Notes on aquatic hyphomycetes and streamborne spora from Austria

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Received 1. 8. 2000

Key words: freshwater hyphomycetes, mitosporic fungi, biodiversity, streams.

Abstract: A short study of waterborne spora from foam and of aquatic hyphomycetes from submerged substrates of some Lower Austrian streams is presented. Ninety identified taxa and 19 spore types are listed. Of these, ten species are new records for Austria. Eleven species were isolated and studied in pure culture. The taxonomy and distribution of some rare or little known species are discussed and several unidentified types of spores are illustrated.

Zusammenfassung: Die Ergebnisse von Untersuchungen an Mikromyzeten einiger fließender Gewässer in Niederösterreich werden vorgestellt. In den abgenommenen Schaumproben und an untergetauchten Pflanzenresten wurden Sporen von insgesamt 90 Taxa gefunden, von denen 19 nicht bekannten Arten zugeordnet werden konnten. Zehn Arten sind Neufunde für Österreich. Elf Arten wurden isoliert und in Reinkultur studiert. Die Arbeit ergänzen Bemerkungen zur Taxonomie und Verbreitung sowie Abbildungen einiger seltener oder wenig bekannter Arten.

Fungal spores of diverse taxonomic identities are accumulated in foam which is formed on running water bodies. We generally are able to identify directly stauroform (branched) and a few scolecoform conidia of aquatic hyphomycetes. Unidentified spores may belong to other mitosporic fungi: aquatic or terrestrial, hypho- or coelomycetous. Ascospores or basidiospores are rarely identified as such.

There are few studies concerning biodiversity of streamborne fungi in Austrian water bodies. Four publications (MESSNER & OBERZILL 1974, WAWRIK 1985, MESSNER & STÜWE 1986, REGELSBERGER & al. 1987) deal with streams of the Waldviertel – an Austrian region in the northeastern part of the country (Lower Austria). That area is geomorphologically as well as geologically very variable, comprising lowlands as well as mountains which may be on calcareous or on siliceous bedrock. In addition, the publication of REGELSBERGER & al. (1987) also includes data of the Ybbs, a stream of southern Lower Austria and of the Wulka, a stream located in Burgenland. To our knowledge, there are two other published studies outside the Waldviertel. The first one was carried out by H. PÖTLER in 1975 as an unpublished thesis at the Botani-

cal Institute of the University of Graz (Styria). Thirteen species of her list were then published by MAURER & al. (1983), unidentified or uncertain species were omitted. The second study was published by VOGLMAYR (1996) who reports conidia (mainly scoleco- and stauroform) from foam from two small streams in Upper Austria. Finally, HASENJÄGER (1990) completed a diploma thesis on aquatic spores filtered from two streams in the Ötztal Alps (Tirol). The results, as far we are aware, have not been published.

On various occasions, one of which was the 2nd International Meeting on Plant Litter Processing in Freshwaters in Lunz am See (Lower Austria) in September 1999, samples of foam and plant debris were collected in a few Lower Austrian rivers and streams in order to identify fungi. Some of the samples were used to isolate selected species in pure culture. The aim of this contribution is to broaden the knowledge about species diversity of streamborne fungi in Austrian water bodies.

Material and methods

Sampling sites and material collected: (1) Mährische Thaya in Raabs, close above the confluence with the Thaya, 410 m s. m. (VLČEK 1984), foam, May 1995, coll. L. MARVANOVÁ. This is a left tributary of the Thaya ca. 68 km long. (2) Thaya in Dobersberg, near a riffle, above the inlet of the municipal waste water, foam, May 1995, coll. L. MARVANOVÁ. The Thaya is a river more than 300 km long, flowing through several towns and villages. Water quality in the reaches where our sample was taken is of class II (VLČEK 1984). (3) Ysper (left tributary of the River Danube) in the Ysperklamm, near the town Ybbs, ca. 550 m s. m., foam collected at several sites along the river, 10 Oct. 1998, coll. L. MARVANOVÁ. The Ysper is a softwater stream on granite and gneiss bedrock with water temperature varying from 0.5 to 15 °C, circumneutral pH and low conductivity (about 65 µS). It has brown clear water with humic substances (REGELSBERGER & al. 1987). (4) River Ybbs (right tributary of the River Danube) in Lunz am See, several meters above the confluence with the Mühlbach, ca. 600 m s. m., foam and submerged litter, 23 Sept. 1999, coll. L. MARVANOVÁ & V. I. GULIS, respectively. The Ybbs is a hardwater stream on limestone bedrock, with water temperature varying between 2-14 °C, slightly alkaline pH and relatively high conductivity (around 300 µS, REGELSBERGER & al. 1987). (5) Mühlbach (right tributary of the Ybbs) in Lunz am See, ca. 500 m upstream from the confluence with the Ybbs, foam and submerged litter, 23 Sept. 1999, coll. L. MARVANOVÁ & V. I. GULIS, respectively. (6) Oberer Seebach near the Biological Station (within the "Ritrodat" study area), Lunz am See, submerged litter, 24 Sept. 1999, coll. V. I. GULIS. The Obere Seebach flows from the Lake Obersee into the Lake Untersee. It is a shallow coldwater stream (mean maximum water temperature 10.2 °C) with gravel bed, pH is around 8, conductivity slightly above 200 µS (BRETSCHKO 1991).

Fixed foam samples, corresponding microscopic slides and pure cultures from the Ysper are deposited in CCM, those from the substrates in MSKU.

