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Full Length Research Paper

Estimation of conidial concentration of freshwater Hyphomycetes in two streams flowing at different altitudes of Kumaun Himalaya

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Freshwater Hyphomycetes commonly occurs in all types of natural freshwater streams and form one of the most important components of freshwater ecosystem as decomposers. They produce tremendous conidia in submerged condition. In the present study, concentration of these fungi in per unit volume of water in two freshwater streams situated at different altitudes viz., Ratighat (1200 m asl) and Vinayak (1500 m asl) was determined by using the Millipore filter paper technique following Iqbal and Webster (1973b). The results demonstrate that in Ratighat stream, 21 species of freshwater Hyphomycetes belonging to 15 genera were found. Maximum concentration of conidia was observed in the month of December (41.05 × 10^3 conidia/litre) and the minimum number of conidia was observed during May (12.83 × 10^3 conidia/litre). In Vinayak stream 26 species of freshwater Hyphomycetes belonging to 18 genera were found. Maximum concentration of conidia per litre of stream water sample was observed during the month of January (74.40 × 10^3 conidia/litre) and the minimum concentration of conidia was observed during June (30.79 × 10^3 conidia/litre).

Key words: Freshwater Hyphomycetes, conidial concentration, millipore filter.

INTRODUCTION

Freshwater Hyphomycetes frequently colonize the submerged decaying leaf litter of trees and shrubs in well aerated streams. The branched septate mycelium of these fungi ramifies the dead leaf tissues and their conidiophores are projected into the water to release the spores and taken away by the water currents (Iqbal and Webster, 1973a). These spores (conidia) are often collected in accumulated water foam and scum at the barriers. Biologically these fungi are very important as they provide inoculum potential, responsible for decomposition of organic matter in running freshwater bodies (Barlocher, 1985; Gessner et al., 1997; Suberkropp, 1992, 1998; Graca, 2001; Gessner and vanRyckegem, 2003).

A vast literature has been accumulated about their morphology, development, occurrence and ecology from different parts of the world (Ingold, 1965, 1976; Iqbal et al., 1980; Descals and Webster, 1982; Nawawi, 1985; Sridhar et al., 1992; Sati and Tiwari, 1997; Marvanova, 1997). However, there is a paucity of knowledge on the study of conidial concentration of these fungi.

The objective of present investigation was to determine the conidial concentration of freshwater Hyphomycetes per unit volume of water in two freshwater streams flowing at different altitudes viz., Ratighat (1200 m asl) and Vinayak (1500 m asl) of Kumaun Himalaya.

MATERIALS AND METHODS

In order to quantify the conidial concentration of Freshwater Hyphomycetes in unit volume of stream water, Iqbal and Webster (1973b) was followed. Water samples were taken at an interval of 30 days for the period of twelve months from each stream situated at different altitudes viz., Ratighat (1200 m asl, 29° 25′ N Latitude and 79° 32′ E Longitude) and Vinayak (1500 m asl, 29° 22’ N Latitude and 79° 33’ E Longitude). 10 samples of water

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Table 1. Freshwater Hyphomycetes recorded by the Millipore filtration of the unit volume of water from Ratighat and Vinayak streams.

