ECOTROPICOS 20(2): 82-85 2007
Sociedad Venezolana de Ecología

AQUATIC HYPHOMYCETES IN TWO BLACKWATER STREAMS OF VENEZUELA

HIFOMICETOS ACUATICOS DE DOS RÍOS DE AGUAS NEGRAS DE VENEZUELA

Claudia Cressa[1] and Gunta Smits[2]

[1]Universidad Central de Venezuela, Centro de Biología Experimental, Laboratorio de Ecología de Sistemas Acuáticos Continentales, Apartado Postal 47114, Caracas 1041-A. Venezuela. E-mail: ccressa@ciens.ucv.ve

[2]Universidad Central de Venezuela, Instituto de Biología Experimental, Laboratorio de Fitopatología, Apartado Postal 47114, Caracas 1041-A. Venezuela. E-mail:gsmits@ciens.ucv.ve

Key words: blackwater streams, aquatic hyphomycetes, Dinira National Park, Venezuela

Palabras clave: rios de aguas negras, hifomicetos acuáticos, Parque Nacional Dinira, Venezuela

Aquatic hyphomycetes are the dominant microorganisms colonizing leaf litter in streams and thus have an important role on the energy flow of woodland streams (Baldy *et al*.1995, Gulis & Suberkropp 2003, Methvin & Suberkropp 2003). However, their importance on the decomposition of organic matter, diversity or richness is not well documented in tropical waters since only a few studies have been conducted in this region (Santos-Flores & Betancourt-López 1997). In order to increase our knowledge on these microorganisms in Venezuela, a taxonomic and ecological study of the aquatic hyphomycetes of rivers in National Parks was initiated in 2000. The objective of this paper is to report the hyphomycetes present in two blackwater streams (Quebrada Los Pinetes and Quebrada El Vino) of the Dinira National Park (Lara State, Venezuela) along with the hydro-physico-chemical characteristics of the streams sampled.

METHODS

Study site

Dinira National Park is located on the Serranía de Barbacoa (9° 27' 3''– 9° 50'10.8'' N and 69° 55' 38.4''– 70° 20'43.8'' W), a transitional zone between the Andes and the Cordillera del Interior of Cenozoic origin (Tertiary period) (Guevara & Guevara 1983, Gabaldón 1992). It covers an area of 42,000 ha with a difference in altitude between 1800 and 3585 m (Gabaldón 1992), and annual precipitation varies between 642 to 2100 mm (Weidman *et al.* 2003). The vegetation in the area includes a wet montane forest, cloud forest and subalpine páramo (Weidman *et al.* 2003). The first two are characterize by a dense forest (umbrophylus) while on the altitudinal páramo level (where the sampling was done), the ecosystem is characterized by an open vegetation of shrubs and grass. Furthermore, this area has a high number of endemic species (Gabaldón 1992, Huber 1997).

The structural geology of the region is characterized by a number of faults of the Cenozoic period, with limestone as the main component of the lithology. Soils are the product of sedimentary rocks alternating with sandstones and lutites (Guevara & Guevara 1983).

The river channel in Quebrada Los Pinetes (LP; 9° 46' 18.5''N - 70° 01' 44.34'' W) is completely covered by the riparian vegetation with canopies interlocking over the stream. This is a narrow, low depth stream (Table 1) whose substrate is mainly cobbles (5-10 cm) and gravel. Quebrada El Vino (EV; 9° 46' 42.66'' N - 70° 02' 27'' W) is a wide fast running (turbulent) stream with a steep gradient (a waterfall of 90 m, which is a tourist attraction) and rocks as the main substrate, around which gravel accumulates. The riparian vegetation is shrub-type, very sparse and it does not cover the river bed. The river course of LP is surrounded by agriculture fields of onion and flowers and cow raising farms while in EV human activities, other than a light tourism, are not permitted.

Ver nota en http://ecotropicos.saber.ula.ve

Physico-chemical measurements

Samples were taken on November 21 of 2002 and the variables measured at the sampling sites included river width, mean current velocity (Ott meter Model C1, five to six measurements equidistant along a transect), mean depth (at the same place as velocity), conductivity (Corning PS-17, Yellow Springs Model 33 SCT Meter) pH (Hanna), Oxygen meter (Yellow Spring Oxygen-meter, Model 55), spot temperature (mercury thermometer). Water samples were collected at both sites, kept in a cooler and taken to the laboratory were cations and anions were determined with atomic absorption spectrophotometry and anion chromatography, respectively, as soon as possible.