Field and laboratory technique: Foam was collected in jars and immediately mixed with a formaldehyde-alcohol-acetic acid (FAA) solution, or the jars were stored in a thermoflask with ice cubes at the bottom. To identify species, foam with FAA was dropped on microscopic slides, air-dried, stained with lactofuchsin and covered with a coverslip. The slide was then scanned with a compound microscope under phase contrast at magnification 10 x 40. When necessary, the objective x 100 with immersion oil was used. Plant litter was collected in plastic bags and processed after returning to the laboratory. The leaves or twigs were washed under tap water, rinsed with distilled water, and incubated singly in Petri dishes with distilled water or submerged in test tubes aerated with air flowing through hypodermic needles. The plant litter was directly examined under a dissecting microscope, and conidial suspensions were used to prepare microscopic slides as described above. In addition, the flotation technique (BANDONI 1981, SRIDHAR & BÄRLOCHER 1993) was employed. Isolations from foam were performed by streaking a loopfull of liquefied foam onto object slides with a thin layer of 2% malt

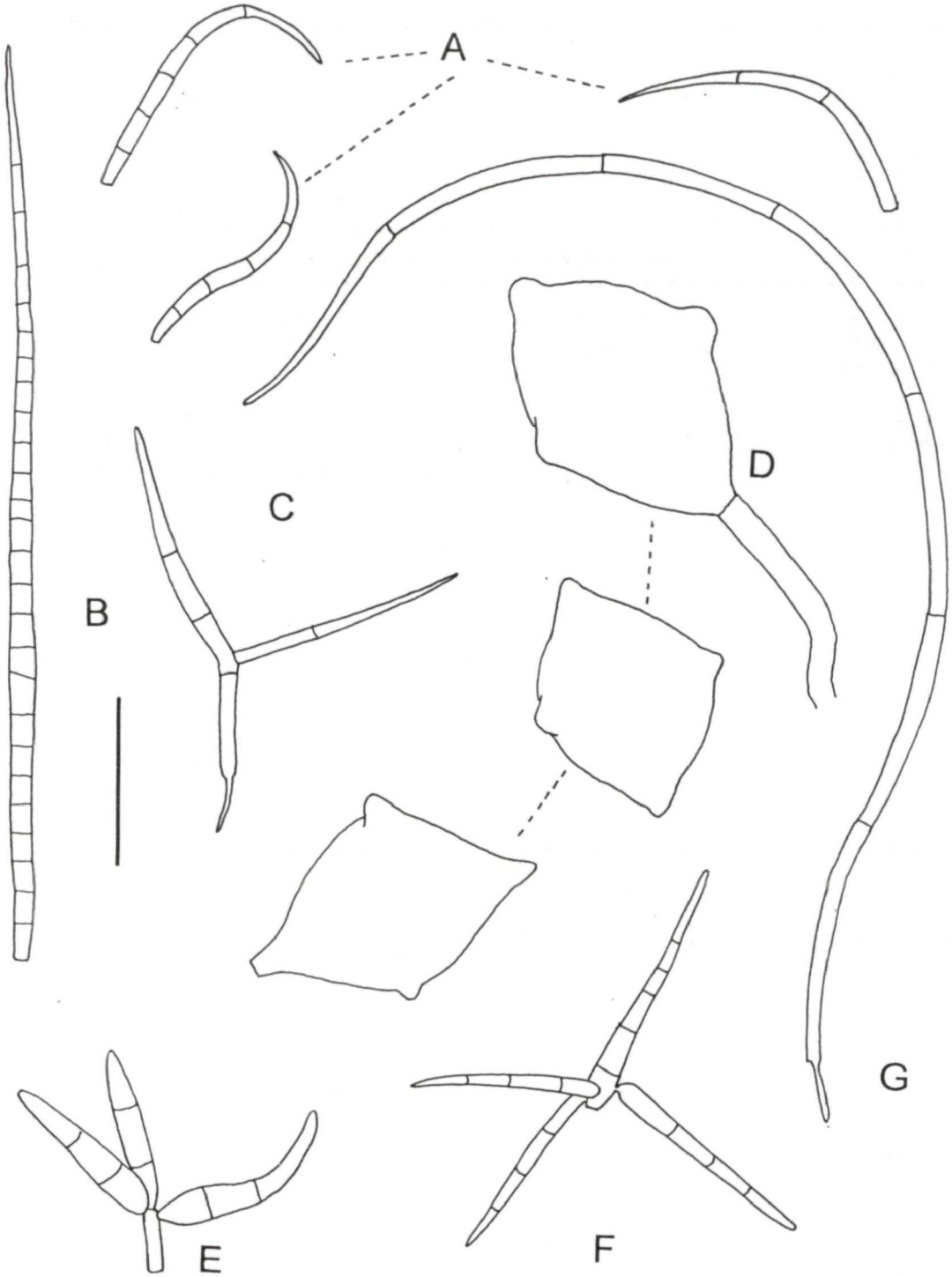

Fig. 1. Conidia from foam. *A* Unknown No. 1. *B* Unknown No. 2. *C* Part-conidium of *Varicosporium tricladiiforme*. *D* Unknown No. 3. *E* Unknown No. 4. *F* cf. *Triscelophorus acuminatus*. *G Anguillospora filiformis* (*A*, *B*, *E*, *F* from Mährische Thaya, the rest from Thaya). Bar: 25 µm.

extract agar (MA) with chloramphenicol (100 mg/l) and incubated at 15 °C for 24 hours. Germinating conidia were transferred onto fresh 2% MA. When isolated from substrates, suspended conidia were settled onto 0.1% MA supplemented with 200 mg/l of penicillin G and 200 mg/l of streptomycin sulphate in Petri dishes. Germinating spores were transferred to another Petri dish with the same medium and eventually subcultured on 2% MA without antibiotics (DESCALS 1997 b).

Results and discussion

We distinguished 90 taxa (Table 1), which we were able to identify at various levels of reliability. Many staurospores and a few scolecospores can be identified up to species level. Nineteen forms remained unidentified. Ten species (marked with an asterisk) are reported from Austrian waters for the first time. Twenty-five were obtained on leaves or twigs submerged in the laboratory, and 11 were isolated in pure culture.

The highest species diversity was encountered in the Ysper, confirming the results of previous investigations (MESSNER & STÜWE 1986, REGELSBERGER & al. 1987). After more than 10 years we found about 70% of the aquatic spores reported by the previous authors, which indicates a high stability of the aquatic ecosystem in the Ysper. In spite of the relatively intensive tourism – there is an attractive tourist trail along the Ysper leading to ancient holy places of Druids in the Ysperklamm and several groups of 30-40 people pass through each day during the season – the impact on species diversity does not seem to be significant. The number and types of species are comparable to those of two softwater streams on granite bedrock in Upper Austria (VOGLMAYR 1996).

The Obere Seebach in Lunz has a significantly lower number of species. This is probably due to the fact that we had no foam samples. Foam is known to accumulate conidia from various substrates distributed along an extended reach of the watercourse, as well as those washed in from litter along the stream banks.

The Thaya and its tributary Mährische Thaya have not previously been sampled for aquatic hyphomycetes. The community composition differs from that seen in oligotrophic softwater streams. Only roughly one third of the taxa was common to both Thayas and the Ysper.

