RHIZOSPHERE AND RHIZOPLANE MYCOFLORA OF SOME INDIAN MANGROVE PLANTS

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ABSTRACT

Rhizosphere and rhizoplane mycoflora of three mangrove plants, viz., *Rhizophora mucronata*, *Avicennia officinalis* and *Heritiera minor* from Sunderban (West Bengal) area, has been studied. The pH and salinity of rhizosphere mud was lower than the non-rhizosphere mud, whereas the organic matter was high in rhizosphere of all the three plants. In all, 77 fungal species were isolated from rhizosphere, non-rhizosphere mud and rhizoplane. Phycomycetes were absent in non-rhizosphere mud but were isolated from rhizosphere mud and rhizoplane. All the phycomycetous fungi belong to the order Mucorales. Ascomycetes were more in rhizoplane. Basidiomycetes were not encountered at all in the present study. Fungi Imperfecti isolated frequently and in abundance formed the dominant mycoflora of rhizosphere and rhizoplane

INTRODUCTION

Mangrove mud which is characterized by high salt and moisture content, low aeration, and high organic matter supports a very special type of vegetation known as "mangrove vegetation" consisting of specially adopted group of plants the "halophytes" which can grow in this abnormal type of ecological habitat. These specialized ecological conditions also influence micro-organic population in the area.

No information is available regarding the rhizosphere and rhizoplane mycoflora of the plants growing in Indian mangrove swamp. With a view to find out the interaction between the mycoflora and the plant roots, the rhizosphere and rhizoplane study of some Indian mangrove plants, viz., *Rhizophora mucronata*, *Avicennia officinalis* and *Heritiera minor* was undertaken and was compared with non-rhizosphere mycoflora.

MATERIAL AND METHODS

Three mangrove plants, viz., *Rhizophora mucronata*, *Avicennia officinalis* and *Heritiera minor*, from Indian mangrove swamps were selected for this study. They were removed carefully from the mangrove swamp of Sunderban area (Fig. 1) and were brought to the laboratory. Non-rhizosphere mud samples were taken from areas all round the plant at a distance of nearly 22.9-30.5 cm from the root-system. The soil dilution plate method (Waksman & Fred, 1922) was used to isolate fungi from both rhizosphere and non-rhizosphere mud. In case of rhizoplane, serial washing technique of Harley and Waid (1955) was employed. Czapek-Dox agar medium supplemented with Dicrysticin was used for this study.

All inoculated dishes were incubated at 29 ± 1°C for seven days and retained for at least two to three weeks so that slow growing fungi could be isolated. Taxonomical and morphological studies of isolated mycoflora were made. The rhizosphere soil suspension left after inoculations was oven-dried at 110°C, cooled and weighed. From the weight of dry soil, thus obtained, the weight in one ml of the rhizosphere solution was calculated. The number of fungi isolated from one ml of the solution was determined.

