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Fontanospora fusiramosa sp. nov., a hyphomycete from live tree roots and from stream foam

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Fontanospora fusiramosa is described from *Alnus* roots and from stream foam. It is based on isolates from the U. K., Canada and the Czech Republic.

Key words: *Fontanospora*, aquatic hyphomycetes, endophytes, streams.

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Je popsán nový druh rodu *Fontanospora* (mitosporní houby, hyfomycety), vyskytující se jako endofyt v kořenech olše. Jeho konidie bývají také nalézány v pěně v potocích, zejména na slatinných lokalitách. Druh byl izolován v Anglii, v Kanadě a v České republice.

INTRODUCTION

Fontanospora Dyko (1978) was based on *Tricladium eccentricum* R. H. Petersen, differing from the heterogeneous *Tricladium* Ingold by its subopposite conidial branching. Hitherto three species were described: *F. eccentrica* (R. H. Petersen) Dyko 1978 (type species of the genus), *F. alternibrachiata* Dyko 1978 and *F. minima* Ando 1993. We are describing a fourth species, which appears in stream foam in cold climates and is capable of endophytic existence in submerged *Alnus* roots.

MATERIALS AND METHODS

The ex-type culture of our new species was isolated from roots of *Alnus glutinosa* (L.) Gaertn. growing under water. The root pieces were washed in running water prior to surface sterilization by immersion in 75 % ethanol for 1 min., in a 0.93–1.3 M solution of sodium hypochlorite (3–5 % available chlorine)

for 3 min. and in 75 % ethanol for 5 min. Root segments were then placed onto 1.5 % Oxoid malt extract agar and incubated at 20 °C. Isolations were made from hyphal tips which grew into the agar. The other three cultures were monoconidial isolates from stream foam. Sporulation was observed on submerged pieces of agar cultures in standing sterile distilled water at 15 °C in daylight or diffuse artificial light, or in aerated distilled water at 10 or 18 °C.

TAXONOMY AND DISCUSSION

Fontanospora fusiramosa Marvanová, Fisher et Descals, sp. nov.

Figs 1–3

Fungi mitosporici, hyphomycetes. Teleomorphosis ignota.

Coloniae in agaro maltoso pallide brunneolae, modice crescentes, glabrae, cum mycelio aerio adpresso interdum funiculoso in centro coloniae, nonnullae roseolae si submersae sub aqua in luce. Cellulae inflatae hyalinae, elongatae vel globosae, tenuitunicatae vel crassitunicatae, catenatae vel aggregatae, nonnumquam in sclerotiis minutis in mycelio adsunt. Conidiophora singularia, usque ad c. 600 μm longa, illa curta parce, illa longa valde ramosa, ramis acrotonis. Cellulae conidiogenae incorporatae vel discretae, usque ad ternae, apicales vel postea intercalares, polyblasticae, saepe cum conidiis concurrentes, 17–50 × 3–4 μm. Conidia fasciculata, raro singularia, saepe bina vel terna, in successione crescentia, 'tetraradiata', cum elementis septatis, apicibus subulatis. Axis (30–)45–98(–120) × 2.5–4.5 μm, inter ramos typice flexus et ibidem attenuatus; pars proxima fusoidea vel cylindrica, saepe brevior, extensio basalis abest vel brevissima; pars distalis anguste obclavata. Rami typice duo, laterales, sub centro vel prope partem tertiam inferiorem axis crescentes, subopposite, obclavati, insertione constricta; ramus proximus (10–)25–63(–75) × 2.5–5 μm, ramus distalis (7–)15–48 × 2–5 μm.

Habitat: in radicibus submersis arboris *Alnus glutinosa* in flumine Dart loco Dartmoor dicto, Devon, Anglia.

Holotypus: IMI 374530 (praeparatum e cultura artificiali P. J. Fisher No. 57 = CCM F-10096)

Mitosporic fungi, hyphomycetes. Teleomorph unknown.