For our contribution, we were able to obtain about one third of the fungi sporulating on natural substrata or in pure culture. This allows more reliable species identification than that based solely on conidia observed in foam. We hope that our paper will stimulate further studies of aquatic hyphomycetes in Austrian water bodies.

Remarks on some species

Arbusculina spec. (Figs. 2 F, 5 A-D) was seen in Austria also by MESSNER & STÜWE (1986) and REGELSBERGER & al. (1987) in the Ysper and by VOGLMAYR (1996) in a small stream in Upper Austria (fig. 3 a). The conidia from foam differ from those of *A. irregularis* (R. H. PETERSEN) MARVANOVÁ & DESCALS by larger span and elongate end cells of conidial arms (Fig. 2 F and REGELSBERGER & al. 1987, fig. 4 A_{1-3}). These

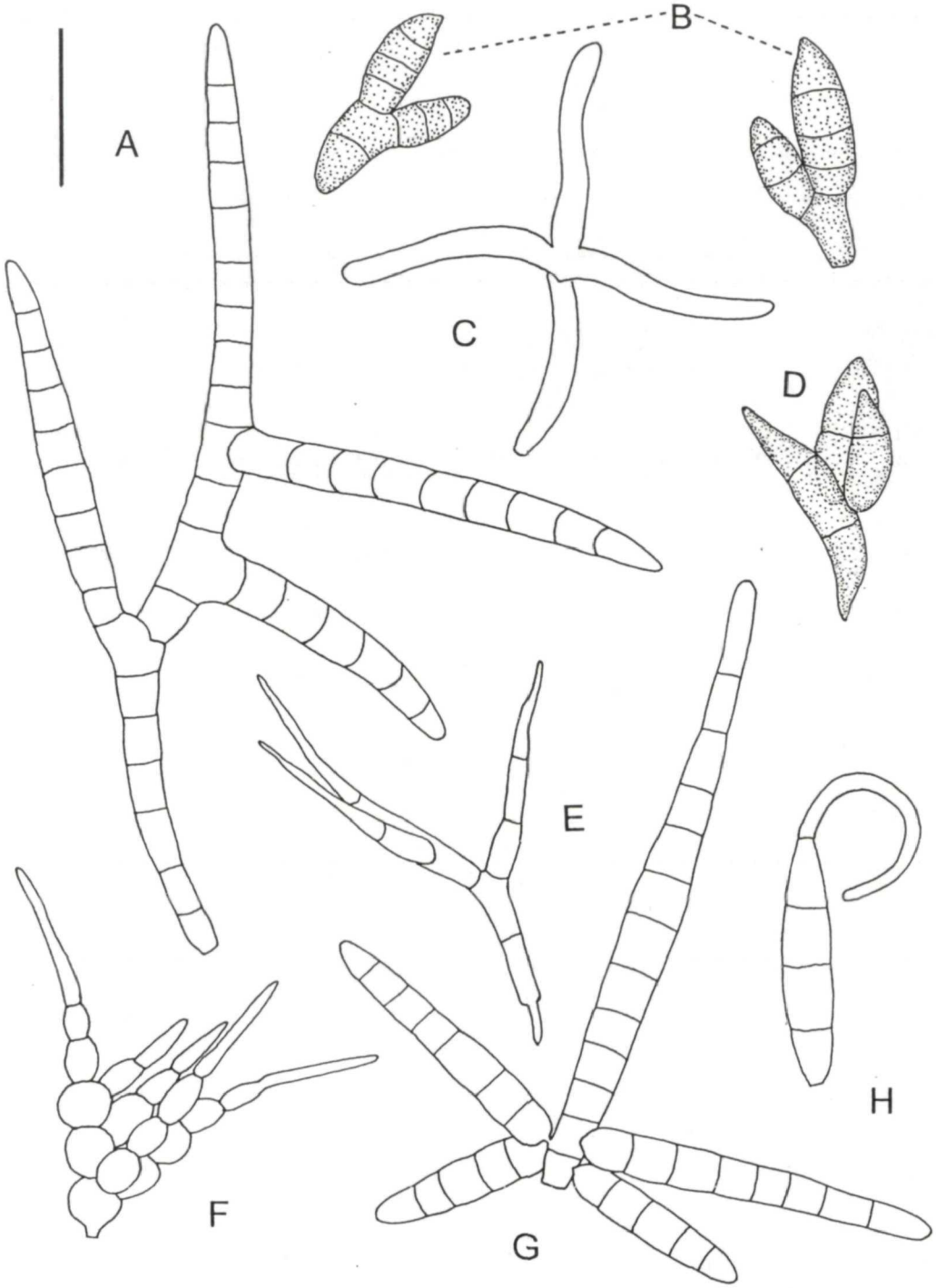

Fig. 2. Conidia from foam. *A Tricladium robustum*. *B* Unknown No. 5. *C Lemonniera cornuta*. *D* Unknown No. 6. *E* Unknown No. 7. *F Arbusculina* spec. *G Dendrospora* spec. *H* Unknown No. 8 (All from Ysper). Bar: 25 µm.

characters do not appear in pure culture of our isolate from the Ysper (Fig. 5 A-D), whose conidia are very similar to those depicted by PETERSEN (1963, fig. 4) in the protologue. However, in contrast to the description of the type species, our culture is blackish instead of brown and therefore at present we prefer not to identify the European isolate with the American one. Our fungus differs from *A. moniliformis* (DESCALS) DESCALS & MARVANOVÁ by considerably smaller conidia and the absence of a recognizable axis, which is typically seen in the latter.

