

Filamentous Fungi Isolated from the EEZ along the West Coast of India

N. PRABHAKARAN and RANU GUPTA

National Institute of Oceanography Regional Centre, Cochin - 682 018

Thirty nine isolates of filamentous fungi of the genera *Alternaria*, *Cladosporium*, *Fusarium* and *Penicillium* were isolated from 78 water samples of 15 stations during FORV Sagar Sampada cruise No. 24 (16-11-1986 to 04-12-1986). *Cladosporium* was dominant including the marine species *C. herbarum*. Most of the filamentous fungi isolated restricted themselves to the coastal areas and the islands indicating their terrigenous origin and adaptation to high salinity.

Aeromycological studies of four laboratories and hydrographic winch area of the ship revealed the presence of *Aspergillus*, *Cephalosporium*, *Curvularia*, *Drechslera*, *Fusarium* and *Penicillium*. *Fusarium* was dominant followed by *Aspergillus* including *A. flavus*.

Few studies have been made on filamentous fungi in the open oceans and seas (Johnson & Sparrow, 1961; Roth *et al.*, 1964; Willingham & Buck, 1965; Cvetkovic & Ristanovic, 1980). Fell (1967) reported the occurrence of filamentous fungi while studying the distribution of yeasts in the Indian Ocean. It is well known that the incidence of molds (filamentous fungi) is partially dependent on the proximity of the land and terrigenous materials. These molds show a wide range of ecological adaptations for their existence in the marine ecosystem. No systematic study has been carried out on the filamentous fungi of the EEZ along the Indian coast.

This paper reports on the filamentous fungi isolated from the water samples at different stations during FORV Sagar Sampada cruise No. 24 in the EEZ along the west coast of India. The aeromycoflora of four of the laboratories and the hydrographic winch area of the ship was also studied during the cruise.

Materials and Methods

Water samples were collected at 15 different stations (Fig. 1) from different depths ranging from 0 to 1000 m with Rosette water sampler, and with ZoBell's bacteriological water sampler from 0 and 10 m. Rosette bottles were thoroughly cleaned and surface sterilized by wiping with cotton wool soaked in alcohol before every operation. Hydrographic parameters such as temperature, salinity, dissolved oxygen and pH were also recorded simultaneously. Processing of samples was started immediately after the collection was over at each station. Samples (500ml of each) were filtered separately through 0.45 μ m porosity millipore membrane filters. The membranes were placed in petri plates on Gy-Agar (Johnson & Sparrow, 1961) containing 0.01% chloramphenicol to suppress bacterial growth. All the cultures were incubated for 3 to 4 days at $26 \pm 2^\circ\text{C}$ when maximum fungal colonies showed up. The colony counts were then taken for each samples. For each

sample triplicate plates were prepared and a mean of the three was taken as the actual count. Aeromycofloral studies of different laboratories (Dry Fish Laboratory, Wet Fish Laboratory, Hydrographical Laboratory and Dry Chemical Laboratory) and the hydrographic winch area of Sagar Sampada were carried out by exposing petri plates with Sabourauds Dextrose Agar (SDA) and Potato Dextrose Agar (PDA) for 5 min on alternate days between 10 a.m. and 10.30 a.m. for three days. These plates were incubated at $27 \pm 2^\circ\text{C}$ for three to four days. The colonies were isolated and identified according to standard mycological books. Blank plates with nutrient medium were also kept for each set as control plates.

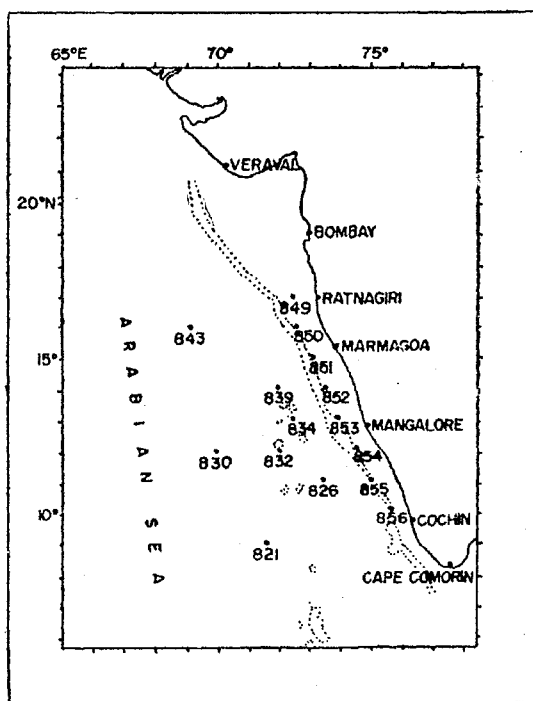


Fig. 1. Map showing location of sampling stations.