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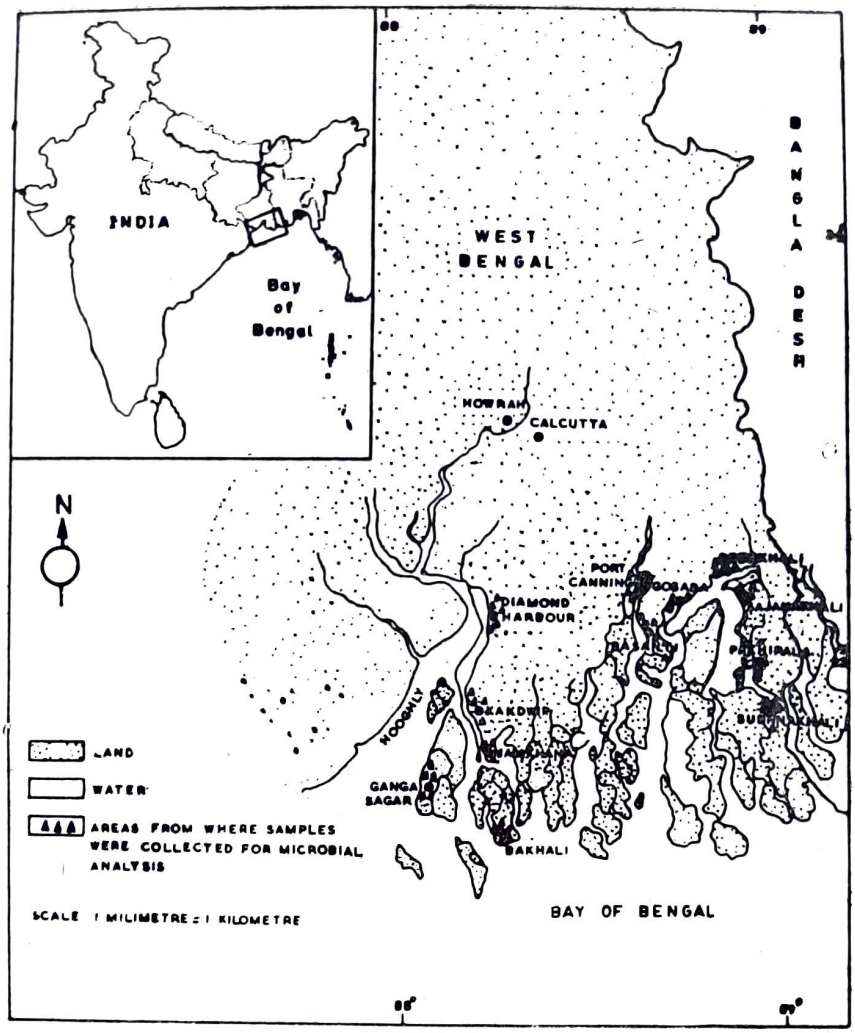

Fig. 1. Showing various localities of Sunderban, West Bengal from where plant samples were collected.

The total number of fungi per gm of rhizosphere soil was also calculated. The pH, salinity, and organic matter were also analysed in case of rhizosphere and non-rhizosphere samples.

OBSERVATION AND DISCUSSION

It has been observed that in the rhizosphere mud, the pH (RS, 7.3 to 8.0 ; NRS, 8.0 to 8.7) and salinity (RS, 2.3% to 4.05% ; NRS 3.10% to 4.95%) are less and organic matter (RS, 3.23% to 5.27% ; NRS, 2.83% to 4.80%) is high than that of the non-rhizosphere mud of all the three plants. Quantitative and qualitative 'rhizosphere effect' for all the three plants investigated here were calculated by dividing the total number of fungal colonies (quantitative) and total number of fungal species (qualitative) for rhizosphere mud by the same value for the non-rhizosphere mud. The data on the rhizosphere effect have been given in Table 1. It was noted that in all the cases, the rhizosphere effect was more than one i.e., of (+) nature.

A total number of 77 fungal species belonging to various groups, isolated from rhizosphere, rhizoplane and non-rhizosphere zones are arranged alphabetically in table 2. Of these, three species belonged to the Phycomycetes, 11 species to the Ascomycetes, three to the *Mycelia sterilia* and rest to the Fungi Imperfecti. Only four fungal forms were common in rhizosphere, rhizoplane and non-rhizosphere. Amongst the total of 72, 54 and 49 rhizosphere, rhizoplane and non-rhizosphere fungi from respectively the three mangrove plants, 13, 13 and 6 fungi were common while others were restricted to individual plants.

Table 1—Showing the rhizosphere effect of three mangrove plants

Name of plant	Quantitative (in thousands)		Qualitative	
	RS/NRS	R/S	RS/NRS	R/S
Avicennia officinalis	15.6/8.0	1.9(+)	44/25	1.7(+)
Rhizophora mucronata	18.0/9.8	1.8(+)	53/28	1.8(+)
Heritiera minor	13.9/7.1	1.9(+)	39/22	1.7(+)

Quantitative —Total number of fungal colonies per gm of mud
Qualitative —Total number of fungal species
R/S —Rhizosphere effect
(+) —Positive

Table 2—Showing the distribution of various fungi in rhizosphere, non-rhizosphere and rhizoplane of three mangrove plants

