
***Hyalocamposporium*, a new genus of hyphomycetes from submerged wood**

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During investigations of freshwater microfungi two undescribed hyphomycete species, which resembled species of *Camposporium* were found. A new genus, *Hyalocamposporium* is introduced to accommodate hyphomycetes whose characteristics are close to those of *Camposporium*, but differ in the lack of pigmentation of conidiophores and conidia. *Hyalocamposporium longiflagellatum* sp. nov. and *H. acutum* sp. nov. are described and illustrated. Two new combinations, *H. hyalinum* and *H. marylandicum* are proposed. The host range and distribution of species of *Camposporium* recorded in Hungary are discussed. The habitats of *Camposporium* and *Hyalocamposporium* species are compared.

Key words: anamorphic fungi, *Camposporium*, taxonomy, ecology

Introduction

During of many years studies of hyphomycetes inhabiting forest litter in terrestrial and aquatic habitats different species resembling to *Camposporium* were collected on many occasions. In the present paper the establishment of a new genus is proposed to accommodate four species with hyaline conidiophores and conidia, two of which are new species.

The genus *Camposporium* was established by Harkness (1884), with a single species, *C. antennatum* Harkn. Hughes (1951) reviewed the genus and described a new species, *C. cambrense* Hughes and proposed a new combination, *C. pellucidum* (Grove) Hughes, instead of *Bactrodesmium caulicola* Corda var. *pellucidum* Grove. Subsequently 14 additional species have been described in this genus (Rao and Rao, 1964; Dudka, 1966; Ichinoe, 1971; Matsushima, 1971, 1983; Shearer, 1974; M.B. Ellis, 1976; Abdullah, 1980; Castañeda, 1985; Mercado, Heredia and J. Mena, 1995; Whitton, McKenzie and K.D. Hyde, 2002).

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Camposporium is characterised by dematiaceous, simple conidiophores and polyblastic, integrated, terminal, sympodial, denticulate conidiogenous cells. The conidia are cylindrical or fusoid, transversely pluriseptate, the apical cell without or with one or more appendages, the basal cell provided with a short remnant scar of the separating cell. Conidia are concolourous or more frequently the end cells are paler in pigmentation than the central cells.

Camposporium is a heterogeneous genus. From the all species described up till now, 15 species are currently accepted in this genus. As the type of conidiogenesis of *Camposporium aquaticum* Dudka is quite different from that of other species of *Camposporium* first it was transferred to *Vargamyces* by Tóth (1979). Later Hyde and Goh (1999) considering the large conidia to chlamydospores transferred *C. aquaticum* to *Xylomyces* as *X. aquaticus*.

Holubová-Jechová (1990) discussed the problems arising in the generic classification of the dematiaceous hyphomycetes. She was on the opinion that in generic classification dark pigmentation of conidiophores is more important than pigmentation of conidia. When some entirely hyaline species are in a genus, which originally includes only species with pigmented conidiophores and conidia it might necessitate transferring the disparate elements into another, separate genus. *Camposporium* according to the original description might include only species with pigmented conidiophores and conidia. In a detailed study of hyperparasitic hyphomycetes with denticulate conidiophores, Deighton and Pirozynski (1972) described the genus *Paratrichoconis* with *P. chinensis* (Hansf.) Deighton. *Paratrichoconis* was established for those hyperparasitic species that are morphologically similar to *Trichoconis* but differ by their deep brown, stoutwalled conidiophores. Castañeda *et al.* (1997) transferred *Camposporium antillanum* R.F. Castañeda, which has brown conidiophores with long pedicells and hyaline conidia, to *Paratrichoconis*. Whitton, McKenzie and Hyde (2002) proposed that other species of *Camposporium* with hyaline conidia namely, *C. hyalinum* Abdullah, *C. marylandicum* Shearer and *C. scolecosporum* Matsush., might also be more appropriately treated in *Paratrichoconis*. We are on the opinion that this genus with its pigmented, stoutwalled conidiophores is not suitable for these species. Moreover the species of *Trichoconis* and *Paratrichoconis* typically overgrow other fungi and certainly occupy different ecological niche than aquatic saprotrophic species.

