Occurrence, distribution and seasonality of riverine fungi

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Occurrence and distribution of 34 species of watermoulds in the rivers Mula and Mutha, Pune, were described. 11 genera and 34 species were isolated from 11 different sampling stations of the rivers. Both the rivers show occurrence of equal number of species. Maximum number of fungal forms were isolated in winter and minimum in summer. *Saprolegniales* and *Lagenidiales* show distinct seasonal periodicity. Seasonal periodicity was controlled by DO, pH and temperature. *Thraustotheca clavata* was isolated as a pollution indicator. All zoosporic fungi maintained the seasonal rhythm.

Key-words—Riverine moulds, Distribution, Seasonality, Pollution indicator

INTRODUCTION

THOUGH very exhaustive and significant work has been done on the taxoecological studies of watermoulds, it is mostly restricted to lentic environment (Butler, 1907, Sparrow, 1968; Alabi 1971; Dick, 1976; Das Gupta, 1982; Klich & Tiffney 1985; Dayal & Kiran, 1988 Manoharachary, 1991). However, a few attempts have been made towards the study of aquatic fungi from lotic environment, particularly riverine fungi (Hunter, 1975, Khulbe *et al.* 1995). Zebrowska (1976) criticized the mycoflora of lentic and lotic systems. Waterhouse (1942) discussed both the systems in detail and finally concluded that lotic fungal flora is less rich but more variable in fungal population. In view of this, taxoecology of the watermoulds of the two rivers, Mula and Mutha is studied. In the present paper occurrence and distribution of watermoulds in the rivers are discussed.

MATERIAL AND METHOD

General survey of the rivers Mula and Mutha with respect to their nearby localities was undertaken to establish the sites for regular sample collections. Five sampling stations A, B, C, D, E on the Mutha and six F, G, H, I, J, K on the Mula, were selected for the fortnightly collections of water samples. These water samples were regularly collected in glass bottles of 120 ml. capacity with glass stoppers and brought to the laboratory for further analysis. Water samples thus collected from each station were poured in the sterilized autoclaved petridishes and were bailed with sterilized opium seeds, grass leaves, maize leaves, etc. The isolates were purified by transferring them to the sterilized water and by the single hyphal culture technique. Identification of different species of zoosporic fungi were made with the help of monographs and relevant literature (Coker, 1923; Johnson, 1956; Sparrow, 1960; Waterhouse, 1968a, 1968b; Seymour, 1970; Dick, 1973). Physiochemical parameters were studied by applying standard methods (APHA, AWWA, & WEE, 1992).

Table 1. Zoosporic fungi isolated from the rivers Mula and Mutha showing percentage occurrence.

1. *Chytridiales*	2.91%
Rhizophlyctis hyalina Karling	
2. *Blastocladiales*	5.92%
Allomyces arbuscula Butler	
Blastocladiella simplex Mathews	
3. *Saprolegniales*	76.47%
Achlya americana Humphrey	
A. caroliniana Coker	
A. conspicua Coker	
A. debaryana Humphrey	
A. dubia Coker	
A. flagellata Coker	
A. imperfecta Coker	
A. klebesina Pieters	

A. megasperma Humphrey
A. oblongata de Bary
A. orion Coker & Couch
A. proliferoides Coker
A. dayalii Gandhe & Desale
A. punensis
Aphanomyces sp.
A. scaber de Bary
Dictyuchus sterile Coker
D. monosporous Leitgeb
D. carpophorus Zopf
Protoachlya paradoxa Coker
Saprolegnia delica Coker
S. ferax (Gruith) Thuret
S. irregularis Johnson & Seymour
S. lapponica Gaumann
S. parasitica Coker
Thraustotheca clavata (de Bary) Humphrey

