



ENCOUNTER OF FRESHWATER MITOSPORIC FUNGI OF MAHARASHTRA

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vasupatil13@gmail.com**Abstract:**

The present paper deals with distribution and substratum range of 362 species of freshwater Mitosporic fungi (346 Hyphomycetes and 16 Coelomycetes) reported so far from freshwater habitats of India. They were found as saprophytes on woody debris and leaf litter submerged in freshwater environment. Conidia of most of these fungi were encountered in foam samples. A checklist of freshwater Mitosporic fungi recorded from India is compiled on the basis of present studies in Maharashtra, Gujarat and Madhya Pradesh and published literature. Distribution of 362 species of freshwater Mitosporic fungi reported so far from various states of India is provided. The most frequently collected species of the genera are *Camylospora*, *Canalisporium*, *Flabellospora*, *Lemmoniera*, *Tetracladium*, and *Tricladium*. The checklist includes detail of the location and substrata on which they encountered. This data will be useful in the compilation of freshwater fungal biodiversity of India.

Keywords: Freshwater, Mitosporic fungi, Submerged leaves, Foam samples.

Introduction

Freshwater fungi are defined as “fungi that for the whole or part of their life cycle rely on freshwater” (Thomos, 1996). Estimates for the number of fungi in the world range up to ca. 13.5 M species (Kirk et al., 2008). So far only 1.7 million species of organisms are known to the Science as against the estimated species on our planet. It indicates the large number of organisms are yet unknown to the Science ((Hawksworth, 2001). Among the known 1.7 million species, 0.2 million (13 %) are reported from our country (Manoharachary et al., 2005).

In India, though these fungi are being studied at a very few states (Assam, Tamil Nadu, Andhra Pradesh, Goa, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Gujarat), yet about 360 species have also been recorded (Natarajan and Udaiyan, 1978; Udaiyan and Hosogaudar, 1991; Udaiyan and Manian, 1991a, b; Tiwari, 1992; Sati and Tiwari, 1997; Sridhar et al., 1992; Manoharachary, 1989; Bhat et al., 2009; Sati and Joshi, 2011) including some new species (Sridhar and Kaveriappa, 1987; Rajashekhar et al., 1991; Udaiyan, 1991; Sati and Tiwari, 1992, 1993, 2003; Sati et al., 2009; Sridhar and Kaveriappa, 2002; Soosamma et al., 2001; Nair and Bhat, 2001, 2002a, b).

We have been investigating diversity of freshwater higher fungi that decay leaves and wood submerged in the rivers, streams, and lakes in the central part of India. Previous work on these fungi from Madhya Pradesh were made by Hasija and Shanware (1986), Agrawal et al. (1989, 1991, 1992), Hasija and Singhal

(1991) and Upadhyaya et al. (2012). Previous work on these fungi from Maharashtra were made by Patil and Rao (1972), Patil and Kapadnis (1979), Thakur (1977), Patil (1998a, b, 2000, 2003a, b, 2007), Talde (1981, 1983), Shinde and Pawar (2008, 2009), Borse and Patil (2006, 2007); Borse et al. (2008, 2014); Patil (2009); Pawara et al. (2009, 2011); Wagh et al. (2009); Patil et al. (2011, 2012a,b); Patil and Borse (2011, 2012); Jadhav et al. (2011); Nemade et al. (2009, 2010); Nemade and Patil (2010); Ghanwat and Reddy (2011); and Wagh and Borse (2014). Previous work on these fungi from Gujarat was made by Ahire et al. (2009).

Materials and Methods

The samples of submerged woody debris, leaves and foam were collected from both the lentic and lotic habitats randomly during 2011-15 from different lentic and lotic habitats from Maharashtra, Gujarat and Madhya Pradesh. The following three methods were used for isolation of various fungal species.

Wood analysis: The samples woody debris were placed in plastic bags and sealed well in order to avoid moisture loss. On returning to the laboratory, samples with debris and fouling organisms were washed thoroughly with running tap water. Surface fouling organisms were scrapped off, following rinsing in tap water. The fresh samples were examined using a stereomicroscope for fungal growth. After initial observations, samples were incubated in plastic boxes and kept moist by spraying with distilled water and periodically examined for presence of fungal growth.

Leaf litter analysis: Submerge leaves of different kinds were collected randomly from sampling sites and brought to the laboratory in moist polythene bags. They were washed several times in tap water and finally in distilled water. They were cut into small bits and incubated separated in Petri dishes containing distilled water at laboratory temperature (25 - 30°C). The water was replaced in Petri dishes once in two days to minimize the growth of bacteria and other organisms. The leaf bits were screened under an inverted microscope at 24 hours intervals for 60 days to detect the water borne fungi appearing on them.

