Original Research Article

Diversity of Soil Fungi from Thiruvarur District, Tamil Nadu, India

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A B S T R A C T

Keywords

Fungal diversity; Thiruvarur District; Physico-chemical properties; Conidial population.

The present study aimed, isolation and identification of soil fungi from seven taluk of Thiruvarur District, Tamil Nadu deals with diversity and distribution of fungal population in an around soil. 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 macro nutrients (Nitrogen, Phosphorus, Magnesium, Calcium) and micronutrients (Iron, Copper, Zinc, Manganese) were present in seven different Taluk of Thiruvarur District. Totally 35 different species of soil fungi were observed from the soil samples, they were collected from Thiruvarur, Needamangalam, Mannargudi, Valangaiman, Nannilam, Kudavasal and Thiruthuraipoondi Taluk. Among that the identified fungal species like *Aspergillus sp, Pencillium sp, Trichoderma sp Rhizopus sp.* were predominant in all the soil samples. 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 fungi might also get affected by climate. Soil can be managed to optimize its fertility and health under natural and agricultural land uses, so as to benefit to fungal diversity. Due to the dispersed nature of the soil asset, a broad but consistent and economically appealing approach to its protection is needed. Fungal species are especially important components of biodiversity as major contributors to the maintenance of the earth's ecosystem, biosphere and biogeochemical cycle fungi perform unique and indispensible activities on which larger organisms including human depend. General ideas about species diversity suggest that habitat heterogeneity is a major factor controlling diversity.

Introduction

Biodiversity refers to the variability of life on Earth, all the living species of animals, plants and microorganisms (Hawksworth, 2001). 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). Soil is a

complex ecosystem, delimited by physicochemical 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 are 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). Fungi are one of the important microbial components of the soil. Since 1860's, research have been carried out on the fungi of different soil types, such as soils of forest driftwood, grasslands (Robosk and Daniel, 2009) polar region, desert, marine and mangrove habitats and coastal sand belt 24 from various parts of the world. Microbial communities, particularly bacteria and fungi constitute an essential component of biological characteristics in soil ecosystems. It has been estimated that 1.5 million fungal species are present in natural ecosystems, but only 5 –10% have been described formally (Hawksworth, 2001). Schmit and Mueller (2007) estimated that there is a minimum of 7, 12,000 fungal species worldwide. The actual number of fungi is still unknown; however, only 5-13 % of the total estimated global fungal species have been described. Research on fungal diversity provides a basis for estimating the functional role of fungi in ecosystems (Wang *et al.* 2008). The present study was undertaken to throw a light on the diversity and abundance of fungal species to reveal the characteristic distribution and diversity with special reference to fungi. The study involves isolation, identification and enumeration of fungal species from different ecological soil types in and around the Thiruvarur district of seven Taluk.

Materials and Methods

Thiruvarur District is situated in the tail end of the Cauvery Delta and it is also a coastal district. Thiruvarur is located at 9°17'N 79°18'E9.28°N 79.3°E. The town has an average elevation of 3 metres (9.8 ft) from the sea level. The municipality covers an area of 10.47 km^2 (4.04 sq mi). Sampling sites of the present study mainly comprises of Thiruvarur District of seven taluk in December 2012 to August 2013. Soil nutrient content analysis of site namely Thiruvarur(S1), Nannilam (S2), Kodavasal (S3), Valangaiman (S4), Needamangalam (S5), Mannargudi (S6) and Thiruthuraipoondi (S7) revealed that, Soil moisture, pH, organic carbon of the soil sample. The Macro (N, Ca, P, K, Mg) and Micro (Zn, Cu, Fe, Mn) nutrients varies from seven different Taluks. The fungi were isolated from soil sample collected from seven location of Thiruvarur District. The fungal isolates were isolated using PDA medium. 1ml of soil suspension (10^{-4}) were inoculated separated petriplates. Then the plates were incubated at 37°C for 4 days. The colony forming units (CFU) of the fungal isolates were counted. All the experiments were calculated in statistical analysis. Further pure cultures of the fungal isolates were maintained and identified microscopically with the help of microscope. The fungal isolates were stained with lactophenol cotton blue. Percentage frequency and conidial

population was calculated as follows:

$$\% \text{ of frequency} = \frac{\text{No. of soil sample from which fungi recorded}}{\text{No. of soil samples}}$$

