



ISSN: 0976-3031

Available Online at <http://www.recentscientific.com>

International Journal of Recent Scientific Research
Vol. 7, Issue, 7, pp. 12337-12341, July, 2016

**International Journal of
Recent Scientific
Research**

Research Article

CHARACTERIZATION OF BACTERIAL AND FUNGAL DIVERSITY OF SOILS AT DIFFERENT SEASONS IN THIRUVAIYARU TALUK, TAMILNADU, INDIA

Vinothini K., Victoria J* and Dhivaharan V

Department of Microbiology Mannargudi- 612 001, Tamilnadu, India

ARTICLE INFO

Article History:

Received 19th April, 2016

Received in revised form 12th May, 2016

Accepted 26th June, 2016

Published online 28th July, 2016

Key Words:

Bacteria, Fungi, Diversity, Macronutrients, Micronutrients.

ABSTRACT

The present study was aimed at the isolation and identification of soil Bacteria and Fungi from Thiruvaiyaru Taluk of Thanjavur District, Tamilnadu. The physico – chemical parameters of such soils were identified. The physical parameters includes the analysis of pH, temperature and moisture content of the soil. The chemical parameters such as macro nutrients (Nitrogen, Phosphorus, Potassium, Magnesium, Calcium) and micronutrients (Iron, Copper, Zinc, Manganese) were present in Thiruvaiyaru Taluk of Thanjavur District. Totally 20 different species of bacteria and 20 different species of fungi were observed from the soil samples, they were collected from three villages namely, Thiruvaiyaru (S₁), Thirupalanam (S₂) and Karugudi (S₃). The highest percentage of frequency of bacteria isolated from all the soil samples were recorded in which *Bacillus mucoides*, *Streptococcus sp*, *Bacillus sp* and *Aerobacter aerogenes* were predominant followed by other species of bacterium. For fungi, the highest percentage was recorded, *Aspergillus flavus*, *Fusarium oxysporum* and *Aspergillus nidulans* were predominant followed by other fungal species. They are dependent on the nature of substrate and temporal regions that favour the colonization, growth and substrate possession of the fungi. Population of soil Bacteria and Fungi might also get affected by climate.

Copyright © Vinothini K and Victoria J., 2016, this is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Soil is a complex ecosystem, delimited by physiochemical parameters that hold enormous number of living organisms. Nevertheless, microbes are the least unstated mechanism of soil by both agronomists and soil practitioners. On the farm several soil organisms offer benefits to crop growing in an ecosystem, but not well understood. The soil microbes decompose the plant and animal residues entering the soil and convert them into 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 composition. The plant species growing on the soil also equally influence the population and species composition of the soil fungi (Hackel *et al.*, 2000).

The biological components occupy a tiny fraction of the total soil volume and make less than 10% of the total soil organic

matter. This living component consists of plant roots and soil organisms. Soil microorganisms are responsible for a large part of biological activity which is associated with processes regulating nutrient cycles and decomposition of organic residues.

Biodiversity refers to the variability of life on Earth, all the living species of animals, plants and microorganisms. Fungi are a major component of biodiversity, essential for the survival of other organisms and are crucial in global ecological processes. Fungi being ubiquitous organisms occur in all types of habitats and are the most adaptable organisms. 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, 1977).

According to the Australian Department of the Environment and Water Resources, biodiversity is "the variety of life: the different plants, animals and micro-organisms, their genes and the ecosystems of which they are a part". Biodiversity and soil are strongly linked, because soil is the medium for a large variety of organisms, and interacts closely with the wider biosphere. Conversely, biological activity is a primary factor in the physical and chemical formation of soils.