S. No.	Fungi	Ratighat stream	Vinayak stream
1.	*Acaulopage tetraceros* Drechsler	♦♦	_
2.	*Alatospora acuminata* Ingold	♦♦♦	♦♦♦
3.	*A. pulchella* Marvanova	♦	♦
4.	*Anguillospora crassa* Ingold	♦	_
5.	*A. longissima* (Sacc. & Therry) Ingold	♦♦	♦♦
6.	*Beltrania rhombica* Penzing	♦	_
7.	*Camposporium pellucidum* (Grove) Hughes	_	♦
8.	*Campylospora chaetocladia* Ranzoni	♦	♦♦♦
9.	*C. parvula* Kuzaha	♦♦♦	♦
10.	*Clavariopsis aquatica* de Wildeman	♦♦	♦♦♦
11.	*Diplocladiella longibrachiata* Nawawi & Kuthub.	_	♦
12.	*Helicomyces roseus* Link	♦	_
13.	*Heliscella stellatacula* Marvanova	_	♦
14.	*Heliscus lugdunensis* Sacc. & Therry	♦♦	_
15.	*Lemonniera terrestris* Tubaki	_	♦
16.	*L. cornuta* Ranzoni	_	♦♦♦
17.	*L. pseudofloscula* Dyko	_	♦
18.	*Lunulospora curvula* Ingold	♦♦♦	♦♦♦
19.	*L. cymbiformis* Miura	♦♦♦	♦♦♦
20.	*Pestalotiopsis submersus* Sati & Tiwari	♦	♦♦
21.	*Pleurophragmium sonam* Sati & Tiwari	_	♦
22.	*Setosynnema isthmosporum* Shaw & Sutton	_	♦♦♦
23.	*Speiropsis scopiformis* Kuthub.& Nawawi	♦♦	♦♦
24.	*Tetrachaetum elegans* Ingold	♦♦	♦♦♦
25.	*Tetracladium apiense* Sinclair & Eicker	_	♦♦
26.	*T. marchalianum* de Wildeman	♦♦♦	♦♦♦
27.	*T. setigerum* (Grove) Ingold	♦♦♦	♦♦
28.	*Tricladium chaetocladium* Ingold	_	♦
29.	*Tricladium* sp.	♦	_
30.	*Tripospermum myrti* (Lind)Hughes	_	♦
31.	*Triscelophorus acuminatus* Nawawi	♦♦♦	♦♦♦
32.	*T. monosporus* Ingold	♦♦♦	♦♦♦

♦♦♦ = Commonly frequent species; ♦♦ = frequent species; ♦ = rare species; □ = species absent.

(approximately 100 ml water) were collected from different substations in both the streams and a composite sample of one litre water was made for each stream separately. This was brought to the laboratory and filtered with a Millipore filter (5 µm pore size). Millipore filters were then treated with cotton blue and lactophenol to stain the conidia. Treated filter papers were then heated in lactic acid at 50 to 60°C to make them transparent for low power microscope examination. This allows the recognition and identification of various kinds of conidia on the filter paper. The conidia were identified with the help of relevant monographs and papers (Ingold, 1975; Marvanova, 1997). Data was recorded for each month and each stream separately.

RESULTS

The composite water samples of unit litre volume each of two different studied streams were filtered at monthly intervals and data are presented in Tables 1 and 2. The filtration process causes many conidial forms overlapping to each other; therefore, conidial counting was made very carefully at each vision field of microscope to scan the treated millipore filter.

In the Ratighat stream 21 species of Freshwater Hyphomycetes belonging to 15 genera viz., *Acaulopage*, *Alatospora*, *Anguillospora*, *Beltrania*, *Campylospora*, *Clavariopsis*, *Helicomyces*, *Heliscus*, *Lunulospora*, *Pestalotiopsis*, *Speiropsis*, *Tetrachaetum*, *Tetracladium*, *Tricladium* and *Triscelophorus* were reported (Table 1) Of these, *Alatospora acuminata*, *Campylospora parvula*, *Lunulospora curvula*, *L. cymbiformis*, *Tetracladium marchalianum*, *T. setigerum*, *Triscelophorus acuminatus*

Table 2. Estimation of conidial concentration of Freshwater Hyphomycetes on unit litre of composite water sample from Ratighat and Vinayak streams.

Month	Ratighat			Vinayak		
	(No. of conidia × 10^3 /litre)	Temperature (°C)	pH	(No. of conidia × 10^3 /litre)	Temperature (°C)	pH
March-07	25.65	10.5	7.2	35.92	13.0	7.6
April	20.52	15.8	7.9	41.05	17.9	7.9
May	12.83	22.5	9.0	35.92	19.3	8.8
June	23.09	21.8	7.6	30.79	24.3	8.2
July	17.96	22.9	7.6	38.48	23.7	8.0
August	15.39	23.6	7.9	48.74	23.0	8.2
September	30.79	21.0	7.7	43.61	19.5	8.6
October	33.35	21.5	7.9	46.18	19.5	8.7
November	35.92	19.5	7.3	51.31	15.5	8.3
December	41.05	15.5	7.2	61.57	12.0	8.2
January-08	30.79	9.0	7.5	74.40	9.0	8.2
February	28.22	8.0	7.2	69.27	8.0	8.2

and *T. monosporus* were found as frequently occurring species in each month of observation.