Results and Discussion

Thiruvarur district is made up of tertiary and alluvial deposits. In the present investigation a total of 36 species of fungi were isolated from seven Taluk with monthly variation. The fungal isolates were recorded in soil microbiota of Thiruvarur (24), Needamangalam (19), Mannargudi (17), Valangaiman (15), Nannilam (14), Kodavasal (10) and Thiruthuraipoondi (10) in the Table 1. The species of *Aspergillus sp, Rhizopus sp, Pencillium sp* and *Trichoderma Sp* were dominant than other genera. Well marked variation in soil mycoflora in different areas were also found in different months between December 2012 to August 2013 were the dominant associated mycoflora in Thiruvarur Taluk of all the samples in different months. Some fungi were more restricted and reported in the particular environmental conditions like *Alternaria sp, Pythium sp, Torula sp* and *Gliocladium sp* were occur in the months of January, March, April, June and August. Generally soil contains higher organic matter, which in the presence of adequate level of pH (7.65) on Thiruvarur taluk followed by the organic carbon level in 0.83% in Nannilam. In macronutrients such as Nitrogen (132.5), Phosphorus (4.56), Magnesium (119) and Calcium (11.8) were maximum amount of nutrients in Valangiman, Thiruvarur, Mannargudi and Kodavasal Taluk followed by the Copper (1.32),Iron (8.75),Manganese (3.49) and Zinc (1.96) have the higher amount of micronutrients in Valangiman, Thiruthuraipoondi, Thiruvarur and Needamangalam in the Table- 2-8. Our finding correlated that most of the soil fungi in all five land use types, which belonged to the classes *Zygomycetes* and *Deuteromycetes*, are very common soil fungi that have been reported in various agricultural and reported as having a worldwide distribution with apparently higher frequencies in the sub-tropical region (Domsh *et al*., 1993). The fungal populations were correlated with nitrogen levels and soil moisture and they were statistically significant (Lorgio *et al*., 1999). Among that the identified fungal species like *Aspergillus sp, Pencillium sp , Trichoderma sp, Rhizopus sp.* were predominant in all the soil samples. 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 fungi might also get affected by climate (Rani and Panneerselvam, 2010).

Distribution of Fungal Diversity

The total number of fungal population found in the studied various taluk sites (S_1-S_7). In total CFU of fungi in Thiruvarur (98.05%), Needamangalam (98.56%), Mannargudi (95.35%), Valangaiman (93.25%), Nannilam (89.85%), Kudavasal (82.4%) and Thiruthuraipoondi (73.4%) in the Table-9. Soil microorganisms play an important role in biogeochemical process which determine plant productivity, successful functioning of introduced microbial bioinoculants and their influence of soil health. Exhaustive efforts have been made to explore soil microbial diversity of indigenous community, their distribution and behavior in soil habitats (Saravanakumar and Kaviyasaran 2010).

Fungal species are especially important components of biodiversity as major

Table.1 Soil Mycobiota of Thiruvarur District

S.No	Fungal genera	Studied sites (+Present; -Absent)						
		S_1	S_2	S_3	S_4	S_5	S_6	S_7
1.	*Alternaria sp*	+	+	+	-	+	+	-
2.	*Aspergillus sp*	+	+	+	+	+	+	+
3.	*Cladosporium sp.*	+	+	+	-	+	-	+
4.	*Fusarium sp*	+	-	+	+	+	+	-
5.	*Gliocladium sp*	+	-	-	+	-	+	-
6.	*Mucor Sp*	+	+	-	-	+	+	+
7.	*Pythium Sp*	+	+	+	-	+	-	-
8.	*Pencillium sp*	+	+	-	+	+	+	-
9.	*Rhizopus sp.*	+	+	-	-	-	+	-
10.	*Torulla sp*	-	-	-	-	+	-	-
11.	*Tricoderma sp*	+	-	+	+	+	+	-

S₁-Thiruvarur; **S₂-**, Nannilam; **S₃**-Kodavasal **; S₄-** Valangaiman; **S₅-** Needamangalam **S₆-** Mannargudi; **S₇-** Thiruthuraipoondi

Table.2 Physico-Chemical parameters of Thiruvarur Taluk (December 2012-August 2013)