*Corresponding author: **Victoria J**

Department of Microbiology Mannargudi- 612 001, Tamilnadu, India

MATERIALS AND METHODS

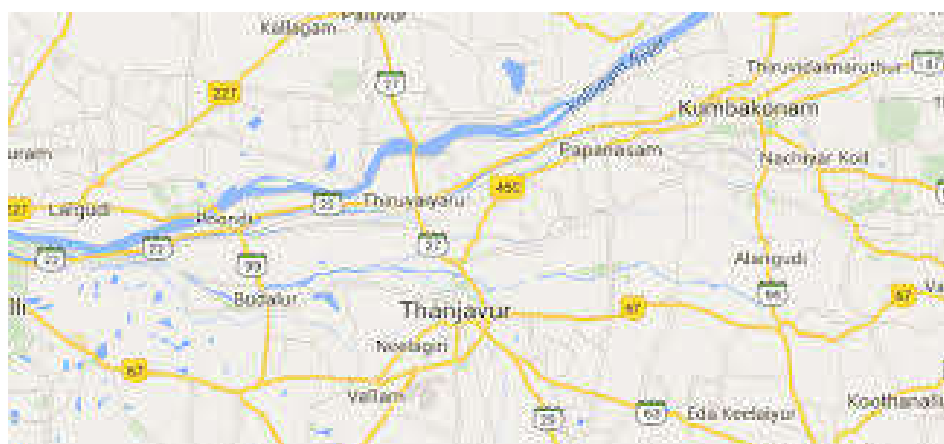
Description of the Study Site

Thiruvaiyaru is a panchayat town in Thanjavur District in the Indian state of Tamil Nadu. Thiruvaiyaru is situated on the banks of the river Kaveri, 13 km from Thanjavur. Thiruvaiyaru has an old Siva temple dedicated to Panchanatheswar. Though pilgrims flock to this temple throughout the year, Thiruvaiyaru is more renowned for its association with Saint Thyagaraja, who, along with Muthuswami Dikshitar and Shyama Sastri, comprised the Trinity of Carnatic music. Thiruvaiyaru means *Five Rivers around the city*. The Five Rivers are Arisilaaru, Vennaaru, Vettaaru, Kudamuruttiyaaru and Kaveriaaru.

Thanjavur District Map



Thiruvaiyaru Taluk Map



Sample Collection

Soil samples were collected from the villages namely Thiruvaiyaru (S₁), Thirupalanam (S₂) and Karugudi (S₃) in Thiruvaiyaru Taluk of Thanjavur District Tamilnadu, India. The soil samples were collected from paddy fields (up to 30cm depth) into a small sterilized polythene bags and brought to laboratory for further studies.

Physical Analysis

The moisture content was determined by using Griffin (1970) method. The pH of the suspension was determined using pH meter. The temperature was determined by using Thermometer. Electrical conductivity was determined by using Erlenmeyer flask.

Chemical analysis

Organic carbon content was determined by using standard procedure of Wakely and Black (1984) method. Available Nitrogen was estimated by using Subbaiah and Asija method. Available Potassium was estimated by using Flame photometer (Toth and Prince, 1949). Available Calcium and Phosphorus was estimated by using Bray and Kutz (1945) method. Available Magnesium was estimated by using Williams (2006) method. Iron, Manganese, Zinc and Copper were analyzed by using Atomic Absorption Spectrophotometer method.

Isolation of bacteria from the soil

Soil samples were taken from each container and subjected to serial dilution followed by pour plate method. Nutrient agar medium was used for pour plate method. 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 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. The colonies were subjected to staining method, in order to identify the morphology and Gram's reaction of the bacterium. A thin smear was prepared on a clean slide using the isolated individual colony. The motility was situated by employing hanging drop method. Biochemical test such as Indole test, MR – VP test, Citrate utilization test, Catalase test, Oxidase test and triple sugar iron agar test was used to identify the bacteria.

Isolation of fungi from soil

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. Rose Bengal 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 upto 10^{-3} to 10^{-4} . The inoculated plates were incubated at $28 \pm 2^\circ\text{C}$ for 3 days. Fungi were used to identify the lactophenol cotton blue staining technique.

Conidial population

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

$$\text{Number of CFUs of fungi per gram dry weight of soil} = \frac{\text{Mean no. of colonies} \times \text{dilution factor}}{\text{Dry weight of the soil.}}$$

The number of colonies per plate in 1g of soil was calculated. The percent contribution of each isolate was calculated by using the following formula:

$$\% \text{ contribution} = \frac{\text{Total no. of CFU of an individual species}}{\text{Total no. of CFU of all species}} \times 100$$

RESULTS AND DISCUSSION

The present study was carried out to isolate the bacterial and fungal species of different crop field soils from Thiruvaiyaru (S_1), Thirupalanam (S_2) and Karugudi (S_3) in Thiruvaiyaru Taluk of Thanjavur District in Premonsoon to Monsoon (September - 2014 to August - 2015).

