, silty clay, loamy sand, saline alkaline, and saline alluvial soil, Actinomyces was found. Clay, loamy sand, and saline alkaline soil all had Microbispora species (Table-3 &4).

Table -4: Actinomycetal species count recorded during four different seasonal soil samples of Thiruvarur district, Tamil Nadu

S.No	Name of the organism	Shape	Gram	Indole	MR	VP	Citrate	Catalase	TSI	Oxidase	Urease	Motility	Endospore
1	*Actinomyces sp*	Rod	+	-	+	-	-	-	-	-	-	-	-
2	*Actinoplanes sp*	Spherical	+	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+	+
3	*Micromonospora sp*	Branched myceliu m	+	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+	+
4	*Microbispora sp*	Branched myceliu m	+	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-	-	+
5	*Nocardia sp*	Rod	+	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-	-	-
6	*Streptomyces sp*	Filament	+	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-	-	+

Note:MR-Methyl Red, VP-Voges-proskauer, + - Positive, --Negative

DISCUSSION

The soil type was discovered after physico-chemical examination of the soil near the microbiology laboratory at the University of Ilorin's main campus. All of the samples had a pHranging from 7.10 to 7.81. According to the soil texture analysis, the soil is loamy sand, with a mean composition of 89 percent sand, 7% silt, and 4% clay, respectively. The water holdingcapacity ranged from 0.28 to 0.53 ml per gram. The moisture level varied between 2.10 and 5.23 percent. Loamy sand was discovered to be the soil type. According to Brown's work from 2003, this is correct.

Furthermore, an uncultureable study of Gangotri soil reveals that it is rich in bacterialdiversity, as evidenced by the presence of a large number of different bacterial taxa. Furthermore, the presence of many unclassified taxonomic sequences indicates the presence of novel bacterial diversity. Furthermore, Proteobacteria, Acidobacteria, and Actinobacteria were found in abundance in Gangotri soil, whereas Bacteroides and Firmicutes were found in greater abundance in Kandakhal soil. Firmicutes were the third most abundant phylum in Kandakhal, but their abundance was very low in Gangotri, indicating that high altitude has a negative impact on gram positive bacteria diversity (Demergasso *et al*., 2004).

Due to a selective increase in proteobacterial diversity and a decrease in Firmicutes diversity, Gangotri soil has a high ratio of Gram-negative to Gram-positive bacteria. As a result, in high-altitude ecosystems, altitude has a significant impact on the ratio of Gram negative to Gram positive bacteria. Bacteroides, Gemmatimonadetes, Nitrospirae, Verrucomicrobia, Armatimonadetes, Cyanobacteria, Planctomycets, and Chloroflexi were among the bacterial phyla found in both soils. High altitude was found to be positively correlated with the abundance of Cytophaga, Flavobacterium, and Bacteroides (CFB). Many studies have reported the presence of these phyla in cold deserts (Yang *et al*., 2006).

SUMMARY AND CONCLUSION

The current research focused on "Analysis of soil types for its physico-chemical parameters and the seasonal distribution of Actinomycetes from Thiruvarur District, Tamil Nadu". Monsoon, post-monsoon, summer, and pre-monsoon seasonal soil samples were collected in Thiruvarur district, Tamil Nadu. Among the eight types of soil found in this district were sandy clay loam saline alluvial, clay loam saline alluvial, silty clay alluvial, loamy sand, clay, silty clay, saline alluvial, and saline alkaline soil. pH, temperature, moisture, loss of ignition, electrical conductivity, nitrogen, nitrate, ammonium, phosphorus, potassium, sulphur, and hydrogen sources were investigated in the soil samples. *Actinoplane species, Actinomyces species* and *Micromonospora species* were found throughout the year. The *Nocardia species* present only during the monsoon season.

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