S.No	Name of the Parameters	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
1	pH	7.65	8.26	7.69	7.58	7.23	7.98	7.43	7.20	7.64
2	Carbon (%)	0.36	0.23	0.59	0.64	0.54	0.43	0.56	0.74	0.42
3	Nitrogen (Kg/ac)	110.2	94.5	110.5	114.3	128.2	119.3	121.1	120.4	113.5
4	Phosphorus(Kg/ac)	4.50	4.25	4.36	4.56	2.56	5.25	3.13	3.26	2.72
5	Magnesium(ppm)	5.7	5.2	6.9	9.8	10.1	8.7	9.6	9.8	6.7
6	Calcium(ppm)	6.3	11.3	7.5	9.4	6.4	8.1	7.9	8.5	6.9
7	Copper (ppm)	1.47	0.75	0.65	1.26	1.23	1.35	1.45	1.20	0.98
8	Zinc (ppm)	0.55	1.66	1.36	0.25	0.14	0.74	1.58	0.89	1.46
9	Iron (ppm)	4.21	4.36	4.64	8.23	8.25	7.26	5.36	8.00	7.40
10	Manganese (ppm)	2.35	3.36	3.49	3.25	2.58	2.98	3.01	3.47	2.63

Table.3 Physico-Chemical parameters of Nannilam Taluk (December 2012-August 2013)

S.No	Name of the Parameters	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
1	pH	7.6	7.47	7.98	7.45	7.46	7.98	7.56	7.65	7.14
2	Carbon (%)	0.25	0.42	0.56	0.36	0.30	0.29	0.31	0.37	0.35
3	Nitrogen (Kg/ac)	97.4	114.3	110.5	106.3	115.2	96.5	112.5	109.6	109.4
4	Phosphorus(Kg/ac)	3.65	4.50	4.75	3.45	4.35	4.26	4.58	4.60	4.01
5	Magnesium(ppm)	10.1	9.4	9.1	8.3	8.7	8.4	10.2	7.2	5.7
6	Calcium(ppm)	4.2	3.7	6.5	9.6	10.6	11.3	10.6	9.4	8.4
7	Copper (ppm)	1.45	1.25	1.43	1.09	1.22	1.65	0.47	1.30	0.94
8	Zinc (ppm)	1.56	1.50	1.20	1.24	1.05	1.22	1.14	1.40	1.43
9	Iron (ppm)	1.22	2.29	2.35	3.11	1.43	2.39	2.45	2.25	2.01
10	Manganese (ppm)	1.48	3.45	3.47	3.76	3.99	2.56	2.95	3.31	2.45

Table.4 Physico-Chemical parameters of Kodavasal Taluk (December 2012- August 2013)

S.No	Name of the Parameters	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
1	pH	7.19	7.56	7.89	8.16	7.79	7.67	7.99	7.94	8.04
2	Carbon (%)	0.32	0.19	0.36	0.83	0.59	0.06	0.58	0.38	0.11
3	Nitrogen (Kg/ac)	93.5	99.6	129.7	127.4	114.9	121.1	108.1	112.3	100.4
4	Phosphorus(Kg/ac)	3.69	3.56	3.48	4.26	4.89	4.78	4.56	4.83	3.01
5	Magnesium()ppm	6.3	9.1	9.8	7.3	7.8	9.7	8.8	8.2	9.3
6	Calcium(ppm)	5.9	6.3	9.4	8.7	11.0	11.8	9.9	9.5	8.1
7	Copper (ppm)	0.54	0.55	0.89	1.15	1.58	1.27	1.79	1.01	1.10
8	Zinc (ppm)	0.58	0.49	0.89	1.23	1.97	1.67	0.45	1.80	0.97
9	Iron (ppm)	2.45	4.89	4.98	7.69	8.36	7.97	7.49	8.30	2.89
10	Manganese (ppm)	1.29	2.49	2.88	3.01	3.07	2.89	2.19	3.06	2.15

Table.5 Physico- Chemical parameters of Valangaiman Taluk
(December 2012- August 2013)

S.No	Name of the Parameters	Dec	Jan	Feb	Mar	Apr	May	Jun	Aug
1	pH	7.53	7.48	7.38	7.45	8.26	7.38	7.59	7.17
2	Carbon (%)	0.83	0.79	0.35	0.49	0.73	0.96	0.63	0.69
3	Nitrogen (Kg/ac)	116.5	94.3	106	93.3	114.5	126.5	132.5	105.1
4	Phosphorus(Kg/ac)	4.25	4.19	3.47	3.75	3.25	4.51	3.45	3.29
5	Magnesium()ppm	7.4	9.2	6.9	12.3	11.2	8.4	12.6	6.4
6	Calcium(ppm)	5.8	6.2	6.5	9.6	10.6	5.9	8.8	9.3
7	Copper (ppm)	1.32	1.15	1.32	1.25	1.58	1.12	1.24	12.9
8	Zinc (ppm)	1.25	1.28	1.01	1.13	1.05	1.01	1.21	1.08
9	Iron (ppm)	4.67	7.28	8.11	9.16	9.62	9.36	9.50	9.28
10	Manganese (ppm)	2.65	1.65	3.89	3.65	3.98	3.39	3.97	3.15