Name of species	Avicennia officinalis			Rhizophora mucronata			Heritiera minor		
	RS 1	NRS 2	RP 3	RS 4	NRS 5	RP 6	RS 7	NRS 8	RP 9
Achaetomium globosum Rai & Tewari	+		+	+	+	+			
A. luteum Rai & Tewari						+			
Acrophialophora nainiana Edward	+		+				+	+	
Alternaria tenuis Nees	+		+	+	+			+	
Aspergillus aeneus Sappa					+		+		
A. amstelodami (Mangin) Thom & Church	+			+	+		+	+	
A. avenaceus Smith	+	+		+			+	+	
A. carbonarius (Bainier) Thom	+	+	+	+	+	+	+		+
A. carneus (van Tiegh.) Blochwitz				+	+	+	+		+
A. clavatus Desmazieres	+		+	+		+			
A. cremeus Kwon & Fennell							+	+	
A. fischeri Wehmer	+	+	+	+					
A. flavipes (Bain. & Sart.) Thom & Church				+	+				
A. flavus Link	+	+	+	+		+	+	+	+
A. fumigatus var. *albus* Rai, Tewari & Agarwal	+	+		+	+	+		+	
A. fumigatus var. *sclerotiorum* Rai, Agarwal & Tewari				+			+	+	
A. janus Raper & Thom	+			+					
A. japonicus Saito	+	+	+					+	
A. nidulans (Eidam) Wint.	+		+	+	+	+		+	
A. nidulans var. *lata* Thom & Raper	+	+		+	+	+	+		+
A. niger van Tieghem	+	+	+	+	+	+	+	+	+
A. niveus Blochwitz				+		+	+		+
A. ochraceus Wilhelm	+	+	+	+	+				
A. parasiticuss speare							+		
A. penicilliformis Kamyschko	+							+	
A. ruber (Konig, Spiek., & Brem.) Thom & Church		+					+	+	
A. sulphureus (Fres.) Thom & Church	+	+		+					
A. sulphureus var. *crassus* Rai, Agarwal & Tewari	+			+					

Table 2—(*contd.*)

A. sydowi (Bain. & Sart.) Thom & Church				+	+	+	+		
A. tamarii Kita				+	+	+			
A. terreus Thom	+	+	+	+	+	+	+	+	+
A. terreus var. *africanus* Fennell & Raper				+		+	+	+	
A. ustus (Bain.) Thom & Church									+
A. variecolor (Berk. & Br.) Thom & Raper	+						+		
A. versicolor (Vuill.) Tiraboschi	+	+		+					
Cephalosporium zonatum Sawada							+	+	
Chaetomium arcuatum Rai & Tewari				+	+		+		
C. globosum Kunze			+	+		+			+
C. indicum Corda	+		+	+		+			
C. nigricolor Ames			+			+			
Cladosporium indicum Rai, Tewari & Mukerji	+	+	+		+	+	+	+	
C. oxysporum Berk. & Curt.			+	+			+		+
Cunninghamella echinulata Thaxt.							+		+
Curvularia lunata (Wakker) Boedijn var. *aeria* (Batista, Lima & Vasconcelos) Ellis	+		+	+		+			
C. tuberculata Jain	+	+		+	+		+		
Dactylium fusarioides Frag. & Cif.	+	+					+		
Doratomyces microsporus (Sacc.) Morton & Smith			+	+			+		
Fusarium chlamydosporum Wollenweber & Reinking	+		+	+		+			
F. dimerum Penzig	+			+	+	+			
F. oxysporum Schlecht.	+	+	+	+		+			+
F. roseum Link	+								
F. solani (Mart.) Sacc.	+	+	+	+	+	+	+	+	+
Helminthosporium hawaiiense Boug.	+						+		
Humicola fuscoatra Traaen	+			+		+			+
Mucor racemosus Fres.							+		+
Mycelia sterilia (Dark)	+	+	+	+	+	+	+		+
Mycelia sterilia (Hyaline)		+	+	+		+	+		
Neocosmospora vasinfecta Smith						+			+
Paecilomyces indicus Rai, Tewari & Mukerji			+	+		+			+
P. varioti Bain.	+	+	+	+			+		
Penicillium chrysogenum Thom	+		+		+	+	+	+	+
P. funiculosum Thom	+	+	+	+	+	+	+	+	+
P. pallidum Smith				+	+				
P. piceum Raper & Fennell							+		
P. vinaceum Gilman & Abbott	+		+	+					+
Pestalotiopsis versicolor (Speg.) Steyaert				+			+		+
Rhizopus nigricans Ehrenberg			+	+		+			
Rhizoctonia sp.	+		+				+	+	+
Scopulariopsis brevicaulis (Sacc.) Bain.	+	+	+	+					
Talaromyces wortmanni (Kloecker) Benjamin				+	+	+			+
Talaromyces sp.						+			
Thielavia sepedonium Emmons		+	+	+		+			
T. terricola (Gilman & Abbott) Emmons				+		+			
Trichoderma koningii Oud.	+		+	+	+	+		+	+
T. lignorum (Tode) Harz.	+		+	+	+	+	+		+
T. viride Pers. ex Fr.				+	+				+
Verticillium lecanii (Zimm.) Viegas	+	+					+		