The genus *Dendrospora* was represented by *D. erecta* INGOLD, *D. polymorpha* A. ROLDÁN, DESCALS & HONRUBIA, *D. tenella* DESCALS & J. WEBSTER, and *Dendrospora* spec. (Figs. 2 G and 5 E-G). The last, obtained in pure culture, has conidia in some way intermediate between *D. fusca* DESCALS & WEBSTER and *D. fastuosa* DESCALS & WEBSTER as described by DESCALS & WEBSTER (1980). With *D. fastuosa*, it has in common the somewhat inflated 7-11 µm wide conidial cells. With *D. fusca* it shares the frequent presence of two or three verticils of conidial branches instead of a single one, typical for *D. fastuosa*. From both species our isolates differ by developing secondary branches in about 20% of conidia in standing water culture. There is no yellow oily protoplasm in the conidial cells as reported for *D. fusca* and the colony on 2% MA is whitish, with low, spare aerial mycelium. No sectors with reddish brown hyphae and no microconidial state appears in culture, as is typical for *D. fastuosa*. Conidia of both species are rarely being reported from field samples and probably have not been cultured since their description. The protologue is based on a single isolate of each species, so the morphological variation in conidial shapes as well as possible aberrations in gross colony morphology may not be known. More work with pure cultures of all these species is necessary.

cf. *Geniculospora grandis* (GREATHEAD) NOLAN (Fig. 4 J) – a single conidium was found in foam from the Ysper. It corresponds well in size and shape to conidia seen in the authentic material from GESS (née GREATHEAD) by the first author and also to the conidia obtained in pure culture from an isolate from Malawi (DESCALS & al. 1984). Fungi under this name were reported several times from water bodies in Europe (MIL'KO 1965, CZECZUGA & al. 1990) or Canada (SRIDHAR & BÄRLOCHER 1993). All these records, including our, have to be confirmed in pure culture. The isolate by MIL'KO (1965) was described in terms which contradict the protologue (cf. also MARVANOVÁ & HYWEL-JONES 2000).

Goniopila monticola (DYKO) MARVANOVÁ & DESCALS. We want to point out its occurrence in the Ysper, wherefrom we obtained it in pure culture. Its conidia may very easily be confused with those of *Margaritispora aquatica* INGOLD, which are practically of the same shape and overlap considerably. The latter species was reported twice from the Ysper, identified on the base of detached conidia (MESSNER & STÜWE 1986, REGELSBERGER & al. 1987), but never confirmed in pure culture. *G. monticola* is rarely recognized in foam samples and hence the reports of occurrence in streams may be biased towards lower numbers (or may not reflect the real abundance). According to our experience it seems to occur in softwater as well as hardwater streams. In the former Czechoslovakia it was isolated several times from streams on calcareous bedrock (MARVANOVÁ & DESCALS 1985).

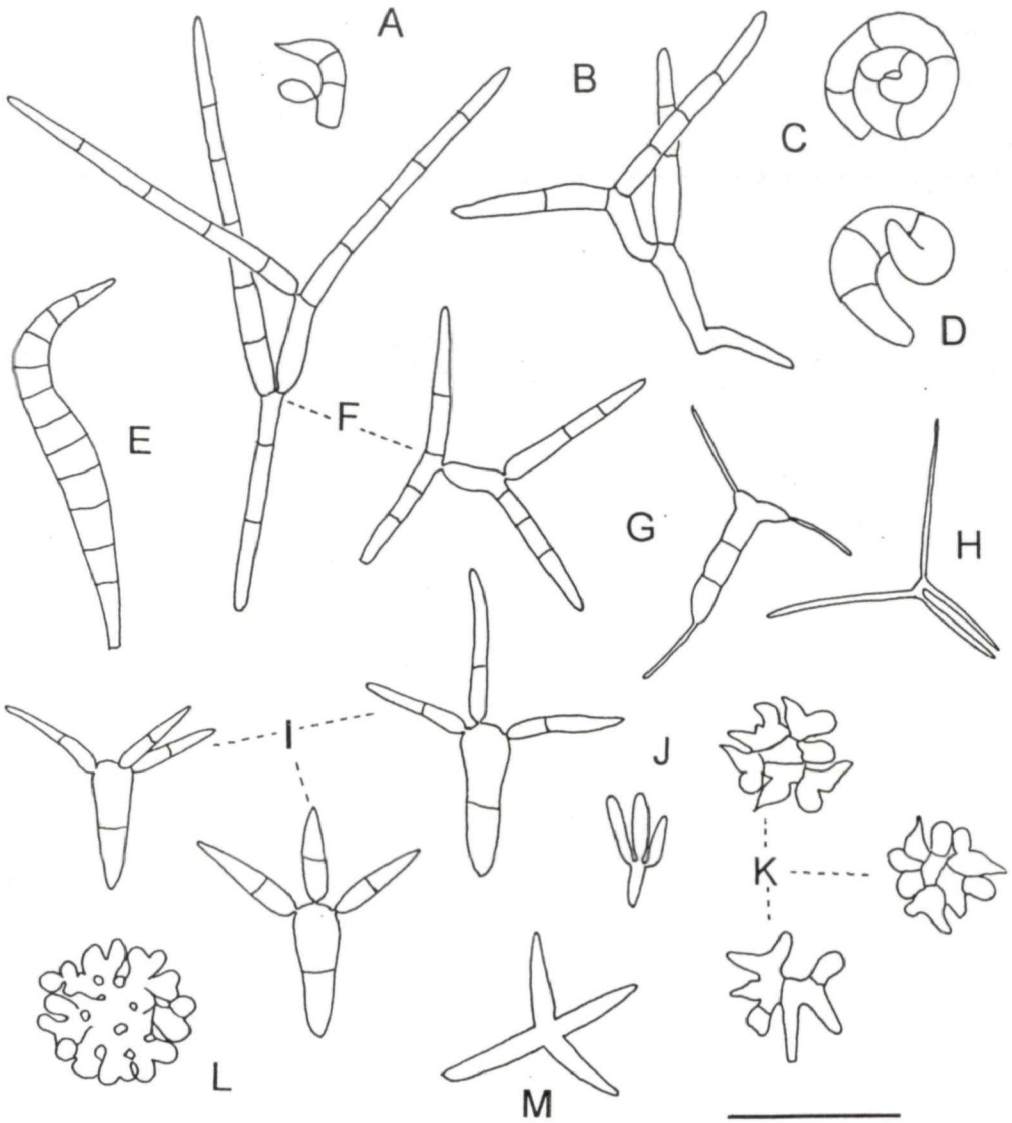

Fig. 3. Conidia from foam. *A* cf. *Gyoerffyella myrmecophagiformis*. *B Tricladium caudatum*. *C* Unknown No. 9. *D* Unknown No. 10. *E* Unknown No. 11. *F Pleuropedium* spec. *G* Unknown No. 12. *H* Unknown No. 13. *I Heliscina antennata*. *J Tricellula* spec. *K Dendrosporium* spec. *L* Unknown No. 14. *M* Unknown No. 15 (All from Ysper). Bar: 25 µm.

cf. *Gyoerffyella myrmecophagiformis* MELNIK & DUDKA (Fig. 3 A). Conidia similar to those of this species are sometimes collected in foam from oligotrophic softwater streams (MESSNER & STÜWE 1986, REGELSBERGER & al. 1987, VOGLMAYR 1996). This species was originally described from marginal parts of conidiomata of a fungus parasitizing on tree leaves in the Far East (DUDKA & MELNIK 1990). Some other members of this genus were also repeatedly reported from plants: *Gyoerffyella entomobryoides* BOERMA & ARX from necrotic lesions on rose twigs, *Gyoerffyella rotula* (HOEHNEL) MARVANOVÁ on senescent leaves of *Myosotis alpestris* SCHMIDT (MARVANOVÁ & al. 1967). Isolation and studies in pure culture may cast more light on the identity of the waterborne conidia, which usually bear more primary branches than described for *G. myrmecophagiformis*.