During our investigations of freshwater microfungi we found in Hungary several times a hyphomycete species, which resembled a species of *Camposporium*. Prompted by the collection of another apparently undescribed taxa clearly similar to some species of *Camposporium*, which appear to form a distinct group, it now seems justified to segregate these taxa. In this paper a

new genus is introduced to accommodate hyphomycetes whose characteristics are close to those of *Camposporium*, but differ in the lack of pigmentation of conidiophores and conidia. Two new species are described and two new combinations are proposed. In the case of *Camposporium scolecosporum* no formal transfer to *Hyalocamposporium* is proposed. The conidia of *C. scolecosporum*, which are subulate and slightly curved, are differently shaped from those typical of the new genus. Moreover, *C. scolecosporum* was described from terrestrial decaying leaves, while the other four species were collected on submerged woody substrata in aquatic habitats.

Materials and methods

Submerged wood was collected from various streams in Hungary. Samples were transported in a cooling box to the laboratory. After rinsing in tap water, substrates were placed in plastic boxes filled with distilled water and aerated by compressed air in a refrigerator at 10-12 °C. After one week of aeration the samples were examined for the presence of fungal fruiting structures. Then the twigs were placed in Petri-dishes with moistened filter paper and incubated in a refrigerator with a glass-door (10-12 °C) for some weeks. All samples were examined periodically and remoistened when necessary. Semipermanent slide preparations were made and herbarium specimens kept when possible.

Results and discussion

Taxonomy

Hyalocamposporium Révay & Gönczöl, **gen. nov.**

Mycobank: 510551

Etym.: *hyalus* (Gr.), *hyaline*, refers to the hyaline conidia and conidiophores + *Camposporium*.

Coloniae in substrato naturali effusae, non dematiaceae. *Mycelium* partim in ligno substrato immersum vel partim superficiale. *Conidiophora* macronemata, mononemata, simplicia, erecta, recta vel saepius flexuosa, cylindrica, ad apicem attenuata, sympodiala, septata, hyalina. *Cellulae conidiogenae* in conidiophores incorporatae, terminales, polyblasticae, denticulatae. Cellula reparans frangens, pars in conidiophora persistens. *Conidia* solitaria, cylindrica vel fusioidea, elongata, hyalina, apice saepe appendiculata.

Species typica: *Hyalocamposporium longiflagellatum* Révay & Gönczöl, sp. nov.

Colonies on natural substrate effuse, non-dematiaceous. *Mycelium* partly immersed in woody substratum and partly superficial. *Conidiophores* macronematous, mononematous, simple, erect, straight or more usually irregularly bent, cylindrical, attenuated slightly toward the apex, sympodial,

septate, hyaline. *Conidiogenous cells* integrated, terminal, polyblastic, denticulate. Separating cell fracturing and remaining as a persistent peg-like extension. *Conidia* solitary, cylindrical to fusoid, elongate, hyaline, apex often elongated, with or without a filiform appendage.

***Hyalocamposporium longiflagellatum* Révay & Gönczöl, sp. nov.** (Figs 1-8)
MycoBank: 510552

Etym.: longus (Latin: long) + flagellum (Latin: whip), referring to the long, whip-like appendage of the conidium.

Coloniae in substrato naturali effusae, in sicco calcaeae. *Mycelium* partim in ligno substrato immersum vel partim superficiale. *Conidiophora* 20-80 × 2.0-2.5 µm, hyalina, simplicia, erecta, laevia, recta vel irregulariter arcuata, septata. *Cellulae conidiogena*e in conidiophoris incorporatae, terminales, polyblasticae, sympodiales, denticulatae. *Conidia* 38-70 × 6-7 µm, holoblastica, solitaria, hyalina, cylindrica vel fusoida, elongata, 6-16-septata, apice appendiculata, hyalina, aseptata, 60-180 µm longa.

Colonies on natural substratum effuse, chalky white when dried. Mycelium partly immersed in the woody substratum and partly superficial. *Conidiophores* 20-80 × 2-2.5 µm, hyaline, simple, erect, straight or irregularly bent, thin-walled, smooth, 0-5 septate. *Conidiogenous cells* integrated, terminal, polyblastic, sympodially proliferating, denticulate, denticles cylindrical 2-3 µm long. *Conidia* 38-70 × 6-7 µm, holoblastic, solitary, hyaline, cylindrical to fusoid, elongate, 6-16-septate, basal cell truncate with a persistent portion of the denticle attached, the apical appendage aseptate, filiform, up to 180 µm.

