Seasonal occurrence of water-borne fungi in Konaje stream (Mangalore), India

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Abstract

The Konaje stream near Mangalore University Campus has been surveyed during 1980–1981 for the occurrence of water-borne fungi by using three methods: leaf litter observations, foam analysis and water filtration. A total of twenty species of fungi has been recorded. Three species of fungi, *Lunulospora curvula*, *Triscelophorus monosporus* and *Triscelophorus* sp. were found to occur throughout the year. In all three methods *Lunulospora curvula* occurred in highest frequency. The occurrence of different species was found to correlate with the rainfall and leaf deposition in this region and not with water temperature.

Introduction

The occurrence of water-borne fungi has been reported from various parts of Europe, Africa, America, Asia and Australia (Ingold, 1975; Subramanian, 1971). The colonization of plant twigs by fungal spora in a freshwater stream in England was extensively studied by Willoughby & Archer (1973). The seasonal succession of water-borne mycoflora on different leaves has been reported by Bärlocher & Kendrick (1974). The seasonal periodicity of occurrence has been observed by many mycologists including Iqbal & Webster (1973, 1977); Müller-Haeckel & Marvanová (1979); Bärlocher & Rosset (1981) and Gönczöl (1975). The present investigation reports on the seasonal periodicity of water-borne fungi in a freshwater stream near Mangalore University Campus over a period of two years.

Materials and methods

The investigation was carried out in Konaje stream which flows adjacent to Mangalore University Campus in Konaje village and joins the Arabian Sea near Uchila, Mangalore. Five sampling sites at 1 km intervals, 60–115 m MSL were selected along the stream (Fig. 1). The stream bed is mostly rocky with fast flowing water and thick vegetation. It is lined by diverse natural vegetation and plantation crops (Table 1). The survey was undertaken for two years during 1980–1981. The submerged leaves, foam and water were collected from each site every 15 days and analysed by the following methods:

Method 1 – Leaf litter analysis

Submerged leaves of different kinds were collected randomly from each sampling site and brought to the laboratory in moist condition in polythene bags. They were washed several times in tap water and finally in distilled water. Eight leaves selected from the collections at each site were cut into small bits and incubated separately in Petri dishes containing distilled water at laboratory temperature (25–30 °C). The water in the Petri dishes was replaced once in two days to minimize the growth of bacteria and other organisms. The leaf bits were screened under an inverted microscope (×125) at 24

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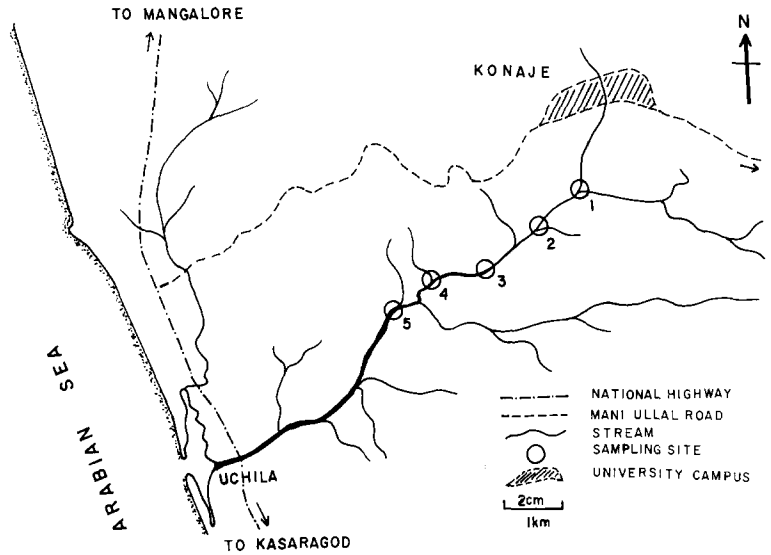

Fig. 1. Map of the investigation area with the sampling sites along the Konaje stream.

hour intervals for 60 days to detect the conidia of water-borne fungi appearing on them. The types of conidia encountered on the bits of each leaf were recorded separately.

