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Population Dynamics of Marine Soil Fungi from Chennai and Thiruvallur District

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A B S T R A C T

The present investigation deals with population dynamics of marine soil fungi from Chennai and Thiruvallur district. Marine soils from three different sites along the east coastline of Tamil Nadu were studied for the presence of fungi. Soil plating, dilution plating, soil steaming and boiling methods were adopted to isolate the fungi from saline soils. The soil fungi like *Aspergillus niger, A. flavus, A. terreus, A. candidus, A. fumigatus, Pencillium* sp*, P. longibrachiatum, P. lanosum, P. citrinum, Fusarium* sp*, F. solani, Cunninghamella vitricillate, Neurospora* sp and *N. crassa* were recorded from three different places of Marina Sea, Fore shore estate of Chennai district and Pazhaverkadu of Thiruvallur district soil samples were analyzed. Maximum number of colonies (61) from the soil sample were seen in Marina Sea, whereas foreshore estate (42) and Pazhaverkadu (48) had the minimum number of colonies. The soil physicochemical characters like colour, texture, temperature, pH, organic carbon, organic matter, salinity, available nitrogen, phosphorus, potassium, zinc, copper, iron, manganese and sodium, calcium, magnesium, potassium were experimentally carried out from three different places of marine soil sample preformed. The Pearson correlation matrix were applied to the obtained databases and the following parameter showed significant result at ($p<0.05\%$) level. Fungal populations are an important component of soil and perform a variety of roles in activities that are essential to the environmental flow of energy.

***Key words*:** Marine soil, Fungal populations, Number of colonies, Physicochemical, Correlation analysis

The general health and whole quality of the soil determine the productivity of agriculture and the environment as well as the pleasure of all living beings [1]. In developing nations, infectious diseases are the major cause of high morbidity and mortality. Among the major hurdles in treating these infectious disorders carried on by pathogenic microorganisms is the growth of antibiotic resistance to a wide range of medications [2]. By affecting various microorganisms' ability to grow, reducing soil organic matter, and compacting soil and porosity, soil pollution impacts the biodiversity of the soil [3]. In addition to being a rich source of biodiversity, the oceans, which make up more than 70% of the surface of the Earth, are also a rich source of microorganisms with immense potential. A wide variety of plants, animals, and bacteria can be found in the maritime environment. Bacteria, viruses, and other microorganisms found in marine microbial communities provide several advantages in biotechnological processes [4]. More especially, the diversity of secondary metabolites suggests that marine-adapted fungi have great potential. The goal of this work is to identify the new fungal metabolites derived from marine sources. This article is meant to serve as an introduction to marine fungi and taxonomic problems related to marine-derived fungi. The majority of fungi will be referred to as "marine-derived" as facultative and obligate species of fungi make up the marine ecosystem [5]. The physicochemical characteristics of soil such as pH, organic matter, cation exchange capacity (CEC), soil texture, and water chemistry can be impacted by a variety of factors including altitude, parent rocks, vegetation, and anthropogenic activities. The optimal range for soil pH, which affects the availability of nutrients, is in between pH 5 and 7 [6]. The physical-chemical analysis of the soil samples being analyzed reveals irregular concentrations of various properties. In the analysis, significant

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micronutrient distributions were observed, which could be attributed to fertilizer that were added during crop production [7]. An ever-growing collection of information on the level to which pollution has caused severe environmental degradation has accompanied and in some cases been the primary cause of the dramatic rise in public awareness and concern about the state of the local and global environments that has occurred in recent decades. Environmental toxins have been demonstrated to have a variety of detrimental consequences on ecosystems, agricultural production, and human health [8]. In order to compare physico-chemical properties, a more basic and simple method based on statistical correlation has been developed in recent years. Using Person's Correlation, extensive research has been done utilizing statistical analysis to evaluate the surface soil quality of the Ganga River in Haridwar, India. There have been reports of statistical investigation of the physico-chemical characteristics of soil from various regions of India [9]. The micro fungi which control biological activity in soil. The research focused on the soil fungal population in relation to the marine. The chemical composition of the substrates and the condition of the environment are both impacted by the way that microorganisms break down organic substances [10]. In the present study, an attempt has been made to evaluate isolation and identification of marine soil fungi and thereby to analysis correlation between fungal population and physico-chemical parameters.