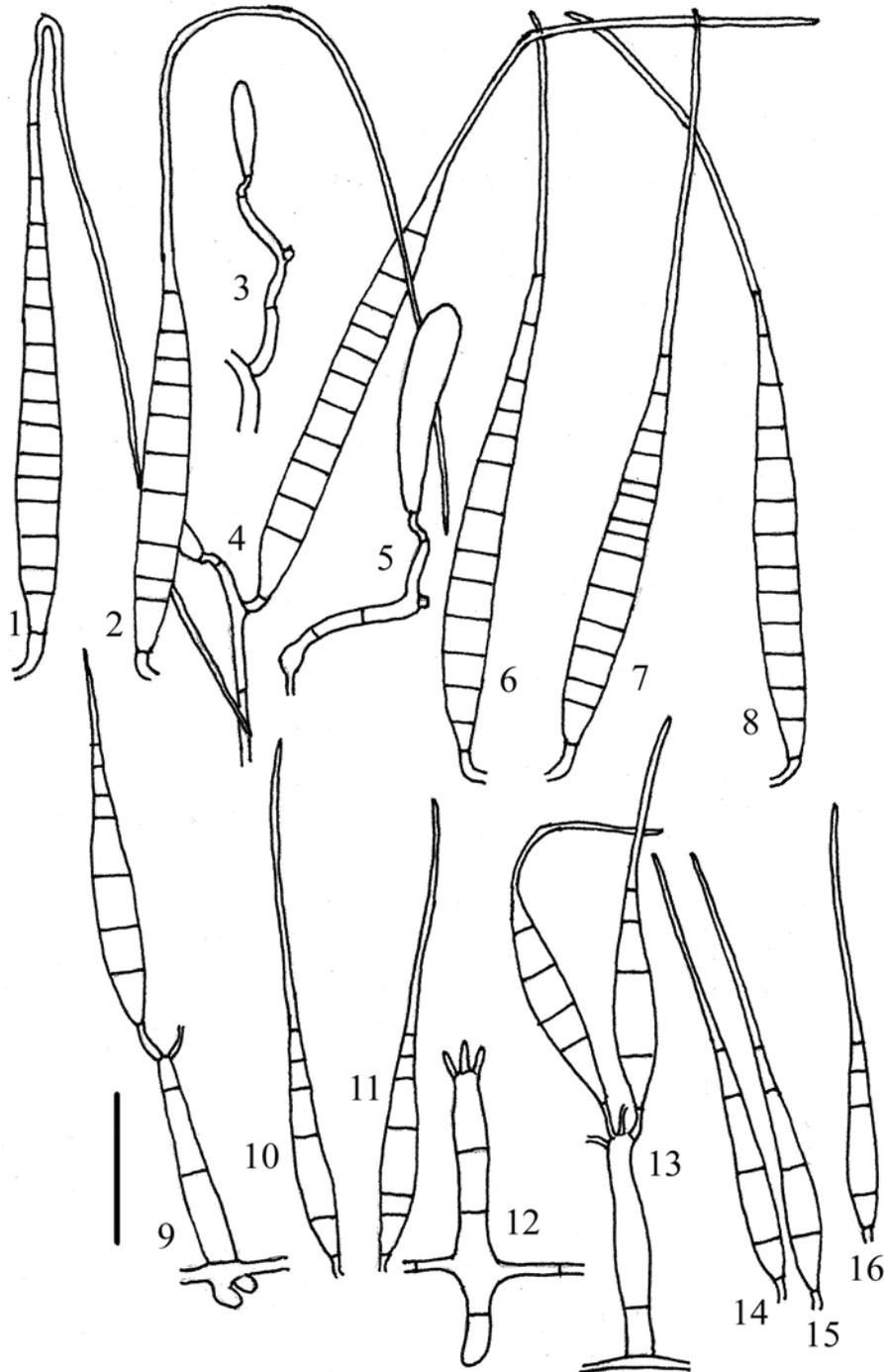
Holotypus: HUNGARY, Börzsöny Mountains, in the stream Nagyvasfazék-patak, near Királyrét, on submerged wood, 10 Oct. 2005, Á. Révay and J. Gönczöl (BP 98968).