Heliscina antennata MARVANOVÁ (Fig. 3 I) was described from a spring site in the Hrubý Jeseník mountains (Czech Republic, MARVANOVÁ 1980) and since then seen in a stream in the French Pyrenees (SW France: DESCALS & CHAUVET 1992, GESSNER & al. 1993) and in the Catalan Pyrenees (Spain), wherefrom it was isolated in pure culture (DESCALS 1997 a). The fungus seems to prefer low-nutrient softwater streams.

Naiadella fluitans MARVANOVÁ & BANDONI. Apart from the two watercourses listed in Table 1, conidia of this species were obtained with the flotation technique from leaf litter collected in a small (temporary?) stream near the Lake Obersee, ca. 7 km SE from Lunz am See, 24. Sept. 1999 (V. I. GULIS). Sporulation was also seen on an aerated twig with bark collected from the Grünaubach near Mariazell (Austria, Styria, Eastern Alps, near the path between Vorderer and Mittlerer Zellerhut on 22 June 1991 (MARVANOVÁ, unpubl.).

Pleuropedium spec. conidia (Fig. 3 F) belong to an undescribed species, depicted also by DESCALS (1998, fig. 5 A, C, D) from Spain (Basque Country and Cantabria) and by DESCALS & CHAUVET 1992 (fig. 4 A-F, as unidentified) from the French Pyrenees. Their size varies greatly. The smaller ones resemble conidia of *Pleuropedium tricladioides* MARVANOVÁ & S. H. IQBAL, but this species lacks the broad-angled flexion on the primary conidial branch.

Tetracladium palmatum A. ROLDÁN (Fig. 4 G) was described from Spain by ROLDÁN & al. (1989) and previously reported as unknown by ROLDÁN & al. (1987 b, figs. 2 L-N, 3 D) from Serranía de Cuenca, Spain. Since then its conidia were reported by VOGLMAYR (1996) from foam from two streams in Upper Austria. We have seen two conidia differing from the typical ones by the absence of the filiform branch. In this they match some conidia depicted by ROLDÁN & al. (1989, fig. 8 I, J, R). In fact, the conidial configuration resembles that in *Cladoconidium articulatum* BANDONI & TUBAKI (1985), but the latter has pale fuscous conidia with only digitiform elements.

Tricladium robustum MARVANOVÁ (Fig. 2 A). Conidia of this species were reported twice from Spain: from a stream in Catalonia (DESCALS 1987, fig. 9 A, B); and from a mountain stream on siliceous bedrock in the Sierra Nevada (ROLDÁN & al. 1988, fig. 4 A, B). This species is rare and has not been reisolated into pure culture after its description.