Physico-chemical parameters

Physical and Chemical parameters was recorded in the four different season. The high level of pH was observed in Monsoon (7.4, 7.9 and 7.7). The high level of Moisture was present in Postmonsoon season (46, 39.4 and 40.8%). The high level of Temperature (45, 45 and 46 C) and Electrical conductivity was present in Summer season (2.1, 2.3 and 1.9 ds/m). The texture of soil samples collected from Thiruvaiyaru, Thirupalanam and Karugudi were sandy clay loam, Sandy loam and loamy particles respectively. The high levels of carbon (0.23, 1.3 and 1.32 Kg/ac) and Phosphorus (3.15, 3.25 and 4.15 Kg/ac) were noticed in Postmonsoon season. The high level of Nitrogen (92.6, 87.6 and 96.3Kg/ac) and Potassium was observed in Monsoon season (76.5, 74.5 and 73.5 Kg/ac). The level of calcium content was high in Premonsoon season (9.8, 9.4 and 9.3 ppm) in all the villages respectively. The high level of magnesium content was present in monsoon season (10.4, 10.2 and 9.5 ppm) for the three different villages respectively.

Table 1 Analysis of physical parameters of soils in four different seasons

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	7.4	7.9	7.7	7.29	7.5	7.4	7.6	7.8	7.5	7.7	7.4	7.8
Moisture (%)	37.5	38.5	39.5	39.4	40.5	40.2	46	39.4	40.8	32	38.5	41.2
Temperature(C)	28	31	30	38	39	36	45	45	46	32	36	32
Electrical conductivity	1.9	1.7	1.5	1.8	1.6	2.0	2.1	2.3	1.9	1.5	1.2	1.6
Soil texture	SCL	SL	L	SCL	L	SCL	L	SL	SCL	L	SCL	L

S₁ – Thiruvaiyaru S₂ - Thirupalanam S₃ – Karugudi SCL – Sandy clay loam SL – Sandy loam L – Loamy

The high levels of Zinc (0.99, 1.1 and 1.3 ppm) and copper (1.4, 1.2 and 1.3 ppm) content was observed in premonsoon season. The high levels of iron content (4.5, 4.4 and 4.3 ppm) and manganese were present in summer season (3.1, 3.2 and 1.1 ppm) (Table 1 & 2).

Table 2 Analysis of chemical parameters of soils in four different seasons

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
Carbon(%)	0.29	0.96	0.12	0.28	1.3	1.32	0.2	1.2	1.5	0.9	0.8	0.87
Nitrogen(Kg/ac)	92.6	87.6	96.3	80.4	81.5	86.9	98.1	84.5	85.4	87.4	84.5	84
Potassium(kg/ac)	76.5	74.5	73.5	70.3	69.1	68.5	65.5	71.2	71.6	72.1	69.8	70.1
Phosphorus(kg/ac)	3.74	1.8	2.4	3.15	3.25	4.15	3.67	1.8	2.4	1.52	4.56	1.25
Magnesium(ppm)	10.4	10.2	9.5	8.5	8.9	9.1	9.5	8.7	8.8	9.4	10.5	9.6
Calcium(ppm)	7.5	8.5	8.4	7.5	7.1	7.2	6.5	9.9	9.5	9.8	9.4	9.3
Copper(ppm)	0.99	0.79	0.95	1.1	1.8	1.7	0.98	0.97	0.96	1.4	1.6	1.7
Iron(ppm)	2.41	2.55	2.48	3.5	3.1	3.2	4.5	4.4	4.3	3.5	2.47	2.56
Zinc(ppm)	0.73	0.74	0.76	0.87	0.88	1.8	1.5	0.98	2.1	0.9	1.5	1.8
Manganese(ppm)	2.4	1.5	1.8	2.1	2.5	2.4	3.1	3.2	1.1	1.3	1.4	1.7

S₁ – Thiruvaiyaru S₂ - Thirupalanam S₃ – Karugudi

Isolation of bacteria from soil

Total bacterial species was recorded in the Table 3. Totally, 20 different species of soil bacteria were observed from soil samples. The bacterial species were identified according to their morphological character and Bergey’s Manual of Determinative Bacteriology. Conidial population of bacteria was recorded in the table 5. The percentage contribution of bacteria was recorded in the table 7. The highest percentage of frequency of bacteria isolated from all the soil samples were recorded in which *Bacillus mucoides*, *Streptococcus sp*, *Bacillus sp* and *Aerobacter aerogenes* were predominant followed by other species of bacterium.

Recently, [Kalaivani and Sukumaran \(2013\)](#) studied that soil samples from 4 different seasons representing the East Coast of Thanjavur District were examined for bacterial diversity. The study revealed the presence of 25 species of bacteria, among them 11 species was found in all the seasons.