Specimens examined: HUNGARY, in the stream Szén-patak, Börzsöny Mts., near Királyrét, on submerged wood, 14 Feb. 1986 (5/22 slide), 14 Jan. 1991 (2/52-55 slides), 14 Apr. 1992 (2/85 slide), 26 Oct. 1994 (11/9 slide), 06 Oct. 2004 (11/10-11); in the stream Nagyvasfazék-patak, Börzsöny Mts., near Királyrét, on submerged wood, 10 Oct. 2005 (11/12-15 slides), 21 Apr. 2006 (11/16-17 slides), J. Gönczöl and Á. Révay.

Notes: *Hyalocamposporium longiflagellatum* is morphologically similar to *Camposporium marylandicum*, which has also hyaline conidiophores and hyaline, cylindrical to fusiform conidia. However, the conidia of *C. marylandicum* are shorter (24.7-44 × 4.5-6.5). We have found only one record about the conidial measurements of *C. marylandicum* in the literature. Ingold (1976) illustrated conidia of *C. marylandicum*, which were collected in a foam sample, in Britain. These conidia are also much shorter than the conidia of *H. longiflagellatum*.

***Hyalocamposporium acutum* Révay & Gönczöl, sp. nov.** (Figs 17-25)
MycoBank: 5105513

Etym.: acutus (Latin: pointed) referring to the pointed conidium



Figs 1-8. *Hyalocamposporium longiflagellatum*. **Figs. 1-2, 6-8.** Conidia, **Figs. 3-5.** Conidiophores with conidia, **Figs. 9-16.** *Hyalocamposporium hyalinum*. **Figs. 10-11, 14-16.** Conidia, **Figs. 9, 12-13.** Conidiophores with conidia. Bar = 20 μ m.

Coloniae in substrato naturali effusae. *Mycelium* partim in ligno substrato immersum vel partim superficiale. *Conidiophora* 42-110 × 4-5 µm, hyalina, simplicia, erecta, laevia, recta vel irregulariter arcuata, septata. *Cellulae conidiogenae* in conidiophoris incorporatae, terminales, polyblasticae, sympodiales, denticulatae. *Conidia* 56-78 × 6-7 µm, holoblastica, solitaria, hyalina, cylindrica vel fusioidea, elongata, 5-14-septata, ad apicem attenuata.

Colonies on natural substratum effuse. Mycelium partly immersed in the woody substratum and partly superficial. *Conidiophores* 42-110 × 4-5 µm, hyaline, simple, erect, straight or irregularly bent, thin-walled, smooth, 0-3 septate. *Conidiogenous cells* integrated, terminal, polyblastic, sympodially proliferating, denticulate, denticles cylindrical 2-3 µm long. *Conidia* 56-78 × 6-7 µm, holoblastic, solitary, hyaline, cylindrical to fusoid, elongate, 5-14-septate, basal cell truncate with a persistent portion of the denticle attached, tapered toward the apex.

Holotypus: HUNGARY, Börzsöny Mountains, in the stream Csömöle-patak, near Szokolya, on submerged wood, 20 Apr. 2006, Á. Révay and J. Gönczöl (BP 11/20 as slide)

***Hyalocamposporium hyalinum* (Abdullah) Révay and Gönczöl, comb. nov.**

MycoBank: 510554

(Figs 9-16)

Basionym: *Camposporium hyalinum* Abdullah, Transactions of the British Mycological Society 75: 514-517.

Conidiophores 32-42 × 3.2-4 µm. *Conidiogenous cells* terminal, denticulate, denticles cylindrical 4-5 µm long. *Conidia* 29-39 × 4-5 µm, 3-4-septate, at the apex with a long filiform appendage, 32-43 × 1-1.5 µm.