Foam analysis: In aquatic habitats, foam is formed by the movement of the water against natural barriers like stones, logs, twigs, especially in lotic habitats, constitutes a natural trap for the conidia of aquatic Hyphomycetes. Foam samples were collected at morning and evening time. Samples were placed in cleaned wide mouthed plastic bottles and kept for 24 hours to enable the foam to dissolve. It was prepared by adding FAA to yield 5% foam solution. Then samples were brought to laboratory and scanned under low or high power of a microscope using 15 x eyepiece for the presence of conidia of freshwater Mitosporic fungi.

Permanent voucher slides of fungi were prepared according to the 'double cover glass method' described by Volkmann-Kohlmeyer and Kohlmeyer (1996). Reports of fungi studied were

confirmed with the help of Bilgrami et al. (1991), Sridhar et al. (1992), Jamaluddin et al. (2004) and relevant literature.

Results and Discussions:

A list of 362 species of Freshwater Mitosporic fungi which have been identified to species level by various researchers of India is provided alphabetically in Table 1. They were found as saprophytes on submerged leaves (179 sp.), Conifer needles (26 sp.), Root endophytes (19 sp.), submerged woody debris (204 sp.), water samples (64 sp.), conidia in stem flow (44 sp.) and conidia in foam samples (142 sp.) Most records of these fungi were from states of Maharashtra (79 sp.), represent intensity of studies on these fungi. As aquatic habitats are increasingly altered and degraded, it is imperative that the freshwater fungal species of the remaining high quality aquatic habitats be characterized and isolated. Such baseline information is essential to understand the role of fungi in aquatic habitats and how fungi could be used in the remediation of damaged aquatic habitats. It is clear those additional collections from worldwide, especially in tropical areas and along altitudinal gradients, are needed to fully characterize the biodiversity, geographical distribution pattern, systematics and evolution of freshwater Mitosporic fungi. In summary, we hope that the information presented herein will prompt future studies to document Freshwater Mitosporic fungi of India.

Table 1. Freshwater Mitosporic Fungi of India: (F-Foam, L- leaf, CN-Conifer Needles, RE-Root Endophytes, SF-Stem Flow, W-Water, WD-Wood, MS-Maharashtra,

Sr No	Name of species	Substrates	Location
	Hyphomycetes	F,L,CN,R E,SF,W, WD	Maharashtra
1	<i>Actinosporella megalospora</i> (Ingold) Descals et al.	F	+
2	<i>Anguillospora angulata</i> (R.H. Petersen) Wolfe	L	+
3	<i>A. gigantea</i> Ranzoni	F	+
4	<i>Articulospora inflata</i> Ingold	F,W	+
5	<i>Articulospora tetracladia</i> Ingold	F,L,W, WD	+
6	<i>Bactrodesmium indicum</i> Udaiyan	WD	+
7	<i>Beltrania rhombica</i> Penz.	F,L,W	+
8	<i>Beltraniopsis tanzaniensis</i> Pirozy.	L	+
9	<i>Brachiosphaera tropicalis</i> Nawawi	F,W	+
10	<i>Camposporidium cristatum</i> Nawawi & Kuthubu.	F	+

11	<i>Camposporium antennatum</i> Harkness	F,L	+
12	<i>C. pellucidum</i> (Grove) S. Hughes	F,L,W	+
13	<i>Campylospora chaetocladia</i> Ranzoni	F,CN,RE, W,WD	+
14	<i>Campylospora filicladia</i> Nawawi	F,L	+
15	<i>Canalisporium exiguum</i> Goh & Hyde	WD	+
16	<i>Canalisporium pulchrum</i> (Hol.-Jech. & Mercado) Nawawi & Kuthub.	WD	+
17	<i>Chaetendophragma africana</i> (Pirozynski) Sutton & Hodges	F,L	+
18	<i>Clavariopsis aquatica</i> De Wild.	F,L,CN, RE,W	+
19	<i>Clavariopsis azlanii</i> Nawawi	F,L,W	+
20	<i>Clavatospora tentacula</i> (Umphlett) Sv. Nilsson	F,L,W	+
21	<i>Condylospora spumigena</i> Nawawi	F,L	+
22	<i>Dactylella submersa</i>	F,WD	+