Results and Discussion

Twenty nine out of 78 water samples collected were positive to the presence of fungi (37%). Thirty nine fungal isolates

belonging to the genera *Alternaria*, *Cladosporium*, *Fusarium* and *Penicillium* were isolated. Dense population was found at stations 832, 834, 852 and 855. The filamentous fungi isolated from the pelagic environment is presented in Table 1. *Cladosporium* sp. showed maximum frequency (59%) followed by *Penicillium* sp. (41%), *Fusarium* sp. (14%) and *Alternaria* sp. (3%). Obligate marine fungus *C. herbarum* represented 17%. Control plates did not show any fungal colony. The water samples collected using ZoBell's bacteriological water sampler and Rosette water sampler gave more or less similar results.

Table 2 shows that most of the filamentous fungi isolated showed restricted distribution near the coastal areas and near the islands. This indicates that their presence was influenced by terrigenous sources and in most cases their terrestrial origin.

Table 1. Filamentous fungi isolated from the pelagic environment of EEZ of west coast of India

Species	Number of samples in which species occurred	Frequency of occurrence* %
<i>Alternaria</i> sp.	1	3
<i>Cladosporium herbarum</i> (Pers.) Link ex S.F. Gray	5	17
<i>Cladosporium</i> sp.	17	59
<i>Fusarium</i> sp.	4	14
<i>Penicillium</i> sp.	12	41

* Frequency (%) in water samples with filamentous fungi present

Table 2. *Filamentous fungi isolated from different water samples in the EEZ along the west coast of India*

Station No.	Position	Depth (m)	Total no. of propagules per litre	Species isolated				
						50	6	herbarum C. herbarum
						100	20	Cladosporium sp.
						500	—	—
821	09°00 N 71°30' E	0 10 50 100 500 1000	— 4 6 — — —	— C. herbarum Cladosporium sp.	834	13°00 N 72°30' E	0 28	Alternaria sp. and Penicillium sp.
							10	36 Penicillium sp. and Cladosporium sp.
826	11°00 N 73°30' E	0 10 50 100 500 1000	14 2 — — — —	Fusarium sp. and Penicillium sp. Cladosporium sp.			20 30 40	4 Cladosporium sp. 8 Cladosporium sp. 12 Cladosporium sp.
					839	14°00 N 71°57' E	0 10	4 Penicillium sp. 8 Penicillium sp.
830	11°59' N 70°03' E	0 10 50 100 500 1000	16 — — — — —	Cladosporium sp.			50 100 500	— — —
					843	15°45' N 69°14' E	0 50 50 100	— — — —
832	12°00 N 71°58' E	0 10	34 18	Fusarium sp., Penicillium sp. and Cladosporium sp. Fusarium sp. Penicillium sp. and Cladosporium	849	17°00 N 72°31' E	0 10 20 30 70	— 2 Cladosporium sp. 40 C. herbarum — —
					850	16°00 N 72°48' E	0	14 Cladosporium sp. and Penicillium sp.

Table 2 (contd.)

		10	18	<i>Cladospo- rium</i> sp.
		30	—	—
		75	—	—
		100	—	—
851	15°00 N	0	4	<i>Clados- porium</i> sp.
	73°15'E	10	14	<i>C. her- barum</i>
		30	—	—
		75	—	—
		100	—	—
852	14°00 N	0	24	<i>Fusarium</i> sp. and <i>Penicillium</i> sp.
	73°34'E	10	20	<i>Penici- llium</i> sp.
		30	8	<i>Clados- porium</i> sp.
		50	—	—
		75	—	—
853	13°00 N	0	12	<i>Penicil- lium</i> sp.
	74°00'E	10	—	—
		30	—	—
		75	—	—
		90	—	—
854	12°00 N	0	—	—
	74°36'E	10	—	—
		30	—	—
		50	—	—
		100	—	—
855	11°00 N	0	32	<i>Clados- porium</i> sp. and <i>Penicil- lium</i> sp.
	75°09'E	10	12	<i>Clados- porium</i> sp
		30	6	<i>Clados- porium</i> sp.
		75	—	—
		100	—	—

856	10°00 N	0	—
	75°40'E	10	—
		30	—
		75	—
		100	—

In his study of Indian Ocean, Fell (1967) reported 30% samples positive to molds with an average of 3 cells per litre of water sample. He too concluded that their incidence appeared to be partially dependent on the proximity of land and terrigenous materials. Willingham & Buck (1965) also observed that the fungi exhibited a wide range of ecological tolerance and high physiological adaptations.

