Distribution of Aquatic Fungi in Relation to Physicochemical Factors of Kosi River in Kumaun Himalaya

P. C. Paliwal [1], S. C. Sati [2]

1 Botany Department, Kumaun University, Nainital-263002, India. Email: ppali2002@gmail.com; p_pali2002@yahoo.co.in
2 Botany Department, Kumaun University, Nainital-263002, India. Email: satisc2000@yahoo.co.in

Abstract: Watermolds- the members of Chytridiomycetes and Oomycetes fungi, and possess ability of colonizing a variety of substances. Kosi river water was assessed with reference to watermolds diversity, pH, water temperature and total organic matter at 3 study sites viz., Kosi, Kwarab and Khairna, from November 2000 to October 2001. During study, a total of 16 fungal species belonging to 7 genera of watermolds were isolated. Maximum number of fungal species was recorded during spring and rainy season, while minimum number of watermolds was observed during winter season. During present study, sterile species of watermolds showed dominance followed by eccentric species. The interaction of physicochemical factors greatly influence to the diversity of watermolds. [Nature and Science. 2009;7(3):70-74]. (ISSN: 1545-0740).

Key words: *watermolds, Kosi river, physicochemical factors.*

1. Inatroduction

Aquatic fungi contribute significantly in aquatic ecosystem and are seriously concerned with the utilization and degradation of animal and plant remains (Johnson, 1956; Sparrow, 1968). The members of Chytridiomycetes and Oomycetes are mostly aquatic and commonly known as watermolds. They are widely distributed and ubiquitous in occurrence (Liu and Volz, 1976; Nelson and Scott, 1962; Cummins et al, 1966). These fungi are mostly aquatic but several of them reported from other habitat too. Majority of them play a vital role in degradation of complex organic matter in simple one and recycling of nutrients. The watermolds are primarily saprophytic in nature but they have ability to colonize a variety of substances, as primary invaders. A few of them show parasitic association with living hosts, i.e. plants and animals and showed remarkable influence on biological productivity (Scott, 1961; Sati, 1981; Sati et al., 1992; Khulbe and Verma, 1983).

These fungi are mostly aquatic and commonly known as watermolds, but several of them reported from other habitat too. The study of watermolds have been carried out in all over the world by Coker (1923), Middleton (1943), Johnson (1956), Scott (1961), Seymour (1970), Robertson (1980) and Dick (1990). The studies of watermolds from various Indian water habitats were made by different investigators including Bhargava (1946), Dayal and Thakurji (1968), Khulbe (1977), Mer et al. (1980), Manoharachary (1991), Mer and Khulbe (1984), Mishra and Dwivedi (1987) and Sati (1997). The present paper deals with the study of distribution and seasonality of watermolds in Kosi river. In the present investigation, Kosi river water has been analyzed for watermolds diversity.

2. Material and Methods

Kumaun Himalaya - a north west region of India, is located between 28^0 44' - 30^0 49' N latitude and 78^0 45'- $81^0$1' E longitude in the western part of Central Himalaya. Climatically, major parts of this area represents a temperate zone and monsoon pattern of rain fall with dry summer and winter. The Kosi – a perennial river of Uttarakhand (India) was selected for the present study which originates from southern slope of the Bhatkot - Kausani range (2517 m) near Kausani and enters the Bhabar near Ramnagar (346 m). It drains 150 Km area in the mountains of Almora, Nainital and Udham Singh Nagar districts. For the present investigation three sites were selected on Kosi river viz., Kosi (1110 m), Kwarab (1000 m) and Khairna (790 m).

The water samplings were made seasonally for a period of one year during November, 2000 to October, 2001 from Kosi river in sterilized plastic bottles. 50 ml of composite sample of each water sample was pored into sterilized petridishes, baited with different sterilized animal and plant baits. Colonized baits

were washed with sterilized water and placed in different sterilized petridishes containing sterile water. The isolates were purified by single hypha culture method and identified with the help of various standard monographs (Coker, 1923; Johnson, 1956; Scott, 1961 and Dick, 1990).The physico-chemical properties (pH, water temperature, and total organic matter) of water analyzed by following standard methods of APHA (1989).

Result and Discussion

16 species belonging to seven genera of Blastocladiales, Saprolegniales and Peronosporales have also been recovered from Kosi river water (Table 1). Of these, one species belong to Blastocladiales of the class Chytridiomycetes, while twelve species belongs to Saprolegniales and 3 species belongs to Peronosporales of the class Oomycetes.

The Kosi river water at Kosi yielded 12 species of watermolds, whereas 8 and 10 fungal species were isolated at station Kwarab and Khairna stations of Kosi river, respectively (Table 1). On genera identification, *Achlya* showed higher diversity with 4 species followed by *Saprolegnia* with 3 species, while *Aphanomyces, Dictyuchus and Pythium* represent 2 species each. During present study, 4 species of watermolds viz., *Achlya* sps., *Dictyuchus sterile, Saprolegnia* sps. and *Pythium debaryanum* were observed most frequent occurring species as they recovered from all the stations. On the other hand, 6 fungal species viz., *Allomyces anomalous, Achlya klebsiana, Dictyuchus monosporous, Thraustotheca clavata*, *Pythium undulatum* and *P. afertile* were isolated only once and showed restricted distribution.