As evident from Table 2 the maximum number of conidia was found in the month of December (41.05 × 10^3 conidia/litre) and the minimum number of conidia was observed during May (12.83 × 10^3 conidia/litre). The seasonal fluctuation of Freshwater Hyphomycetes was found negatively correlated with water temperature and pH (for temperature r = -0.370456, for pH r = -0.635664).

In the Vinayak stream 26 species of freshwater Hyphomycetes belonging to 18 genera viz., *Alatospora*, *Anguillospora*, *Camposporium*, *Campylospora*, *Clavariopsis*, *Diplocladiella*, *Heliscella*, *Lemonniera*, *Lunulospora*, *Pestalotiopsis*, *Pleurophragmium*, *Setosynnema*, *Speiropsis*, *Tetrachaetum*, *Tetracladium*, *Tricladium*, *Tripospermum* and *Triscelophorus* were reported (Table 1). Of these 10 species viz., *Alatospora acuminata*, *Campylospora chaetocladia*, *Clavariopsis aquatica*, *Lemonniera cornuta*, *Lunulospora curvula*, *L. cymbiformis*, *Setosynnema isthmosporum*, *Tetrachaetum elegans*, *Tetracladium marchalianum*, *Triscelophorus acuminatus* and *T. monosporus* were found frequently in all the months.

Maximum concentration of conidia per litre of stream water sample was observed during the month of January (74.40 × 10^3 conidia/litre) and the minimum concentration of conidia was observed during June (30.79 × 10^3 conidia/litre). The seasonal fluctuation of Freshwater Hyphomycetes was found negatively correlated with water temperature and pH (for temperature r = -0.783035) and positively correlated with water pH (r = 0.031326).

DISCUSSION

Foam collected at well-aerated streams contains a dense accumulation of spores and it is an effective trap for studying the spores of Freshwater Hyphomycetes (Ingold, 1961, 1967; Nilsson, 1964; Iqbal and Webster, 1973a). Observation of foam is a very quick way of getting an idea of the Freshwater Hyphomycetous fungus flora of that stream. In the present study the stream water was filtered through a Millipore filter to get conidial concentration of water borne conidial fungi in a unit volume of stream water. Though the present method is the best to measure quickly the concentration of spores of water borne conidial fungi in any water body but filtration process causes overlapping of some conidial forms to one other. Therefore, it requires a careful counting of conidia under the microscope. During this study Vinayak (higher altitudinal stream) was found with high concentration of conidia in per unit volume of stream water ranging from- 30.79 - 74.40 ×10^3 conidia/litre than the Ratighat stream (low altitudinal stream) ranging from 12.83 – 41.05 ×10^3 conidia/litre.

As evident from Table 2 the stream water of two sites had considerable monthly fluctuations in the conidial concentration per unit volume of water. Ingold (1976) has also reported a sharp seasonal variation in the monthly conidial concentration. Maximum conidial concentration in per unit volume of composite water sample was recorded during low temperature months i.e., December and January. This indicates that the winter months support greater conidial concentration than the other months. These findings are almost similar to Iqbal and Webster (1973 b), Muller – Haeckel and Marvanova (1979).

During this study it was interesting to note that higher altitudinal stream supports greater species richness (26 species) than the lower altitudinal stream (21 species). Raviraja *et al*., (1998), Chauvet (1991) and Fabre (1996) also found greater number of species in higher altitudinal streams as compared to lower altitudinal streams.

Conclusion

The estimation of conidial concentration of Freshwater Hyphomycetes in any water body would be useful to have a quick idea not only for its fungal flora but also to get the conidial inoculum potential of a stream in the particular season responsible for the decomposition of litter in the aquatic ecosystem.

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