Table 3 List of isolated bacteria from soils of Thiruvaiyaru Taluk

S.no	Organisms	Monsoon	Postmonsoon	Summer	Premonsoon
1	<i>Agrobacterium sp</i>	+	-	-	+
2	<i>Bacillus sp</i>	+	-	+	+
3	<i>Bacillus cereus</i>	-	+	-	-
4	<i>P. fluorescens</i>	-	+	-	-
5	<i>Aerobacter aerogenes</i>	-	+	-	-
6	<i>E.coli</i>	-	-	+	+
7	<i>Pseudomonas sp</i>	-	-	+	+
8	<i>Bacillus coagulans</i>	-	-	+	+
9	<i>Bacillus cirulans</i>	+	-	-	-
10	<i>B.mucoides</i>	+	-	-	-
11	<i>Brevibacterium sp</i>	+	-	-	-
12	<i>Serratia marcescens</i>	-	-	-	-
13	<i>Proteus vulgaris</i>	-	-	-	-
14	<i>Streptococcus sp</i>	+	-	+	+
15	<i>Flavobacterium sp</i>	-	+	+	+
16	<i>P.putida</i>	+	-	-	-
17	<i>Staphylococcus sp</i>	+	+	+	+
18	<i>Nitrobacter sp</i>	-	+	-	-
19	<i>Micrococcus sp</i>	-	+	-	-
20	<i>Bacillus subtilis</i>	-	-	+	+

+ - Present
- - Absent

Isolation of fungi from soil

Total fungal species was recorded in the Table 4. Totally, 20 different species of soil fungi were observed from soil samples.

Table 4 List of isolated fungi from soils of Thiruvaiyaru Taluk

Organisms	Monsoon	Postmonsoon	Summer	Premonsoon
<i>Aspergillus niger</i>	+	+	-	+
<i>Aspergillus fumigates</i>	+	-	+	-
<i>Aspergillus nidulans</i>	-	+	+	-
<i>Aspergillus spinulosus</i>	+	-	-	-
<i>Fusarium oxysporum</i>	+	+	+	-
<i>Trichoderma harizianum</i>	-	+	+	-
<i>Penicillium sp</i>	+	-	-	-
<i>Collectotrichum falcatum</i>	+	-	-	-
<i>Fusarium semitectum</i>	+	-	-	-
<i>Rhizopus oryzae</i>	+	+	+	-
<i>Fusarium sp</i>	+	-	-	+
<i>Penicillium turbatum</i>	-	+	+	-
<i>Trichoderma viride</i>	-	+	+	-
<i>Cladosporium sp</i>	-	+	+	-
<i>Absidia glauca</i>	-	+	+	+
<i>Aspergillus terreus</i>	-	-	+	+
<i>Cladosporium herbarum</i>	-	-	-	+
<i>Trichoderma sp</i>	-	-	-	+
<i>Curvularia lunata</i>	-	-	-	+
<i>Aspergillus flavus</i>	-	-	-	+

+ - Present
- - Absent

Table-5 Total number of colonies (cfu/ml) of bacteria in Thiruvaiyaru Taluk

Seasons	Total number of colonies			Bacteria (CFU/ml)		
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
Monsoon	37	36	32	3.7×10 ⁻⁶	3.6×10 ⁻⁶	3.2×10 ⁻⁶
Postmonsoon	35	34	33	3.5×10 ⁻⁶	3.4×10 ⁻⁶	3.3×10 ⁻⁶
Summer	31	32	33	3.1×10 ⁻⁶	3.2×10 ⁻⁶	3.3×10 ⁻⁶
Premonsoon	36	38	39	3.6×10 ⁻⁶	3.8×10 ⁻⁶	3.9×10 ⁻⁶

S₁ - Thiruvaiyaru S₂ - Thirupalanam S₃ - Karugudi

Table-6 Total number of colonies (cfu/ml) of fungi in Thiruvaiyaru Taluk

Seasons	Total number of colonies			FUNGI (CFU/ml)		
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
Monsoon	39	36	40	3.9×10 ⁻⁵	3.6×10 ⁻⁵	4.0×10 ⁻⁵
Postmonsoon	35	31	34	3.5×10 ⁻⁵	3.1×10 ⁻⁵	3.4×10 ⁻⁵
Summer	32	30	33	3.2×10 ⁻⁵	3.0×10 ⁻⁵	3.3×10 ⁻⁵
Premonsoon	36	37	39	3.6×10 ⁻⁵	3.7×10 ⁻⁵	3.9×10 ⁻⁵