Fungi sampling

Water samples for fungal analysis were collected on polyethylene bottles (1 L) and kept in a cooler until being processed. In the laboratory the water was filtered (1 L, Millipore HA, 0.45 µm) and replicate filters were examined under the microscope to determine the richness of the mycobiota. Whenever possible foam was collected on glass jars (25 ml) and kept refrigerated until examination in the laboratory. Additional details on the procedure of samples are described in Smits & Cressa (2005).

Table 1. Hydrological and physicochemical variables of the rivers sampled.

River	Quebrada El Vino	Quebrada Los Pinetes
Altitude (m asl)	1857[a] (1686[b])	1899
Width (m)	3.50	1.21
Depth (m)	0.31	0.13
Velocity (m/s)	4.21	0.37
Discharge (m^3/s)	3.95	0.06
Dissolved Oxygen (%)	54.50	70.90
Dissolved Oxygen (mg/L)	5.47	7.03
T °C	15.40	15.80
Conductivity (µS/cm)	23.50	130.80
pH	5.40	7.80
Ca^{++}(mg/L)	2.91	16.25
Mg^{++} (mg/L)	0.48	0.69
Na^{+} (mg/L)	0.63	0.89
K^{+} (mg/L)	0.26	0.48
Cl^{-} (mg/L)	1.80	2.87
$S0_4^{--}$ (mg/L)	0.90	10.70

[a]above waterfall

[b]below waterfall

RESULTS AND DISCUSSION

Physicochemical characteristics

These rivers, which are tributaries of the river Curimagua, differ in their measured physical variables. LP has a smaller watershed area (9.53 km^2) than EV (16.02 km^2), as well as its channel is narrower and its discharge is two orders of magnitude lower than EV (Table 1). Regarding their chemical composition, LP has a higher conductivity than EV, which explains the higher concentrations of cations and anions especially in Ca^{++} and SO_4^{--} (Table 1). However, the ranking in cations is similar ($Ca^{++} > Na^{+} > Mg^{++} > K^{+}$) but not in anions since in EV the concentration of Cl^{-} was higher than SO_4^{--} (Table 1). This difference could be the reflection of land use at the sampling sites but it could also be due to the complexity of the blackwater rivers of Venezuela which could not be characterize as simple as the ones in the Amazon region (Vegas-Vilarrúbia *et al*. 1988). Furthermore, these blackwater rivers has not yet been so extensively characterized as those on the eastern region (in the Guayana shield) and thus further sampling along the watershed as well as at different seasons is needed for meaningful comparison among black water streams of Venezuela, which is far beyond the preliminary nature of this study.

Aquatic Hyphomycetes

The density and richness of fungi present in Table 2, are from examination of foam samples. The density and richness was low since only a total of fourteen species were found (Table 2). As expected, in harmonic waters (pH 6.2 - 6.5) (Chamier 1992), EV had a higher density and richness than LP (Table 2). Nevertheless, sampling sites have a different community of hyphomycetes as none of the species were common. Furthermore, there is a difference in the hyphomycetes found on the two sampling places of EV, since richness is much higher above (9 species) than below (3 species) the waterfall (Table 2).

Comparisons are difficult to make because, as mentioned above, density is low, however, it is interestingly to note that *Flagellospora penicillioides* was found only at the sample site below the waterfall. This species was reported by

Table 2. Density (numbers/0.5 mL) of aquatic hyphomycetes in two black water rivers.

Species	Quebrada (above waterfall)	El Vino (below waterfall)	Quebrada Los Pinetes
Alatospora acuminata Ingold	5	2	
Anguillospora crassa Ingold	2		
Anguillospora longissima (Sacc. & Syd) Ingold	3		
Campylospora chaetocladia Ranzoni			1
Condylospora spumigena Nawawi	1		
Diplocladiella scalaroides Arnaud			1
Flabellospora crassa Alasoadura			1
Flagellospora penicillioides Ingold		1	
Helicomyces spp.			2
Helicomyces torquatus Lane & Shearer	1		
Heliscus submersus Hudson	1		
Lemoniera aquatica De Wildeman	5	1	
Lunulospora curvula Ingold	1		
Triscelophorus acuminatus Nawawi	2		

Nilsson (1962) as present in streams of the Andes without any specification of the localities. The other two species found at this place are coincidentally, the more abundant at the top of the fall (*Alatospora acuminata* and *Lemoniera aquatica*, Table 2). Furthermore, *Condylospora spumigena* Nawawi and *Lemoniera aquatica* De Wildeman, are reported for the first time for Venezuela and those increase the number of species previously reported by Smits *et al.* (2007) from fifty three (53) to fifty five (55). On the other hand, the species found in LP were already reported for other places of Venezuela (Smits *et al.* 2007).