MATERIALS AND METHODS

Sample collection

Marine soil sample were collected from three different sites of Marina Sea, Fore shore estate in Chennai district and Pazhaverkadu in Thiruvallur district, Tamil Nadu, India. Soil sample were provided to the laboratory. Within 48 hours, soil samples were weighed and kept at room temperature in a closed chamber with a moist atmosphere.

Isolation and identification

Potato Dextrose Agar medium (PDA) was prepared and sterilized in an autoclave at 121°C for 15 minutes by using grams of soil samples from marine sediments. Streptomycin sulphate solution was added to the medium (1:1) and then poured into the petri plates. 0.1mL of a serially diluted soil sample was added to the medium after solidification. The inoculum was spread equally and left undisturbed in a room with no dust for three to five days. There was a count of the fungus colonies. On the standard potato dextrose agar medium, the pure cultures were sustained [10].

The identification of fungi was observed after 72 hours using Nikon optiphot microscope. The organisms were confirmed using standard manual of soil fungi [11], Dematiaceous Hyphomycetes [12], A manual of penicillia [13], soil fungi [14].

Physicochemical parameters

The physico-chemical parameters of collected marine soil were analyzed by standard methods [15].

Statistical analysis

Pearson correlation matrix was calculated by using SPSS software. Correlation coefficients of physicochemical parameters and fungal populations for level of significance is recorded.

RESULTS AND DISCUSSION

The diversity and productivity of plant communities are significantly influenced by soil microorganisms [16]. The spread of mycoflora is greatly influenced by environmental parameters such as soil pH, moisture, temperature, organic carbon, and nitrogen [17]. These are the essential components influencing the diversity and population of fungi. Soil dilution petri plates and soil were used to separate fungus. On soil plates, more species and colonies were isolated than on dilution plates, and as sample dilutions were increased, very few species were isolated altogether [18].

In the present study, the fungi isolated from three different sites of marine soil with their occurence on a regular frequency were recorded (Table 1). The isolated fungi in Marina sea soil include *Aspergillus niger, A. flavus, A. candidus, A. awamori, A. fumigatus, Pencillium* sp, *P. citrinium, Fusarium* sp, *F. solani, Neurospora* sp, *N crassa* and Fore shore estate soil such as *Aspergillus niger, A. flavus, A. candidus, A. awamori, A. fumigatus, Pencillium citrinium, P. longibrachiatum, P. lanosum, Fusarium* sp, *F. solani, Cunninghamella vitricillate, Neurospora* sp and Pazhaverkadu soil include *Aspergillus niger, A. flavus, A. terreus, A. candidus, A. awamori, A. fumigatus, Pencillium* sp, *P. longibrachiatum, P. lanosum, Fusarium* sp, *F. solani, Neurospora* sp, *Neurospora crassa* confirmed to be recorded accurately. The maximum fungal colonies were screened (61) from Marina soil whereas minimum colonies were observed (42) from Fore shore estate and (48) from Pazhaverkadu soil.

A total of 30 fungal isolates were identified and 10 different strains were sub-cultured and maintained for further examination based on their morphology [2]. The isolates microscopic and cultural properties were observed. The isolates of fungi were from the *Aspergillus, Pencillium, Mucor*, and *Fusarium* species [19].

In the current research, the three different marine soil fungi were identified (Table 1). Totally 15 fungi were identified and recovered. The microscopic and cultural characteristics were observed. The fungal isolates belonged to 5 genera as follows *Aspergillus* (18.7%), *Pencillium* (4.5%), *Fusarium* (7%), *Neurospora* (5%) and *Cunninghamella* (1%). The *Aspergillus* (8.7%) genera was mostly presented in Marina Sea soil, *Pencillium* (4%) were maximum observed in Fore shore estate soil, *Fusarium* (2.5%) was mostly present in same percent of Marina Sea and Fore shore estate sea soil, *Neurospora* (1.5%) was maximum in Marina Sea and Pazhaverkadu soil. The *Cunninghamella* (1%) was recorded in only Fore shore estate soil. In particularly, *Aspergillus* genera was mostly occupied by the three different soils.

Seven marine sediment samples that were taken from different areas along India's southeast coast and included Thondi coastal sediments were analyzed physicochemical characteristics. Based on the study, variations in sediment supply led to variations in physical characteristics and mud contents [7]. The soil properties such as texture, calcium carbonate content, electrical conductivity (EC), pH, organic carbon (OC), available nitrogen, available phosphorus, available potassium, iron, manganese, zinc, copper, and cation exchange capacity were analyzed. Additionally, the physical and chemical boundaries of the marine soil samples and the total actinobacterial isolates were analyzed using the correlation coefficient method [20].