4. *Legenidiales* 5.92%

Olpiodiopsis saprolegniae var. *levis* Coker
O. achlyae Mc Larty

5. *Peronosporales* *9.92%*

Pythium carolinianum Mathews
P. proliferum de Bary
P. catenulatum

RESULT AND DISCUSSION

The species isolated from the rivers and their percentage frequency are presented in Table 1. Altogether, 11 genera and 34 species were isolated from 11 sampling stations of the rivers. It is evident that there is a considerable variation in the different groups of watermoulds in both the rivers. *Saprolegniales* is dominant with the highest percentage frequency of 76.47% in both the rivers and show luxuriant occurrence throughout the year with twenty-six species. *Chytridiales, Blastocladiales, Lagenidiales and Peronosporales* were isolated with low percentage frequency. The two rivers, Mula and Mutha show occurrence of almost equal number of species. The data collected for two year show (Tables 2, 3 and 4) that three major factors control fungal population at the different stations. DO and pH show positive significant correlation to the occurrence of watermoulds. However, not single factor was responsible for the occurrence of watermoulds but a combination of many factors together. This observation is similar to that of Alabi (1971) and Khulbe *et al.* (1995). The values of DO markedly fluctuated in both the rivers between 0 to 8.8 mg/lit. from station to station. Maximum DO concentration was at the stations A and B of Mutha in September and October and reduced to 0 at station E from February to June. Similarly, maximum concentration of DO was recorded at stations F and G on the Mula in September and the same went down to a minimum level 0 at the station K in April and May. The station E always exhibited lowest DO content (0 to 3.0 mg/lit). throughout the year. The station D was also poor in DO where it was 0.4 to 6.0 mg/lit. During winter and rainy season DO content was high and the number of *Saprolegniales* increased. The number was affected during summer when DO level decreased. Towards down stream stations of both the rivers the number of *Saprolegniales* decreased with gradual decrease in DO content. However, the species of *Peronosporales* and *Chytridiales* were not affected by DO as they were isolated from different stations throughout the year. *Blastocladiella* remained unaffected by DO fluctuations. The genus *Allomyces* was isolated during rainy season when DO content started increasing. Like DO, pH was also interfering in maintaining fungal population. Both the rivers are slightly acidic to alkaline and pH was fluctuating from 6.8 to 8.4 at different stations of both the rivers. Accordingly, they are grouped into constant alkaline species, alkaline species, moderate alkaline species, wide pH range species, neutral to alkaline species, and moderately alkaline to alkaline species. It is found that many watermoulds occurred in between 7.8 to 8.5 pH range. We observed that the species of *Peronosp-orales* and *Chytridiales* did not show marked seasonal periodicity while the species of *Blastocladiales, Saprolegniales* and *Lagenidiales* showed distinct seasonal periodicity in their occurrence. Base line stations showed occurrence of maximum number of species because of

Table 2. Presence (+) or absence (-) of watermoulds in two rivers of Pune city in different seasons

	Fungi Species	Mutha			Mula		
		Seasons			Seasons		
		W	S	R	W	S	R
1	*Achlya americana*	+	+	+	+	+	+
2	*Achlya caroliniana*	+	-	+	-	-	+
3	*A. conspicua*	+	-	+	+	-	+
4	*A. debaryana*	-	+	+	-	-	-
5	*A. dubia*	+	+	+	+	-	+
6	*A. flagellata*	+	+	+	+	-	+
7	*A. imperfecta*	+	+	+	+	-	+
8	*A. klebsiana*	+	-	-	-	-	-
9	*A. megasperma*	+	-	+	-	-	+
10	*A. oblonagata*	+	+	+	+	+	+
11	*A. orian*	-	-	+	+	-	-
12	*A. proliferoides*	+	+	+	+	+	+
13	*A. dayali*	-	-	+	-	-	-
14	*A. punensis*	+	-	+	-	-	-
15	*Allomyces arbuscuala*	+	-	+	-	-	-
16	*Aphanomyces sp*	+	+	+	+	+	+
17	*A. scaber*	+	+	-	-	-	-
18	*Blastocaldiella simplex*	+	+	+	-	-	-
19	*Dictyuchus carpophorus*	+	-	+	-	-	+
20	*D. monosporus*	+	-	+	-	-	+
21	*D. sterile*	+	+	+	-	-	-
22	*Olpidiopsis saprolegniae*	+	-	-	-	-	-
23	*O. achlyai*	+	-	-	-	-	-
24	*Protoachlya paradoxa*	-	-	+	-	-	-
25	*Pythium catenulatum*	-	-	-	+	-	+
26	*P. carolinianum*	+	+	+	+	+	+
27	*P. proliferum*	+	+	+	+	-	+
28	*Rhizophylactis hyalina*	+	+	+	+	+	+
29	*Saprolegnia delica*	+	-	-	+	-	-
30	*S. ferax*	+	-	-	+	-	-
31	*S. irregularis*	+	-	-	+	-	-
32	*S. lapponica*	+	-	-	+	-	-
33	*S. parasitica*	+	+	-	+	+	-
34	*Thraustotheca clavata*	+	+	-	-	-	-