	(Ingold) S. Nilsson		
23	<i>Dicranidion gracilis</i> Matsushima	SF	+
24	<i>Dictyosporium digitatum</i> Chen et al.	WD	+
25	<i>Dictyosporium gaunti</i> Bhat & Sutton	WD	+
26	<i>Dictyosporium heptasporum</i> (Garov) Damon	WD	+
27	<i>Dictyosporium tetraseriale</i> Goh et al.	WD	+
28	<i>Diplocladiella longibrachiata</i> Nawawi & Kuthub.	F,L,W	+
29	<i>Diplocladiella scalaroides</i> Arnaud	F,L	+
30	<i>Diplocladiella tricladioides</i> Nawawi	F	+
31	<i>Dwayaangum dichomata</i> Nawawi	F,L,SF	+
32	<i>Endophragma alternata</i> Tubaki & Saito	WD	+
33	<i>Exserticlava triseptata</i> (Matsus.) Hughes	WD	+
34	<i>Flabelloladia gigantea</i> Nawawi	L	+
35	<i>Flabellospora amphibian</i> (Price & Talbot) Descals	F	+
36	<i>F. crassa</i> Alasoad.	F,L,SF,W D	+
37	<i>F. multiradiata</i> Nawawi	F,L,SF,W	+
38	<i>F. verticillata</i> Alasoadura	F,L,CN,S F	+
39	<i>Flagellospora curvula</i> Ingold	F,L,SF,W D	+
40	<i>F. penicillioides</i> Ingold	F,L,CN, SF,W,WD	+
41	<i>F. prolifera</i> Petersen	F	+
42	<i>Gyoerffyella tricapillata</i> (Ingold) Marvanova	F	+
43	<i>Helicoma polysporum</i> Morgan	L	+
44	<i>Helicosporium griseum</i> Berk. & Curtis	F,L,WD,	+
45	<i>H. phragmitis</i> Honnel	F,L	+
46	<i>Hydrometrospora symmetrica</i> Gonczol & Revay	F	+
47	<i>Ingoldiella hamata</i> Shaw	F,L,W	+
48	<i>Isthmotricladia gombakiensis</i> Nawawi	F,L,W	+
49	<i>Isthmotricladia laeensis</i> Matsushima	F,L,SF,W	+
50	<i>Koorchalomella oryzae</i> Chona, Munjal & Kapoor	L	+
51	<i>Laridospora appendiculata</i> (Anastasiou) Nawawi	F,L,W	+
52	<i>Lateriramulosa un-inflata</i> Matsus.	F,L,SF,W	+
53	<i>Lemonniera aquatica</i> De Wild.	F,L,SF,W	+
54	<i>Lunulospora curvula</i> Ingold	F,L,CN,R E,SF,W,	+

		WD	
55	<i>Phaeoisaria sparsa</i> Sutton	L,WD	+
56	<i>Phalangispora constricta</i> Nawawi & J. Webster	F,L,SF,W	+
57	<i>Pleiochaeta setosa</i> (Kirchn.) Hughes	F	+
58	<i>Saccardaia echinocephala</i> Cavara	L	+
59	<i>Setosynnema isthmosporum</i> Shaw & Sutton	F,L,CN,W	+
60	<i>Speirospis pedatospora</i> Tubaki	F,L,SF,W	+
61	<i>Stachylidium bicolor</i> Link	F,WD	+
62	<i>Tetrachaetum elegans</i> Ingold	F,L,CN,S F,W	+
63	<i>Tetracladium marchalianum</i> De Wildeman	F,L,CN,R E,W	+
64	<i>Tetracladium setigerum</i> (Grove) Ingold	F,L,RE,W	+
65	<i>Tetraploa aristata</i> Berk. & Br.	F,L	+
66	<i>Trichocladium angelicum</i> Roldon & Honrubia	L,WD	+
67	<i>Trichocladium englanese</i> Hyde & Goh	WD	+
68	<i>Tricladium angulatum</i> Ingold	F,L,W	+
69	<i>Tricladium splendens</i> Ingold	F,L,CN,S F,W	+
70	<i>Triscelophorus konajensis</i> Sridhar & Kaveriappa	F,L,SF,W, WD	+
71	<i>Triscelophorus monosporus</i> Ingold	F,L,CN,S F,W,WD	+
72	<i>Varicosporium scoparium</i> Roldon & Honrubia	F	+
73	<i>Wiesneriomyces laurinus</i> (Tassi) P. M. Kirk	F,L,W,W D	+
74	<i>Xylomyces elegans</i> Goh et al.	WD	+
75	<i>Xylomyces pucillus</i> Goh et al.	WD	+
76	<i>Chaetospermum carneum</i> Tassi	F,L,WD	+
77	Coelomycetes	F,L,CN,R E,SF,W, WD	
78	<i>Chaetospermum chaetosporum</i> (Pat.) Smith & Ramsb.	F,L,WD	+
79	<i>Chaetospermum indicum</i> Talde	L	+

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