Method 2 - Foam analysis

Approximately 10 ml of foam formed due to fast flowing turbulent water at each site was collected in clean plastic bottles and fixed in FAA (mixture of 40% formaldehyde, 10 ml; glacial acetic acid, 5 ml and 70% ethyl alcohol, 85 ml) on the spot, and later examined under a low power microscope (×125) to detect the presence of conidia.

Table 1. Vegetation lining Konaje stream.

Plantation crops	Natural vegetation
Anacardium occidentale Linn. (Cashew)	*Artocarpus heterophyllum* Lam. (Jack)
Areca catachu Linn. (Areca)	*Ficus bengalensis* Linn. (Banyan)
Carica papaya Linn. (Papaya)	*Mangifera indica* Linn. (Mango)
Cocos nucifera Linn. (Coconut)	*Tectona grandis* Linn. (Teak)
Musa paradisiaca Linn. (Banana)	
Mannihot utilissima Pohl (Tapioca)	
Theobroma cacao Linn. (Cacao)	

Method 3 - Water filtration

About one litre of water was collected from each site in a clean plastic bottle and filtered separately through Millipore filters (filter type HA; pore size, 0.45 μm; from Millipore Corporation, Bedford, Massachusetts 01730) immediately after arrival at the laboratory. The filters were wetted with 0.1% cotton blue in lactic acid to stain the conidia. The dishes containing filters were later incubated at 55 °C for 45 minutes and allowed to cool. Each filter was cut into 2 halves and each half was placed on glass slide before screening under a microscope (×300) for the presence of conidia (Iqbal & Webster, 1973).

The conidia were identified with the help of monographs (Ingold, 1975; Subramanian, 1971) and also from original descriptions (Nawawi, 1974, 1975; Nawawi & Webster, 1982).

The temperature, pH and dissolved oxygen of water were recorded at each sampling site. The average monthly rainfall was also recorded.

Observations

Over a period of two years, a total of twenty species of water-borne fungi were recorded (Table

Table 2. Water-borne fungi recorded from Konaje stream.

Fungi	Method of observation		
	Leaf litter	Faom analysis	Water filtration
Alatospora acuminata Ingold	+	+	+
Beltrania rhombica Penzig	+	+	+
Campylospora sp.	-	+	+
Dactylella submersa (Ingold) Nilsson	+	+	-
Flabellospora verticillata Alasoadura	-	+	-
Flagellospora curvula Ingold	+	+	+
F. penicillioides Ingold	+	+	+
Helicosporium guianensis Linder	+	+	+
Helicosporium sp.	+	-	-
Ingoldiella hamata Shaw	+	+	+
Lateriramulosa uni-inflata Matsushima	+	+	-
Lunulospora curvula Ingold	+	+	+
Phalangispora constricta Nawawi & Webster	+	+	+
Pyramidospora constricta Singh	+	+	+
Tricladium brunneum Nawawi	+	+	-
Triscelophorus acuminatus Nawawi	+	+	+
T. monosporus Ingold	+	+	+
Triscelophorus sp.	+	+	+
Varicosporium elodeae Kegel	-	+	-
Wiesneriomyces javanicus Koorders	+	+	+

\+ encountered
\- not encountered

2). Out of these, four species viz., *Campylospora* sp., *Dactylella submersa, Lateriramulosa uni-inflata* and *Tricladium brunneum* were recorded only in two of the methods and three species viz., *Flabellospora verticillata, Helicosporium* sp. and *Varicosporium elodeae* were recorded only in one of the methods. The remaining thirteen species were found with all the methods. The data on the frequency of occurrence of different species in the three methods is shown in Fig. 2. In all three of them, *Lunulospora curvula* was most common, followed by *Triscelophorus monosporus, Triscelophorus* sp. and *Flagellospora penicillioides. Pyramidospora constricta, Campylospora* sp., *D. submersa, F. verticillata, V. elodeae* and *Helicosporium* sp. occurred in very low frequency. *L. curvula, T. monosporus* and *Triscelophorus* sp. were recorded throughout the period of two years with all three methods.