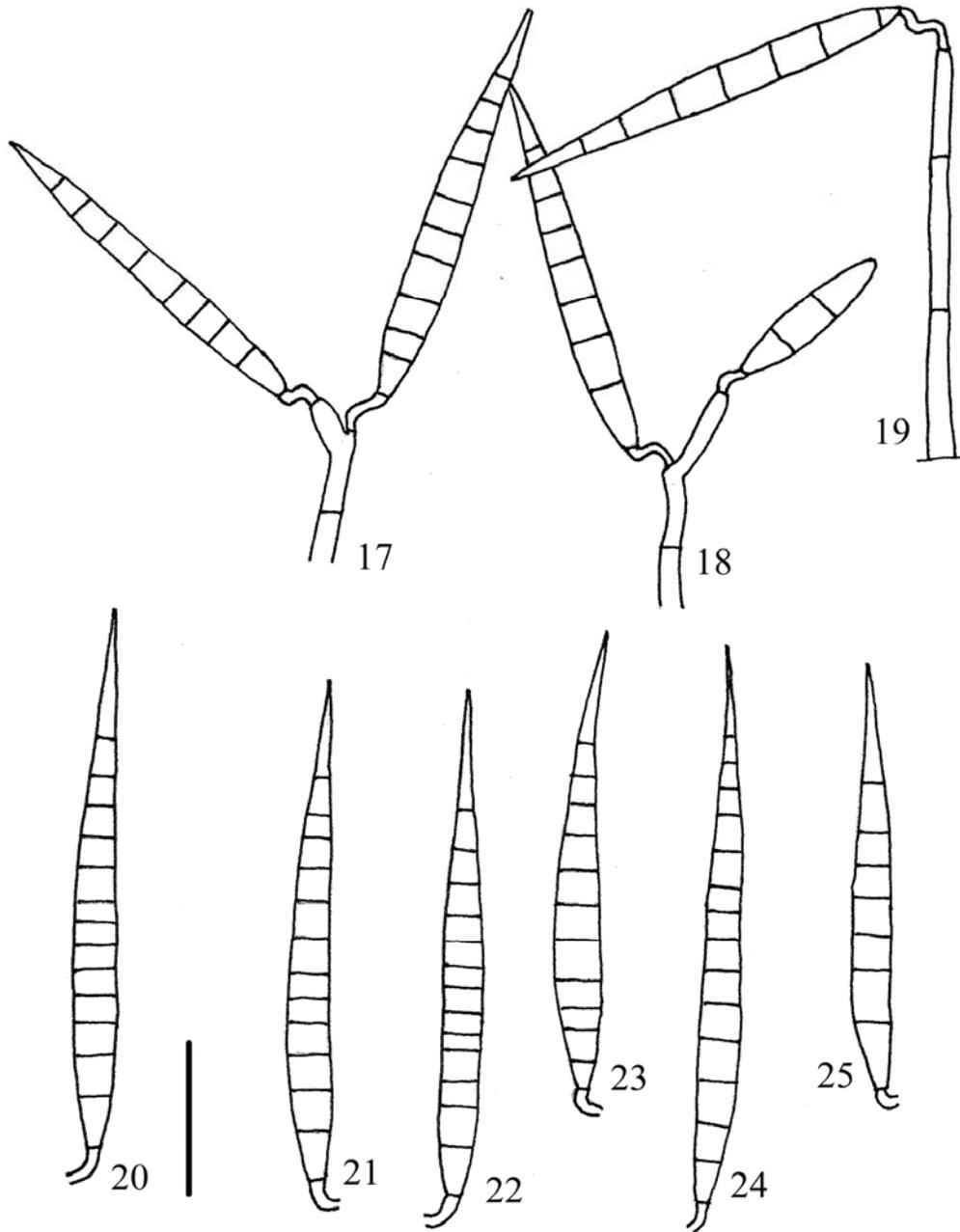
Specimens examined: HUNGARY, in the stream Szén-patak, Börzsöny Mts., near Királyrét, on submerged wood, 17 Sep. 1993 (2/96 slide); in the stream Nagyvasfazék-patak, Börzsöny Mts., near Királyrét, on submerged wood, 10 Oct. 2005 (11/18-19 slides), J. Gönczöl and Á. Révay.

Notes: The present collections differ slightly from the holotype in their somewhat longer conidia. It is difficult to know from the original description the exact size of the conidia, because their size are given including the size of appendages. The morphology of the conidia also differs slightly. In the current specimens we can see regular, fusoid conidia, while conidia illustrated by Abdullah are more variable and suggest somewhat aberrant conidial forms.

***Hyalocamposporium marylandicum* (Shearer) Révay and Gönczöl, comb. nov.**

MycoBank: 510555

Basionym: *Camposporium marylandicum* Shearer, Mycologia 66: 16-24.