W- Winter season- October to February

S- Summer season March to May

R- Rainy season June to September

extremely slow flow rate of water and high concentration of DO. The number of watermoulds remarkably lowered towards the stations as DO gradually decreased. The deposition of organic wastes increased towards down stream stations. It is evident that both the rivers maintained alkaline condition at all the stations. From the Tables 2 and 3 it is clear that maximum number of species were isolated during winter from November to January and very few in April and May in both the rivers. The number of species starts

Table 3. Number of fungal forms obtained during the year 1993 and 1994 from Mula and Mutha rivers

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Station A	93	14	9	7	8	3	4	5	7	9	9	10	8
	94	13	8	9	4	3	6	7	6	4	7	8	9
Station B	93	12	9	8	4	1	4	4	8	7	8	11	13
	94	11	8	6	4	1	6	7	8	7	7	8	8
Station C	93	11	6	7	5	3	6	6	6	7	9	6	10
	94	11	8	5	3	3	7	4	10	4	4	6	5
Station D	93	8	4	3	5	4	4	5	7	7	7	7	4
	94	7	5	4	3	3	4	0	11	6	3	6	6
Station E	93	5	2	4	4	0	2	3	4	2	6	3	3
	94	2	2	2	2	0	2	3	4	6	3	3	2
Station F	93	5	3	3	2	1	6	4	5	9	9	8	7
	94	5	4	3	2	1	3	4	6	8	9	8	8
Station G	93	5	4	3	2	2	6	6	8	8	8	7	8
	94	3	3	2	2	1	5	7	7	7	8	6	6
Station H	93	3	3	3	2	1	7	4	7	5	9	7	6
	94	4	2	4	3	1	3	5	6	7	7	9	7
Station I	93	5	7	5	2	1	6	3	8	8	9	6	7
	94	5	3	3	2	1	6	5	8	8	9	7	6
Station J	93	5	4	3	2	1	4	1	6	6	5	6	4
	94	5	3	2	2	1	6	5	8	8	7	7	6
Station K	93	4	3	2	2	1	4	2	6	6	2	4	4
	94	5	2	2	1	1	3	3	5	5	5	6	5

decreasing from March and again starts increasing during rainy season for June probably due to suitable water temperature. However, water temperature did not show positive significant correlation with the occurrence of species as in many temperate countries. Robert (1963) and Hunter (1975) observed that low water temperature in winter is favourable for the growth of water moulds in temperate countries. In India, we have isolated maximum number of species either in monsoon or winter and the least during summer. Therefore, it shows insignificant importance of water temperature. Roberts (1963) observed the sudden decrease in number of species mainly due to flood water. We also have made similar observations. The genus *Achlya* with its 14 species was the dominant genus followed by *Saprolegnia* and other genera. It is observed from the tables that, the genus *Thraustotheca* with the only species was isolated only from highly polluted and organically rich habitat, at the station E, Sangam bridge from the river Mutha. The species. *T. clavata,* therefore, indicated highly polluted water quality at the station and the species is referred

Table 4. Linear regression analysis

Physico-chemical factors	Rivers	(r)	Regression equation Y = a + bx
Water temperature	Mutha	-0.63	Y= -2.06+98.42X
	Mula	-0.21	Y= -1.02+46.97X
pH	Mutha	0.63	Y= 27.64+-192.62X
	Mula	0.61	Y=27.10+-196.55X
DO	Mutha	0.66	Y= 3.00+0.92X
	Mula	0.76	Y= 4.25+-0.84X

Y = Predicted number of fungal species a = intercept with Y axis
X = Physico-chemical factors b = slope values

as the pollution indicator. However, *Aphanomyces* shows its common occurrence both in polluted as well as in nonpolluted water in both the rivers. The species of *Pythium* show their increasing occurrence towards down stream stations. The genus *Blastocladiella* revealed its tolerance to the polluted water. On the other hand, *Dictyuchus carpophorus, Pythium catanulatum* were only found in the Mula. All zoosporic fungi maintained seasonal rhythm.

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