In the present investigation, the physicochemical properties including marine soil samples were collected from three different zones with Marina Sea and Fore shore estate sea soil from Chennai district and Pazhaverkadu soil from Thiruvallur district of Tamil Nadu, India. The maximum parameters (Table 2) in Fore shore estate such as colour,

texture, temperature, pH, organic carbon, organic matter, salinity, available nitrogen, phosphorus, potassium, zinc, copper, iron, manganese and sodium, calcium, magnesium, potassium were (brown colour), (fine texture), (38°C), (7.9 pH), (0.72%), (0.92%), (250.68 mg/kg), (50.09 mg/kg), (321.20 mg/kg), (0.96 ppm), (0.57 ppm), (5.74 ppm), (2.81 ppm), (11.5 ppt), (1.56 ppm), (1.89 ppm), (1.66 ppm), (0.73 ppm) when compared to Marina sea soil and Pazhaverkadu soil sample was recorded. The micronutrients like iron, manganese, zinc and copper were recorded maximum at all soil samples. The minimum organic carbon, organic matter, available zinc and copper, potassium were observed in all soil samples respectively. It is clear that future research on and significant financial investments in renewable energy sources should focus on the threat that ocean acidification process is prevailing in marine ecosystems and species [21].

The direction of the relationship is denoted by the sign placed in front of the correlation coefficient value. In order to understand the association and relationship of various physical and chemical parameters, including heavy metals of the Nawabganj Lake, Pearson correlation coefficients were obtained. Using SPSS software, the Pearson correlation matrix was calculated for various physicochemical parameters (pH, EC, DO, TDS, TS, Mg, Cl, NO_3, PO_4, SO_4, Na, K, F, Fe, Zn) [9]. Moreover, there was a significant difference ($p<0.01$) in Na and Mg, with higher levels in D soils (with higher levels in M soils). This could indicate that the soils had differing mineral contents. Also, there were significant differences in clay and sand (with higher values in M soils) ($p<0.05$) (With higher contents in M soils) [6].

In the present study, the correlation coefficient of physicochemical parameters (temperature, pH, organic carbon, organic matter, salinity, available nitrogen, phosphorus, potassium, zinc, copper, iron, manganese and sodium, calcium, magnesium, potassium) and population density of fungi were analyzed. A study of how linearly related two quantitative variables are termed in Pearson's correlation analysis (r). It provides an overview of a linear pair of variables' magnitude. Relationship values can range from -1 to +1, with +1 representing an absolutely perfect linear relationship between the bivariates, 0 denoting no linear relationship, and -1 denoting an absolutely inverse relationship. The physicochemical parameters was positively correlated at $p<0.05\%$ level of significance was recorded and population density of fungi was negatively correlated at $p<0.05\%$ level of significance were analyzed.

Table 1 Identification of fungi from Marine soil samples (CFU/ml)

Name of the fungi	Different soil sample		
	Marina sea soil	Fore shore estate soil	Pazhaverkadu soil
Aspergillus niger	29	9	11
A. flavus	12	7	8
A. terreus	-	-	10
A. candidus	2	1	2
A. awamori	6	3	2
A. fumigatus	3	5	2
Pencillium citrinum	2	2	-
P. longibrachiatum	-	3	1
P. lanosum	-	3	2
Pencillium sp	2	-	3
Fusarium sp	3	2	2
F. solani	2	3	2
Cunninghamella vitricillate	-	2	-
Neurospora crassa	2	-	2
Neurospora sp	1	2	1
Total number of colonies	61	42	48
Total number of species	11	12	13

Table 3 Analysis of physicochemical parameters of different soil samples

Physicochemical parameters	Marina sea soil	Fore shore estate soil	Pazhaverkadu soil
Colour	Brown	Brown	Brown
Texture	Fine	Fine	Fine
Temperature (°C)	32	38	35
pH	7.5	7.9	7.8
Organic carbon (%)	0.62	0.72	0.65
Organic matter (%)	0.72	0.85	0.78
Available nitrogen (mg/kg)	230.40	252.68	241.00
Available phosphorus (mg/kg)	28.12	50.09	31.15
Available potassium (mg/kg)	248.15	321.20	212.28
Available Zinc (ppm)	0.81	0.96	0.76
Available Copper (ppm)	0.42	0.49	0.41
Available Iron (ppm)	5.12	5.74	5.13
Available Manganese (ppm)	2.64	2.81	2.45
Salinity (ppt)	9.2	11.5	9.8
Sodium (ppm)	1.23	1.56	1.34
Calcium (ppm)	1.65	1.89	1.71
Magnesium (ppm)	1.32	1.66	1.26
Potassium (ppm)	0.66	0.73	0.61

