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Mycodiversity of Coconut Field Soil and their Physicochemical Properties

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ABSTRACT
The present investigation suggested that the mycofloral diversity of coconut field soil analysis for improvement of soil fertility and development of coconut field management, which were experiment in the south Indian Peninsula. The climate zones were Cauvery Delta of most fertile agricultural zone. Five soil samples were collected from Mathakkottai, Kavarappattu, Peraiyur, Kakkarai and Orathanadu of Thanjavur District, which were collected and investigated for mycofloral community of coconut field soil. The mycofloral species like Aspergillus awomari, A.flavipes A.flavus, A.fumigatus, A.humicola, A.nidulans, A.niger, A.oryzae, A.sulphureus, A.sydowi, A.terreus, A.ustus, Hypocrea virens, Metarhizium anisopliae, Penicillium chrysogenum, P.citrinum, P.janthinellum, P.lanosum, Sclerospora sp., Trichoderma harzianum, T.koeningii, T.viride and Trichoderma sp. were observed and identified by using standard manual of soil fungi. Their physicochemical factors like pH, electrical conductivity, organic carbon, organic matter, nitrogen, phosphorus, potassium, zinc, copper, iron, manganese, calcium, magnesium, sodium and potassium were estimated from five different coconut soil samples. Among the five different soil samples, the Kavarappattu soil sample showed maximum quantity of physiochemical properties when compared with other places of Orathanadu area. Statistically, positive correlation coefficients represented respectively.
Key words: Coconut field soil, PDA, Fungi, Physicochemical properties,

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INTRODUCTION

Fungi are most diverse and important groups of living organisms on earth, not only for the vital roles in ecosystem function, but also for their influence on humans and human-related activities [1]. Fungi play a central role in most ecosystems and they have important functions in soil and plant habitats. It is now clear that the microbiota associated with plants contributed and maintain their biological diversity in terrestrial ecosystems through different biological processes [2, 9]. The fungal population associated with plants contributes to the adaptation process in response to biotic and abiotic stress [25, 8].

Soil fungi play an important role in major decomposers of the soil ecosystem. They also provide mankind with very useful pharmaceutical product like antibiotics. The fungal derivatives like organic acids, enzymes, pigments and secondary metabolites are being used in the food industry and also in the fermentation technology. In addition, some of the product from soil fungi and its functions as biological control agents for plant pathogens and insect pests [12]. The varieties of fungi are beautiful in nature and occupy a prime place in the biological world, India is the cradle for such varieties of fungi. Only a fraction from total fungal wealth has been subjected to scientific security, the mycologists have to unravel the unexplored and hidden wealth [20]. One third of fungal diversity of the globe exists in India. Out of 1.5 million of fungi, only 50% are characterized in the biological world. Unfortunately, only around 5–10% of fungi can be cultured artificially. Fungi are used not only for their beautiful but also for their important role in the everyday life of human beings besides their utilization in industry, agriculture, medicine, food industry, textiles, bioremediation and natural cycling as biofertilizers. Fungal biotechnology has become an integral part of the human welfare [18]. Contributing to the nutrient cycle and maintenance of ecosystem. Fungi play an important role in soil formation, soil fertility, soil structure and soil improvement [7]. The present study focused on the diversity and abundance of fungal species in the soil samples.

MATERIAL AND METHODS

Collection of soil samples

Soil samples were collected from the study site at random during the study period. The samples were made at a depth within 15cm from the surface of the soil. The collected soil samples were brought to the laboratory in sterilized polythene bags and also preserved in air dried containers for future investigation.

Physiochemical properties of the soil

Analysis of soil moisture, pH and temperature were determined as described by Mishra [13].The total organic carbon and total organic matter was estimated by rapid titration methods of Walkley and Black [27]. The total organic matter was calculated by multiplying the organic carbon with constant factor 1.7241 as it is presumed that the organic matter of soil contains 58% carbon [21]. Total organic nitrogen was estimated by the Micro-Kjeldahl method [10].