S₁ - Thiruvaiyaru S₂ - Thirupalanam S₃ - Karugudi

Table 7 -Percentage contribution of bacteria

S.No	Field	Average	B.c	P.v	B.m	Ent	Str	B.s	P.f	A.a	S.sp	Nit	B.m	P.p	Fla	B. m	B.cog	E.c	B.sp	Mi.sp
1	S1	33	3	4	3	2	3	4	5	1	2	2	2	1	2	2	-	-	-	-
2	S2	33	-	-	-	-	6	-	3	-	-	-	-	-	7	2	5	6	2	2
3	S3	35	-	-	-	-	7	-	3	-	5	6	-	-	-	-	4	-	5	3
Total= 100			3	2	16	4	13	1	7	8	2	1	9	4	8	6	7	3	6	4
% of contribution			2.9	1.9	15.6	3.9	12.6	0.98	6.8	7.8	1.9	0.98	8.8	3.9	7.8	5.8	6.8	2.9	5.8	3.9
<i>B.c- Bacillus cereus,</i>			<i>Fla- Flavobacterium sp</i>			<i>P.v- Proteus vulgaris</i>														
<i>B.m- Bacillus mucoides</i>			<i>Str-Streptococcus sps</i>			<i>B.s- Bacillus subtilis,</i>														
<i>P.f- Pseudomonas fluorescens,</i>			<i>A.a- Aerobacter aerogens,</i>			<i>S.sp- Staphylococcus sps.,</i>														
<i>Nit- Nitrobacter</i>			<i>Ent- Enterobacter sp</i>			<i>B.sp-Bacillus sp</i>														
<i>B.c- Bacillus cirulans,</i>			<i>P.p- Pseudomonas putida,</i>			<i>E.c- E. Coli,</i>														
<i>B.cog- B. Coagulans</i>			<i>Mi. sp- Micrococcus sps</i>																	

Table-8 Percentage contribution of fungi

S.No	Field	Average	A.fu	A.n	A.f	A.s	A.nid	T.h	Cur	Col	F.s	F.o	Fus	R.o	P.t	Clad	A.g	T.v	A.t	C.l	C.h
1	S1	32	-	-	4	4	-	-	3	-	3	-	-	4	-	-	5	-	3	3	3
2	S2	33	-	-	6	-	3	4	-	-	-	5	4	-	6	4	-	-	4	-	-
3	S3	34	2	4	5	-	4	-	-	4	-	4	-	3	-	-	4	-	-	-	-
Total = 100			2	4	15	4	7	4	3	4	3	9	4	7	4	6	5	4	7	3	4
% of contribution			2	4	15	4	7	4	3	4	3	9	4	7	4	6	5	7	4	3	4

A.n- *Aspergillus niger* Coll- *collectotrichum falcatum*, A.g- *Absidia glauca*- F.o- *Fusarium oxysporum* R.o- *Rhizopus oryzae* P.t- *Penicillium tarbatum*-
Pen- *Penicillium sp* Cu - *curvularia lunata* A.f- *Aspergillus flavus* A.nid- *Aspergillus nidulans*- A.t- *Aspergillus terreus* F.s- *Fusarium semitectum*- A.fu -*Aspergillus*
fumigates A.s- *Aspergillus spinulosus*- A.g- *Absidia glauca*- Cla- *Cladosporium sps*- T.v-*Trichoderma viridae* T,h- *Trichoderma harizianum*

The colonies showed characteristic colour of black, green, white and brown and they were identified by their morphological characters. Conidial population of fungi was recorded in the table 6. The percentage contribution of fungi was recorded in the table 8. The highest percentage of frequency of fungi isolated from all the soil samples were recorded, *Aspergillus flavus*, *Fusarium oxysporum* and *Aspergillus nidulans* were predominant followed by other fungal species.

Recently, Uma maheswari and Komalavalli (2013) studied that the physico chemical parameters of such soils were identified the physical parameters includes the analysis of pH and moisture content of the soil. The chemical such as macronutrients and micronutrients were present in seven different Taluk of Thiruvavur District. Totally 35 different species of soil fungi were observed from the soil samples, they were collected from seven Taluk. Among that the identified fungal species, *Aspergillus sp.*, *Penicillium sp.*, *Trichoderma sp.*, *Rhizopus sp* was predominant in all the soil samples.