Figure 3 summarises the monthly data on the number of species encountered, water temperature and rainfall. With all three methods, the total number of species is higher between July and December than between January and June in both years. This increased number of fungal species in the water corresponds with the rainfall data in the region. However, there is no such correlation between water temperature and the number of species recorded. The pH and dissolved oxygen during investigation ranged between 6.9–8.3 and 7.9–9.8 l^{-1} respectively.

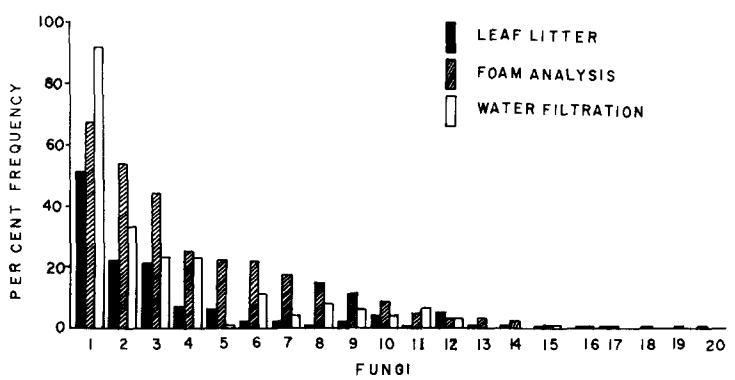

Fig. 2. Percent frequency of occurrence of different species of water-borne fungi in Konaje stream, *Lunulospora curvula* (1), *Triscelophorus monosporus* (2), *Triscelophorus* sp. (3), *Flagellospora penincillioides* (4), *Wiesneriomyces javanicus* (5), *Helicosporium guianensis* (6), *Phalangispora constricta* (7), *Triscelophorus acuminatus* (8), *Beltrania rhombica* (9), *Ingoldiella hamata* (10), *Alatospora acuminata* (11), *Flagellospora curvula* (12), *Lateriramulosa uni-inflata* (13), *Tricladium brunneum* (14), *Pyramidospora constricta* (15), *Campylospora* sp. (16), *Dactylella submersa* (17), *Flabellospora verticillata* (18), *Varicosporium elodeae* (19), *Helicosporium* sp. (20).

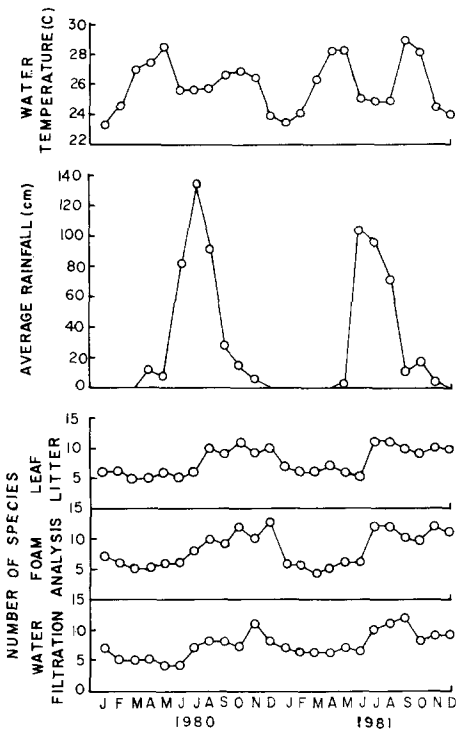

Fig. 3. Monthly data on the number of species of water-borne fungi, average rainfall and water temperature.