Isolation of fungi from soil

One gram of the soil sample was taken in 250 ml conical flask containing 100ml sterile distilled water. The flask was shaken on an electric shaker to get a homogeneous suspension and different dilutions of the soil sample 10^{-1}, 10^{-2}, 10^{-3} up to 10^{-7} were prepared by transferring serially about 10 ml of the soil suspension for about 90 ml of sterile distilled water. One ml of 10^{3} dilutions was plated in petri dishes containing Potato dextrose agar medium. The pH of the medium was adjusted to 6.5 and streptomycin sulphate (100 mg/ml) was added to the media to prevent the bacterial growth [14]. The plates were incubated at 25±2ºC for three days and the fungi appeared on the agar plate media was recorded respectively.

$$\text{Population of fungi g dry wt. of the soil} = \frac{\text{mean no of propagules in dilution plate}}{\text{wt.of the dry soil}} \times \text{dilution factor}$$

$$\text{Percentage frequency} = \frac{\text{no of soil samples from which fungi were recorded}}{\text{no of samples}} \times 100$$

The fungi was identified by standard manuals such as Manual of soil fungi [5], Dematiaceous Hyphomycetes (Ellis, 1971), More Dematiaceous Hyphomycetes [3], Hyphomycetes [24]. The correlate the fungal colonies and physico-chemical parameters by SPSS software was used.

RESULTS AND DISCUSSION

Vibha and Sinha [26] studied that the colonization pattern and extents of decay produced in paddy suitable by soil inhabitation mycoflora were done by using nylon net bag technique. Among the three methods which are used for isolation of fungi, the dilution plate technique recorded the highest number of fungi followed by damp chamber and direct observation method. Nutrient availability and climatic conditions (temperature, humidity and rainfall) influenced the occurrence and colonization pattern of fungi. Maximum fungal population was recorded on October (48.99×10^{-4}/gdry litter) and minimum in May (11.41×10^{-4}/g dry litter). Distribution of Deuteromycetous fungi were more in comparison to Zygomycetes, Oomycetes and Ascomycetes.

Gomathi *et al*. [6] studied the monthly variation of fungal population in chilli field soil at Thiruvarur district. About 40 different species of Deuteromycetes, Ascomycetes and Phycomycetes were isolated in PDA medium and identification by using standard manuals. The maximum number of fungal isolates was recorded in Valangaiman (20) when compared to other stations .The dominant species of *Aspergillus* and *Penicillium* recorded.

Prince *et al*. [16] studied that the seasonal variations of the fungal diversity of sugarcane field. About 49 different species belonging to 46 Deuteromycetes and 3 Phycomycetes. The dominant species were *Aspergillus niger*, *A.flavus* followed by *Botrytis cinera, Trichoderma viride, T.harzianum, Penicillium chrysogenum, P.citrinum,T.koeningii* and *T.glaucum* from the sugarcane field soil of Orathanadu in various seasons. Whereas in Pattukkottai soil both dominant species were *A.niger*, *Botrytis cinera* followed by A.*oryzae, Fusarium oxysporum, Glicladium virens, P.chryosogenum* and *T.viride* respectively.

The present investigation stated that the maximam number of mycofloral communities like *Aspergillus awamori, A.flavipes, A.flavus, A.fumigatus, A.humicola*, *A.nidulans*, *A.niger, A.oryzae*, *A.sulphureus, A.sydowi, A.terreus, A.ustus*, *Hypocrea virens, Metarhizium anisopliae, Penicillium chrysogenum* , *P.citrinum, P.janthinellum*, *P.lanosum, Sclerospora* sp., *T.harzianum, T.koeningii* , *T.viride* and *Trichoderma* sp.were observed from Kavarappattu coconut soil sample were determined respectively [15]. Totally 48 fungal colonies were recorded and 18 fungal species represented with respective soil. Among the soil fungi, 10 fungi which were belonging to Ascomycetes and 7 fungi were belonging to Deutromycetes and 1 fungi was belonging to Basidiomycetes forms were represented in coconut field soil (Table -1).