Colonies on 2 % malt agar (MA) pale beige, growing moderately fast, glabrous, with appressed aerial mycelium, or slightly funiculose in the centre, pale beige, in some isolates pinkish when submerged under daylight. Inflated cells elongate or globose, thin- or thick-walled, hyaline, c. 12 μm diam., in chains or clusters on the mycelium, in CCM F-12089 aggregated in small colourless soft sclerotia up to 350 μm diam. Conidiophores single, up to c. 600 μm long, branching profuse, acrotonous, or sparse. Conidiogenous cells integrated or discrete, up to three per

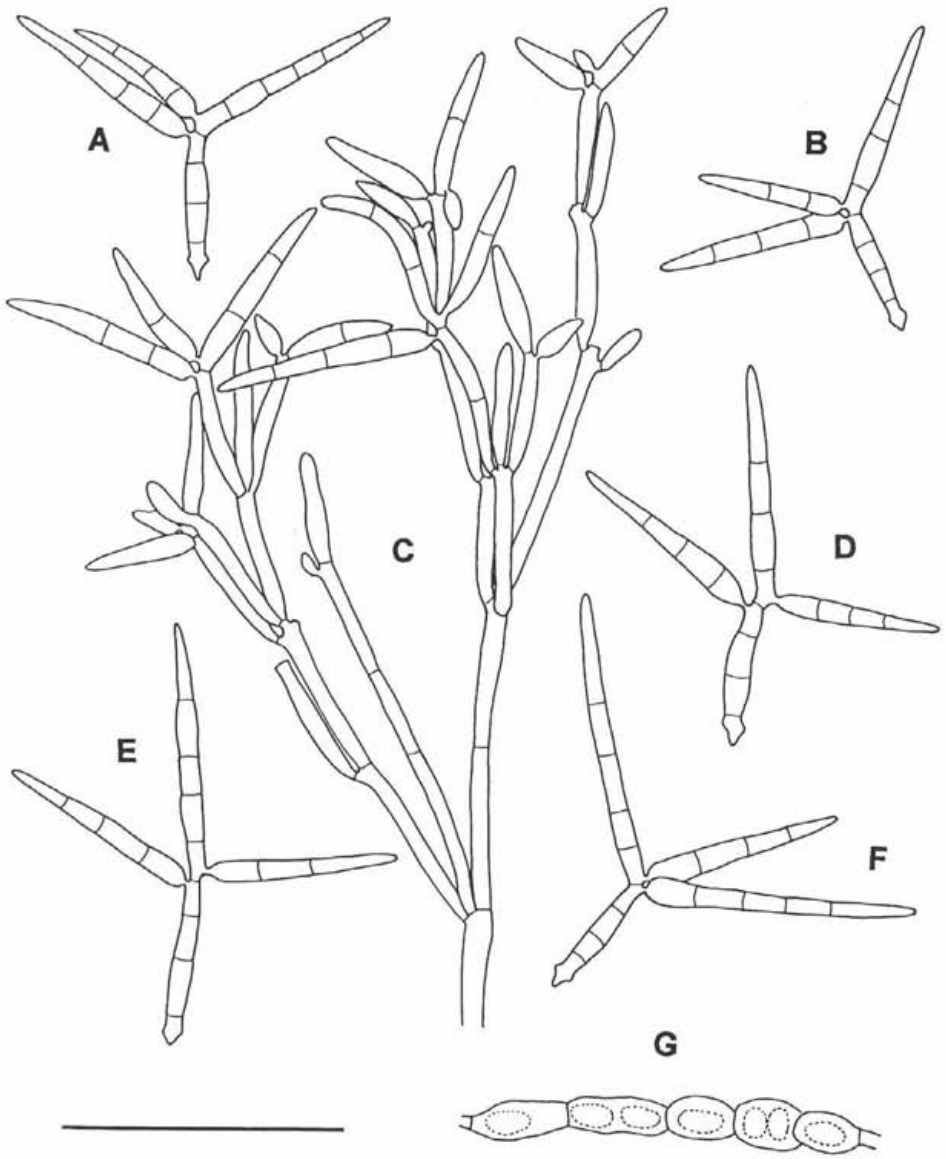

Fig. 1. *Fontanospora fusiramosa*, type. A,B,D-F, conidia. C, conidiophore with developing conidia and spent conidiogenous cells. G, inflated cells. From 10 day old standing water culture. Scale = 50 μm.