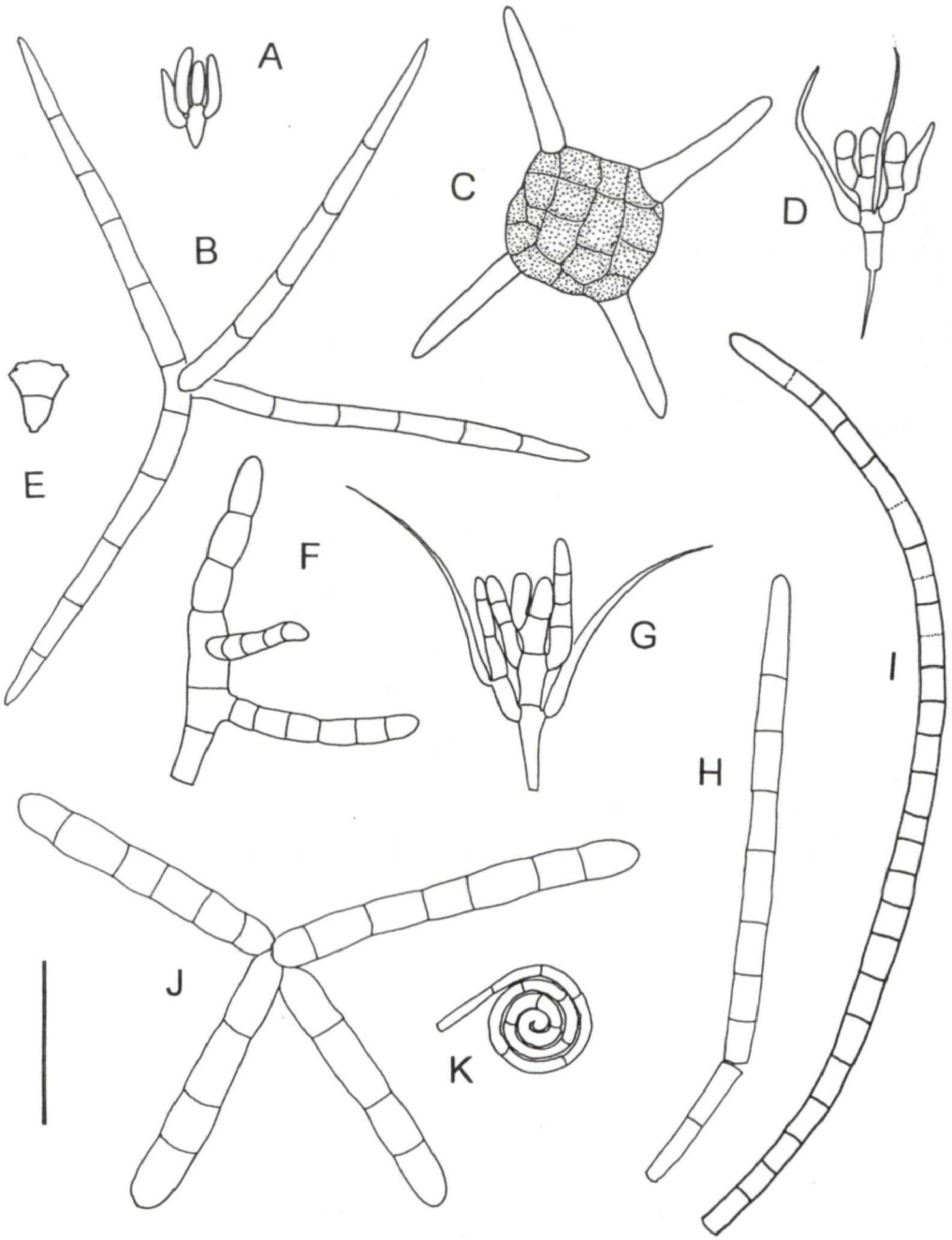

Fig. 4. Conidia from foam. *A* Unknown No. 16. *B* Unknown No. 17. *C Petrakia* spec. *D* cf. *Tetracladium breve*. *E Heliscella* spec. *F Pachycladina* spec. *G Tetracladium palmatum*. *H* Unknown No. 18. *I* Unknown No. 19. *J* cf. *Geniculospora grandis*. *K Helicosporium* spec. (*A*, *E* from Ybbs; *B*, *C*, *D*, *F*, *G* from Mühlbach; *H*, *K* from Thaya; *I* from Mährische Thaya; *J* from Ysper). Bar: 25 µm.

Unknown No. 1 (Fig. 1 A) – from the Ysper depicted by REGELSBERGER & al. (1987, fig. 8 $C_{1,2}$).

Unknown No. 2 (Fig. 1 B) – often seen in foam from clean streams (MARVANOVÁ, unpubl.), usually does not germinate. First report from Austria.

Unknown No. 3 (Fig. 1 D) – as far we know, such spores have not been reported from elsewhere.

Unknown No. 4 (Fig. 1 E) – it has a configuration similar to conidia of a *Flabellospora*, but does not match any described species. First report from Austria.

Unknown No. 5 and 6 (Fig. 2 B, D) – dematiaceous conidia, as far as we know, not previously reported from water.

Unknown No. 7 (Fig. 2 E) – first report from Austria.

Unknown No. 8 (Fig. 2 H) – a similar spore was reported by DESCALS & CHAUVET (1992, fig. 7 H) from the French Pyrenees as *Camposporium* spec. It was rather frequent in the Ysper, but all attempts to germinate it failed.

Unknown No. 9 (Fig. 3 C) – first report from Austria.

Unknown No. 10 (Fig. 3 D) – seen in the Ysper also by REGELSBERGER & al. (1987, fig. 7 $H_{1,2}$) and in the Kesselbach by VOGLMAYR (1996, fig. 11 g). Also reported by DESCALS & CHAUVET (1992,fig. 6 K, L) from the French Pyrenees.

Unknown No. 11 (Fig. 3 E) – we have not recognized these conidia among the unbranched ones depicted from Austrian water bodies by previous investigators.

Unknown No. 12 (Fig. 3 G) – such conidia were reported as *Cornutispora* spec. (cf. DESCALS & al. 1995, Central Spain, fig. 4 G'), a coelomycete growing on lichens and *Rhytismatales*. However, both *Cornutispora* species were described with aseptate conidia and integrated 'cellular appendages' (HAWKSWORTH 1976). The conidia from foam usually possess 0-2 septa and the 'appendages' (filiform branches) are discrete, sometimes separated by a septum from the conidial body.

Unknown No. 13 (Fig. 3 H) – probably conspecific with some of the conidia reported from the Ysper by REGELSBERGER & al. (1987, fig. 3 C_{1-6}).

Unknown No. 14 (Fig. 3 L) – resembles the 'basal plate' of conidia of *Nidulispora* (NAWAWI & KUTHUBUTHEEN 1990).

Unknown No. 15 (Fig. 3 M) – first report from Austria.

Unknown No. 16 (Fig. 4 A) – illustrated from the Ysper by MESSNER & STÜWE (1986, fig. 3 Q) and REGELSBERGER & al. (1987, fig. 4 C).

Unknown No. 17 (Fig. 4 B) – resembles a huge conidium of *Alatospora acuminata* s. l., but the dimensions (axis 108 x 3.6 µm) exceed the maximum given for this fungus in MARVANOVÁ & DESCALS (1985, 87 x 2.5 µm).

Unknown No. 18 (Figs. 4 H, 5 H-J) – these typically straight or slightly curved conidia appeared abundantly in the Ysper, but they mostly did not germinate or ceased growth after the germ tube reached the length of several micrometers. After many attempts a single pure culture was obtained, with an extremely restricted growth on 2% MA. This fungus resembles that obtained by DESCALS (1997 a, figs. 2 and 3, as *Anguillospora* spec.) in pure culture from the Catalan Pyrenees. In our opinion it cannot be satisfactorily accommodated in any known genus and will be subjected to further study.