Table.6 Physico-Chemical parameters of Needamangalam Taluk (December 2012- August

S.No	Name of the Parameters	Dec	Jan	Feb	Mar	Apr	May	Jun	Aug
1	pH	7.20	7.35	7.15	7.63	7.25	7.59	7.45	7.31
2	Carbon (%)	0.13	0.19	0.25	0.45	0.51	0.69	0.48	0.39
3	Nitrogen (Kg/ac)	160	156	165	167	169	172	179	161
4	Phosphorus(Kg/ac)	3.75	4.75	3.15	4.19	2.49	2.56	2.19	4.01
5	Magnesium(ppm)	5.7	6.3	6.9	9.4	11.2	14.6	10.2	6.5
6	Calcium(ppm)	5.8	6.1	6.8	9.5	10.6	9.5	5.4	9.8
7	Copper (ppm)	0.49	0.47	1.15	0.48	1.20	1.05	1.01	1.04
8	Zinc (ppm)	0.52	0.61	0.63	0.99	1.56	1.96	1.25	0.99
9	Iron (ppm)	2.14	2.56	2.69	4.56	4.69	8.26	9.11	4.24
10	Manganese (ppm)	1.35	1.25	1.15	1.02	1.22	2.69	2.54	1.96

Table.7 Physico-Chemical parameters of Mannargudi Taluk (December 2012- August 2013)

S.No	Name of the Parameters	Dec	Jan	Feb	Mar	Apr	May	Jun	Aug
1	pH	7.89	7.37	7.56	7.11	7.72	7.35	7.45	7.38
2	Carbon (%)	0.32	0.79	0.46	0.13	0.65	0.58	0.64	0.49
3	Nitrogen (Kg/ac)	99.9	98.3	126.5	116.8	114.8	95.7	97.5	110.5
4	Phosphorus(Kg/ac)	3.75	4.75	3.45	4.0	3.49	3.79	3.73	3.61
5	Magnesium(ppm)	11.9	6.27	7.44	9.29	10.99	10.83	9.50	9.01
6	Calcium(ppm)	7.0	9.5	10.6	12.01	11.91	9.90	8.94	11.4
7	Copper (ppm)	0.69	1.25	0.79	1.06	1.12	1.49	1.55	1.01
8	Zinc (ppm)	0.73	1.15	0.76	1.12	1.21	1.01	1.37	0.94
9	Iron (ppm)	2.81	9.13	2.45	4.19	5.68	4.89	3.59	5.41
10	Manganese (ppm)	1.39	1.58	0.43	0.99	1.87	2.98	2.55	2.33

Table.8 Physico-Chemical parameters of Thiruthuraipoondi Taluk
(December 2012- August 2013)

S.No	Name of the Parameters	Dec	Jan	Feb	Mar	Apr	May	Jun	Aug
1	P^H	7.16	7.89	7.69	7.70	7.56	7.57	7.96	7.31
2	Carbon (%)	0.29	0.36	0.39	0.45	0.89	0.79	0.36	0.70
3	Nitrogen (Kg/ac)	99.5	106.2	126.9	123.5	110.8	116.3	123.8	112.4
4	Phosphorus(Kg/ac)	3.45	3.65	2.25	3.87	3.37	3.58	3.88	2.45
5	Magnesium(ppm)	7.5	9.6	10.6	11.2	9.9	8.7	6.7	7.9
6	Calcium(ppm)	6.9	7.1	7.3	8.9	9.5	10.6	7.9	7.7
7	Copper (ppm)	0.74	0.56	0.78	0.94	1.25	1.98	1.76	0.89
8	Zinc (ppm)	0.54	0.65	1.54	1.56	1.89	1.58	0.79	0.94
9	Iron (ppm)	2.45	8.75	8.48	8.65	8.36	8.75	4.12	4.44
10	Manganese (ppm)	1.92	1.34	2.94	2.54	3.25	3.15	3.30	3.01

Table.9 Population of seven Taluks Thiruvarur District

S.NO	Sampling place	No. of population×10^{-3} dilution
1	Thiruvarur	99.05
2	Nannilam	89.05
3	Kodavasal	82.5
4	Valangaiman	9..25
5	Needamangalam	98.56
6	Mannargudi	95.56
7	Thiruthuraipoondi	73.41

contribute the maintenance of the earth's ecosystems, biosphere and biogeochemical cycle. Fungi perform unique and indispensible activities on which large organisms including human depended. General ideas about species diversity suggest that habitat heterogeneity is a major factor controlling diversity.

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