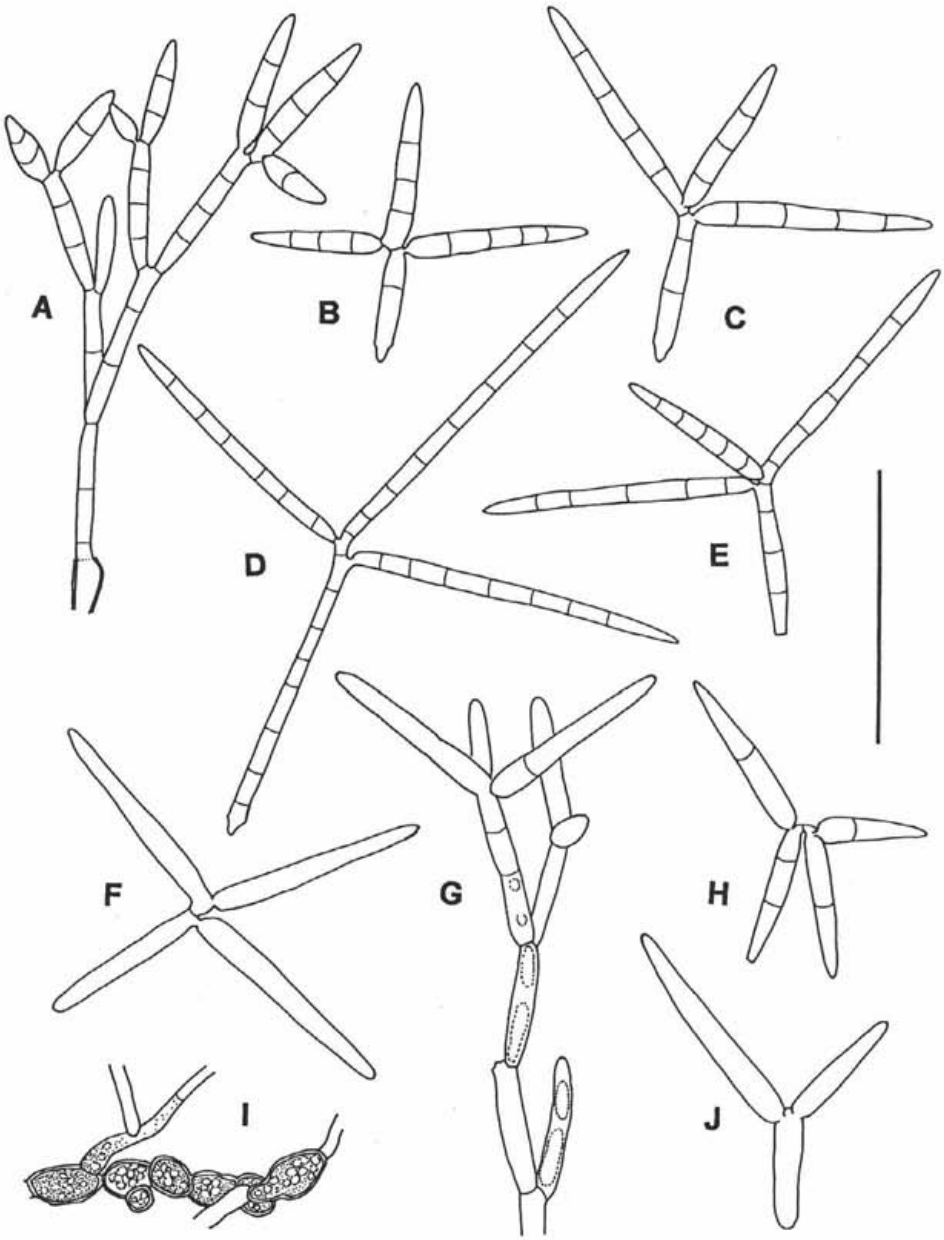

Fig. 2. *Fontanospora fusiramosa*. A-E, CCM F-12089, from standing water culture. A, conidial development. B-E, detached conidia. F-J, E. Descals A212–1–8. G, conidial development. F, H,J, detached conidia. I, inflated cells. Scale = 50 μm.