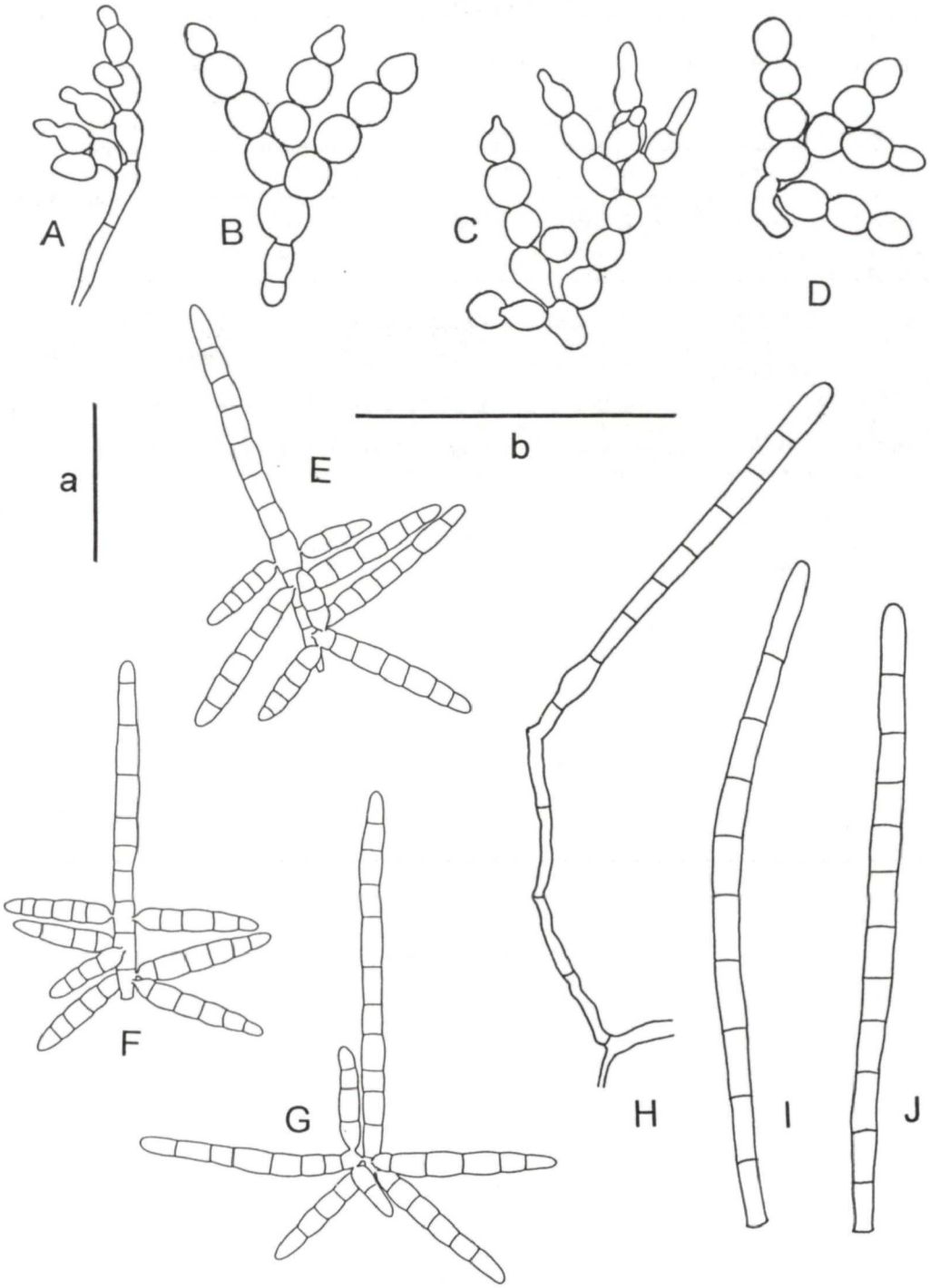

Fig. 5. Sporulation in pure culture. *A-D Arbusculina* spec., CCM F-23699. *A* Developing conidium. *B-D* Detached conidia. *E-G Dendrospora* spec., CCM F-22299, detached conidia. *H-J* Unknown No. 18, CCM F-23599. *H* Conidial development. *I, J* Detached conidia. Bars: a 50 µm (valid for *E-G*), b 50 µm (valid for the rest).

Unknown No. 19 (Fig. 4 I) – this scolecoid spore differs from similar ones by slightly thickened walls. It was recorded from Spain (ROLDÁN & al. 1987 a, fig. 4 H, as unknown, and probably also by DESCALS 1987, fig. 14 H, as unknown).

We are grateful to Dr H. VOGLMAYR (Vienna) for valuable information concerning studies of biodiversity of fungi in Austrian waters and for sending some literature. The present study was supported by the project GACR No. 206/98/0561 granted to the first author. The trip to Austria of the second author was made possible by financial support from the ICSC-World Laboratory (Switzerland). F. BÄRLOCHER (Sackville) is thanked for language corrections.

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Table 1. Distribution of streamborne fungi in watercourses (with references on occurrence in foam or on colonized substrata. * New record for Austria, # isolated in pure culture; Ag *Alnus glutinosa* (L.) GAERTNER, Ac *Acer pseudoplatanus* L., C *Corylus avellana* L., Fr *Fraxinus excelsior* L., Fs *Fagus sylvatica* L., Pc *Picea abies* (L.) KARSTEN cone, Sa *Sorbus aucuparia* L., T *Tilia cordata* MILLER, U *Ulmus* spec., W woody substrates, FT flotation technique, F foam.

Taxon	Stream No.					
	1	2	3	4	5	6
Actinosporella megalospora (INGOLD) DESCALS, MARVANOVÁ & J. WEBSTER	F	F				
Alatospora acuminata INGOLD s. l.	F	F	F#	Ag, Ac, Fs, Fr, Pc, U, FT, F	Ag, Ac, C, Fs, T, FT, F	Ac, C, Fs, Fr, T, FT
Alatospora acuminata INGOLD s. str.	F	F	F#	F	F	
Alatospora flagellata (GÖNCZÖL) MARVANOVÁ				F	FT, F	FT
Alatospora pulchella MARVANOVÁ	F	F	F		F	
Anguillospora crassa INGOLD		F	F#	FT, F	F	
**Anguillospora filiformis* GREATHEAD		F				
cf. *Anguillospora furtiva* J. WEBSTER & DESCALS		F	F			
Anguillospora longissima (SACC. 6 SYD.) INGOLD agg.	F	F	F	Ag, Ac, Fs, Fr, U, W, F	Ac, C, F	FT
Anguillospora rosea J. WEBSTER & DESCALS			F			
Anguillospora spec.		F	F			
Arbusculina moniliformis (DESCALS) DESCALS & MARVANOVÁ				Fs, Pc#	W#	
Arbusculina spec.			F#			
Articulospora tetracladia INGOLD			F	Ag, U, F		C, T
Camposporium pellucidum (GROVE) S. HUGHES	F		F			
Camposporium spec.		F				
Campylospora spec.				F	F	
Clavariopsis aquatica DE WILDEMAN	F	F	F	Ag, Ac, W, F	Ag, Ac, C, T, FT, F	Ac
Clavatospora longibrachiata (INGOLD) MARVANOVÁ & Sv. NILSSON	F	F	F			
Culicidospora aquatica R. H. PETERSEN	F	F	F	F	F	
Culicidospora gravida R. H. PETERSEN	F	F	F		F	
Dendrospora erecta INGOLD			F			
**Dendrospora polymorpha* A. ROLDÁN, DESCALS & HONRUBIA					F	
Dendrospora tenella DESCALS & J. WEBSTER			F			
Dendrospora spec.			F#			
Dendrosporium spec.			F			
Diplocladiella scalaroides MATSUSH.	F			F		
Dwayaangam cornuta DESCALS	F	F	F	FT		
cf. *Filosporella annelidica* (SHEARER & J. L. CRANE) J. L. CRANE & SHEARER	F					
Flagellospora curvula INGOLD	F	F	F	Ag, Fr, FT, F	Ag, C, T, FT, F	Ac, C, Fs, Fr, T, FT
Flagellospora fusarioides S. H. IQBAL	F			F		
cf. *Flagellospora* spec.					F	
cf. *Geniculospora grandis* (GREATHEAD) NOLAN			F			