Of the 406 fungal colonies isolated from 45 plates examined for the aeromycoflora studies of the ship, maximum number of colonies were from the Wet Fish Laboratory and then the Dry Fish Laboratory as compared with the other laboratories tested. The fungal species isolated listed in Table 3 and Table 4 show their frequency.

Table 3. Species of filamentous fungi isolated from different laboratories and near the hydrographical winch of FORV Sagar Sampada

Aspergillus flavus Link
A. fumigatus Fresenius
A. niger van Teighem
Aspergillus sp.
Cephalosporium sp.
Cladosporium resinae (Linadau)
 de Uries
Cladosporium sp.
Curvularia sp.
Drechslera sp.
Fusarium equiseti (Corda) Sacc.
F. solani (Mar.) Appel and Woll
Penicillium sp.

Table 4. List of filamentous fungi recorded from the laboratories and near hydrographical winch of FORV Sagar Sampada

Mycoflora	Total number of colonies	Percentage of contribution
Hydrographical Laboratory		
<i>Aspergillus niger</i>	20	21.28
<i>Aspergillus</i> sp.	15	15.96
<i>Cephalosporium</i> sp.	4	4.26
<i>Cladosporium resinae</i>	1	1.06
<i>Curvularia</i> sp.	3	3.19
<i>Drechslera</i> sp.	1	1.06
<i>Fusarium solani</i>	50	53.19
Dry Fish Laboratory		
<i>Aspergillus flavus</i>	13	10.92
<i>A. fumigatus</i>	24	20.17
<i>A. niger</i>	11	9.24
<i>Fusarium equiseti</i>	8	6.72
<i>F. solani</i>	40	33.61
<i>Fusarium</i> sp.	18	15.13
<i>Penicillium</i> sp.	3	2.52
Unidentified	2	1.68
Wet Fish Laboratory		
<i>Aspergillus flavus</i>	14	11.48
<i>A. fumigatus</i>	12	9.84
<i>A. niger</i>	24	19.67
<i>Cephalosporium</i> sp.	1	0.82
<i>Curvularia</i> sp.	12	9.84
<i>Fusarium solani</i>	48	39.34
<i>Fusarium</i> sp.	10	8.20
Unidentified	1	0.82
Dry Chemical Laboratory		
<i>Aspergillus niger</i>	4	11.76
<i>Aspergillus</i> sp.	2	5.88
<i>Cephalosporium</i> sp.	3	8.82
<i>Cladosporium resinae</i>	1	2.94
<i>Penicillium</i> sp.	24	70.59
Hydrographic Winch Area		
<i>Fusarium solani</i>	13	35.14
<i>Penicillium</i> sp.	24	64.86

Majority of them were not isolated from the water samples collected from the pelagic

environment during the cruise. Table 4 shows that *F. solani* was recorded most frequently in Hydrographical Laboratory, Dry Fish Laboratory and Wet Fish Laboratory, while *penicillium* sp. dominated Dry Chemical Laboratory and hydrographic winch area. This initial study of the aeromycoflora of the Fisheries Oceanographic Research Vessel Sagar Sampada reveals that a good population of filamentous fungi are inhabiting the laboratories and the shipboard. Some of these fungi are well known as fish pathogens. *F. solani* is a common fish pathogen often found in aquatic environment (Alderman & Polglase, 1986). *A. flavus*, *F. equiseti* and others have been reported from decaying dried fishes in the Cochin market (Ranu Gupta & Samuel, 1985). Presence of *A. flavus* in the Wet Fish Laboratory and Dry Fish Laboratory of the ship can be hazardous in view of their representatives well known to be producing virulent group of mycotoxins, the aflatoxins in the infected poultry feeds (Diener, 1965; Gallagher *et al.*, 1978). FORV Sagar Sampada is a research vessel and does not catch fishes for consumption, but the commercial fisheries vessels should watch out for such hazardous contaminations of their catches.

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