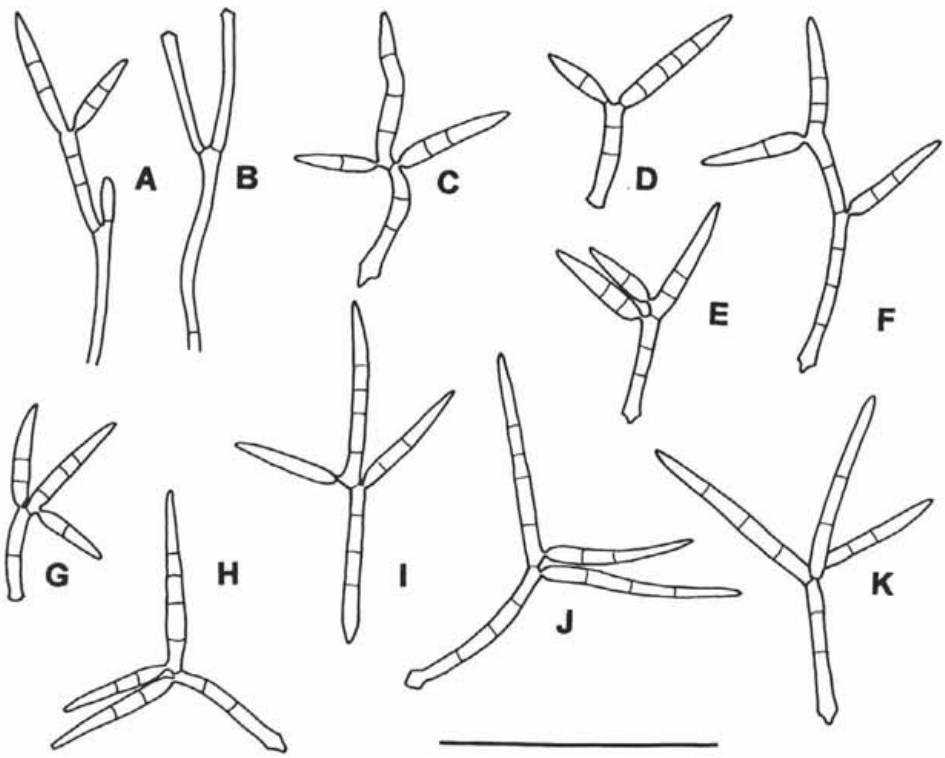

Fig. 3. *Fontanospora fusiramosa* CCM F-21687 after 4 days' aeration. A, conidiophore with developing conidium. B, spent conidiophore. C-K, detached conidia. Scale = 50 μm.

conidiophore branch, apical or becoming intercalary, polyblastic, often concurrent with conidia, 17–50 × 3–4 μm. Conidia in fascicles (rarely single), usually 2–3 per conidiogenous cell, closely sequential, 'tetraradiate', elements septate, ends subulate. Axis (30–)45–98(–120) × 2.5–4.5 μm, typically bent and attenuate between branch insertions, with a septum in the narrowed portion; proximal part fusoid or cylindrical, usually shorter, basal extension lacking or short, typically percurrent; distal part of axis narrowly obclavate. Branches typically two, diverging in different planes, submedian or more often inserted in the lower third of the

axis, subopposite, on either side of the attenuation, obclavate, insertion strongly constricted; proximal branch (12–)25–63(–75) × 2.5–5 μm, distal branch (7–)15–48 × 2–5 μm. Aberrant conidia appear in all our isolates; they may be single-branched (Figs 2 J, 3 D), or with remote branches (Fig. 3 F), or with two subopposite and one remote branche.