Geniculospora inflata (INGOLD) MARVANOVÁ & Sv. NILSSON			F	F		
**Goniopila monticola* (DYKO) MARVANOVÁ & DESCALS			F#	F	F	
Gyoerffyella gemellipara MARVANOVÁ		F				
cf. *Gyoerffyella myrmecophagiformis* MELNIK & DUDKA			F			
Helicosporium spec.			F			
Heliscella stellata (INGOLD & V. J. COX) MARVANOVÁ	F	F	F		FT	
Heliscella spec.				F	F	
**Heliscina antennata* MARVANOVÁ			F			
Heliscina campanulata MARVANOVÁ			F			
Heliscus lugdunensis SACC. & THÉRRY	F	F	F	Fr, FT, W, F	FT, F	Ac, FT
Isthmolongispora spec.					FT	
Isthmotricladia britannica DESCALS			F			FT
Lemonniera aquatica DE WILDEMAN	F	F	F	Ag, Ac, Fs, Fr, T, U, W, F	Ag, Ac, C, T, FT, F	Ac, C, Fr, T
**Lemonniera cornuta* RANZONI			F			
Lemonniera filiformis DYKO			F#			
Lemonniera terrestris TUBAKI	F	F	F	F		FT
Lunulospora curvula INGOLD	F					
Margaritispora aquatica INGOLD	F					
Mycocentrospora acerina (R. HARTIG) DEIGHTON	F	F		F	F	
Naiadella fluitans MARVANOVÁ & BANDONI			F#		FT	
Pachycladina spec.				F		
Petrakia spec.					F	
Pleuropedium spec.			F			
cf. *Rhynchosporium*			F			
Sigmoidea praelonga MARVANOVÁ			F#			
cf. *Sigmoidea praelonga* MARVANOVÁ	F	F		F		
Stenocladiella neglecta (MARVANOVÁ & DESCALS) MARVANOVÁ & DESCALS			F	F	F	
Taeniospora gracilis MARVANOVÁ var. *gracilis*					F	
Taeniospora gracilis var. *enecta* MARVANOVÁ & STALPERS	F	F	F			
Tetrachaetum elegans INGOLD	F		F			
cf. *Tetracladium breve* A. ROLDÁN	F			F	F	
Tetracladium furcatum DESCALS		F			F	
Tetracladium marchalianum DE WILDEMAN	F	F	F	Ag, Ac, Fs, Fr, T, U, FT, F	Ag, Ac, C, Fs, T, FT, F	Ac, C, Fs, Fr, T, FT
Tetracladium maxilliforme (ROSTRUP) INGOLD		F		Ag	FT	
Tetracladium palmatum A. ROLDÁN			F		F	
Tetracladium setigerum (GROVE) INGOLD	F	F	F	F	C, T, FT, F	FT
Tricellula aquatica J. WEBSTER				F	FT, F	FT
Tricellula aurantiaca (HASKINS) ARX				F	F	
Tricellula spec.			F			
Tricladium angulatum INGOLD		F		Fr, F	F	
Tricladium biappendiculatum (ARNOLD) MARVANOVÁ & DESCALS					FT	

Tricladium caudatum KUZUHA			F			
Tricladium curvisporum DESCALS	F	F				
Tricladium patulum MARVANOVÁ & MARVAN			F	F		
**Tricladium robustum* MARVANOVÁ			F			
Tricladium splendens INGOLD	F	F	F			
Tricladium spec.			F			
Tripospermum camelopardus INGOLD, DANN & MCDOUGALL			F			
Tripospermum myrti (LIND.) S. HUGHES			F	FT, F	F	FT
cf. *Triscelophorus acuminatus* NAWAWI	F	F				
Triscelophorus spec.	F					
Tumularia aquatica (INGOLD) DESCALS & MARVANOVÁ	F	F	F			
Tumularia tuberculata (GÖNCZÖL) DESCALS & MARVANOVÁ			F			
**Vargamyces aquaticus* (DUDKA) TÓTH						T
Varicosporium elodeae W. KEGEL		F	F			
**Varicosporium tricladiiforme* A. ROLDÁN & MARVANOVÁ	F	F				
Ypsilina graminea (INGOLD, MCDOUGALL & DANN) DESCALS, J. WEBSTER & MARVANOVÁ	F	F			FT, F	FT
Unknown No. 1 (Fig. 1 A)	F					
Unknown No. 2 (Fig. 1 B)	F		F	F		
Unknown No. 3 (Fig. 1 D)		F				
Unknown No. 4 (Fig. 1 E)	F					
Unknown No. 5 (Fig. 2 B)			F			
Unknown No. 6 (Fig. 2 D)			F			
Unknown No. 7 (Fig. 2 E)			F			
Unknown No. 8 (Fig. 2 H)			F			
Unknown No. 9 (Fig. 3 C)			F			
Unknown No. 10 (Fig. 3 D)			F			
Unknown No. 11 (Fig. 3 E)			F			
Unknown No. 12 (Fig. 3 G)			F			
Unknown No. 13 (Fig. 3 H)			F			
Unknown No. 14 (Fig. 3 L)			F			
Unknown No. 15 (Fig. 3 M)			F			
Unknown No. 16 (Fig. 4 A)				F		
Unknown No. 17 (Fig. 4 B)					F	
Unknown No. 18 (Fig. 4 H)	F	F	F#			
Unknown No. 19 (Fig. 4 I)	F		F			
Total	40	38	70	35	38	16