Discussion

Various mycologists have studied the water-borne fungi by isolating them from leaf litter, foam and water (Ingold, 1975; Bärlocher & Kendrick, 1974; Willoughby & Archer, 1973; Iqbal & Webster, 1973). Trapping conidia by submerged glass slides in water was also done by some investigators (Müller-Haeckel, 1977; Bärlocher *et al.*, 1977).

In the present study it has been possible to record twenty fungal species belonging to sixteen genera by using three methods. Only thirteen species have been detected with all three methods, indicating that the use of different methods increases the number of species recorded in a given region. This study corroborates the earlier views of the authors (Sridhar & Kaveriappa, 1982).

L. curvula, T. monosporus and *Triscelophorus* sp. occur throughout the year indicating that they are the most common fungi of this stream. Their occurrence does not seem to be affected by the presence or absence of leaf litter, rainfall etc. On the other hand, some organisms appeared mostly during the months of July–December, when there was rainfall. The effect of rainfall and the availability of leaf litter on the occurrence of water-borne fungi have been reported earlier (Willoughby & Archer, 1973; Müller-Haeckel & Marvanová, 1979; Bärlocher & Kendrick, 1974; Iqbal & Webster, 1977). Perhaps rains wash in leaf detritus from distant places containing various fungi. The water temperature, pH and dissolved oxygen concentration however, did not seem to correlate with the increase/ decrease in the mycoflora of this stream. Similar observations were made by Willoughby & Archer (1973) and Müller-Haeckel (1977). However, growth and sporulation of some aquatic hyphomycetes are clearly restricted to colder temperature (Gönczöl, 1975; Müller-Haeckel & Marvanová, 1979). Most of the studies on the occurrence of water-borne fungi have been carried out in temperate regions where the temperature of water ranged between 0 and 20 °C (Willoughby & Archer, 1973; Iqbal & Webster, 1973, 1977; Gönczöl, 1975; Müller-Haeckel, 1977; Müller-Haeckel & Marvanová, 1979; Bärlocher & Rosset, 1981). This is one of the few studies on the occurrence of water-borne fungi in a tropical region where water temperature ranged between 23 and 29 °C. Among the organisms which are reported to occur in the temperate regions (Nilsson 1964) only *Alatospora acuminata* and *Flagellospora curvula* were observed in the present study. Of those reported to be predominantly tropical (Nilsson, 1964; Ingold, 1975) *F. penicillioides, L. curvula* and *T. monosporus* were recorded in this stream. According to Ingold (1975) *L. curvula* and *T. monosporus*, though they occur in temperate regions, are much more abundant on the warmer parts of the earth. For a good comparative study some more work on the occurrence of fungi in tropical regions in different parts of the world is necessary. Conway (1970) recorded the largest number of aquatic hyphomycetes two weeks after the beginning of the leaf fall. Iqbal & Webster (1973) correlated the abundance of conidia of *Clavariopsis aquatica* and *F. curvula* to the period of leaf deposition. Gönczöl (1975) found the sporulation peak of *F. curvula* coinciding with the intensive leaf deposition. The leaf fall in the nearby vegetation of this stream usually takes place in the months of June–September. They are carried into stream due to heavy rainfall during June–September. Thus maximum occurrence of water-borne

fungi observed in the present study during July–December correlates with the period of leaf deposition.

Summary

A total of twenty species of water-borne fungi has been recorded in a stream near Mangalore University Campus by using three methods of observation viz., leaf litter, foam analysis and water filtration. In all methods *Lunulospora curvula* was the most common species, followed *Triscelophorus monosporus, Triscelophorus* sp. and *Flagellospora penicillioides. Pyramidospora constricta, Campylospora* sp., *Dactylella submersa, Flabellospora verticillata, Varicosporium elodeae* and *Helicosporium* sp. occurred in very low frequency. The occurrence of the different species appears to correlate with rainfall and leaf deposition rather than with water temperature, pH and dissolved oxygen.

L. curvula, T. monosporus and *Triscelophorus* sp. were found throughout the year with all three methods of isolation indicating that these organisms are the dominant species of Konaje stream.

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