Table 1. Lengths of conidial elements (in μm) of five isolates of *F. fusiramosa* (15 conidia of each isolate measured)

Isolate	Axis	Proximal branch	Distal branch
Type	51–88	32–52	24–47
P. Fisher TS	54–74	29–47	17–39
CCM F-21687	30–74	10–37	7–30
CCM F-12089	55–98(–120)	27–63(–75)	20–48
E. D. B12–2–8	45–70	25–40	15–33

Material examined: P. J. Fisher No. 57 (= CCM F-10096), from aquatic roots of *Alnus glutinosa* collected in the River Dart, Dartmoor National Park, Grid Ref. SX 713 711, Devon, U. K., Sept. 1995, P. J. Fisher. P. J. Fisher TS, same data as No. 57 (conidia occurred as admixture in culture of another endophyte). E. Descals A212–1–8, foam from wooded stream flowing off acid moorland, R. Dundonell, nr. Gairloch, N. W. Scotland, U. K., May 1974, E. Descals and J. Webster. CCM F-21687, from foam in a roadside ditch lined with shrubs in a moorland (very slow flowing water), Rock Point, near Sackville, New Brunswick, Canada, Apr. 1987, L. Marvanová and F. Bärlocher. CCM F-12089, from foam in the right tributary of the river Svratka near the road between Herálec and Kadov, in a forest with prevailing *Picea abies*, c. 500 m alt., West Moravia, Czech Republic, May 1989, L. Marvanová.

The ex-type and Czech isolates produce a pinkish water-insoluble pigment in the superficial layer of the colony when submerged and exposed to daylight. The larger conidia of the Czech isolate (Fig. 2 D) have less tapering elements, thus resembling *F. eccentrica*. However, conidial shapes typical of *F. fusiramosa* prevail. The Canadian isolate (Fig. 3) has conidia with narrower elements and the lower part of the axis is often parallel-walled rather than fusoid. However, its conidial branches and the distal part of the axis in developing conidia do have the typical form of *F. fusiramosa*. This isolate sporulated only in an aerated culture and the simpler conidiophores, relatively short conidial branches and frequent single-branched conidia may be a consequence of those conditions. Shorter conidial elements in aerated versus standing culture have been seen also in the ex-type

isolate; under the latter conditions axis and branches longer by 10–20 % could be observed. Thick-walled inflated cells (Fig. 2 I) occurred only in the E. Descals isolate.

The habitats of this species imply its association with aquatic environment. However, the fungus has not been found on substrates common for freshwater hyphomycetes. i.e. submerged leaves or woody debris. The ex-type culture, E. Descals A212–1–8 and the Canadian strain were isolated from moorland habitats, the Czech one was obtained from a stream on acid bedrock.

Conidia of this new species have been recorded from foam in an acidic stream lined by *Alnus* in Gredos Mountains in central Spain (Descals *et al.* 1995, Fig. 3 F, as *Fontanospora eccentrica*). Most probably they also have been depicted by Aimer and Segedin (1985, Fig. 3 H,K, as *F. eccentrica*) from stream foam in New Zealand: Fig. H from a fast clean medium-sized stream flowing through an undisturbed Podocarp-broadleaf forest (370 m alt.) and Fig. K from a moderately fast, small, clean mountain stream (1340 m alt.).

F. eccentrica (Fig. 4) differs from *F. fusiramosa* by the typically cylindrical shape of the conidial elements, and by the blunt, sometimes slightly swollen, conidial ends. *F. eccentrica* and *F. fusiramosa* conidia overlap significantly when we include the extreme values of CCM F-12089 (tab. 1). However, most conidia of *F. fusiramosa* have a 50–100 μm long axis, whereas in *F. eccentrica,* according to our experience, this is frequently over 120 μm long.