Soil is a vital component, medium of unconsolidated nutrients and materials, forms the life layer of plants. It is a basic life support components of biosphere. The physico chemical parameters of soil determine their adaptability to cultivation and the levels of biological activity that can be supported by the soil. The present work has been carried out to study some parameters of soil samples collected from Thiruvaiyaru Taluk of Thanjavur District. The soil characterization was carried out for the parameters like pH, Conductivity, Organic carbon available Nitrogen, Calcium and Magnesium, Iron, Zinc, Copper and Manganese. The variation in values were observed for the different parameters due to the soil quality in three different places in all the four different seasons.

Soil microorganisms play an important role in soil biogeochemical processes which determine plant productivity, successful functioning of introduced microbial bioinoculants and their influence on soil health. Exhaustive efforts have been made to explore soil microbial diversity of indigenous community their distribution and behaviour in soil habitats.

Table-8 Percentage contribution of fungi

S.No	Field	Average	A.fu	A.n	A.f	A.s	A.nid	T.h	Cur	Col	F.s	F.o	Fus	R.o	P.t	Clad	A.g	T.v	A.t	C.l	C.h
1	S1	32	-	-	4	4	-	-	3	-	3	-	-	4	-	-	5	-	3	3	3
2	S2	33	-	-	6	-	3	4	-	-	-	5	4	-	6	4	-	-	4	-	-
3	S3	34	2	4	5	-	4	-	-	4	-	4	-	3	-	-	-	4	-	-	-
Total = 100			2	4	15	4	7	4	3	4	3	9	4	7	4	6	5	4	7	3	4
% of contribution			2	4	15	4	7	4	3	4	3	9	4	7	4	6	5	4	7	3	4

The biodiversity is very important to increased the fertility of soil. Biodiversity is maintain the soil quality.

CONCLUSION

Microorganisms produce some useful compounds that are beneficial to soil health, plant growth and play an important role in nutritional chain that are important part of the biological balance in the life in our planet. Microorganisms are frequently present in soil, manure and decaying plant tissues which are able to degrade wastes that are correlated with the substrate organic matter.

References

Alexander, M.C. 1977. Inrpduction to soil microbiology. 2nd edition John Wiley and sons, New York. 423-437.
 Bailey, R.W. and Scott, B.G. 1996. Diagnostic Microbiology. 2nd ed. St. Louis: C.V Microorganisms by company.
 Bray, R.H. and Kutz, L.T. 1945. Determination of total, organic and available forms of phosphorus in soils. *Soil sci.*, **59**:39-45.
 Gillman, J.C. 1957. A manual of soil fungi, (Revised 2nd ed). Oxford and I.B.H. publishing company, New Delhi.

Griffin, D.M. 1972. Ecology of soil fungi. *Soil. sci. soc. Am. J.*, **50**:627-633.
 Hackel, E., Bachmann, G. and Boltensern- Zechmeister 2000. *Phyton*. **48**:83-90.
 Han’s Christain Gram. 1884. Cellular response of bacteria to the Gram stain. *Journal of Bacteriology*. **56(2)**:846-856.
 Kalaivani, R. and Sukumaran, V. 2013. Characterization of bacterial diversity in Marine sediment at different seasons in karankadu, Tamilnadu, India. *Int. J. Pure. Appl. Zool.* **1(1)**:97-108.
 Olson, R.K., Schoenherger, M.M. and Aschmann, S.G. 2000. American Society of Agronomy, Madison, Wisconsin, USA. 987-1057.
 Subbaiah, I.V. and Asija, G.L. 1956. Analysis of mineralizable nitrogen from soil. *Curr. Sci.* **25**:258-260.
 Toth, S. and Prince, A.L. 1949. Estimation cation exchangeable Ca, K and Na contents soils by flame photometer. *Soil science*. **64**:439-446.
 Uma maheswari, N. and Komalavalli, R. 2013. Diversity of soil fungi from Thiruvavarur District, Tamilnadu, India. *Int.J. Curr. Microbial. Appl. Sci.* **2(10)**:135-141.
 Walkely, A. and Black, I.A. 1934. Analysis of organic carbon from soil. *Soil sciences*. **37**:29-38.

How to cite this article:

Vinothini K and Victoria J.2016, Characterization of Bacterial and Fungal Diversity of Soils at Different Seasons in Thiruvaiyaru Taluk, Tamilnadu, India. *Int J Recent Sci Res.* 7(7), pp. 12337-12341.