It is evident from the results presented in table 2 that the frequency of watermolds and concentration of different nutrients show variation considerably in different seasons in all the three stations. Kosi river water were found alkaline throughout the study period and ranged from 7.4-8.75 at Kosi, 7.56-8.66 at Kwarab and 7.86-8.66 at Khairna (Table 2). Water temperature of Kosi river varied from site to site due to altitudinal, topographical and various environmental factors, such as vegetation cover, human activities etc. Water temperature ranged between 11.5-24.0 ^{0}C at Kosi, 11.5-25.0 ^{0}C at Kwarab and 11.0-25.4 ^{0}C at Khairna. The maximum amount of total organic matter were recorded at Khairna (190-225 mg/l), while minimum at station Kosi (104-180 mg/l).

Watermolds are of ephemeral nature and consequently exhibits seasonality in aquatic system. During the present study, Kosi river at station Kosi showed highest diversity of watermolds (12 sps.). It might be due to wide range of pH (7.4-8.75) with moderate water temperature (11.5-24.0 ^{0}C). The mixing of fungal inoculums or spores through surface water runoff of catchment and nearby forest area alongwith rain water into river, might be responsible for higher diversity of watermolds during rainy season.

The maximum number of fungal species recovered in Kosi river at station Kosi (5 sps.) and Kwarab (4 sps.) in rainy season, and at Khairna (5 sps.) during spring season. The higher number of watermolds during spring and rainy season might be due to high amount of organic matter alongwith moderate water temperature. The results are similar to Klick and Tiffany (1985). Water temperature showed a positive significant correlation with total number of fungal species at station Kosi ($r = - 0.8266$, $P \leq 0.05$), and Khairna. ($r = - 0.9942$, $P \leq 0.01$). Higher temperature during summer and low temperature (below 15 ^{0}C) during winter has been found unfavorable for most of the aquatic fungi (Dayal and Tendon, 1962; Khulbe, 1991). On the basis of relative contribution, rainy season contribute highest occurrence of watermolds (62.5%), whereas both the spring and summer season contribute 43.75 % occurrence of watermolds. The minimum number of watermolds was observed during winter season, showed only 25% relative contribution. Lower temperature during winter might account for least number of species (Khulbe and Bhargava, 1977). It is interesting to note that 8 species of watermolds were failed to induce their antheridia and oogonia (sterile species) and showed their dominance followed by 6 eccentric species.

Table 1: Seasonal variation of watermolds in a freshwater river Kosi during November, 2000 to October, 2001.

S. No.	Fungal Species	Seasons				
		Winter 2000	Spring 2001	Summer 2001	Rainy 2001	Autumn 2001
1.	*Allomyces anomalous*	-	C	-	-	-
2.	*Achlya klebsiana*	-	-	-	B	-
3.	*A. americana*	-	-	C	B	-
4.	*A. prolifera*	-	-	A	B	-
5.	*Achlya sps.*	-	C	A,B	A,C	-
6.	*Aphanomyces leavis*	-	A	C	A	C
7.	*Aphanomyces sps.*	-	-	A,C	A	A
8.	*D. monosporous*	-	-	-	A	-
9.	*Dictyuchus sterile*	A,B,C	-	-	C	-
10.	*Saprolegnia ferax*	A,C	A	-	-	-
11.	*S. parasitica*	-	A,C	A	-	-
12.	*Saprolegnia sps.*	A	B,C	B	-	-
13.	*Thraustotheca clavata*	-	-	-	-	A
14.	*Pythium debaryanum*	C	C	-	B	A,B,C
15.	*P. undulatum*	-	-	-	-	B
16.	*P. afertile*		-	-	A	-
	TOTAL	**4**	**7**	**7**	**10**	**5**

A= Kosi; B= Kwarab; C= Khairna; + = species present; - = species absent.

Table 2: Some Physicochemical parameters of river Kosi during November, 2000 to October, 2001.

Months	Physicochemical parameters								
	KOSI			KWARAB			KHAIRNA		
	pH	Water Temp. (^{0}C)	Total Org. Matter (mg/l)	pH	Water Temp. (^{0}C)	Total Org. Matter (mg/l)	pH	Water Temp. (^{0}C)	Total Org. Matter (mg/l)
Winter, 2000	7.97	11.5	104	8.59	11.5	113.5	8.36	11.0	190
Spring ,2001	8.75	14.5	140	8.66	14.0	191	8.66	16.5	205
Summer, 2001	7.4	22.5	175	7.56	21.5	155	7.93	23.0	225
Rainy, 2001	8.1	24.0	153	8.05	25.0	139.5	7.98	25.0	198
Autumn, 2001	8.09	19.0	186	7.99	17.5	140	7.86	18.0	220

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