Figs 17-25. *Hyalocamposporium acutum*. **Figs. 17-19.** Conidiophores with conidia, **Figs. 20-25.** Conidia. Bar = 20 μ m.

Ecology

All the four species of *Hyalocamposporium* have been found on submerged woody substrata in aquatic habitats. None of these species have been seen on leaf litter until now. *Hyalocamposporium longiflagellatum* has always been found on submerged, soft, waterlogged wood, in the upper softwater section of the Morgó stream-system. Some conidia probably belonging to this species were seen in a stemflow sample collected from a beech tree (*Fagus sylvatica*) near the Nagyvasfazék stream in the Börzsöny Mts. (Gönczöl and Révay, 2006). Underwater sporulation of *H. longiflagellatum* has never been observed. Its sporulation always appeared in air following the incubation of wood in moist chamber. The same was true for *H. hyalinum* and *H. acutum* also. Conidia of *H. longiflagellatum* and *H. hyalinum* have very rarely been found in foam or among the conidia of aquatic hyphomycetes trapped on membrane filters. Unfortunately, details on the sporulation habit of *H. hyalinum* or *H. marylandicum* were not given in their protologues: viz., if conidia developed underwater or in air-water interface or in air.

We believe that *Hyalocamposporium* spp. comprises a group of wood-inhabiting hyphomycetes preferring highly processed woody substrata in aquatic habitats. However, the species in this genus appear not to be true aquatic: i.e. conidia do not develop underwater. It is difficult to classify *Hyalocamposporium* in any of the biological groups of freshwater hyphomycetes given by Goh and Hyde (1996). *Hyalocamposporium* species produce conidia in air on woody substrata formerly submerged, but since they lack conidia morphologically adapted for trapping air and floating they should not be grouped under the aero-aquatics. The group of “submerged-aquatic hyphomycetes” typically have dematiaceous hyphomycetes with thick-walled conidiophores and conidia, rather than the delicate, hyaline hyphomycetes. Similar difficulties were discussed in the case of *Aquaphila albicans* Goh, K.D. Hyde & W.H. Ho (Goh *et al.*, 1998). They also speculated to include this fungus into “aero-aquatics” or “submerged-aquatic hyphomycetes”.

The species of *Camposporium* are well-known terrestrial hyphomycetes, but some of them are also known from aquatic habitats or lotic environments. They occur on a wide variety of wood, stem and leaf types. Five species of the genus were recorded in Hungary. The most frequently collected taxon of *Camposporium* in Hungary is, without doubt, *C. pellucidum*. This occurs on the largest number of substratum types and has been reported from various habitats, e.g. terrestrial litter (Gönczöl and Révay, 1983; Révay, 1985), tree-hollows (Gönczöl, 1976; Gönczöl and Révay, 2003), streams (Révay and

Gönczöl, 1990; Gönczöl and Révay, 1992). The wide distribution of *C. pellucidum* in both terrestrial and aquatic habitats has been reported (e.g. Ingold, 1974,1975; Kirk, 1981). Additional three species of *Camposporium*, *C. antennatum* Harkn. (Tóth, 1994), *C. cambrense* S. Hughes (Tóth, 1994; Révay & Gönczöl, 1990) and *C. japonicum* Ichinoe (Gönczöl, 1976, 1985; Révay, 1985; Gönczöl and Révay, 1983, 1992; Tóth, 1994) were also found in both terrestrial and aquatic environments in Hungary. In a recent study, conidia of four *Camposporium* species, *C. cambrense*, *C. japonicum*, *C. pellucidum* and *C. ontariense*, were unexpectedly recovered in rainwater samples collected from living trees (Gönczöl and Révay, 2004).

We believe that *Camposporium* and *Hyalocamposporium* are closely related genera, but they differ in their substratum preference and possibly in their favorite habitats. These two genera also demonstrate that our knowledge about the fungal strategies in aquatic and terrestrial environments is quite limited. Since the discovery of “aquatic hyphomycetes” (Ingold, 1942) we have been forced to create further new terms for several groups of hyphomycetes occurring in aquatic and semi-aquatic habitats. We attempt to place these fungal species into our ecological “boxes” but fungal life strategies appear to be more complicated than our traditional ecological categories.

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