Table 3 Pearson correlation coefficient of physicochemical parameters and population density of three different soil samples

Correl	Temp	pH	OC	OM	AN	AP	AK	AZ	AC	AI	AM	S	Na	Ca	Mg	K	PD
Temp	1																
pH	0.960	1															
OC	0.974	0.873	1														
OM	0.999	0.947	0.983	1													
AN	0.999	0.952	0.980	0.999**	1												
AP	0.922	0.779	0.985	0.938	0.933	1											
AK	0.658	0.423*	0.810	0.690	0.678	0.897	1										
AZ	0.720	0.5*	0.858	0.750	0.739	0.932	0.996**	1									
AC	0.802	0.606	0.916	0.828	0.819	0.970	0.977	0.991**	1								
AI	0.872	0.703	0.960	0.893	0.886	0.993**	0.941	0.967	0.991**	1							
AM	0.471*	0.208	0.658	0.510	0.496*	0.775	0.974	0.951	0.904	0.842	1						
S	0.963	0.852	0.999**	0.974	0.970	0.991**	0.834	0.879	0.932	0.971	0.689	1					
Na	0.981	0.891	0.999**	0.989	0.986	0.978	0.788	0.838	0.901	0.949	0.630	0.996**	1				
Ca	0.960	0.846	0.998**	0.972	0.968	0.993**	0.841	0.884	0.936	0.974	0.697	0.999**	0.995**	1			
Mg	0.788	0.586	0.906	0.814	0.804	0.964	0.982	0.994**	0.999**	0.988	0.914	0.923	0.890	0.927	1		
K	0.580	0.332*	0.748	0.616	0.603	0.849	0.995**	0.982	0.951	0.904	0.991	0.776	0.724	0.783	0.958	1	
PD	-0.978	-0.997**	-0.906	-0.967	-0.971	-0.822	-0.486*	-0.560	-0.661	-0.752	-0.278*	-0.887	-0.921	-0.882	-0.642	-0.398*	1

Correl-Correlation, Temp-Temperature, pH-pH, OC-Organic Carbon, OM-Organic Matter, AN-Available Nitrogen, AP-Available Phosphorus, AK-Available Potassium, AZ-Available Zinc, AC-Available Copper, AI-Available Iron, AM-Available Manganese, S-Salinity, Na-Sodium, Ca-Calcium, Mg-Magnesium, K-Potassium and PD-Population density

*Strongly presented correlation significance at the (p<0.05%) and
**Highly presented correlation significance at the (p<0.05%) respectively

CONCLUSION

In the recent research, the soil sample of three different sites of Marina Sea soil, Fore shore estate soil from Chennai district and Pazhaverkadu soil from Thiruvallur district studied for detecting the fungal diversity. The marina soil sample possess high in fungal population. Due to strong sporulation, *Aspergillus* and *Pencillium* isolates largely dominated in all marine soils from all sites specified. Commonly occurring filamentous ascomycete fungus that has been associated with human opportunistic illnesses is *Aspergillus niger*. *A. niger* has an important part in the economy as a fermentation organism employed in the production of citric acid. In addition to its role as an opportunistic human pathogen. Because of their wide diffusion and capability to create a large variety of bioactive secondary metabolites with biological activities that have been identified, *Penicillium* species are important. The researchers working in agriculture and soil management can benefit mostly from an analysis of the physicochemical characteristics of soil. The soil samples under evaluation's physico-chemical analysis revealed varying concentrations of different boundaries. During the current investigation, irregular distributions of macronutrients and micronutrients were recorded which may be related to potential fertilizer during the period of produce development. All parameters were rather connected with each other based on the correlation study of soil quality measures called Person's Correlation matrix. Positive and Negative correlation coefficient (p<0.05%) were recorded. When analyzing further change was brought on by nature in these soils, the collected data in this soil could be utilized as a baseline and reference point for future studies.

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