Note : RS=Rhizosphere
NRS=Non-rhizosphere
RP=Rhizoplane

Members of Phycomycetes were absent in the non-rhizosphere mud of all the experimental plants while they were isolated from their rhizosphere and rhizoplane. Ascomycetes were isolated frequently—and in abundance, from rhizoplane as compared to the rhizosphere and non-rhizosphere zones. Basidiomycetes were not encountered at all. Members of Fungi Imperfecti were isolated in greater frequency from the rhizosphere. The genus *Aspergillus* was the most dominant form being represented by 31 species and five varieties including seven ascosporic forms.

In the rhizosphere the dominant fungi were *Aspergillus* (*A. carbonarius*, *A. flavus*, *A. nidulans* var. *lata*, *A. niger* and *A. terreus*), *Curvularia tuberculata*, *Fusarium solani*, *Penicillium funiculosum*, *Trichoderma lignorum* and *Mycelia sterilia* (Dark). *Aspergillus fumigatus* var. *albus*, *A. niger*, *A. terreus*, *Fusarium solani* and *Penicillium funiculosum* were frequently isolated from non-rhizosphere mud. *Aspergillus carbonarius*, *A. niger*, *A. terreus*, *Chaetomium globosum*, *Fusarium oxysporum*, *F. solani*, *Penicillium chrysogenum*, *P. funiculosum*, *Trichoderma koningii*, *T. lignorum* and *Mycelia sterilia* (Dark) were encountered in higher frequencies from the rhizoplane of all the experimental plants.

Aforesaid quantitative and qualitative differences in the total number of fungi and the variations in the spectrum of genera and species of different zones and plants noted during this study cannot be attributed to a single factor, but a combined effect of many factors such as, plant species, age of plant, soil nutrient status mainly through root exudates, groups of micro-organisms present therein, soil moisture, organic matter, salinity, and soil reaction, and to some extent, many other environmental conditions so far unknown may be held responsible. (Saxena, 1955 ; Rovira, 1956 ; Alexander, 1961 ; Schroth & Hildebrand, 1964 and Mukerji, 1966).

Fungi from the rhizoplane region were isolated in comparatively lower number (Table 2), and an apparent variation in genera were also seen. Ascomycetes were more commonly isolated from the rhizoplane indicating thereby their preferential habitat. Forms like *Aspergillus*, *Fusarium*, *Penicillium*, *Trichoderma* and *Mycelia sterilia* (Dark) were dominant, both in rhizosphere and rhizoplane regions of investigated plants. *Fusarium* has been reported to be among the important rhizoplane fungi, and, hence, their infrequent isolation from soil dilution plates may be due to its restriction to the fragments of soil organic matter (Booth, 1971; Thomas & Parkinson, 1967). The predominance of Aspergilli and Penicillia may be related to their high sporulating ability, while that of *Trichoderma* to its antagonistic and competitive nature (Wright, 1956).

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