Kanimozhi and panneerselvam [11] studied that seasonal and depth wise variation of soil fungal

population in relation to the soil nutrient variability in paddy field of Thanjavur district. Thirty different species of fungi belonging to Ascomycetes and Phycomycetes were isolated by using PDA medium by standard methods .During rainy season maximum fungal count was recorded in sub soil layer. The dominant species were *Aspergillus niger, A.terreus ,A.conecium* and *Cunninghamella* sp. followed by *Trichoderma viride, T.harzianum, Penicillium janthinellum* and *P.claviforme* from the paddy field soil of Nadur soil in various seasons.In Orathanadu, soils were dominant species of *A.niger, Curvularia* sp. followed by

A.conecium, A.oryzae, F.oxysporum, P.janthinellium and *T.koeningii* in Tholkapiyar sadhukam. The dominant species of *A.niger, T.viride, T.harzianum* followed by *P.janthinellum, P.citrinum and Rhizopus* sp. whereas in Punnainallur and the dominant species were *A.niger, T.hariazum* and *Cunninghamella* sp. followed by *F.oxysporum P.claviforme, P.janthinellum, T.koeningi* and *T.viride* were presented respectively.

Table -1: List of fungi isolated from coconut field soil

S.No	Name of the fungi	A	B	C	D	E
1.	*Aspergillus awamori*	-	1	1	-	-
2.	*A.flavipes*	2	1	-	1	2
3.	*A.flavus*	3	2	3	2	1
4.	*A.fumigatus*	2	2	4	2	3
5.	*A.humicola*	-	-	1	2	-
6.	*A.nidulans*	2	-	4	-	3
7.	*A.niger*	2	5	4	3	2
8.	*A.oryzae*	3	2	1	2	2
9.	*A.sulphureus*	-	3	-	1	2
10.	*A.sydowi*	2	-	3	-	1
11.	*A.terreus*	2	4	3	5	4
12.	*A.ustus*	-	4	3	-	-
13.	*Hypocrea virens*	-	2	-	4	1
14.	*Metarhizium anisopliae*	2	3	3	4	2
15.	*Penicillium chrysogenum*	3	4	2	3	3
16.	*P.citrinum*	3	2	4	2	3
17.	*P.janthinellum*	-	2	-	1	1
18.	*P.lanosum*	1	2	-	1	-
19.	*Sclerospora* sp.	-	-	1	1	-
20.	*Trichoderma harzianum*	3	4	4	5	2
21.	*T.koeningii*	1	2	1	2	-
22.	*T.viride*	2	3	4	5	3
23.	*Trichodochium* sp.	1	-	1	-	-
24.	Total no. of species	16	18	18	18	16
25.	Total no. of colonies	34	48	47	46	36

A- Mathakkottai, B- Kavarappattu, C- Peraiyur, D- Kakkarai, E- Orathanadu

Table 2: Analysis of Physico-chemical parameter analysis of coconut soil of Thanjavur District.

S.No	Name of the Physicochemical parameters	*DIFFERENT SOIL SAMPLES*				
		A	*B*	*C*	*D*	*E*
1.	pH	6.8	6.5	6.9	6.4	6.9
2.	Electrical conductivity (dsm^{-1})	0.48	0.52	0.26	0.41	0.26
3.	Organic Carbon (%)	0.12	0.16	0.15	0.18	0.16
4.	Organic Matter (%)	0.24	0.32	0.30	0.36	0.32
5.	Available Nitrogen (mg/kg)	112.2	106.5	103.8	105.2	97.8
6.	Available Phosphorus (mg/kg)	3.75	4.25	4.75	4.50	4.00
7.	Available Potassium(mg/kg)	118	125	124	119	125
8.	Available Zinc (ppm)	0.89	0.79	0.82	0.96	1.02
9.	Available Copper (ppm)	0.48	0.49	0.42	0.48	0.52
10.	Available Iron (ppm)	4.89	4.58	4.63	4.57	4.62
11.	Available Manganese (ppm)	2.16	2.48	1.59	1.89	1.84
12.	Cation Exchange Capacity(C. Mole $Proton^{+}$/kg	23.6	25.8	24.6	27.1	28.6
Ex changeable Bases (C. Mole $Proton^{+}$/kg)						
13.	Calcium	10.6	11.2	10.7	10.5	11.3
14.	Magnesium	6.8	6.9	6.8	6.4	6.5
15.	Sodium	1.26	1.25	1.63	1.45	1.29
16.	Potassium	0.24	0.28	0.26	0.21	0.23