F. alternibrachiata, according to the protologue, is similar to *F. eccentrica* but has much larger conidia. It cannot be confused with *F. fusiramosa.*

F. minima was described recently from leaf litter in a terrestrial habitat in Japan. It differs from the generic concept accepted by Dyko in its micronematous conidiophores and in the basipetal sequence of conidial branches. Its conidia are minute, not exceeding 21 μm across. Moreover, Ando (1993) interpreted the branching pattern as an axis and three branches, which would imply the presence of one secondary branch and one retrogressive second primary branch. Even if the branching is perceived as one axis and two laterals, the retrogressive sequence of the laterals still remains. Such branching pattern would be unusual in *Fontanospora.* In our opinion *F. minima* should be excluded from *Fontanospora*, but without having seen the type or authentic material, we hesitate to make any formal changes. We see an overall similarity of *F. minima* with *Articulospora ozeensis* Matsushima (1975), a leaf litter fungus with conidia of similar size, but consisting of an axis and three sequential, primary, coronate branches. According to Ando and

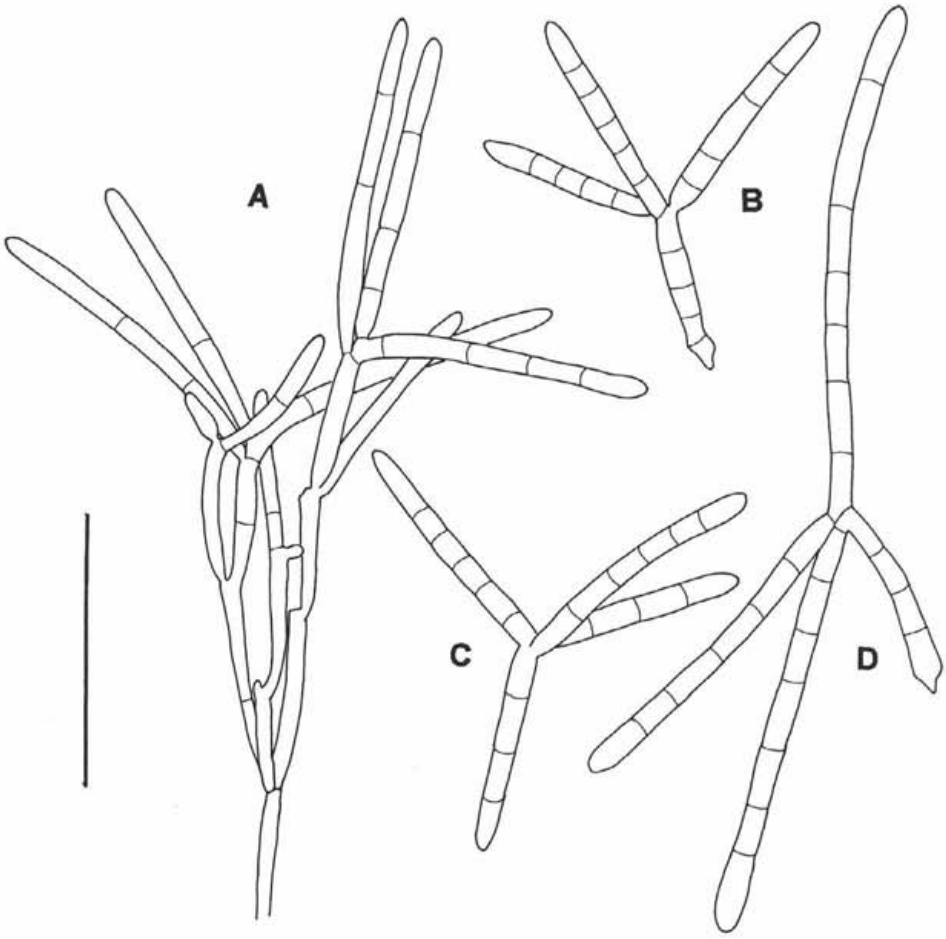

Fig. 4. *Tricladium eccentricum*, type. A, conidial development. B-D, conidia. Scale = 50 μm.

Tubaki (1983) it is not properly accommodated in *Articulospora* Ingold. There is a superficial similarity of the conidia of *Fontanospora minima* with those of *Sympodiocladium frondosum* Descals (Descals and Webster 1982), but the latter has a progressive sequence of one primary and one secondary lateral branches and a different conidiogenesis. *Sympodiocladium* is also unique in the strongly restricted, orange, later dark purple colonies, producing a bluish diffusing pigment on 2 % MA.

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