It is interesting to note, that the composition of species of hyphomycetes found in a foam sample taken from another blackwater river, the Aguaro river (Aguaro-Guariquito National Park), showed some similarity with QV and LP, since of the six (6) species found three are common to the Dinira streams (*Alatospora acuminate*, *Lunulospora curvula and Campylospora chaetocladia*) but the other three were not (*Alatospora acuminate, Anguillospora filiformis, Camposporium pellucidum*).

Finally, this is the first paper reporting the density and composition of hyphomycetes of black tropical rivers. However, in order to characterize these streams or that this information could be use as a monitoring tool of water quality, more sampling is needed.

ACKNOWLEDGMENTS

We sincerely thank Licenciado Sergio Pacheco for his logistic support in the field. This study has been supported partially by the Consejo de Desarrollo Científico y Humanístico (CDCH, Grant No. 03-146.2002). Sampling at the Aguaro-Guariquito National Park was made through the cooperation of the CDCH-Directory while visiting the San Nicolasito Field Station.

LITERATURE CITED

BALDY, V., M.O GESSNE and E. CHAUVET. 1995. Bacteria fungi and the breakdown of leaf litter in a large River. Oikos 74: 93-102.

CHAMIER, A. 1992. Water Chemistry. Pp. 152-172, *in* Barlöcher, F. (eds.): The Ecology of Aquatic Hyphomycetes. Springer-Verlag, Berlin.

GABALDÓN, M. 1992. Parques Nacionales de Venezuela. Pp. 116, *in* Amend, S. and Amend, T. (eds.): Serie Parques Nacionales y Conservación Ambiental. Instituto Nacional de Parques, Caracas.

GUEVARA, C.A. and C. DE ROUDNEFF DE GUEVARA. 1983. Geografía de la Región Centro Occidental. Ariel-Seix Barral Venezolana, Caracas.

GULIS, V. and K. SUBERKROPP. 2003. Leaf litter decomposition and microbial activity in nutrient-enriched and unaltered reaches of a headwater stream. Freshwater Biology 48: 123-134.

HUBER, O. 1977. Ambientes fisiográficos y vegetales de Venezuela. Pp. 279-298, *in* La Marca, E. (ed.): Vertebrados actuales y fósiles de Venezuela. Museo de Ciencia y Tecnología de Mérida. Serie catálogo Zoológico de Venezuela. Vol. 1. Mérida, Venezuela.

METHVIN, B.R. and K. SUBERKROPP. 2003. Annual production of leaf-decaying fungi in 2 streams. Journal of North American Benthological Society 22: 554-564.

NILSSON, S. 1962. Some aquatic hyphomycetes from South America. Svensk Botanisk Tidskrift 56: 351-361.

SANTOS-FLORES, C.J. and C. BETANCOURT-LÓPEZ. 1997. Aquatic and water-borne Hyphomycetes (*Deuteromycotina*) in streams of Puerto Rico (including records from other Neotropical locations). Caribbean Journal of Science. Special Publications 2: 116.

SMITS, G. and C. CRESSA. 2005. Hongos acuáticos en el Río Los Castillos. Saber 17: 491-493.

SMITS, G., R. FERNANDEZ and C. CRESSA. 2007. Preliminary study of the aquatic hyphomycetes of Venezuelan streams. Acta Botánica Venezuélica 30 (2): 345-355.

VEGAS-VILARRUBIA, T., J. PAOLINI and R. HERRERA. 1988. A physico-chemical survey of blackwater rivers from the Orinoco and the Amazon basins in Venezuela. Archiv für Hydrobiologie 111: 491-506.

WEIDMAN, K., R. RANGEL, C. TODTMANN and A. REIG. 2003. Parques Nacionales de Venezuela. Todtmann, O, Caracas.

Recibido 29 de marzo de 2006; revisado 07 de diciembre de 2007; aceptado 26 de enero de 2008.