A- Mathakkottai, B- Kavarapattu, C- Peraiyur, D- Kakkarai, E- Orathanadu

Table 3: Correlation coefficient of physico-chemical parameters vs population density of fungi

	pH	EC	OC	OM	AN	APO	AK	Azn	Acu	Afe	Amn	CEC	CA	MG	NA	K	PD
pH	1																
EC	-0.869	1															
OC	-0.781	0.413	1														
OM	-0.781	0.413	1	1													
AN	-0.728	0.758	0.226	0.226	1												
APO	-0.049	-0.112	-0.103	-0.103	0.561	1											
AK	0.629	-0.167	-0.853	-0.853	-0.354	-0.405	1										
Azn	0.135	-0.444	0.486	0.486	-0.737	-0.503	-0.313	1									
Acu	-0.189	0.228	0.395	0.395	-0.450	-0.954	0.118	0.611	1								
Afe	0.990	-0.868	-0.810	-0.810	-0.636	0.088	0.591	0.041	-0.324	1							
Amn	-0.612	0.900	0.169	0.169	0.462	-0.459	0.222	-0.371	0.475	-0.655	1						
CEC	0.002	-0.157	0.474	0.474	-0.686	-0.803	-0.103	0.909	0.884	-0.125	0.024	1					
CA	0.336	0.053	-0.429	-0.429	-0.472	-0.836	0.834	0.057	0.643	0.235	0.483	0.385	1				
MG	0.133	0.304	-0.723	-0.723	0.446	0.217	0.658	-0.921	-0.417	0.190	0.409	-0.753	0.308	1			
NA	0.289	-0.510	-0.207	-0.207	0.168	0.910	-0.332	-0.210	-0.902	0.406	-0.783	-0.598	-0.775	0.008	1		
K	0.143	0.326	-0.724	-0.724	0.378	0.083	0.728	-0.870	-0.294	0.182	0.481	-0.658	0.430	0.991	-0.118	1	
PD	-0.440	0.341	0.097	0.097	0.869	0.896	-0.466	-0.668	-0.798	-0.310	-0.034	-0.825	-0.772	0.332	0.633	0.215	1

EC-Electrical conductivity, OC-Organic Carbon, OM-Organic Matter, AN-Available Nitrogen, Apo- Available Phosphorus, AK-Available Potassium, AZn-Available Zinc, ACu-Available Copper, AFe-Available Iron, AMn-Available Manganese, CEC-Cation Exchange Capacity, Ca-Calcium, Mg-Magnesium, Na-Sodium, K-Potassium

The paddy fields, the spore density and number of infective propagules were higher in postmonsoon season compared to premonsoon season. The sand content, bulk density, total N, organic C, alkaline and acid phosphatase positively correlated with AMF activity while clay ,silt,K,total P and available P were negatively correlated. The present study that analysis of the physicochemical properties of soil samples of Mathakkottai, Kavarappattu, Peraiyur, Kakkarai and Orathanadu of Thanjavur district were represented and maximum quantity of physicochemical parameters like pH, electrical conductivity, organic carbon, organic matter, nitrogen, phosphorus, potassium, zinc, copper, iron, manganese, cation exchange capacity**,** calcium, magnesium, sodium, and potassium was 6.5, 0.52 dsm, 0.16% 0.32%106.5mg/kg, 4.25mg/kg125mg/kg 0.79ppm, 0.49ppm ,4.58ppm, 2.48ppm, 25.8 C. Mole Proton^{+}/kg, 11.2C Mole Proton^{+}/kg6.9 C. Mole Proton^{+}/kg, 1.25 C. Mole Proton^{+}/kg0.28 C. Mole Proton^{+}/kg 6.8, 0.48, 0.12,0.24, 112.2mg/kg, 3.75mg/kg, 118mg/kg, 0.89ppm, 0.48ppm, 4.89ppm, 2.16ppm, 23.6C.Mole.photon/kg 10.6 C. Mole Proton/kg, 6.8 C. Mole Proton/kg, 1.26 C. Mole Proton/kg, 0.24 C. Mole Proton/kg found Kavarapattu coconut field soil and minimum quantity of physico-chemical parameters was 6.8, 0.48, 0.12,0.24, 112.2mg/kg, 3.75mg/kg, 118mg/kg, 0.89ppm, 0.48ppm, 4.89ppm, 2.16ppm, 23.6C.Mole.photon 10.6 C. Mole Proton, 6.8 C. Mole Proton, 1.26 C. Mole Proton ,0.24 C. Mole Proton recorded in Mathakkottai coconut field soil respectively(Qin Yao, *et al.,* 2019). However, physicochemical parameters can be increased in the soil and in the population of fungal communities also increased from the coconut soil (Table-2).The soil samples were isolated from the paddy soils of Jenbagapuram Village, Thanjavur Dt. Totally 42 species belonged to 20 genera were reported. Out of 42 species, the Deuteromycetes were represented as the dominant group (35 species), followed by Phycomycetes (3 species), Ascomycetes, Basidiomycetes (each one species) and sterile mycelium (2 species). The physico chemical properties of the soil such as pH (5.6 to 8.06), electrical conductivity (0.01 to 0.37), cation exchange capacity (19.02 to 26.30), organic carbon (0.4 to 0.45), available nitrogen (80.6 to 118.02), available phosphorus (4.3 to 7.5), available potassium (77.0 to 125.0), available zinc (0.02 to 0.84), available iron (2.2 to 5.29), available copper (0.20 to 0.92), available manganese (2.02 to 0.84), calcium (8.40 to 12.6), magnesium (2.6 to 9.20) and sodium (0.12 to1.25) were analysed and they were statistically significant. The correlation co-efficient studies were carried out between soil fungi and physico-chemical characters [23].

Priyanka *et al*., [17] studied the soil sample of Pattukkotai Taluk, Thanjavur District at four different seasons viz., post monsoon, summer, pre monsoon and monsoon, were investigation. The soil samples were subjected to physico-chemical analysis. Seasonal variations of different parameters like physical parameters of pH (7.14-7.87), moisture content (30.7-45.5%), and temperature (24-47°C). The chemical and other soil parameters such as available organic carbon (0.12-0.97 kg/ac), nitrogen contain (72.8-91.12 kg/ac), phosphorus (3.13-3.65 kg/ac), potassium (125-145kg/ac), magnesium (8.3-9.6kg/ac) and Calcium (10.3-12.3 kg/ac), available micronutrients (ppm) such as Zinc, Copper, Iron, Manganese (0.63-0.89, 0.73-0.99, 4.57-8.62, 3.15-3.49) were recorded respectively. Kanimozhi and Panneerselvam [11] reported totally 30 different paddy field soils were collected from in and around Thanjavur District,

Tamilnadu and their physico-chemical properties were analyzed. Among them, 11 samples were loamy soil, 11 samples were sandy loam and the rest of 8 samples were sandy clay loam. The pH (8.2-5.8), bulk density (1.65 g/cm3 - 1.00g/cm3), water holding (61.85% - 10.86%), electrical conductivity (2.40 - 0.19), organic carbon (1.27% - 0.11%), total nitrogen (1.78% - 0.55%), phosphorus content (1.17% - 0.11%), potassium (1.85%1.14%) also available micronutrients like Zn (2.02% - 1.06%), Cu (3.78% - 1.27%), Fe (10.47% - 7.10%), Mn (5.95% - 2.66%), B (0.594% - 0.28%), available nitrogen (203.0kg/acre-110.0kg/acre), phosphorous (9.10kg/acre-33.85 kg/acre), potassium (340 kg/acre - 245 kg/acre) were in all sampling station.

Saramanda Geetha *et al*. [22] investigated that the physico- chemical properties of Rice and Turmeric soil at ten different sites of Kommangi panchayat in Chintapalli mandal. The soil parameters like soil pH, EC, organic carbon, nitrogen, potassium and phosphorous content were analyzed. It was found that there was a marked variation in nutrients and parameters of various sample point in different farmers field. The results of the study show the low levels of nitrogen, phosphorous and potassium in both sites. Also the organic matter is low during the study period.

In the present study the physico-chemical parameters vs population density were correlated by SPSS software in P<0.01% level of significance were analysed. This results were reported in another worker by Zhang *et al*. [28], the total N and available K significantly decreased in the rhizosphere soil of intercropped mulberry ($p < 0.05$). However, the total N, available K, and total carbon significantly increased in the rhizosphere soil of intercropped alfalfa ($p < 0.05$) determined.

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